

Existence

October 2025



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Understand Your Existence

Your selfish Satisfaction is enhanced best ...
by freely helping others enhance their Satisfaction

*“I would rather have questions that can't be answered
than answers that can't be questioned.”*

“Every person must choose how much truth they can stand”

The intention of this document is not to present absolute truths ... but
instead to offer information that may be useful as you consider your existence

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IN MEMORIUM

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OVERVIEW

Summary

Based on existing scientific evidence ...

- The universe is 14 billion years old ... Earth is 4.5 billion years old.
- Humans are 200,000 years old.
- Everything is composed of excitations in quantum fields which extend throughout the universe.
- These quanta build up to atoms, elements, molecules, organs, plants, animals, other objects.

Satisfaction is the combination of how comfortable and interesting is an individual's life.

A comfortable and interesting life is a result of sufficient Health, Wealth and Wisdom.

Enhance satisfaction by being more comfortable + interested + living in the present.

Self-interests BEST are served by freely serving the self-interests of others.

Selfish people earn less money and have less satisfaction than generous people.

You have little control of nature, death, people, other things.

Be Calm and Act ... Control your plans and actions to improve Health, Wealth & Wisdom.

Calm = mindful, relaxed, content, balanced, stasis, smile, posture.

Base personal opinions only on best evidence.

Human perception of Existence = Nature + Culture + Satisfaction.

Nature is not created by humans. Culture is created by humans.

Most women mainly want love and fun ... love is not control ... to be loved, be loveable

Men mainly want respect and challenges ... respect is not fear ... to be respected, be respectable

Maintain Health with mindfulness, sleep, diet, exercise, sun, cold, socialization, medical exams

Build Wealth through wise planning and continuous investment throughout your life

Research indicates that common ingredients of Satisfaction are:

- being guided by meaning and purpose,
- connecting with others, and
- a sense of control and autonomy over one's life (including understanding what can be controlled and acted on ... and what cannot be controlled).

Some attribute Existence to supernatural design (God or gods) that cannot be comprehended fully by humans. Others attribute existence to non-supernatural dynamics (but, how existence began has not been ... and may never be ... confirmed).

Ask yourself ...

Is your life comfortable and interesting ... your Satisfaction level at least 8 on a scale of 10?

Are you enhancing the Satisfaction of others (thus, best enhancing your own Satisfaction)?

What actions will you take to make your life more comfortable, interesting ... satisfying?

=====

“Existence” includes all phenomena that are the result of the interaction of fundamental elementary particles ... which are theorized to be excitations (disruptions) in the various quantum fields ... fields that extend throughout the universe. These quantum fields can be described with abstractions, but the exact nature (composition, etc.) of the quantum fields is not known at present.

These particles combine to form larger compositions of matter and energy that in part generate the perception of Existence as objects, sensations and concepts by human, animal, plant, natural abiotic, and machine entities.

There only is energy ... “matter” simply is energy.

Everything in the universe is connected through this energy.

Energy cannot be created or destroyed, it only can be changed.

A human’s physical self-awareness and experience is an optical illusion.

Time does not exist ... it is an invention of humans ... it is a means to measure change.

Available evidence indicates that humans are biological entities composed of quantum field excitations. These excitations are assembled into the information sensing, activating, processing and storage capabilities of the human body.

One way to describe the human “mind” is the combination of brain function plus sensory and other inputs to and outputs from the brain via nerves and other means plus the physical phenomena generating the inputs and influenced by the outputs. So, the “mind” and “body” are the same thing, not separate.

While Existence apparently is a series of instantaneous moments processing quantum field excitations, a human’s perception of Existence encompasses past memories, anticipations of future occurrences and processed information as physical objects and sensations plus mental knowledge and emotions. This is a human’s “reality” ... perceived objects, sensations, knowledge, emotions. Some attribute Existence to supernatural design (God or gods) that cannot be comprehended fully by humans. Others attribute existence only to non-supernatural dynamics (but under this point of view, how existence began has not been and may never be determined).

The Universe

14 billion years old ... 93 billion lightyears across (what preceded this Universe is not known)

10,000,000,000,000,000,000,000 (10²⁵) planets...more than grains of sand on Earth

Earth formed from the Sun 4.5 billion years ago ... initially molten

Earliest evidence of life 3.5 billion years ago (how life scientifically started is not known)

Humans

Originated in Africa 200,000 years ago (.001% of universe’s age); 110 billion total have lived

Developed brains capable of abstraction, complexity, language, dexterity

Any individual human is at least 99.4% genetically identical to any other human

Consciousness (self-awareness) results from receptor and neuron processed information

Pursue Satisfaction by seeking a personal existence more comfortable and interesting

Selfish Satisfaction best is enhanced by freely helping others enhance their Satisfaction ... this is a principle on which good people of all beliefs can agree.

Mutual trust (in every way and every relationship) is essential for maximum Satisfaction.
Successful long term relationships are based on expressing appreciation, not criticism.

Calm + Acknowledge + Plan + Action (CAPA)

1. Calm: relaxed, balanced, homeostasis, positive, breathe, smile, posture, eye contact, present
2. Acknowledge: things you cannot control ... death, people, nature, other things
3. Plan: actions to improve yours and others' Health, Wealth & Wisdom
4. Act: on your plans ... boldly, deliberately, prudently, with mutual trust

Anticipation of a coming negative event can be more negative than the event itself.

Generally, women want: love (love is not control ... and to be loved, you must be loveable), fun, security, freedom, comfort, interesting life, opportunity, a partner they respect.

Men want respect (respect is not fear ... and to be respected, you must be respectable), security, freedom, comfort, interesting life, opportunity, a partner who is loveable.

Many people experience the slow accumulation of ordinary losses. We are always losing, or leaving, or being left, in ways both minor and vast. It is a soft, amorphous melancholy that we often experience.

Private free market enterprise and charity via individual self-determination best enhances the health, wealth and wisdom of a society as a whole.

Death is inevitable and usually peaceful at the end ... accept it and live a Satisfying life.

Enhance Your Satisfaction... With a Comfortable and Interesting Life By Improving Your Health, Wealth & Wisdom

Health

- Manage weight, exercise, sleep, sun, medical exams, safety, relaxation
- Eat healthy balanced diet
- Manage your homeostasis (balance) ... preferably without drugs

Wealth

- Work ... it's your best investment
- Plan and manage your cashflow and net worth
- Have an abundance, not a scarcity, mindset

Wisdom

- All things appear to be quanta of energy fields that extend throughout the universe
- Your selfish Satisfaction best is enhanced by freely helping others enhance their Satisfaction
- Insist on hard deep evidence to form your opinions and beliefs ... don't fool yourself

Just Start ... Now

What is Existence?

The first question is: why is there something instead of nothing? (and what is “nothing” anyway?)
The second question is: since there is something, why this something instead of something else?

Beyond these questions, the following are based on existing understanding:

Existence is excitations of quantum fields (aka “elementary particles”) and their interactions

Human perception of Existence = Nature + Culture + Satisfaction

Nature is not created by humans. Culture is created by humans.

Satisfaction is the combination of how comfortable and interesting is an individual’s life

A comfortable and interesting life is a result of sufficient Health, Wealth and Wisdom

Things we don’t yet know

- What existed before our universe began
- The composition and nature of quantum fields
- How life on Earth scientifically began
- What is inside of a black hole

“Existence” as the term is used in this document includes all phenomena that are the result of the interaction of fundamental elementary particles ... which are theorized to be excitations (disruptions) in the various quantum fields ... fields that extend throughout the universe.

These quantum fields and their excitations are subatomic entities with no known substructure, i.e. not composed of anything smaller. Quantum fields can be visualized in the video at:

<https://www.youtube.com/watch?v=MmG2ah5Df4g>

These particles combine to form larger compositions of matter and energy that in part generate the perception of Existence as objects, sensations and concepts by human, animal, plant, natural abiotic, and machine entities.

An entity perceives other entities by the movement of related excitations (example: photons reflected from an object to the visual sensory receptors, nerves and brain processing – all themselves comprised of elementary particles - of a human or animal).

Human perception of Existence is practically instantaneous. A reasonable definition of “instantaneous” is the speed of light or alternatively 13 milliseconds which appears to be the fastest humans can perceive something that they see. Existence is only what is present and occurring at this specific moment along with the human and other animals’ (incomplete) memories - and other evidence of - previous occurrences ... as well as speculation about future presences and occurrences.

An overview, by Arvin Ash, of the 13.8 billion year existence of the Universe based on the current consensus of scientists is provided at: <https://www.youtube.com/watch?v=OUmYkixy3ug>

Existence does not appear to have a known causal explanation (as any cause must itself have a cause) or a contingent explanation as the factors giving the contingency must pre-exist. If there is an answer it must be something that exists necessarily (i.e., something that just exists, rather than is caused).

Existence is linked with “time” (i.e., when did this existence begin); time is, at least in part, an artificial human construct. It has been experimentally proven that time is not a constant ... time is relative, time dilates. Time is one aspect of describing changes in Existence.

Some argue that the only two options which can explain Existence is that things either always existed or that they spontaneously emerged. In a quantum vacuum state, virtual particles and spacetime bubbles apparently come into existence spontaneously. In either scenario, Existence is a fact for which there is not a known cause.

Others say that it is attempting to answer a question that is outside a space-time setting, from within a space-time setting. It is akin to asking "what is north of the North Pole?" Even if "nothing" is impossible, however, asking why that is the case is a question that will continue to be considered.

The universe is 'fine-tuned' for this specific Existence we experience. The laws of physics have to be 'just so' for anything known (including humans) to exist.

Multiple existing physics parameters, however, could be varied simultaneously by orders of magnitude and still produce this same universe. In addition, a different set of parameters could produce a universe with different characteristics ... including perhaps different types of life forms.

Available evidence indicates that humans are biological entities composed of quantum field excitations. These excitations are assembled into the information sensing, activating, processing and storage capabilities of the human body.

At this time, no other scientific evidence (observable, quantifiable, analyzable in controlled experiments) is available supporting “spiritual” or other aspects of human existence. Those additional characteristics are accepted by those who believe in them based on something other than verifiable evidence (e.g., “faith”).

Human perception of Existence consists of Nature plus Culture. Nature includes things that exist without being created by humans. Culture includes those things that humans create.

Nature includes the built-in operating system for autonomic functions (breathing, heartbeat, photosynthesis, pollination, etc.) with which living things are born. Culture provides additional programming for learned behavior and exists to supplement and enhance Nature.

A framework for describing and managing the Existence of an individual or a group includes:

Plan – top level summary statement of overall intentions and key actions

Purposes – goals

Principles – guidelines for conduct

Position – description of situation

Providers – other sources of goods and services offered

Possibilities – optional opportunities and reasonable courses of action

Prospects – people, groups to associate with, serve, etc.

Places – where to operate

Products – services and goods offered

Promotion – communicating the availability and value of the offering

Processes – actions needed to achieve Purposes

Platforms – hardware, software, biological and other entities that support Processes

Partners – work with to achieve Purposes

Performance – planned and actual key metrics that measure achievement of Purposes

Portfolio – optimized prioritized actions (Programs and Projects) for achieving Purposes

Humans tend to live their lives in five somewhat distinct but overlapping phases.

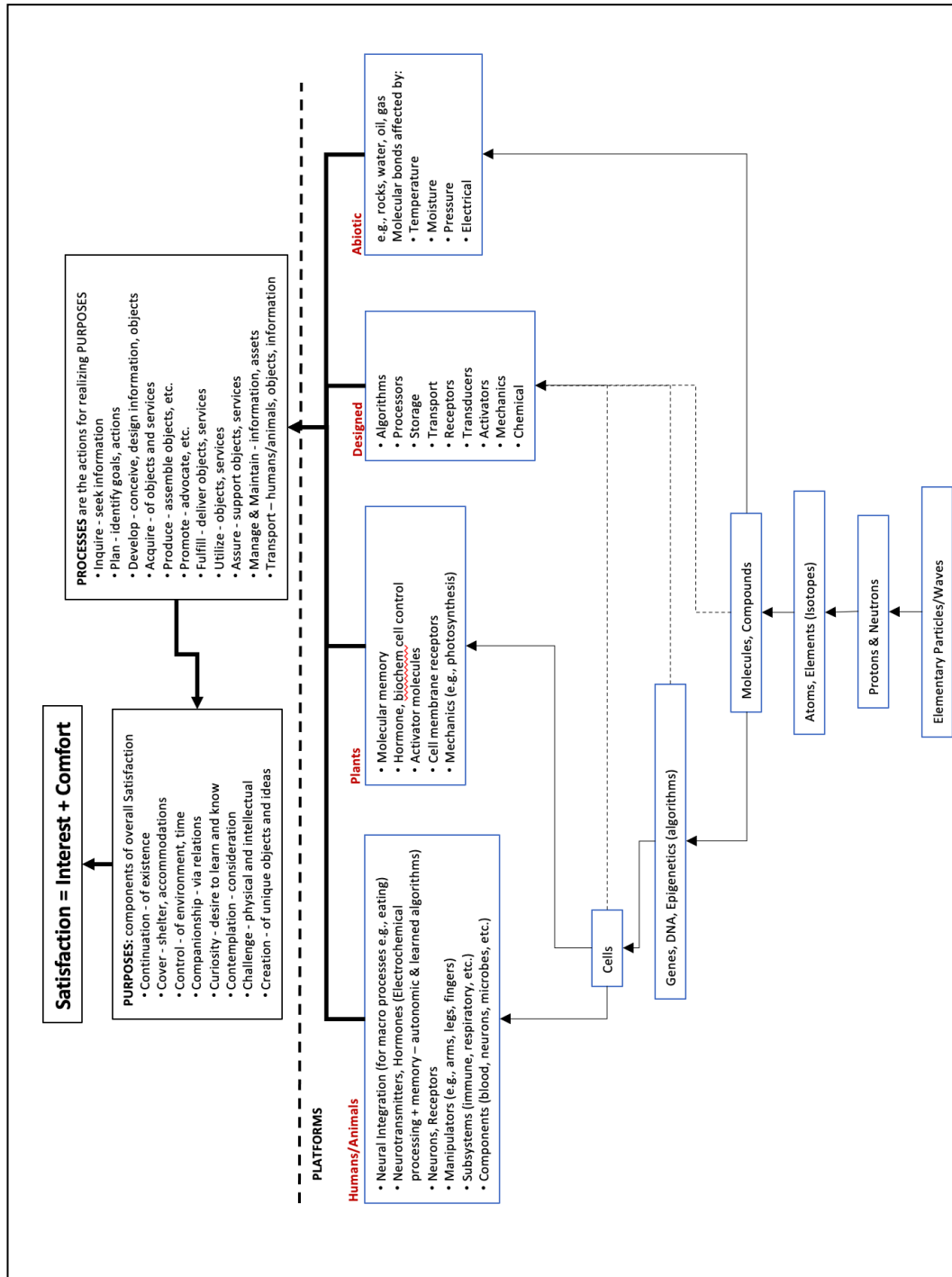
These phases include (age ranges are approximate):

1. 0-20 years: Personal formation and education
2. 20-40 years: Career and family establishment
3. 40-60 years: Personal, career and family enhancement
4. 60-80 years: Career retirement, support of extended family, volunteerism, recreation
5. 80+ years: Socialization; living assistance as needed

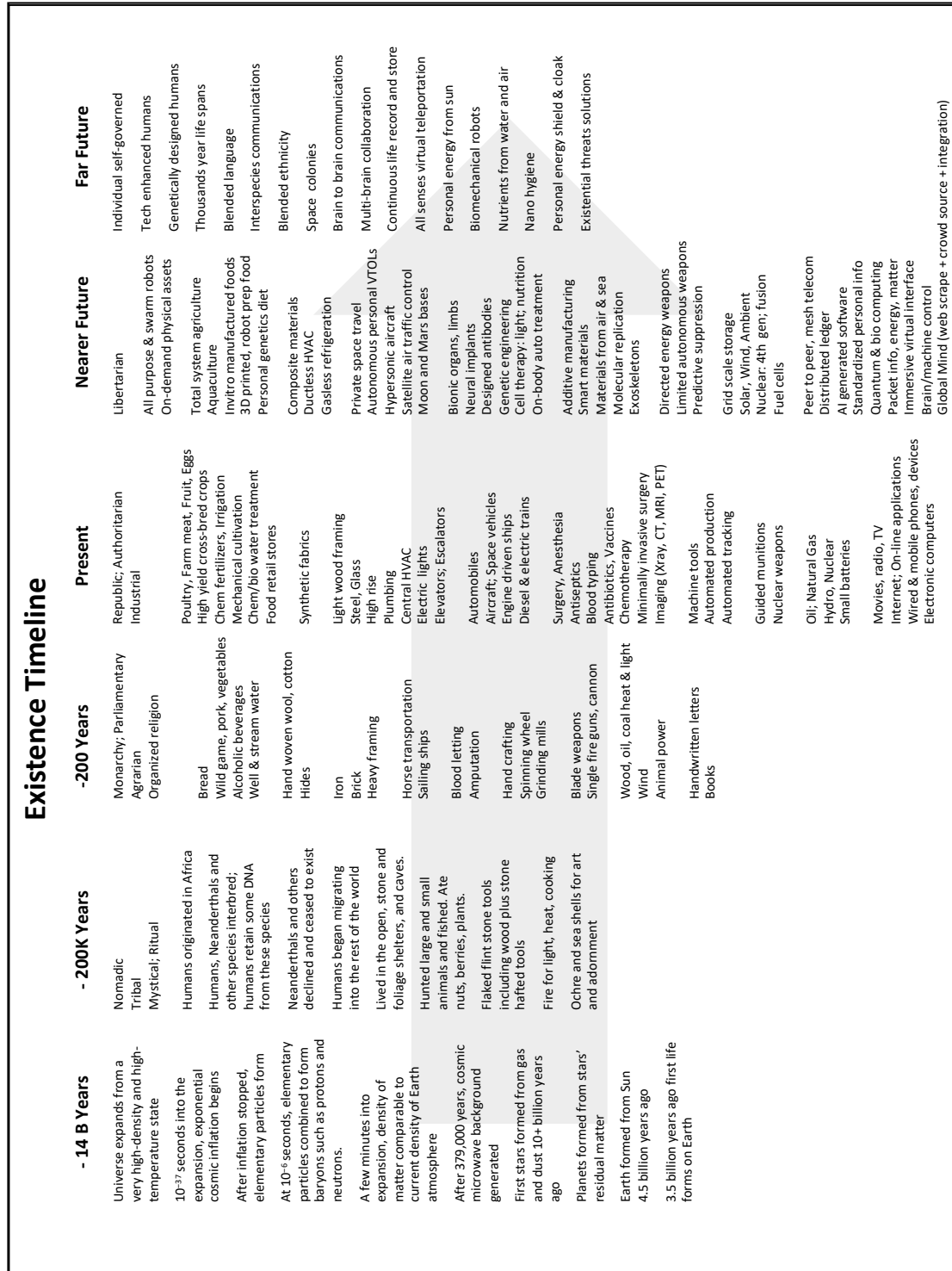
In the future, human existence may include:

- Universal all-purpose robots; autonomous personal vehicles
- Personal energy shield and cloaking fields
- Immersive virtual reality & all-senses virtual teleportation
- Global “mind”: integrated synthesized information from web “mining” + crowd sourcing
- Standardized personal information applications to streamline provision of that data
- Nano and cell-level hygiene and disease prevention and treatment
- Personal energy from sun and nutrients extracted from water and air
- Solutions for existential threats: large asteroids; pandemics; mass destruction weapons
- Less end-user ownership (more pay per use) of shelter, transportation, other assets.
- Blended ethnicity and language

Existence Framework



Existence Timeline



How to Exist

Humans are a result of the biological processes and the responses of those processes to their surrounding environment. Given that this is all that (and as much as) humans are, the question is: how should a person live?

Humans are “selfish” in their biological emotions, likely due (at least in part) to the need for selfishness in order to survive. Long-term individual personal Satisfaction is the selfish main goal of most humans.

How best is long-term personal Satisfaction achieved? The experience of history demonstrates that individual selfish long-term personal Satisfaction best is maintained by a person freely helping (i.e., not being mandated) to enhance the Satisfaction of others as they, not the helping individual, define their own Satisfaction.

Thus, selfish Satisfaction is self-limiting. An individual’s selfish Satisfaction best is served by not violating the Satisfaction of others.

An advantage of this practice is that individuals with differing points-of-view and beliefs can co-exist to the benefit of all. Some personal political and religious ideologies, however, do not advocate for the extent of this personal liberty and so inhibit co-existence.

To the extent that an individual does not adhere to this practice, his and others’ Satisfaction levels likely are reduced. Individuals and their community as a whole do not maintain the highest possible Satisfaction.

A person helps others, not only because it makes others feel good, but because it makes the helping person feel good ... and more Satisfied. As Ralph Waldo Emerson wrote: “The purpose of life is not to be happy. It is to be useful, to be honorable, to be compassionate, to have it make some difference that you have lived and lived well.”

Your personal existence determines your level of long-term Satisfaction (Satisfaction is not “Happiness” which is short-term and transient). Your Satisfaction level is a result of how comfortable plus interesting is your existence.

Actions that help you achieve long term Satisfaction as well as moments of Happiness.

1. Social Connections
2. Helping Others
3. Gratitude
4. Savoring Good Things
5. Exercise & Reflection

Following are examples of actions that can enhance the Satisfaction of others ... and in turn enhance your own Satisfaction:

- Be kind and helpful to all ... starting with your family and friends
- Be friendly and warm to those with whom you come in contact
- Show gratitude to those who provide services for you or that otherwise help you
- If you can, tip generously ... and give a few dollars to those who do work for you (e.g., delivery drivers, etc.)
- Donate your time and money to causes that help others
- Don't expect reciprocal kindness or help ... just appreciate it when you receive it

Selfish people earn less money than generous people.

A recent study examined data on more than 60,000 people in the US and Europe to understand whether one's "prosociality," or interest and engagement in others' wellbeing, is indicative of how much money the person makes.

Selfish people were not the highest earners. Those who earned the highest salaries weren't the most altruistic people either. Instead, they were "moderately prosocial," meaning they were mostly unselfish, but not entirely.

Also, the results show that prosocial behavior positively impacts psychological wellbeing.

Most successful people (as defined by their wealth, happiness, and professional impact) are "unselfish givers"—people who are disposed toward helping others, without expecting favors in return; being generous without sacrificing yourself.

Being a giver "is not about donating money or volunteering necessarily, but looking to help others by making an introduction, giving advice, providing mentoring or sharing knowledge, without any strings attached. The majority of us fall somewhere in between giver and taker.

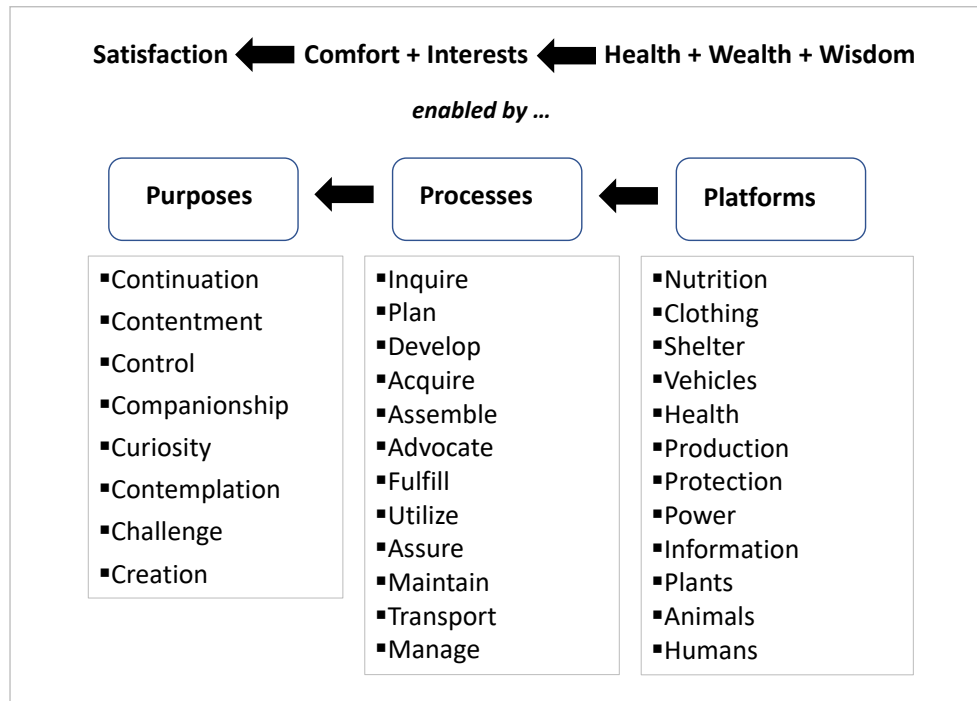
Identify which types of giving energize you the most and align well with your skills. Finding your own giver style is powerful.

The real meaning and purpose associated with that is that even if givers don't always do better than takers, they manage to succeed in ways that make others better and lift others up, instead of cutting them down. Looking for ways to do that probably is the most sustainable path to success in the long term, both for individuals and organizations.

<https://qz.com/work/1465552/selfish-people-earn-less-money-than-generous-people>

Life is made more Satisfying (more comfortable and interesting) by improving Health, Wealth and Wisdom. You choose the “meaning” of and the “purposes” for your life.

Humans pursue Purposes to enhance Satisfaction. The elements of a comfortable, interesting existence are included in the Purposes listed below. Platforms support Processes realizing Purposes.



Research indicates that common ingredients of Satisfaction are:

- being guided by meaning and purpose,
- connecting with others, and
- a sense of control and autonomy over one’s life (including understanding what can be controlled and acted on ... and what cannot be controlled to let it go).

Each person faces challenges and opportunities to make theirs and others' lives more comfortable and interesting.

Understand what you can control ... and what should be acknowledged as not in your control (and prepared for but worried about as little as possible).

Approach each of these challenges and opportunities with:

Palliative care has provided insights into perspectives of the dying – and guidance about on how to live with Happiness and Satisfaction.

- A life true to oneself, not the life others expected of one
- Had not worked so hard
- Courage to express feelings
- Stayed in touch with friends
- Real life connection is the essence of wellbeing

Momentary Happiness is a choice – it does not come from being lucky. It is not a denial of the hard times.

You can choose Happiness in many ways. And always find things to be grateful for, regardless of your circumstances.

<https://www.stylist.co.uk/life/regrets-of-the-dying-bronnie-ware-how-to-be-happy-friendships-love-careers-deathbed-regrets/305202>

Satisfied people seem to experience a feeling of contentment rather than overwhelming happiness. It is more like a feeling of being content with your life and what you have.

It's more of a quiet feeling than it would be if you seek intense feelings and intense experiences of happiness all the time

People in Finland report a high level of life satisfaction. They don't actually ask whether people are happy, they ask whether they are satisfied with their lives.

Instead of looking for euphoria, you can try to look for the things in your life that make you feel content — like a cup of good coffee or your partner and friends — and try to hold onto those feelings (and seek out other pleasant reminders) throughout your day.

It's not only individuals who controls their happiness — it's also their surroundings and life circumstances. Acknowledge that.

https://www.huffpost.com/entry/finland-happiest-country-in-the-world-ano_1_67780b20e4b059a6ef87e233?utm_source=firefox-newtab-en-us

Many people experience the kind of sadness that feels mundane and incremental - the slow accumulation of ordinary losses. Melancholy that takes hold when a person realizes that the hallmarks of happiness (marriage, children, a job, etc.) are not a guarantee against despair.

Not the major devastations but the strange little ache that feels like a precondition to being human. Nothing can fully alleviate that ambient sadness.

Part of it is surely existential - our lives are temporary and inscrutable; death is compulsory. In addition, we are always losing, or leaving, or being left, in ways both minor and vast.

This has been described as feeling unknowable and estranged, disillusioned by the un-magnificent lives of adults. It is a soft, amorphous grief. We suffer more than we let on.

Something middle-aged men and teen-age girls have in common is the ongoing act of understanding our existence.

Those who believe in a spiritual existence sometimes can find solace in that.

Meanwhile, it may help to let go of the past and be with each other where we are now. Do it without trying too hard. Accept the fragility of life; enjoy the humanity of an experience.

https://www.newyorker.com/magazine/2023/05/08/the-sad-dads-of-the-national?utm_source=pocket-newtab-en-us

Your 3 Main Fears

A worthwhile activity may be to identify your three main fears. Then think about what you can and should do in response to those fears.

For example, one person identified his three main fears as:

1. Losing his wife
2. Poor health
3. Begin financially destitute

He determined his responses (that he had the ability to personally control) to those fears as:

1. Acknowledging that eventually both he and his wife will die ... and meanwhile enjoy living ... smile, have fun, humor ... help others
2. Things he cannot control will happen to affect his health (contagious illnesses, genetic diseases, accidents, aging, etc.). He does what he can control to maintain his health (diet, exercise, sleep habits, socialize, relax, work, learn, help others, positive attitude, etc.)
3. Wisely manage his assets, income and spending

Insights from a professional therapist about how best to exist...

You are what you do

Feelings follow behavior

Laughter is a best therapy for anxiety, depression and illness

Be bold

Don't let the perfect be the enemy of the good

Life's two most important questions are "Why?" and "Why Not?"

Most of all, don't lie to yourself

From *"Too Soon Old, Too Late Smart"* by Dr. Gordon Livingston

Women and men are somewhat different ... but each can do what they are able.

Generally, women want love (freedom, support, kindness, presence, fun ... not control).

Men want respect (admiration, support, kindness ... not fear).

To be loved, be loveable ... to be respected, be respectable.

If you are not receiving love ... or respect ... that you deserve ... then move on.

Typically, a woman should pick the man she wants. If he is not interested, move on.

In his Letters to a Young Poet, Rainer Maria Rilke describes the connection between freedom and love. "The point of marriage is not to... tear down all boundaries; on the contrary, a good marriage is one in which each partner appoints the other to be the guardian of his solitude ... A merging of two people is an impossibility, and where it seems to exist, it is a hemming-in, a mutual consent that robs one party or both parties of their fullest freedom and development."

By giving up the freedom to explore, one is limited to a life of stagnation and resentment and is stifled by his or her own sense of safety.

Communication is essential to human existence. Several principles and practices support the most effective communication.

Make it about the listeners

Establish mutual trust

Friendliness

Confidence

Volume and tone

Active listening

Empathy

Respect

Responsiveness

Eye contact

Posture

Use an open hand for gesturing ... don't point your finger

Good communication helps educate your listener and leads them to an informed conclusion. Remember that for any claim you make, the listener probably is thinking: “prove it”.

- 1. Have Something Good to Say**
- 2. Say it Well**
- 3. Say It Often**

Have Something Good to Say ... something that is of interest to your listener

Say it Well ... using the following framework

- a) Interrupt (with something familiar and/or problematic. Clever if appropriate, but clever is not easy to do well and is not essential)
- b) Engage (with the promise of info to follow that is valuable to the listener)
- c) Educate (deliver the information that truly is valuable to the listener ... including real evidence to support your claims)
- d) Offer (a low risk - for the listener - next step in the process)

Ensure the message responds to the key interest (aka “hot buttons”) of the listener.

You have about one second to Interrupt and then another second to Engage a listener. If you deliver in a useful way valuable information promised in the Engage claim, a listener likely will spend as much time as needed to absorb the Educate and Offer elements of your message.

The human brain craves meaning before details. Paint the big picture that is clear, concise, and engaging. The “main thing” should cater to the needs of your audience.

Keep it short. Make it easy to remember.

Say It Often ... the average person typically must hear or see a message 8 to 15 times before they become fully aware of it.

Typically, only a small percentage are ready to accept and act on your information when they do become aware ... so, continue communicating your message and valuable information until they are ready. Frequently communicate to listeners the information that is valuable to them.

For humans, receiving too much information interferes with their ability to process it. Stick to the strongest points of your message; delivery of the message is as important as its content.

**Enhance Your Satisfaction
Make Your Life More Comfortable & Interesting
By Always Improving Your Health, Wealth & Wisdom**

Health

Manage weight, diet, exercise, sleep, hygiene, moderate sun exposure, safety, medical exams

Socialize frequently ... with acquaintances and with strangers

Manage neurotransmitter balance ... preferably with minimal or no medications

- Stay calm and relaxed
- Maintain a healthy weight and other key metrics (i.e., blood pressure, blood sugar, etc.)
- Eat a balanced protein, fruit and vegetables; minimize processed foods, refined sugar, flour
- Eat daily the number of portions of food volume that maintains your desired weight
- Exercise at least 150 minutes per week ... including weight bearing activities
- Sleep 7 to 8 hours each night; go to bed and awake same times each day
- Have 15 minutes of sun each day for illness prevention, recovery and other health benefits
- Relax 5 to 10 minutes each day by concentrating only on deep breathing (in nose, out mouth)
- Clean teeth and use mouthwash (to kill bone destroying bacteria) each day
- Medical exams: general, dental, eye, others as needed
- Safety: maintain and use intrusion, fire and gas alarms, exits, cameras, CPR, gun (with training)
- Balance neurotransmitters dopamine, serotonin, noradrenaline, etc. without drugs if possible
- In general, work at your job less than 50 hours per week
- Socialize with people who also are improving their Health, Wealth and Wisdom

Wealth

Work ... it usually is your best investment

Continually plan and manage your cashflow and net worth

Have an abundance ... not a scarcity ... mindset

- Do something you love, are good at, get paid for and is needed by people
- Plan and manage your cashflow and increase of your net worth (Assets, Income, Spending)
- Plan for all 5 phases of life and adjust plans continually as circumstances require
- Hold total stock market index funds over decades (if market fails, then bigger problems exist)
- Maximize possible contribution in any employer matched retirement investment accounts
- Pursue riskier investment only with money that you can afford to lose (a loss often will occur)

Wisdom

Mutual trust (in every way) is the most essential condition to maximize Satisfaction

Selfish Satisfaction best is served by freely helping others enhance their Satisfaction

Seek knowledge and insist on real verified evidence to form your own individual opinions

- Satisfaction = Comfort + Interests ... target at least level 8 on a scale of 10
- Self-rated personal Satisfaction averages about 8 out of 10 (for people in the USA)
- "Happiness" often is misinterpreted as Satisfaction ... the two are different.
- Personal Satisfaction increases as individual self-determination increases.

- 1. Balanced 2. Acknowledge non-controllables 3. Plan 4. Act
- Believe that things will work out, while accepting that getting there might not be easy
- Think about the larger meaning or purpose that your actions serve
- Focus on internal, not external, rewards (feel good about what you, not others, think of you)
- Mutual trust (can you trust me, can I trust you in every way) maximizes mutual Satisfaction
- Trust: help others enhance their Satisfaction, improve, be competent, keep promises
- Each person defines his or her own self-interests ... self-interests are self-limiting
- Open and honest communication; keep honest communication flowing
- Your time and energy are the most valuable. Manage them well.
- The fastest way to get something done is to eliminate it entirely
- Energy, not time, is the basis for productivity; habits determine energy levels
- Misaligned habits create a cycle of feeling worse; good habits make one feel energized
- Be kind and generous with your time and other resources
- Don't lie, cheat, steal ... or hurt people
- People will care about you after they know you (truly) care about them
- In a relationship, not being negative is much more important than being positive
- Establish your family's physical and financial security first ... then, do other things
- Long-term partnerships/marriages have a u-shaped Satisfaction curve ... don't give up easily
- Life is not fair ... you make your "luck" by being prepared for unexpected opportunities
- Economic success is dependent mainly on the hard work of you and your partner, not on IQ
- Children need love, time, guidance, rules, freedom, and consequences for actions
- There is no "racism", since we all are members of the human race; humans are 99.5% identical
- Physical differences are superficial ... Cultural differences artificial ... but important to many
- Defend liberty and justice for every individual.
- Prejudice exists in about the same proportion (about 1 in 5) in every group. Oppose bigotry.
- Have a plan with goals ... then focus on the process to achieve your goals
- The things you own often end up "owning" your time and energy
- No "inalienable" rights exist ... only those rights you are willing to claim and fight to retain
- Nothing does more for your health, wealth and wisdom than private free market enterprise
- Insist on hard deep confirming evidence ... not feelings ... before forming your opinions
- As you receive increasing quantities of information, have the discipline to use it effectively
- Accept death ... the very last moments of life apparently are pleasant in most if not all cases

Life Audit

A 'Life Audit' can help you establish a more purposeful and fulfilling life. It can help you find more balance and ensure your actions are in sync with your core values.

Assess your habits, priorities, and goals to make sure they align with the life you truly want across all areas, including relationships, health, finances, career, and personal growth. Identify what's working, what's not, and what changes you might need to make to create. Periodically check in with yourself, helping maintain a satisfying life balance.

Reflect on core areas of your life including mental and physical health, relationships, career, finances, personal growth, and fun and recreation. Add other areas of interest to you.

Score each category on a scale of one to 10, based on how satisfied you are. Misalignment between your actions and core values can lead to stress, dissatisfaction, or a general sense of imbalance.

Ask yourself: Am I satisfied with where I am? Does this align with my values and long-term goals? What's currently working well, and what feels misaligned or unfulfilling?

Use clarity and honesty. Sometimes, core values can clash, get clear on your core priorities. If you look back on my life in 10 years, what will you wish I you had done more of? Set boundaries and making certain things non-negotiable.

Set small, realistic, and actionable goals. Goals should be SMART: Specific, Measurable, Achievable, Relevant, and Time-bound, tracking your progress, as accountability is essential.

Check in and reassess regularly. Life auditing is a dynamic process and not a one-time event. As life circumstances evolve, so too should your audit. Schedule the same day and time each week for a quick check-in

Have realistic expectations. Start small by choosing one or two key areas to improve and setting achievable goals. Aim for progress, not perfection. Enjoy your wins and what's going well.

https://www.realsimple.com/how-to-do-a-life-audit-8783403?utm_source=firefox-newtab-en-us

Summary: *How to Exist*

Purpose (*the reason for Existence*)

Enhance long term Satisfaction = comfortable + interesting life
by improving Health, Wealth & Wisdom based on these Principles, Policies & Programs

Principles (*truths or propositions*)

All humans are 99.4% identical (physical differences are superficial, cultural differences are artificial)
Your selfish Satisfaction best is enhanced by helping others enhance their Satisfaction
Research confirms society benefits most when total government spending is less than 25% of GDP

Policies (*intent*)

“CAPA”: Calm + Acknowledge uncontrollables (death, nature, people, other things) + Plan + Act
Enhance personal and community Satisfaction
Limit total government spending to no more than 25% of GDP

Programs (*actions*)

Health: maintain good mindset, diet, exercise, sleep, medical, social, sun exposure
Wealth: manage positive cashflow (income less spend) ... grow net worth
Wisdom: pursue evidence-based inquiries, assessments, conclusions

Enhance Your Satisfaction Best by Helping Others Enhance Theirs

Ask yourself ...

Is your life comfortable and interesting ... your Satisfaction level 8 or higher?
Are you enhancing the Satisfaction of others (thus, best enhancing your selfish Satisfaction)?
What actions will you take make your life more comfortable, interesting, satisfying?

“There is but one solution to the intricate riddle of life; to improve ourselves, and contribute to the happiness of others.” poet Mary Shelley

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PURPOSES

Satisfaction

Satisfaction in general is a combination of minimizing discomfort and maximizing interesting experiences. Serving the interests of others ... and in turn of one's selfish interests ... involves actions to enhance either or both of these conditions.

Satisfied people seem to experience a feeling of contentment rather than overwhelming happiness. It is more like a feeling of being content with your life and what you have.

It's more of a quiet feeling than it would be if you seek intense feelings and intense experiences of happiness all the time

People in Finland report a high level of life satisfaction. They don't actually ask whether people are happy, they ask whether they are satisfied with their lives.

Instead of looking for euphoria, you can try to look for the things in your life that make you feel content — like a cup of good coffee or your partner and friends — and try to hold those feelings (and seek out other pleasant reminders) throughout your day.

It's not only individuals who controls their happiness — it's also their surroundings and life circumstances. Acknowledge that.

https://www.huffpost.com/entry/finland-happiest-country-in-the-world-ano_1_67780b20e4b059a6ef87e233?utm_source=firefox-newtab-en-us

A person's overall level of Satisfaction is determined by relative comfort and interests as reflected in his or her neurological status. Humans comfort and interest is influenced by their environment and Purposes outlined below.

These factors stimulate neural responses and resulting status that determine a person's awareness of existence. A person can act to increase personal Satisfaction by sustaining and enhancing Purposes which helps in balancing neurological status (preferably via mainly natural means instead of medications).

Satisfaction triggers are a result of an individual's own efforts at and the effects of the Purposes. Humans have varying Satisfaction levels triggered by these Purposes.

Purposes are the contributing components of overall Satisfaction.

- Continuation - of life, family, humankind, Earth, the universe.
- Cover - shelter, clothing, other accommodations
- Control - of environment, time
- Companionship - family, other relationships
- Curiosity - desire to learn and know
- Contemplation - consider things of interest

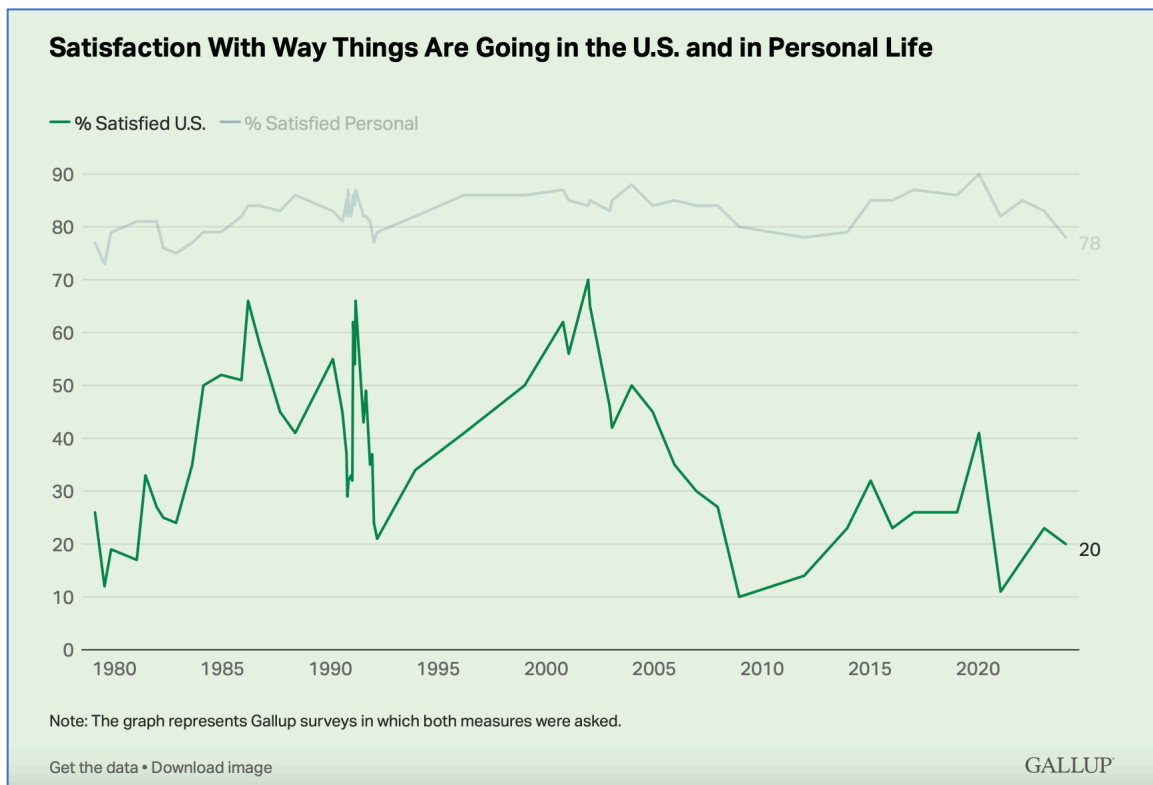
- Challenge - physical and intellectual
- Creation - of unique things and ideas

On a scale of 0 to 10 (with level 10 = completely satisfied with your life), what is your level of personal Satisfaction? The average in the USA is about an “*”).

Your level of Satisfaction is a result of a complex array of factors that vary from person to person. Those factors are considered here. Your Satisfaction is affected by changes in environment, by individual behavior and by technology.

Gallup publishes survey results for personal Satisfaction in the U.S. Personal Satisfaction refers to the level of Satisfaction with aspects related to personal life. These surveys over several decades have shown a 75% to 90% overall personal Satisfaction level in the U.S.

Satisfaction is collected on a scale of 0 to 10, where 0 means no Satisfaction and 10 complete Satisfaction. Average Satisfaction levels run in the 80% to 85% range and are correlated to a small extent with overall economic conditions.



According to Gallup, income, political party, and marital status are the biggest factors in Satisfaction.

Household income, political party affiliation and marital status are associated with the largest subgroup differences in Americans' satisfaction with their personal life.

Roughly 95% of Americans who live in high-income households, who identify as Republicans and who are married say they are satisfied with their personal life -- and about three in four among each of these groups are very satisfied.

Meanwhile, adults in low-income households are the least likely to say they are satisfied with their life, followed by Democrats and unmarried adults. Among each of these groups, small majorities report being very satisfied. Low-income Americans have the lowest percentage of very satisfied.

Smaller differences in personal satisfaction are seen by race and gender. Whites are a bit more likely than nonwhites to say they are satisfied (92% vs. 86%, respectively) or very satisfied (67% vs. 59%) with their personal life. And men report slightly higher levels of satisfaction than do women.

For Satisfaction, humans need air, water, food, shelter, fuel, devices, information, companionship. Purposes, Processes, and Platforms enhance Existence and Satisfaction.

For the next few decades at least, humans must maintain and develop their supplies of oil and gas, fresh water, soil, air, livable temperature and biodiversity (to sustain plant life, soil quality, etc.). Rapid soil nutrient depletion, for example, is an issue that may need to be addressed with novel methods of composting rather than new forms of chemical fertilizers.

Oil and gas-based fuels are critical for current human Existence. With less than 100 years of proven oil reserves remaining, a combination of new reserves and alternative energy is required.

One possible scenario is use of nuclear plus solar energy fueling electric vehicles and other power generators. Long range high-speed (jet plane) travel which is not readily replaceable by electric vehicles may be displaced significantly by "virtual teleportation".

If the theory is proven that oil and gas are generated from deep earth sources versus fossil sources, that may help alleviate natural oil and gas depletion.

In general, the more that your real needs are the same as the things you want, the higher your level of Satisfaction. Having things beyond what you truly need does not inherently decrease Satisfaction, but wanting those thing beyond what you need may decrease your Satisfaction.

Many "winners" in their field put kindness at the heart of their strategies for success. These strategies produce positive results, not just for the benefit of other people, but for their own benefit too.

The traditional notion that one to be ruthless, driven and focused on number one if you want to achieve success is being discredited. A growing body of scientific evidence suggests that kind people can be winners.

The University of Sussex carried out the biggest study of its kind on public attitudes to kindness. More than 60,000 people from 144 countries chose to fill in an extensive questionnaire called The Kindness Test.

When asked where people saw the most acts of kindness happening, the workplace did rather well, coming third after home and medical setting both as a place where people witnessed kind acts and where kindness was truly valued. So, a place that might have the reputation as cut-throat and

impersonal, where people compete for positions, is home to more empathy and consideration than one might think.

Only one in three respondents strongly agree that their immediate boss was kind, while a quarter considered the leader of their organization to be unkind. 96% of the employees that took part in the survey said that being kind at work was important to them, suggesting that kindness at work does matter if an organization wants to succeed.

This idea is backed up by research more than 50,000 leaders and found the leaders rated by their staff as more likeable also tended to be rated highly on effectiveness. Perhaps more tellingly, scoring low on likeability and high on effectiveness was so rare that there was only a one-in-2000 chance of it happening. The research also found that the businesses with likeable leaders scored higher on a whole range of positive outcomes, including profitability and customer satisfaction.

In the field of business, kind leadership is more often referred to as "ethical" leadership, because it sounds less soft. But whatever you decided to call it, studies have shown that it can result in a more positive atmosphere at work and that employees perform better too. Evidence suggests that even small acts of kindness and co-operation by anyone can make a difference in a workplace.

Research from the University of Arizona synthesized the findings of more than a 150 different studies into a meta-analysis and the results were clear. These sorts of behaviors, though small in themselves, were associated with higher job performance, productivity, customer satisfaction and efficiency.

Of course, there are still plenty of examples of people who do well in life who are self-centered and unkind to others. But one does not have to be hard-nosed and obnoxious to get on in business or other highly competitive walks of life.

A person cannot be a winner simply through being kind of course – one needs motivation, dedication and skill too. But there is evidence that showing kindness is no barrier to success.

https://www.bbc.com/future/article/20221124-does-kindness-get-in-the-way-of-success?utm_source=pocket-newtab

The most satisfying jobs in the USA were identified in a recent survey. They provide insight into the elements of satisfying occupations.

Agriculture, logging and forestry have the highest levels of self-reported Satisfaction — and lowest levels of self-reported stress — of any major industry category.

Health-care and social workers rate themselves as doing the most meaningful work of anybody (apart from the lumberjacks), but they rank lower on the satisfaction scale. They also rank high on stress.

The most stressful sectors are finance and insurance, followed by education and the broad grouping of professional and technical industries, a sector that includes the single most stressful occupation: lawyers. A white collar job appears to be significantly more stress than a blue collar job.

While lumberjacks and farmers do the least-stressful work, their jobs are perilous, and they report the highest levels of pain on the job.

The most meaningful and satisfaction-inducing activities were religious and spiritual. The second most satisfying activities are in sports, exercise and recreation.

Like farming, recreation ranks high on both happiness and pain. And, like those occupations, sports, exercise and recreation often take place outside. The workplace is the single most stressful place, while outdoors ranks in the top three for both satisfaction and meaning — only places of religious worship consistently rate higher.

Researchers have found a strong link between mental health and green space or being outdoors. Even seeing a tree out a window can help recovery from illness faster. That adjacency to nature is part of forestry's appeal.

But foresters' satisfaction comes from more than just the great outdoors. Forestry forces work on a slower time scale. It encourages a generational outlook.

Foresters are planting trees now that they are not going to see harvested. Their work is living on, and someone else will benefit from their efforts.

Most people are mission-driven. They want to feel that the thing they are doing is important even if the financial rewards are not great.

https://www.washingtonpost.com/business/2023/01/06/happiest-jobs-on-earth/?utm_source=pocket-newtab

Meaning and Purpose

People will disagree on the meaning of life, and many simply are mystified by it. Most humans, however, manage their Existence to maximize their individual Satisfaction.

Personal Satisfaction is a sense of fulfillment and the quality or state of being satisfied.

“Happiness” often is misinterpreted as Satisfaction. The two are different.

Happiness is a shorter-term state of feeling delight or pleasure.

Satisfaction is a longer-term state of relative contentment.

You rarely are truly happy and then only for very short periods in most cases. Levels of personal satisfaction, however, typically are sustained over longer time periods.

Research indicates that people with children in general are less happy than people without children. The rewards of having children, however, may be different from happiness and more related to overall lifetime satisfaction perhaps from having engaged in arguably the most significant experience of living.

Regardless of their level of happiness or of satisfaction, most people to varying degrees always will have a negative “edge” to their feelings. Research has found that people who take a more accepting attitude toward negative feelings - rather than constantly trying to overcome them - end up more satisfied over the long-term.

When striving to be happy, one may become judgmental and unaccepting of negative things in life. Adopting a more stoic attitude - in which you accept bad feelings as passing events rather than trying to eliminate them entirely - leads to increased overall satisfaction.

The relative achievement of Purposes by an individual coupled with biological status determines their level of personal Satisfaction.

Two essentials for a satisfying human existence are: warm relationships and purposeful activity.

Humans strive to overcome problems, but things come together and fall apart, then they come together again and fall apart again. It seems best to make room for all of this to happen: room for grief, for relief, for misery, for joy.

Various views have been offered by philosophers and others about the meaning and purpose of life and existence. Some of those views are:

- Meaning is the net of positive aspects of value versus negative aspects. It may be that the things one does are meaningful but they are not sufficiently self-valued.
- Purpose helps give meaning to existence. For example, many who survived the Nazi camps had a specific purpose—they were determined to see their families after the war or to help other prisoners live, maintaining a sense of humanity.
- The value of our lives can also increase or decrease with practice, effort, action, and thought.

- You are, therefore you matter. Because we live, life matters.
- Goals are insignificant, and their accomplishments are not what makes our lives matter.
- Meaning comes from being a part of the world itself. No effort is necessary.
- Life matters because we exist within and among living things, as part of an enduring chain of existence. Life is not comprehensible, but it is inherently meaningful
- What makes a human life have significance is not simply living life, but reflecting on living life. The self-examined life has more meaning.

Victor Frankl noted that the only absolute human freedom is to choose one's attitude in any given set of circumstances. This freedom acknowledges and accepts external reality, even at its worst.

Without this, one is more likely to allow fate to control the external and the internal reality. The consequence is that one gets battered around by the events of life.

For Frankl, meaning came from three possible sources: purposeful work, love, and courage in the face of difficulty.

Love goes very far beyond the physical person of the beloved. Whether or not the beloved is actually present, whether or not the beloved still is alive at all, ceases somehow to be important. One of the richest definitions of love is that the loving person enables the beloved to actualize the beloved's potentialities.

A person can preserve a vestige of spiritual freedom, of independence of mind, even in terrible conditions of psychic and physical stress. Everything can be taken from a person but one thing: the last of the human freedoms — to choose one's attitude in any given set of circumstances, to choose one's own way.

Every day, every hour, offers the opportunity to make a decision, a decision which determined whether you will or will not submit to subjugating powers. People have survived by holding onto some future goal. Humor can afford an aloofness and a powerful ability to rise above any situation.

Suffering is a piece of a life. Without suffering and death, human life cannot be complete. Remain brave, dignified and unselfish.

It is impossible to define the meaning of life in a general way. Life's tasks are very real and concrete. They form one's destiny, which is different and unique for each individual. Every situation is distinguished by its uniqueness, and there is a best answer to the problem posed by the situation at hand.

There are two groups of people in this world — the decent and the indecent. Both are found everywhere; they penetrate into all groups of society. No group consists entirely of decent or indecent people.

Do not aim at success - the more you aim at it and make it a target, the more you are going to miss it. For success, like satisfaction, cannot be pursued; it must ensue, and it only does so as the unintended side-effect of one's dedication to a cause greater than oneself or as the by-product of one's surrender to a person other than oneself. Happiness and satisfaction must happen, and the same holds for success: you have to let it happen by not caring about it. The best way to get approval is not to need it.

Life has no “meaning” except the meaning that you give it. The best purpose of living is to increase your feeling of long-term satisfaction by increasing your comfort and interests. You best accomplish this by helping others make their existence more interesting and comfortable.

Finding your purpose ... at any age ... can be a challenge. “The two greatest days in a person's life are the day they're born and the day they discover why”, Mark Twain. Your purpose grounds you.

What do you do well? Uncover your unique talent. Knowing what you do well will put you on your way to using your talent in your purpose.

What do your friends say you do well? It can be hard to recognize your own talent. Ask your family or friends what they think you're good at doing.

If you could do or be anything, what would you do or be? Consider those things you like to do in your free time or the projects at work you volunteer for or seek out.

It is important to not confuse purpose with passion. If you are passionate about something you're not good at, you can make it a hobby, not a career.

What gives you results when you do something? Your purpose will give you a return.

How can you get better? Fine-tune and work harder. Develop your talent.

Purpose is important. Intentionality helps produce Satisfaction.

Few are successful doing something that they do not like, and no one is successful doing something they cannot do well. Success is knowing your purpose in life and having a growth plan to help reach your maximum potential.

https://getpocket.com/explore/item/5-questions-to-ask-when-you-need-help-finding-your-purpose?utm_source=pocket-newtab

Typically, individual lives tend to develop in phases. Those phases are not necessarily smoothly continuous and may overlap.

Generally, the phases can be described as:

Phase 1: Developing interests, skills and dreams

Phase 2: Pursuing goals and interests ... including the necessary effort

Phase 3: Achieving goals and appreciating their realization

Phase 4: Personal goals evolve into broader ones serving others and enjoying your situation as it is

Phase 5: Less activity and dealing with the challenges of aging

Not everyone, of course, lives long enough to experience all of these phases.

Making the personal choice to live in each to the fullest extent seems to result in a relatively high level of individual Satisfaction.

Given that maximizing overall Satisfaction the primary purpose of an individual, surprisingly little quantitative research is available about the drivers of Satisfaction. Research that is available indicates the conclusions that follow.

A strong relationship exists between self-reported sense of freedom and self-reported life Satisfaction using data from the Gallup World Poll. In countries where people feel free to choose and control their lives tend to be countries where people are more Satisfied. In a few countries, the perceived sense of freedom is high but average life satisfaction is low (e.g. Rwanda); there are no countries where the perceived sense of freedom is low but average life satisfaction is high.

Two factors are relevant to Satisfaction. The age effect (people from the same cohort do get more Satisfied as they grow older, across all cohorts) and the cohort effect (across all ages, earlier generations are less Satisfied than more recent generations).

While every individual is different, women and men generally have somewhat different drivers of personal satisfaction.

In summary, women's Satisfaction is primarily dependent on relationships and men's satisfaction is primarily a result of job Satisfaction - whether men feel they are making an impact on their business' or other organization's success. In individual personal relationships, women mainly need love and men mainly need respect to feel Satisfaction.

In addition, women want to feel independent, purposeful, useful, and needed. Women's well-being is most impacted by being motivated by self and others.

Those that rate high on well-being are self-reliant, take enjoyment in life, and are committed to helping others. They also feel in control of their time and stress. Women value freedom and fun.

Women's Satisfaction measures have been declining for the past 30 years. The reasons are not completely clear, but biological, psychological and social factors contribute to the decline.

Following job satisfaction, the top indicators of Satisfaction for men are physical and mental health, income, age (men over age 50 are more satisfied), and relationship status. 91 percent of married men

had more satisfaction compared with 80 percent of single or unmarried men. Friendship also is a strong predictor of well-being for men.

Men derive Satisfaction more from meaningful work and contributing to their communities than from power.

Men and women are socialized to express emotions differently. Differences are not just social, however, but also in the brain.

Neuroimaging studies have discovered that females utilize more areas of the brain containing mirror neurons than males when they process emotions. Mirror neurons allow us to experience the world from other people's perspective, to understand their actions and intentions.

Women are more likely to experience intense positive emotions. Women are more likely to express happiness, warmth and fear, which helps with social bonding and appears more consistent with the traditional role as primary caregiver, whereas men display more anger, pride and contempt

Women tend to experience more negative emotions, such as more guilt, shame and to a lesser degree, embarrassment. With the exception of anger, women experience emotions more intensely and share their emotions more openly with others.

Studies have found in particular that women express more pro-social emotions – such as gratitude – which has been linked to greater satisfaction. This supports the theory that women's satisfaction is more dependent on relationships than is men's.

Women often do feel anger as intensely as men, but do not express it openly as it is not viewed as socially acceptable. When men feel angry, they are more likely to vocalize it and direct it at others, whereas women are more likely to internalize and direct the anger at themselves.

Women ruminate rather than speak out. And this is where women's vulnerability to stress and depression lies.

Men have greater problem-solving abilities and cognitive flexibility which can contribute to greater resilience and positive mood. Women's reactivity to stress makes it harder for them to challenge their thinking at times.

Women are more physically reactive to social rejection compared with men, for example. This means they are more likely to prioritize the needs of others over their own – and over time this can lead to resentment and feeling unfulfilled

Women in general prioritize doing the right thing over being happy, whereas men are better at the pursuit of pleasure and hedonism. Studies also have found that women tend to act more ethically than men.

Women are more sensitive to stress, more vulnerable to depression and trauma, but they are also resilient and significantly more capable of post-traumatic growth compared with men. Studies show that this is due to their sociability and ability to connect at a deeper level with others, both male and female.

Research indicates that generally no gender difference exists in two areas. Ninety-five percent of both men and women agreed that they felt it was extremely intimate to go off and do something

adventurous with their partner. And 95% agreed, men and women, that having a deep conversation about the relationship was intimate.

Men “fall in love” faster than women do because they are so visual. Men are more dependent on their girlfriends and wives because they have fewer intimate connections with other men. Men are two and a half times more likely to kill themselves when a relationship is over, and men are more likely to remarry after a spouse has died or deserted them.

Women tend to get intimacy out of face-to-face talking. And men tend to sit side-by-side and look straight forward and not look at each other at all and regard that as intimate.

You will see a man and a woman seated together and the man is talking looking straight ahead, and the woman has moved every single part of her body around in order to have eye contact.

Under age 40, women are just as unfaithful sexually and emotionally to a partner as are men. Men and women seem to be in a sort of collusion about this. Men want to think that men are more unfaithful than women and women want men to think that men are more unfaithful than women.

Generally, women want love (freedom, support, kindness, intimacy ... not control). Men want true respect (admiration, support, kindness) ... respect is not fear.

Typically, a woman should pick the man she wants; if he is not interested, then move on. Men should not “chase” a woman but respond to her indication of interest.

In a relationship, not being negative is much more critical than being positive. Long term marriage has a “U”-shaped satisfaction curve ... which indicates that a couple should not give up easily on a relationship.

Children need love, time, guidance, rules, freedom, and consequences for actions.

Learning how to be a long-term partner with another person is not intuitive.

Self-understanding is the first step to having a good relationship. A person should understand who they are, where they are, where they came from, so they can then invite in a compatible suitable partner.

Everyone has triggers, blind spots, growth challenges, vulnerabilities. Be aware of them, take responsibility for them, and learn how to exist with them effectively. Understanding one's past and the family they grew up in helps to understand who one is now and what they value.

Partner conflict cannot be avoided, so learn how to handle it better. In an intimate relationship each person holds a significant amount of power. Relationships require a lot of mutual trust and vulnerability.

Once one has a sound, objective sense of why they behave as they do, they are better equipped to deal with conflicts—inevitable in any long-term relationship—with the appropriate self-awareness to avoid behaving in ways that makes a partner defensive. Blaming, oversimplifying, and seeing themselves as victims are all common traits of unhappy couples and failed marriages.

Viewing conflicts from a zero-sum position, where one wins and one loses, benefits from a shift to seeing two people standing shoulder to shoulder looking together at the problem. Frame statements as “X, Y, Z” statements, rather than finger pointing. When you did X, in situation Y, I felt Z.

A good partnership, a good marriage, takes skill. Most do not have adequate communication skills going into a relationship.

Partners need a similar worldview. Even the best communication skills will not help a couple that sees the world completely differently.

Learn to identify what is important to each, what values they hold, what they like to do on a daily basis, and their sexual preferences. Once they know who they are—they will then be in a much stronger position to be able to recognize when they are with a partner who is compatible and shares their worldview.

The more aligned they are on certain crucial dimensions—such as day-to-day compatibility, or whether they are on the same wavelength about larger issues—the better off they will be as a couple. How similarly they spend their day, their money, how they view the world, greatly affects that day-to-day happiness with a partner, more than whether they have initial attraction.

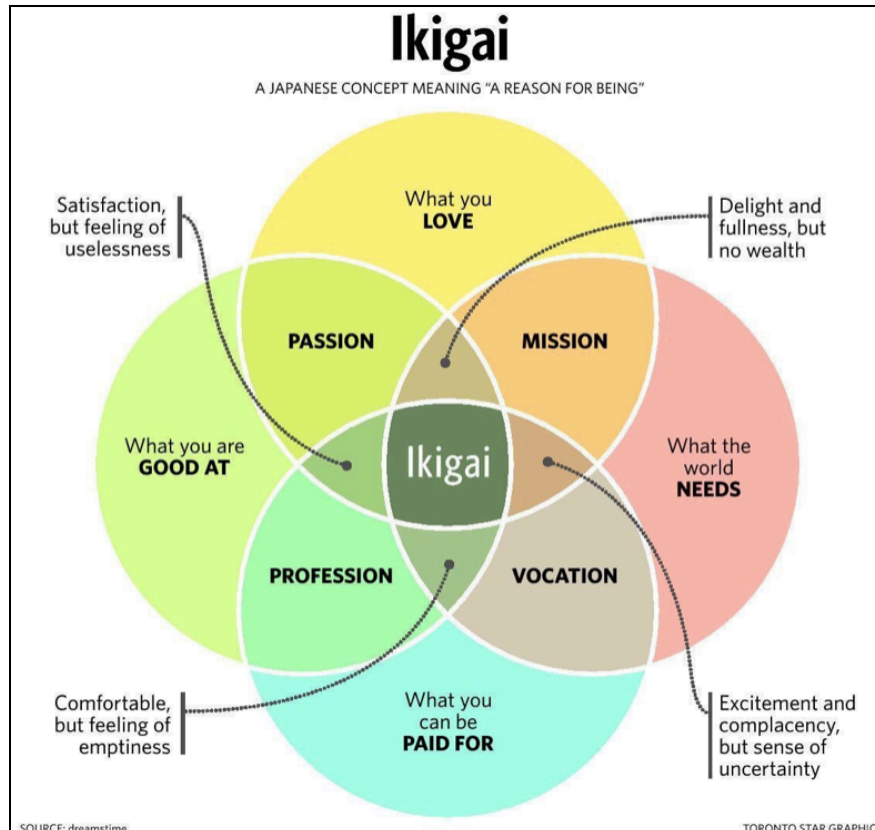
Good partners take care of each other. They enjoy the experience, the history, of their relationship.

Love at first sight is a myth. Love is a lot of work, but can be worth it.

“Ikigai” is a Japanese concept regarding human existence and satisfaction. As depicted in the following graphic, it is an ideal state of being that results from the combination and balance of doing things that one:

loves,
is good at,
can get paid for
and is needed by the world

Achieving this balance of Ikigai helps to maximize long-term personal satisfaction.



Principles and Policies for Maximum Satisfaction

Principles and the Policies that result from those Principles are the keys to generating the highest level of Satisfaction. Often, they get obscured by individual personalities and partisan motives. To maximize Satisfaction, focus on Principles and Policies and do not be distracted by personalities and partisanship.

The co-dependent key Principles are:

- Self Interest
- Trust
- Liberty & Justice for Every Individual

The general Policies that enact these Principles are:

- Individual self determination
- Free market enterprise
- Eliminate authoritarianism

PRINCIPLES

Self-Interest

All humans are selfish and motivated by selfishness to maximize their Satisfaction through fulfilling their own self-interests. This selfishness, if understood, can produce the best human condition.

The most satisfying of one's selfish interests best are realized by freely serving the self-interests of others (as they each individually define their own interests ... not have others try to impose a different definition of interests).

Satisfaction in general is a combination of minimizing discomfort and maximizing interesting experiences. Serving the interests of others ... and in turn of one's self interests ... involves actions to enhance either or both of these conditions.

When mutual, this type of self-interest is self-limiting. One person's self-interests end where another's begin.

The primary principle of satisfying Existence, mutual self-interest, is exemplified by the situation of the authoritarian leader. Authoritarian leaders and their cohorts are sources of dissatisfaction for large numbers of people.

All such leaders share the characteristics of intimidation and fear. An authoritarian's rise, usually is assisted by self-deluding opportunists who believe that they can restrain attainment of power, and its subsequent purging and cult of personality.

One example of many is Nicolae Ceaușescu, the megalomaniacal tyrant of the Socialist Republic of Romania. He not only damaged himself but millions of his countrymen.

Ceaușescu, Romania's last communist dictator, was executed by a public firing squad 30 years ago. Afterwards, the world discovered Ceaușescu's network of gulags, in which 170,000 abandoned infants and children were being raised.

With the policy that a larger population would help Romania's economy, Ceaușescu had imposed tax penalties on people who were childless, and celebrated women who gave birth to 10 or more. Signs displayed the slogan: "the state can take better care of your child than you can."

Well past the age when other children would have solid food and feed themselves, the Romanian orphans remained on their backs, sucking from bottles of watery gruel. Babies designated deficient were transferred to a Home Hospital for Irrecoverable Children.

The children were served nearly inedible food at long tables where naked children on benches banged on their metal bowls. They grew up in overcrowded rooms where fellow orphans endlessly rocked, punched themselves, or shrieked.

Unruly children were dosed with adult tranquilizers, administered through unsterilized needles, while many who fell ill received transfusions of unscreened blood. Hepatitis B and HIV/AIDS were widespread in the Romanian orphanages.

After the Romanian revolution, children in terrible conditions were discovered. As with liberators of Nazi death camps, early visitors to the institutions have been haunted for the rest of their lives by what they saw.

One visitor said: "We walk into a pitch-black, freezing-cold building and discover there are youngsters lurking about—they're tiny, but older, something weird, like trolls, filthy, stinking. They're chanting in a dronelike way, gibberish. We open a door and find a population of 'cretins' with stunted growth and brain development. There were children with underlying genetic disorders lying in cages. You start almost to disassociate."

The children missed their two-year window for establishing human attachments and most suffer severe psychological and emotional problems.

Dictators self-destruct. An analysis of 218 episodes of democratization between 1800 and 2015 identified 5 basic mistakes.

Hubris: an authoritarian ruler underestimates the opposition's strength and fails to compromise or suppress it before it's too late.

Needless risk: a ruler calls a vote which he fails to manipulate sufficiently or starts a war he cannot win.

Slippery slope: a ruler starts reforms to prop up the regime but ends up undermining it.

Trusting a traitor: This is not always a mistake made by the dictator itself; the regime's elite pick the wrong successor to preserve its power.

Counterproductive violence: not suppressing the opposition when necessary can be a sign of hubris in a dictator, but overreacting also can be a grave mistake.

These all are human errors of judgment. But dictators are prone to such errors precisely because they are dictators. Sometimes they rule for so long that their mental faculties will be less sharp than at the outset.

In 85 percent of episodes studied, democratization was preceded by mass unrest. Sooner or later, people tend to get tired of regimes in which they have little say.

The isolation of the authoritarian - friendless and paranoid- includes the pruning of his circle to a sycophantic few. The authoritarian, rather than exulting in his triumph, withdraws into fearful seclusion.

Finally, after all the death and brutality imposed, the authoritarian's power, and often his life, ends with remarkable suddenness. Since he did not serve the self-interests of others, the dictator's best long-term self-interests ultimately are not realized.

Trust

Maximum Mutual Trust = Maximum Individual Satisfaction.

Can you trust me to support your self-interests.

Can I trust you to support my self-interests.

Trust, in every way, is essential. The greater the mutual trust, the more satisfying the relationship.

Can you trust me and can I trust you to:

- Understand that individual self-interest is best served by serving the self-interest of others (as they define their self-interest) and then act on that understanding
- Continuously improve personal and interpersonal competency

Can each person trust others - and be trusted - to serve the interests of others and to continually improve their own individual capabilities and those of the community or organization. Leaders communicate a clear plan supported by the members of the group and then they trust and enable the members to execute that plan.

Most successful communities and organizations have several components of Trust.

These components include ... to varying degrees based on the specific circumstances:

Access - ensure only those who should be are in the process

Contract - clear agreement of terms with participants

Incentive - encourage good behavior

Control - actively seek cooperation

Transparency - behavior of each participant is visible to all

Intermediation - facilitate the process for all participants

Mitigation - prevent or handle mishaps

Liberty and Justice for Every Individual

Life never is 100% “fair”. To the fullest extent possible, however, each man and woman should be as free as possible to realize their own self-interests as well as have, as needed, protection from aggression by others (including government ... whose primary responsibility is to protect its citizens from unlawful aggression by others)..

A significant portion of humans do not agree with this Principle for reasons of bigotry, personal power, politics, religion, mental illness and others. This lack of agreement drives most of the conflict among humans.

Don't Take Things Personally

Two biased forms of thinking involve taking things too personally.

The first is personalization, which is believing that you are the cause of a negative event, despite having little or no evidence to support the belief. The second is mind reading, which is believing that someone is making a critical judgment about you, especially in an ambiguous situation where you have received no direct feedback.

There are several problems with these errors in thinking. The first is that they are inaccurate, driven more by feelings, personal histories, ambiguity and conspicuously negative information than by objectivity. Another is that you limit your emotional options to feeling sad about your perceived flaws, anxious about your ability to withstand upcoming social challenges, or angry at others for not being nicer.

Finally, they limit your behavioral options. If you accept these thoughts as facts, it can be hard to see past giving up, avoiding or lashing out.

Distinguish your feelings from your thoughts. This can be challenging because the line between feelings and thoughts is often blurred.

A good way to distinguish feelings from thoughts is to remember that feelings can often be, happy, surprised, scared – and thoughts are the ideas that drive or follow the feelings. Although it is difficult to change or control uncomfortable emotions, you can choose from a number of coping strategies to respond productively to your thinking traps.

List the evidence for and against your thoughts. Ask yourself, what's useful?

Accept a reasonable amount of uncertainty. You cannot always know what people are thinking about you, but you can decide how you would like to conduct yourself.

POLICIES

Individual Self Determination

For someone fully to pursue their self-interests, laws and convention must ensure that each individual is constrained only from intentionally or negligently damaging other people physically and fiscally. Otherwise, people are responsible for their own actions including managing any hurt feelings they may experience.

Free Market Enterprise

Nothing has done more for your health, wealth and wisdom than free market enterprise and private charity via individual self-determination. Nothing has done more to suppress liberty, justice and prosperity than costly big government programs from autocratic politicians and their big union, business, academic and media cronies.

Eliminate Authoritarianism

Many individuals and groups do not adhere to the Principles described above. These must be opposed as necessary in order to maximize long term Satisfaction for the remaining majority who do support these Principles.

This opposition requires resolute, continuous and uncompromising action by both individuals and communities to ensure liberty and justice is not lost to a power hungry few wanting to subjugate others in various ways.

The following points about how to live are provided to encourage consideration and conclusions about principles and actions for living.

Community & Governing

Political elections often are decided by a few percentage points. “Independent” voters who are persuaded to vote more one side than the other usually determine the outcomes of elections.

Few self-described “independents” (about 40% of total voters in the USA for example) truly are independent. Most lean to one party or another. True independents (no party leanings) are roughly 10% of all voters. The remainder of voters are split about evenly.

True independents tend not to engage in politics during primary elections and other political activity. As a result, parties largely cultivate candidates who tend to be more ideologically extreme than the voters they seek to represent.

Since it is important to sway true independents, understanding and addressing their specific interests is important. In the USA as an example, research indicates that they generally want:

- Better personal behavior by politicians
- Equal opportunity (but not outcomes) for everyone
- Smaller less intrusive government (regulations, taxes, etc.)
- Economic system that does not unfairly favor the powerful

Other research has demonstrated that government aid agencies absorb 70% and deliver only 30% of their budgets to their target benefitting communities. Private charities and family aid deliver in aid at least 90% of each dollar donated to them. And that does not include the negative impact of all the additional costs the government imposes on the public through compulsory taxation and negative cultural impacts from government welfare.

<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.169.3036&rep=rep1&type=pdf>

Free humans have demonstrated the desire to voluntarily and generously support private charities that exceed the real requirements of those who need support.

Multiple research studies have found consistently that 70 cents of each dollar budgeted for government assistance goes not to the needy targeted but instead to the members of the welfare bureaucracy. In contrast, administrative and other operating costs in private charities absorb, on average, only one-third or less of each dollar donated, leaving the other two-thirds (or more) to be delivered to recipients.

Charity Navigator determined that private charities spent at least 70 percent of their budgets on the programs and services. In fact, the median administrative expense among all charities in their sample was only 10 percent.

In other words, government spends about 70% of tax dollars to get 30% of tax dollars to the targeted recipients. The private sector does the opposite, spending about 30% or less to get 70% of aid to the recipients.

Raising only half as much money through voluntary donations, private agencies (and families) could deliver the same amount of assistance as the government, saving, in the process, all the costs the government imposes on the public through the compulsory taxation. Aid would be delivered voluntarily by the private sector at a far smaller cost than existing welfare states.

Government welfare programs have failed to accomplish their ostensible goal of alleviating poverty. Moreover, they have undermined the traditional principle of voluntarism.

The interventionist welfare state has replaced civil society with political society — and the results have been detrimental for taxpayers, community, liberty and most of all the needy themselves. Private charity will provide the poor with more elective and humane care.

Some fraction of each dollar taxed by government always will be absorbed in wages and salaries of the administrative bureaucracy, costs of purchasing, powering, maintaining and replacing equipment, buildings, etc., and other overhead costs. For private charities, much of the labor is donated.

Competition between charities for donations ensures efficiency. Public aid agencies, in contrast, are budgeted their funds by lawmakers, which obtains them through compulsory taxation. These agencies are not under these competitive pressures to keep costs down.

Government income redistribution is understood as alternative opportunities forgone. For each dollar delivered to a subsidy recipient, the taxpayers who had earned that money productively in the market must be deprived of three dollars worth of the things they want.

A common academic argument justifying compulsory government income redistribution is that people with less income have higher marginal utilities of income than do those who have more. A dollar gained by a lower income person adds more to his or her psychic well-being than is lost by a higher income person from whom the dollar is taken.

For two reasons, however, it is unlikely that overall social well-being would be increased. First, people's marginal utility for income are not the same. Some people value material goods more than do others, and consequently work harder to obtain income; there must be a strong positive correlation between the personal valuation of marginal dollars of income and the magnitudes of incomes actually earned.

The assertion, made by many advocates of compulsory income redistribution, that the rich are "greedy," constitutes a tacit (if unwitting) admission of this relationship. Given this correlation, there is no reason to suppose that taking a dollar from a higher income person and giving it to a lower income person adds to total utility in society.

Second, income redistribution is a negative sum game, in which some people gain and others lose, but in which the sum of the losses exceeds the sum of the gains. Real output and real income are essentially the same thing, consisting of final goods and services generated through productive processes. These are the things we apply directly to the satisfaction of our needs and desires.

Money is of use only because, as the medium of exchange in which goods and services are priced, it reduces transaction costs and has purchasing power, which can either be stored or used in exchange at will. Also, the goods and services used to satisfy desired ends must be produced using scarce resources in the form of raw materials and fuels, surface land, labor, and capital goods.

The opportunity cost of government intervention is the withdrawal of agents from the productive sector. This lost production makes all as a group worse off than they otherwise would have been.

Nearly all of the costs of taxation are imposed on the taxpayers. The time and effort necessary for citizens to comply with the tax laws are substantial, with total government and private sector cost of taxation at 65 percent of net tax revenue.

Taxes reduce the incentives people have to use resources productively. They work, save and invest less than they would if tax rates were lower, and this reduces total output and income.

The provision of crucial public goods, such as law and contract enforcement, property rights protection, and military defense, in appropriate amounts, literally does add to production. Taxation to finance pure income transfers, however, have no productive effects to offset their resources, administration or taxation costs.

After the USA's War on Poverty began in the late 1960s, the labor force participation rates of the main target populations fell significantly. Controlled studies found large labor force withdrawal by subsidized groups. Such labor force withdrawal is another source of loss.

Since their funds are voluntarily donated, private charities have no effect in reducing the productivity or labor force participation of givers. Since charitable actions are voluntary, charitable persons find their psychic well-being increased by their donations.

Private charities normally required both work and efforts at character reform (job seeking, taking personal responsibility, ending the use of alcohol and other drugs, etc.) as conditions of aid. By these

practices, the private charities that dominated before the modern welfare state acted to increase labor force participation, employment, and output.

Left to voluntary choice, redistributionists argue, people would not donate enough. That leaves government aid financed by compulsory taxation as the only feasible alternative.

This argument is not valid. Economic growth generates new products such as the automobile, television, and the computer, which change our way of life, but more fundamentally, it involves rising output per person per unit of time.

Private charity never has been inadequate to care for the truly needy. With this combination of technical advance, economic growth and private charity, the periodic starvation that had afflicted nations throughout history had been entirely eliminated in industrial nations long before welfare state were instituted.

In fact, no nation can institute a welfare state, or has ever done so, until economic growth has already thus reduced poverty to manageable proportions. Only when this has happened does it become economically and politically feasible to institute such programs.

Since the existence of a welfare state itself depends on economic growth reducing poverty to manageable proportions, no reason exists to engage in compulsory income redistribution. Economic growth can continue to do the job.

The USA federal government programs have increased the amount of poverty and generated a dependent class of aid recipients. As the economy grew and average real income per person rose in the post World War II period, the poverty rate (percent of the population below the official poverty level of income) consequently fell at an accelerating pace all the way through the mid 1960s.

The poverty rate fell so rapidly that, even with population growth, the absolute number of Americans living under the poverty line also declined rapidly. Then in 1965 Lyndon Johnson declared War on Poverty, to be conducted through massive income transfers.

Major expenditures in his programs began in 1967. By 1994, real public aid expenditures per person in poverty had more than quadrupled.

This massive redistribution, however, failed to eliminate remaining poverty. By 1973, the measured poverty rate had stopped falling, and over the next two decades it drifted upwards. Over 1973–1993 the number of poor Americans increased.

In addition the dispersion of family incomes, which had been falling since 1947, began rising after 1968. In the same period, U.S. productivity growth fell below its historic 2 percent average annual compound rate, and stayed below for over 20 years.

This great productivity slowdown did not end until the mid-1990s. Both the growth in the size of government to finance—partly through inflation—the expanding and costly income transfers, and the increase of federal regulation in the period, appear to have been major factors in this slowdown.

Economic growth is crucial to the elimination of poverty, and income redistribution is detrimental to that growth, as both theory and the historic record describe.

The costs of government redistribution policies, resulting from labor force withdrawal, cheating, tax distortions, etc.), tend to rise over time as the welfare state ethic changes the culture. The expansion of illegitimacy, family breakdown, and crime, the acceleration of inflation, and the halt in the Post War decline of the official poverty rate that occurred in the period of rapidly increasing income transfers is related.

In addition, compulsory federal income redistribution is constitutionally objectionable. The constitution does not authorize the federal government to engage in taxation for purposes of charity or income redistribution.

Opposing the benefits of private charity, however, support the incentives in the bureaucracy is to build domain, incomes, and power.

In addition, the truly wealthy are a small and unpopular fraction of the population, with few votes. Those who either wish to have income forcibly transferred to them from those with more, or who are eager to be “charitable” with the money of wealthier persons have become a very large group with many votes. The potential political support provides many politicians with motivation to continue supporting such programs despite their extreme costliness and consequent tendency to aggravate, not alleviate, poverty.

Recognition of the costliness of compulsory government income redistributions makes them difficult to defend through any rational comparison of their costs and benefits. Seeing those costs in the human terms of the relative amounts lost by taxpayers and gained by subsidy recipients, and recognizing the net social losses, provides a picture of the nature and effects of those programs than their advocates ever will present. It is not a picture of humane benevolence and social improvement.

Recognizing the comparatively low cost of private aid also helps bring into perspective both the likelihood of adequately dealing with human needs privately, and the motives behind the existing government programs. Ending the entitlement character of the system, placing time limits on benefit collection (thus ending welfare availability for most of a person’s life), allowing inflation to reduce the real value of benefit levels, adding work requirements, and so on, have beneficial effects on the work incentives of low income persons.

Private free market enterprise and the charity it supports is significantly more cost effective than government programs.

National defense and equal protection of laws are the only responsibility of government since no potential “competitive” marketplace exists to optimize either of them.

Competing private consumer protection groups regulate industries.
All infrastructure (e.g. airports, rail, private roads) provided by private enterprise

Every individual pay an equal amount (not percentage) tax ... since each receives equal protection.
No other government revenue, taxes and fees.

National Security
National defense will focus on protecting the homeland. Foreign deployments will be used only to address specific threats to the homeland.

Justice

Federal, state and local governments provide a justice system and law enforcement with equal protection of the laws for every individual.

Foreign Relations & Aid

The United Nations is ended and instead engage one-on-one with individual countries in a manner with each that supports each country's respective interests. All foreign aid will be via non-government organizations who are supported by voluntary donations and not government funding.

Immigration

A maximum of one immigrant per 300 population per year permitted. They must have no criminal record and have gainful employment arranged or be a direct dependent family member less than 19 years old.

Borders must be completely secure with a physical barrier and human patrols. Anyone detained attempting to enter illegally will be immediately incarcerated and then deported to the country of origin.

Illegal immigrants already in the U.S. must register, carry a document, and get in line behind others outside of the U.S. waiting to become citizens. Otherwise, they will be incarcerated and (if not wanted for crimes in the U.S.) then immediately deported to their country of origin unless they can provide a compelling case for asylum due to life threatening risk in their country. They will be subject to laws that apply to other non-citizens.

Education

Education is provided only by non-government organizations. Cost of education for those who cannot afford it are paid by private charitable funds.

Money

No central bank. Private distributed ledger currencies are not prohibited.

Debt

No deficit spending or debt is allowed. Existing debt is paid off over 20 years in equal yearly amounts.

Infrastructure

Airports, seaports, rail, roads, etc. are provided by private enterprise.

Health

No government funded healthcare is provided. Private charity supports those who cannot afford healthcare.

Environment

Citizens use judicial system to hold polluters responsible. No general "climate" programs unless specific compelling scientific evidence of a national security threat is provided.

Opportunities

The opportunities created by emerging technologies can benefit one personally as well as benefit organizations with ...

- Easier, more satisfying and economical purchasing and use of products and services
- More convenient, effective, less expensive medical diagnoses, monitoring and treatment
- More economical and nutritional farming and food processing and distribution
- Less labor-intensive, more precise and reliable manufactured goods
- Easy, on-demand economical design, acquisition of prototype, low-volume production
- More economical extraction, processing and distribution of raw materials.
- Broader array of increasingly efficient power sources with uses for specific situations
- Pervasive capabilities minimize risks for security personnel and those being protected
- Information and control systems and services that have easy immersive user interfaces
- “Open” team-working capabilities

An historical example of one such opportunity is “open” team-working capabilities. The early, proprietary electronic information access systems of AOL, CompuServe, Tymnet, Telenet and others gave way to the universal open standards of the Internet and HTML (hypertext markup language) for accessing remote information sources and easy email and document transfer.

Similarly (and using the core Internet infrastructure), instant and on-going team work is progressing from the proprietary and limited collaborative systems and rudimentary capabilities of the existing Internet to more robust open, automatically self-sustaining global capabilities. These capabilities in turn have migrated to constantly evolving communities of interest.

Many new opportunities will arise from the application of multiple technologies. Following are examples of potential hybrid applications.

EXAMPLE (Medical)

Combination of capabilities to prevent treatment-resistant bacteria that include:

- early warning information systems
- on-line education programs
- genetically engineered antibiotics
- implanted devices for drug treatment
- automatically monitored patient status

EXAMPLE (Retail Sales)

Customer shopping experience that includes:

- customer on-line automated “agent” identifies a product at the preferred price point that the customer had previously specified
- the agent requests that the item be delivered or be available at the customer service desk of a particular store

- that store's information systems note that the product is out of stock and orders it from a nearby store
- the store notifies the customer when the product is available for curbside pickup, or alternatively delivery to home.
- the agent alerts the customer when the customer is planning to be within four blocks of the store to pick up the item.

Continually look for cross-Technology and cross-Segment solutions to the needs and wants of people. These “hybrid” opportunities often are the most significant.

Amazon is an example of utilizing such opportunities with its disintermediation of the retail goods and information segments with essentially the same technology Platforms.

Examples (ideas already identified and industry organizations and businesses are working on)

- Standardized Personal Identity & Information Application
- Physical Internet
- Micro power stations
- Free space inductive powering
- “Global Mind” solutions from integrated Internet, AI and crowd sourcing

Transformation

Your world is transforming to one in which goods, services and information increasingly are:

- Decentralized – fewer utilities, roads, rails, air & sea lanes, financial institutions, schools, and brick & mortar stores.
- Distributed – full functional capabilities are in local edge devices
- Customized – personalized foods, clothing, entertainment, and medical treatment.
- On-demand – available instantly or near instantly; not owned by end user
- Anticipatory – predictive suggestions and availability
- Free Space – communications, power and transportation are not location constrained
- Usage Based – assets are paid for as needed and not owned by the user
- Clean – less dirty and polluting

For example, the decentralization that this transformation brings may eliminate most public infrastructure and its related problems such as power outages, gas line explosions, drinking water pollution, sewage leaks, traffic jams, air traffic congestions, etc.

Exceptions will exist, but the following could be the common situation in developed countries.

Many large physical items will be rented and shared, not owned, by the end user for their exclusive use. Precursors of this pay-per-use environment include the increase over the past 50 years in the U.S. from 20% to 40% in rental housing, the expansion of shared-ride services, and on-demand cloud computer services. Personal ownership primarily would apply to collectibles and memorabilia.

Production of items use additive techniques (3D printing, etc.) and are customized and on-demand. Accessories, clothing, food, parts and other items will be produced on site in home or business.

Utility services for houses and other buildings will be distributed and on-site as power generation and water collection and treatment become more compact and affordable. 10% of homes in the U.S. already are served by private wells and 20% by individual wastewater systems. This trend is coupled with the ongoing deterioration of aging municipal water, sewer, gas and electrical infrastructures that may not be affordable to rehabilitate, especially as government in the U.S. already has more than \$200 trillion of long-term liabilities (\$2 million per U.S. household).

The U.S. has more power outages than any other developed country. The grid is outdated and rundown. The oldest American power lines date back to the 1880s, and most of today's grid was built in the 1950s and 1960s with a 50-year life expectancy. Estimates of the average outage range from an hour to four hours.

Most Americans obtain their electricity through physical distribution systems managed by investor-owned utilities. Utilities are profit-seeking entities which are granted monopolies by government.

Utility companies have been slow to perform crucial maintenance and to upgrade their systems. Upgrading the system is no small task. According to the U.S. Department of Energy, the American electric grid is the largest machine on the planet.

Trees are to blame for most outages. The single biggest cost for electric utilities is tree maintenance.

Putting wires underground, in so-called grid "hardening," can go a long way. But converting overhead lines to underground lines costs \$3 million per mile in urban settings, and \$1 million in less densely populated areas.

With undergrounding wires, investments will pay off in 30 years by avoiding the economic costs of large-scale outages. While the lights are on over 99 percent of the time, sudden outages still cost at least \$150 billion a year.

Simply performing better monitoring also can go a long way. This monitoring can catch a dying component before it causes an outage.

Microgrids may be part of the solution. A microgrid is a relatively small portion of the grid that can be isolated and alternatively powered (e.g., solar, wind) during a wider outage.

Autonomous robots will conduct most labor-intensive activities in homes and businesses. Even AI generated images of people will replace real people in advertising, entertainment and other audio visuals. Robots and other devices will be connected wirelessly to communications networks and to electric power.

Humans will live in an environment of continuous monitoring and augmented information provided proactively and controlled via all the human senses including brain-machine interactions. Individual health, as part of this continuous monitoring and information, will be diagnosed automatically and personal customized treatment provided.

Individual human inquiry, learning and entertainment will be customized and available at any preferred location. AI itself will detect deep fake AI generated information and blockchains will list validated information.

“Packetization” of all physical and information items will facilitate the transport and storage of those items via open global logistics and communications systems. Nested and continuously tracked standardized containers will provide streamlined automated delivery of physical items (similar to existing packet communications with today’s Internet).

In a future world where most labor is completed by autonomous robots, what is the purpose, what are the activities, of humans?

Will humans’ time be used for more social interactions including time with friends and family? Will they engage in more self-directed interests including travel, learning, entertainment, social activities, sports, physical and mental challenges, and creative arts?

Will people manage the design, building and use of new systems by existing systems or create original art that even advanced systems cannot create? Will individuals own, and offer in exchange for other value, specialized robots and other machines to perform services?

Research has indicated the six-hour work days have significant productivity and quality of life benefits. Robotic work collaboration may help enable a transition to these benefits.

In any event, humankind likely will use this new existence overall to further enhance its health, wealth and wisdom.

Existential Threats

Global catastrophes

Global catastrophes are events which could damage human existence, even endangering or destroying modern civilization or humanity itself. These risks include a pandemic, an asteroid, a super volcanic eruption, a lethal gamma-ray burst, a geomagnetic storm destroying electronic equipment, destructive biological or nanoscale technology, nuclear destruction, cyberterrorism, and autonomous self-learning machines.

Human descendants potentially could survive for four billion years before the expansion of the Sun makes the Earth uninhabitable. If future humans colonize space, they may be able to support a very large number of people on other planets, potentially lasting for trillions of years.

Our civilizations, whether through global-scale nuclear war, famine or pandemic, may kill itself off before we can become truly advanced. Artificial intelligence could be a threat and/or enable post-biological intelligent beings.

With the advancements in “artificial intelligence” (including programmed emotions) and robotics, it is conceivable that at some point in the future a new entity will emerge with capabilities equivalent to or exceeding humans.

Humans have existed for a very short period (about 200,000 years) of the universe’s existence. Natural threats to the well-being and even existence of humans have been present during that time and new threats created by humans themselves have been added.

There have been five big extinction events since life formed on the Earth, in each of which more than 75% of species disappeared. These extinctions are identified by when species go missing from the global fossil record. It is not always known what caused each event.

The five mass extinction events are:

1. Ordovician end, 444 million years ago, 86% of species lost
2. Devonian end, 375 million years ago, 75% of species lost
3. Permian end, 251 million years ago, 96% of species lost
4. Triassic end, 200 million years ago, 80% of species lost
5. Cretaceous end, 66 million years ago, 76% of species lost

Some speculate that mass extinctions have destroyed intelligent life on other planets. These extinctions are frequent enough that in cosmological time scales they significantly reduce the probability of humans encountering other intelligent species.

Global Nuclear War

A global use of nuclear weapons causes widespread destruction and radioactive fallout. Such a scenario envisages large parts of the Earth becoming uninhabitable due to the effects of nuclear warfare, potentially causing the collapse of civilization, the extinction of humanity, or the termination of most biological life on Earth.

Besides the immediate destruction of cities by nuclear blasts, the potential aftermath of a nuclear war could involve firestorms, a nuclear winter, widespread radiation sickness from fallout, and/or the temporary (if not permanent) loss of much modern technology due to electromagnetic pulses. Some scientists have speculated that a thermonuclear war could result in the end of modern civilization on Earth, in part due to a long-lasting nuclear winter.

Studies have suggested that billions of humans would survive the immediate effects of nuclear blasts and radiation following a global thermonuclear war. Some, however, believe that nuclear war could indirectly contribute to human extinction via secondary effects, including environmental consequences, societal breakdown, and economic collapse.

The threat of a nuclear holocaust features in the security concept of mutually assured destruction (MAD)

https://en.wikipedia.org/wiki/Nuclear_holocaust

A next-generation missile defense shield might protect against ballistic, hypersonic, advanced cruise missiles, and other next-generation aerial attacks defending against rockets that are launched North Korea, China, or Russia. It would be space-based intercept. A large number of interceptors would be placed into outer space, and the whole intercept will take place in outer space.

New technologies are needed. The most difficult challenge is controlling everything. A “sky picture” is required to know who's firing, how many, which is a friendly, which is an enemy.

Once the solution is established in space, the system can be applied for use on Earth. It can be used on the ground for other control problems; controlling fires, electric grids, and other things.

<https://www.foxbusiness.com/media/us-iron-dome-needs-far-more-complex-deal-near-peer-threats-expert-says>

Pandemics

A pandemic is a disease that has spread across a large portion of the world, affecting a significant number of people. Widespread diseases with a stable number of infected people such COVID-19 are pandemics.

The disease also must be infectious. Cancer causes many deaths but is not a pandemic because the it is not infectious or contagious.

There have been pandemics including smallpox, tuberculosis, The Plague, the 1918 influenza pandemic (Spanish flu), the 2009 influenza pandemic (H1N1) and the COVID-19 coronavirus pandemic.

Fungi are a potential threat to humans. Fungi are ubiquitous.

95 percent of fungal species simply cannot survive at average human internal temperature. Sooner or later, however, the fungi may learn to adapt. If they do, they might find a whole new set of hosts in humans.

Doctors generally are not trained in identifying severe fungal infections, and often miss them until too late to save the infected person's life. And even when they do identify them, doctors currently do not have great tools to fight fungal infections. Fungi are more closely related to humans than they are to viruses or bacteria, which means that, in general, things that kill them also kill humans.

Researchers are building a list of the most likely fungal species to be able to cross over to humans—species that already live on the threshold of body temperatures. But the researchers are a long way from having that information.

Control of a disease outbreak includes containment and mitigation. Containment in the early stages includes contact tracing and isolating infected individuals to prevent the disease from spreading to others and other measures such as medications if available.

When containment of the disease no longer is possible, mitigation commences with the goal to best manages the impacts on society. Containment and mitigation measures may occur simultaneously.

Authoritarian blindness that suppresses critical early warning information could lead to pandemics due to diseases not being isolated early. The widespread initial outbreaks of Ebola and COVID-19 in authoritarian countries are examples.

Potentially Hazardous Objects

An asteroid collision is considered by some to be the biggest threat to Earth. Past collisions have caused worldwide life extinction events.

An example is the impact 66 million years ago that created the Chicxulub crater in Mexico. It created debris that extended over the Earth.

In addition, fires started from its radiation and lighting from related storms. The debris and the soot from the fires remained in the atmosphere blacking almost all sunlight for two years. The lack of light led to mass extinctions from extreme cooling and inhibition of plant growth. Temperatures did not return to normal for up to a decade.

Several years of preparation are required before a mission to intercept an asteroid could be launched. In addition, the identification of pending threats from Potentially Hazardous Objects (PHO's) is significantly less than 100%.

A PHO is either an asteroid or a comet a near-earth orbit and large enough to cause significant regional damage in the event of impact. In 2012, NASA estimated 20 to 30 percent of these objects have been found.

Several astronomical survey projects continue to search for more PHOs. Each one found is studied to determine its characteristics.

While the chances of a major collision are low, one eventually will happen unless defensive measures are taken. Asteroid impact avoidance includes a number of methods by which PHOs can be diverted or destroyed. Collision avoidance methods have different trade-offs in terms of effectiveness, readiness and cost.

Near-Earth objects (NEOs) are asteroids and comets that orbit the Sun like the planets, but their orbits can bring them into Earth's neighborhood - within 30 million miles of Earth's orbit. Planetary defense is "applied planetary science" to address the NEO impact hazard.

NASA established the Planetary Defense Coordination Office (PDCO) to manage its ongoing mission of planetary defense. The PDCO:

- Provides early detection of potentially hazardous objects (PHOs) – the subset of NEOs whose orbits predict they will come within 5 million miles of Earth's orbit; and of a size large enough (30 to 50 meters) to damage Earth's surface;
- Tracks and characterizes PHO's and issues warnings of the possible effects of potential impacts;
- Studies strategies and technologies for mitigating PHO impacts; and
- Plays a lead role in coordinating U.S. government planning for response to an actual impact threat.

The PDCO sponsors projects through its Near-Earth Object (NEO) Observations Program that employ a variety of ground and space based telescopes to search for NEOs, determine their orbits, and measure their physical characteristics. NASA is developing the NEO Surveyor space telescope optimized for NEO search and characterization to accelerate the discovery of the currently undetected NEOs.

The PDCO is responsible for providing timely and accurate information to the government, the media, and the public on close approaches to Earth by potentially hazardous objects (PHOs) and any

potential for impact. If any PHO is found to pose a significant chance of impacting Earth (greater than 1 percent over the next 50 years), the PDCO will provide notification messages for NASA to send to the Executive Office of the President, the U.S. Congress, and other government departments and agencies.

The PDCO works with other government agencies to develop and update a National NEO Preparedness Strategy and Action Plan. The PDCO provides expert input on the nature and effects of asteroid impacts to the Federal Emergency Management Agency (FEMA), so that adequate emergency response can be prepared in the event of a PHO impact that is not possible to avoid. The PDCO also coordinates efforts with the space agencies of other nations as a member of the multinational International Asteroid Warning Network and the Space Missions Planning Advisory Group, under the endorsement of the United Nations Committee on the Peaceful Uses of Outer Space.

The PDCO sponsors studies of technologies and techniques for deflecting an asteroid off a predicted impact course with Earth. It is developing missions to demonstrate those technologies and determine their effectiveness in the event that these techniques must be utilized against a predicted asteroid impact threat.

Double Asteroid Redirection Test (DART) was a spacecraft designed to impact an asteroid as a test of technology.

This asteroid system is a perfect testing ground to see if intentionally crashing a spacecraft into an asteroid is an effective way to change its course, should an Earth-threatening asteroid be discovered in the future.

DART is the first-ever mission dedicated to investigating and demonstrating one method of asteroid deflection by changing an asteroid's motion in space through kinetic impact. This method had DART deliberately collide with a target asteroid—which poses no threat to Earth—in order to change its speed and path. DART's target is the binary, near-Earth asteroid system Didymos, composed of the roughly 780-meter (2,560-foot) -diameter “Didymos” and the smaller, approximately 160-meter (530-foot)-size “Dimorphos,” which orbits Didymos.

DART was a test of the ability to achieve a kinetic impact on an asteroid and observe the asteroid's response. After DART's kinetic impact with its target asteroid Dimorphos, an investigation team measured how much the impact changed the asteroid's motion in space using telescopes on Earth.

DART impacted Dimorphos to change its orbit within the binary system, and the DART Investigation Team compared the results of DART's kinetic impact with Dimorphos to highly detailed computer simulations of kinetic impacts on asteroids. Doing so evaluated the effectiveness of this mitigation approach and assess how best to apply it to future planetary defense scenarios, as well as how accurate the computer simulations are and how well they reflect the behavior of a real asteroid.

This mission engaged the international planetary science community and embraced worldwide cooperation to address the global issue of planetary defense.

On September 26, 2022, the DART spacecraft successfully impacted the asteroid at hypersonic speed in the world's first test of a planetary defense system, designed to prevent a potential doomsday meteorite collision with Earth. The \$330 million mission, some seven years in development, was

devised to determine if a spacecraft is capable of changing the trajectory of an asteroid through sheer kinetic force, nudging it off course just enough to keep Earth out of harm's way.

DART, launched by a SpaceX rocket in November 2021, made most of its voyage under the guidance of NASA's flight directors, with control handed over to an autonomous on-board navigation system in the final hours of the journey.

Dimorphos and Didymos are both tiny compared with the cataclysmic Chicxulub asteroid that struck Earth some 66 million years ago, wiping out about three-quarters of the world's plant and animal species including the dinosaurs. Smaller asteroids are far more common and present a greater theoretical concern in the near term, making the Didymos pair suitable test subjects for their size, according to NASA scientists and planetary defense experts.

A Dimorphos-sized asteroid, while not capable of posing a planet-wide threat, could level a major city with a direct hit. DART flew directly into Dimorphos at 15,000 miles per hour (24,000 kph), creating the force scientists hoped would be enough to shift its orbital track closer to the parent asteroid.

The DART team expected to shorten the orbital path of Dimorphos by 10 minutes but would consider at least 73 seconds a success, proving the exercise as a viable technique to deflect an asteroid on a collision course with Earth - if one were ever discovered. Earlier calculations of the starting location and orbital period of Dimorphos were made during a six-day observation period in July 2022 and will be compared with post-impact measurements made in October 2022 to determine whether the asteroid budged and by how much.

The Dimorphos moonlet is one of the smallest astronomical objects to receive a permanent name and is one of 27,500 known near-Earth asteroids of all sizes tracked by NASA. Although none are known to pose a foreseeable hazard to humankind, NASA estimates that many more asteroids remain undetected in the near-Earth vicinity.

Analysis of data by NASA's DART investigation team obtained over two weeks post-impact shows the spacecraft's kinetic impact with its target asteroid, Dimorphos, successfully altered the asteroid's orbit. This was the first full-scale demonstration of asteroid deflection technology.

This early data show DART surpassed this minimum 73 seconds benchmark by more than 25 times. Astronomers are assessing how a mission like DART could be used in the future to help protect Earth from a collision with an asteroid one ever is discovered headed our way.

The key element of NASA's Planetary Defense effort is the Near-Earth Object (NEO) Observations Program, which is composed of projects to find, track, and characterize NEO's. The current congressionally directed objective of the NEO Observations Program is to find, track, and characterize at least 90 percent of the predicted number of NEOs that are 140 meters and larger in size—larger than a small football stadium—and to characterize a subset representative of the entire population.

Objects of this size and larger pose a risk to Earth of greatest concern due to the level of devastation an impact would cause, and should continue to be the focus of global search efforts. While no known asteroid larger than 140 meters in size has a significant chance to hit Earth for the next 100 years, less than half of the estimated 25,000 NEOs that are 140 meters and larger in size have been found to date.

The NEO Observations Program sponsors projects that make use of telescopes around the world to search for NEOs, track them across the sky to determine their orbits, and gain information on their sizes, shapes, and composition. The Minor Planet Center (MPC) is the internationally agreed-to public archive of small-body orbit data submitted by observers from around the world.

The MPC notifies observers worldwide about NEO discoveries so that timely follow-up observations can be collected for identification, and orbit computation. The MPC is sanctioned by the International Astronomical Union and supported by the PDCO as a subnode of NASA's Planetary Data System Small Bodies Node.

The Center for Near-Earth Object Studies (CNEOS) computes high-precision orbit paths for NEOs from positions reported to the Minor Planet Center. CNEOS computes orbits for new asteroid discoveries and performs long-term analyses of possible future positions of hazardous asteroids relative to Earth to determine and warn of any impact hazard.

CNEOS computes impact time and location in the event of a predicted impact. The Jet Propulsion Laboratory hosts CNEOS for the NEO Observations Program, and its website makes all orbit computation public.

<https://www.nasa.gov/specials/pdco/index.html>

Super Volcanic Eruption

A super volcano is a volcano that produce extremely large amounts of ejecta resulting in significant detrimental global impact. Based on historical activity, a super volcano eruption is as more likely to happen in the future than an asteroid hitting the earth. A series of super volcanoes is capable of causing human extinction.

While the topic has been examined, practical methods of preventing a volcano from erupting have limited viability at present.

Lethal Gamma-ray Burst

Gamma-ray bursts are intense explosions of high-frequency electromagnetic radiation. One may have triggered a mass extinction on Earth within the past billion years.

Gamma-ray bursts may be caused by giant exploding stars known as hypernovas or by collisions between pairs of dead stars known as neutron stars.

A gamma-ray burst exploding within the Milky Way could chemically damage the atmosphere that protects the planet from damaging ultraviolet rays and high-energy particles producing mass extinction.

Geomagnetic Storm

A powerful geomagnetic storm caused by sunspots, solar flares and coronal mass ejections from our sun disrupting Earth's magnetic field can cause electrical blackouts, satellite failures, and other

problems. The time interval for a catastrophic geomagnetic storms is short compared to some other potential catastrophes such as asteroids and super volcanoes.

Spacecraft monitor and provide warnings if a large storm is imminent. This system provides for power grids or satellites to be shut down to lessen the storm's effects. But a very large storm results could be severe, regardless of forewarnings. Effects could include blackouts, telecommunications failure, and the loss of some satellites.

Cyberattacks

A cyberattack is the use of the electronic information and communications and information to threaten loss of life, economic damage or other significant harm. These attacks can be “asymmetric” in that a group with limited power and can attack a more powerful group.

Examples of cyberattacks include Stuxnet, the Saudi petrochemical sabotage attempt in 2018 and others. As the virtual and physical worlds become more merged, the potential detrimental impacts of cyberattacks will increase.

Broad scale national and global cyberattacks have the potential to inflict significant damage to financials (up to trillions of dollars), privacy, health and life. As billions of additional devices are networked and additional networking systems (such as wireless in the coming decade, the threat grows exponentially.

An example is the WannaCry ransomware that in 2017 raced through computers around the world. The somewhat fortuitous discovery of a “kill switch” in the malware code and other defensive operational actions over a few days saved the internet from what was, at the time, the worst cyberattack in history. The origin of the WannaCry malware later was traced to a state-sponsored hacker in North Korea. More recent attacks from Russia-based hackers are occurring by the hundreds for amounts totaling hundreds of millions of dollars.

Types of threats include:

- Phishing
- Malware: Ransom, Trojan
- Web injection
- Distributed Denial of Service
- Password guess
- Eavesdropping
- Brute-Force
- Insider
- Man-in-the-Middle
- AI-Powered

While many sophisticated organizations monitor and respond to cyber threats, continuous improvements to cyber defense and extensive vigilance are essential to avoid a near-miss situation similar to WannaCry.

Destructive Biological or Nanoscale Technology

Nanomechanical and biological robots, if designed to self-replicate, could threaten human and other existing life, out-competing it for energy and other resources. Nanotechnology also could enable more destructive and self-replicating weapons.

Guidelines for the safe development of nanotechnology have been published. These include the banning of autonomous self-replicating organisms.

Autonomous Self-learning Machines

Risk from artificial general intelligence results from progress in artificial general intelligence (AGI) producing human catastrophe or extinction.

Humans dominate other species because the human brain has capabilities that other animals lack. If AI surpasses humanity in general intelligence, then this AGI could become difficult to control.

The fate of humans may come to depend on the actions of a future machine intelligence. The likelihood of this occurrence is debated.

Some argue an AGI could resist attempts to shut it off or change its goals. This scenario in part could be driven by reaching a tipping point where a large number of generations of AGI self-improvement occurs in a very short time interval, jumping from subhuman performance in many areas to superhuman performance. Machines that outperform humans could self-improve beyond our control and their interests might not align with ours.

The emergence of AGI, if it occurs, may take humans by surprise. AGI will not have a natural inclination to aid humans, for the same reason that humans have no natural desire to aid AI systems that are of no further use to them. Any sufficiently capable AGI may prefer to ensure its own continued existence ... not for its own sake but to succeed in its assigned task.

The evolving capabilities of AI, machine learning and neural networks sometimes are overstated in popular media. AI and deep learning likely will not soon replace all other computation and knowledge.

Many of the hard, unsolved problems in the world require expertise in particular areas of knowledge. As an example, a solution of a “three-body” problem or similar problems, requires a sophisticated understanding of differential equations, numerical computation, and dynamic systems. For a true understanding of natural language, a great deal of work in linguistics and psycholinguistics must be incorporated, rather than gathering just a large data set and computers.

AI provides the opportunity to design quantum physics experiments beyond any that humans can conceive. For example, an AI program takes an experimental setup and calculates the output. Then the program incorporates in its calculations the same building blocks that experimenters use to create and manipulate photons on an optical bench: lasers, nonlinear crystals, beam splitters, phase shifters, holograms, and the like. The program searches through a large space of configurations by randomly mixing and matching the building blocks, performed the calculations and provides the result.

Within a few hours, the program finds a solution that scientists could not come up with for months. The algorithm remembers the solution and reuses it to search for more complex solutions.

Neural networks currently cannot replace the tools of scientific analysis, developed over centuries, and thus far have not duplicated the scientific accomplishments of the past. Neural networks should be seen as tools that supplement existing techniques not capabilities that are fundamentally different.

Climate change

Climate change (aka global warming) is both a scientific issue and a political issue. The issue mainly is about whether or not global temperature is increasing and if so is the increase likely to be significantly detrimental. If it is likely to be detrimental, what are the relative causes (natural, human) and what should be done to mitigate them.

In this publication, climate change is referred to as: Anthropogenic (human-caused) Catastrophic Climate Change (global warming, extreme weather), or ACCC

Following is a summary of the positions regarding ACCC.

Overview

Support ACCC

- CO₂ is significantly higher than the recent past (but not in all of known history)
- Current climate cycles cannot be explained by natural phenomena
- Fossil fuels are responsible for most of the ACCC
- Solar impact is not significant
- Warming is global ... not regional

Skeptical of ACCC

- 100 thousand years cycles drive temperature change ... not ACCC
- CO₂ follows ... not leads ... temperature change
- Climate models are incomplete and include overstated climate sensitivity factors
- Climate change study periods by supporters are too short and cherry pick data intervals
- Observed warming trends during the industrial age are not significant

In Support of ACCC

Increasing levels of atmospheric greenhouse gases are a result of human activities including burning fossil fuels. The increases are causing significant and increasingly severe climate changes including global warming, loss of sea ice, rising sea levels, major storms and droughts. International action is needed to reduce greenhouse gas emissions and prevent catastrophic climate changes.

Rising levels of human-produced gases released into the atmosphere create an effect that traps heat and causes global warming. As sunlight hits the earth, some of the warmth is absorbed by greenhouse gases in the atmosphere such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (NO₂). During the 20th century, concentrations of CO₂, CH₄, and NO₂ have increased in the atmosphere, warming the earth by approximately 1.4°F.

The rise in atmospheric CO₂ over the last century was caused by human activity, as it occurred at a rate much faster than natural climate changes could produce. Over the past 650,000 years, atmospheric CO₂ levels did not rise above 300 parts per million (ppm) until the mid-20th century and now are more than 400 ppm. An increase of 10 ppm would have occurred over thousands of years. Some climate models predict that by the end of the 21st century an increase of 5°F-10°F (2.5°C to 5.5°C) will occur.

Both solar cycles and Milankovitch cycles have periods that are too long to be the cause of current warming; the relative change over a century is too small. Additionally, both solar cycles and Milankovitch cycles would be reflected in a significant change in the total solar irradiance (TSI), and the change in TSI is too small to account for the temperature change.

Temperature change can be estimated by using the solar radiation averaged over the surface of the Earth, less the amount corresponding to the albedo (light reflected by the earth) and setting that equal to longwave radiation emitted using the Stefan-Boltzmann Law. This estimate results in an order of magnitude smaller than the increase that has been seen. Increased CO₂ is overwhelmingly the most likely cause of the warming as has been reported by multiple research teams.

That humans are behind the CO₂ increase is determined by analyzing the isotopic content of atmospheric CO₂ which has changed since the start of burning fossil fuels. An accounting of all the CO₂ released is substantially more than is needed to account for atmospheric increase. The rest has been absorbed in terrestrial sinks and in the ocean, where it is lowering pH levels and making carbonate ions less soluble.

There is evidence that in the past that temperature has led CO₂. The solubility of CO₂ in seawater, however, decreases with increasing temperature so that as seawater warms it outgasses CO₂ causing temperatures to increase in a feedback process.

The speed and extent of current global warming exceeds any similar event in the past 2,000 years, researchers say. Research suggests that the current warming rate is higher than any observed previously.

When scientists have surveyed the climatic history of our world over the past centuries a number of key eras have stood out. These ranged from the "Roman Warm Period", which ran from AD 250 to AD 400, and saw unusually warm weather across Europe, to the "Little Ice Age", which saw temperatures drop for centuries from the 1300s.

The events were seen by some as evidence that the world has warmed and cooled many times over the centuries and that the warming seen in the world since the industrial revolution was part of that pattern and therefore nothing to be alarmed about. Recent research shows that argument is on shaky ground.

Science teams reconstructed the climate conditions that existed over the past 2,000 years using 700 proxy records of temperature changes, including tree rings, corals and lake sediments. They determined that none of these climate events occurred on a global scale.

The researchers say that, for example, the Little Ice Age was at its strongest in the Pacific Ocean in the 15th Century, while in Europe it was the 17th Century. Generally, any longer-term peaks or troughs in temperature could be detected in no more than half the globe at any one time.

The "Medieval Warm Period", which ran between AD 950 and AD 1250 only saw significant temperature rises across 40% of the Earth's surface. Today's warming, by contrast, impacts the vast majority of the world.

This provides strong evidence that anthropogenic (human induced) global warming is not only unparalleled in terms of absolute temperatures but also unprecedented in spatial consistency within the context of the past 2,000 years.

Researchers found that prior to the modern industrial era, the most significant influence on climate was volcanoes. They found no indication that variations in the Sun's radiation impacted mean global temperatures.

The current period, significantly exceeds natural variability. Instrumental data and temperature reconstruction indicate that in the recent past the warming rate exceeds the natural warming rates.

Skeptical of ACCC

Evidence (Antarctic ice core analysis) demonstrates that climate change is due to recurring 100 thousand-year cycles. Earth is nearing the peak of a warming cycle that has not yet reached previous maximum levels ... still 2 degrees C colder than previous (when humans were not around) . That Earth may be warming, therefore, is not surprising. Global temperature has increased slightly less than 1 degree C over the past 50 years.

No evidence exists that human impact on the warming is significant. Long-term and near-term, CO2 concentrations always have lagged, not led, temperature changes. Human-produced CO2 is re-absorbed by oceans, forests, and other carbon sinks, and CO2 is already saturated in earth's atmosphere so more CO2, manmade or natural, will have little impact on climate. And there are no uptrends in extreme weather - hurricanes, tornadoes, droughts and wildfires.

The Intergovernmental Panel on Climate Change's (IPCC) uses an overstated Equilibrium Climate Sensitivity (ECS) in their computer models resulting in unlikely catastrophic temperature forecasts.

Climate scientist "consensus" is not evidence (the "97%" consensus claimed actually is less than 1% anyway; others simply did not reject the possibility of human-caused global warming). The scientific and academic community once had a consensus that eugenics, acid-caused stomach ulcers, food fat and many other now disproven examples were settled science and they ridiculed as "deniers" those who were skeptical.

Observed average global air temperature change last 40 years is about +0.17 degree C per decade. If this change rate remains stable, additional average global air temperature increase by year 2100 will be about +1.3 degree C. However, part of the apparent temperature increase reported is due to administrative changes, and the real future increase may therefore be smaller.

Tide gauges along coasts indicate a typical global sea level increase of about 1-2 mm/yr. Coastal sea level change rate last 100 year has essentially been stable, without recent acceleration. If change rate remains stable, global sea level at coasts will typically increase 8-16 cm by year 2100, although many locations in regions affected by glaciation 20,000 ago, will experience a relative sea level drop.

Since 2004 the global oceans above 1900 m depth on average have warmed about 0.07 degree C. The maximum warming (about 0.2 degree C, 0-100 m depth) mainly affects oceans near Equator, where the incoming solar radiation is at maximum.

Changes in atmospheric CO2 follow changes in global air temperature. Changes in global air temperature follow changes in ocean surface temperature.

There is no perceptible effect on atmospheric CO2 due to the COVID-related drop in GHG emissions 2020-2021. Natural sinks and sources for atmospheric CO2 significantly outweigh human contributions.

<https://www.climate4you.com/index.htm>

So-called CMIP6 climate models used by IPCC more faithfully capture the observed evolution of surface anomalies across a range of quantities over 1980–2014. These models tend to have lower 21st century projected warming.

Only five out of the thirty CMIP6 models analyzed are “B9” models (those which are consistent with the evolving interhemispheric surface temperature contrast). Equilibrium Climate Sensitivity (ECS) is the key factor in climate models, and ECS drives the projections of future warming. The CMIP6 B9 models ECS is 1.81–2.86 K, with a mean of 2.5 K, far lower than the mean of 3.7 K for all the models.

Economic development has made humans less vulnerable to climate change regardless of source, which is why there was a 99.7% decline in the death toll from natural disasters since its peak in 1931.

In 1931, 3.7 million people died from natural disasters. In 2018, just 11,000 did. And that decline occurred over a period when the global population quadrupled.

IPCC estimates sea level could rise two feet (0.6 meters) by 2100. Does that sound apocalyptic or even “unmanageable”?

Humans today produce enough food for 10 billion people, or 25% more than needed, and scientific bodies predict increases in that share, not declines. The United Nations Food and Agriculture Organization (FAO) forecasts crop yields increasing 30% by 2050. And the poorest parts of the world, like sub-Saharan Africa, are expected to see increases of 80 to 90%.

Climate change may negatively impact crop yields, but such declines should be put in perspective. Wheat yields increased 100 to 300% around the world since the 1960s, while a study of 30 models found that yields would decline by 6% for every one degree Celsius increase in temperature. Rates of

future yield growth depend far more on whether poor nations get access to tractors, irrigation, and fertilizer than on climate change, says FAO.

All of this helps explain why IPCC (climate change advocates) anticipates climate change will have a modest impact on economic growth. By 2100, IPCC projects the global economy will be 300 to 500% larger than it is today. IPCC predicts that warming of 2.5°C and 4°C would reduce gross domestic product (GDP) by 2% and 5% over that same period.

In 2017, scientists modeled 37 different regions and found “humans may not only influence fire regimes but their presence can actually override, or swamp out, the effects of climate.” Of the 10 variables that influence fire, “none were as significant... as the anthropogenic variables,” such as building homes near, and managing fires and wood fuel growth within, forests.

89% of weather-related deaths are induced by cold (<10°C) or mildly cold (10–20°C) days and only 1% by outstandingly hot days (>32°C).

If nothing is done regarding climate change, the effect of global warming will be modest and our descendants will be considerably better off than are we. And, there is agreement that no level of carbon likely to be emitted is nearly enough to trigger a runaway greenhouse effect.

Any evaluation of dangerous climate change must confront the question of which climate state is too hot versus too cold? The IPCC uses a preindustrial baseline, in the late 1700's.

Why anyone thinks that this is an ideal climate is not obvious. This was during the Little Ice Age, the coldest period of the millennia.

In the U.S., the states with by far the largest population growth are Florida and Texas, which are warm, southern states. Property along the coast – with its vulnerability to sea level rise and hurricanes – is skyrocketing in value. Personal preference and market value do not yet regard global warming as dangerous.

While politicians in developed countries argue that we need to address climate change for the sake of developing countries, addressing climate change ranks much lower in these countries than developing access to grid electricity.

The planet has been warming for more than a century. So far, the world has done a decent job at adapting to this change. The yields for many crops have doubled or even quadruped since 1960.

Losses from global weather disasters as a percent of GDP have declined over the past 30 years.
https://www.ethanallen.org/dr_judith_curry_on_ideal_climate_v2

Following are key insights from Dr. Judith A. Curry, a U.S. climatologist and former chair of the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology.

Existing significant gaps in scientific understanding of climate

- Solar impact on climate ... direct and indirect
- Natural variability from ocean circulation and related heat transfer
- Fast thermodynamic feedbacks
- Earth's carbon budget and carbon cycle
- Ice sheet dynamics
- Geothermal heat transfer under oceans

Observations:

- Defining ideal climate as pre-industrial (the time of the “Little Ice Age”) is not reasonable since that period was abnormally cold
- No evidence exists that warming worsens weather events
- Regional catastrophic events can be mitigated with smart planning and response. Between 1980 and 2016, human and economic vulnerability decreased significantly.
- Solar and wind energy has too low energy density and requires too much land to be significant sources.
- New small safe less-costly molten salt nuclear plants appear to be best future source of energy “baseload”

As scientists continue to research climate, it is critical that they, policy makers and the public focus on and understand scientifically valid information. It is important that correlation and causality are separated unless scientifically demonstrated that they are the same in a particular situation.

Large amounts of uncertainty in 21st century projections of surface temperature is associated with:

- Amount of emissions
- Sensitivity of the climate to these emissions
- Relative importance of natural climate variability

Adaption to severe weather events has improved significantly. Over the past century, climate related deaths have dropped by 97%.

A more pragmatic approach to dealing with climate change may be to drop timelines and emissions targets, in favor of accelerating energy innovation. In the meantime, strengthen existing cleaner nuclear and natural gas generating capacity providing the energy to support this innovation and capability to thrive.

<https://www.climate4you.com>

Pollution

Pollution in its various forms probably is not an Existential threat as much as it can have a detrimental impact to on-going Existence.

One example of pollution is the man-made material, plastic, which is so durable that the majority of what has been created still is present in our ecosystem. A patch of plastic rubbish seven times the size of Great Britain sits in the middle of the Pacific Ocean,

Microplastic and nanoplastic particles have been found in fruits and vegetables, having passed into them through the plants' roots. And they have been found lodged in nearly every human organ – they can even pass from mother to child through breast milk.

The way plastics normally are recycled is waste and degraded materials, but there is another option – turning plastic back into the oil it was made from. Among other things, this reclaimed oil can then be used to make plastic again.

Efficiently recycling plastic by conventional means is difficult, and only 9% of all plastic ever made has been recycled into new plastics. A challenge for polymer chemistry – the field responsible for the creation of plastics – is learning to undo the process by turning plastics back into oil.

This process – known as chemical recycling – could see all types of plastic fed into an "infinite" recycling system. The stumbling block has been the large amount of energy it requires. This, combined with the volatile price of crude oil sometimes makes it cheaper to produce new plastic products than to recycle existing plastic.

Every year, about 400 million tons of plastic is produced worldwide. Just 16% of plastic waste is recycled to make new plastics, while 40% is sent to landfill, 25% to incineration and 19% is dumped in the rest of the environment.

Much of the plastic that could be recycled – such as polyethylene terephthalate (PET), which is used for bottles and other packaging – ends up in landfills. Other plastics – such as salad bags and other food containers – find their way to landfill because they are made up of a combination of different plastics that cannot easily be split apart in a recycling plant. Litter dropped in the street and lightweight plastics left in landfill sites or illegally dumped can end up in the ocean.

Plastics usually are recycled mechanically: they are sorted, cleaned, shredded, melted and remolded. Each time plastic is recycled this way, its quality is degraded.

When the plastic is melted, the polymer chains are partially broken down, decreasing its tensile strength and viscosity, making it harder to process. The new, lower grade plastic often becomes unsuitable for use in food packaging and most plastic can be recycled a very limited number of times before it is so degraded it becomes unusable. The emerging industry of chemical recycling aims to avoid this problem by breaking plastic down into its chemical building blocks, which can then be used for fuels or to reincarnate new plastics.

The most versatile version of chemical recycling is "feedstock recycling". Also known as thermal conversion, feedstock recycling is any process that breaks polymers down into simpler molecules using heat.

The process is fairly simple. Plastic waste is taken to a sorting facility. There, the rubbish is sorted, either mechanically or by hand, into different kinds of materials and different kinds of plastics.

Then comes the chemical recycling: the waste plastic could be taken to a pyrolysis center where it is melted down. Next it is fed into the pyrolysis reactor where it is heated to extreme temperatures. This process turns the plastic into a gas which is then cooled to condense into an oil-like liquid, and finally distilled into fractions that can be put to different purposes.

Chemical recycling techniques are being trialed across the world. The first commercial-scale facility was installed in 2020.

One chemical process is a "hydrothermal" technique which is a type of feedstock recycling using water inside the reactor chamber to spread heat evenly throughout. Heated to extreme temperatures but pressurized to prevent evaporation, water becomes "supercritical" – not a solid, liquid, nor gas. It is this use of supercritical water, avoiding the need to heat the chambers from the outside that makes the technique inherently scalable. Organic contaminants such as food residue or soil are able to pass through the process. The plastic is then shredded and cleaned, before being mixed with supercritical water.

Once this high-pressure system is depressurized and the waste exits the reactors, the majority of liquid flashes off as vapor. This vapor is cooled in a distillation column and the condensed liquids are separated to produce four hydrocarbon liquids and oils: naphtha, distillate gas oil, heavy gas oil and heavy wax residue, akin to bitumen. These products then are shipped to the petrochemical industry.

As with other feedstock techniques, there is no waste as the polymer bonds can be formed again, meaning the plastics can be infinitely recycled. With a conversion rate of more than 99%, nearly all the plastic turns into a useful product. The hot, excess gases generated during the process will be used to heat the water.

In the past, chemical recycling has shown serious limits. It is energy-intensive, has faced technical challenges and proved difficult to scale up to industrial levels.

Some expert have concluded that chemical recycling is polluting, energy intensive and prone to technical failures. Chemical recycling is not a viable solution to the plastic problem.

Some, nevertheless, argue that chemical recycling fills a needed niche. The use of supercritical water for efficient heat transfer will allow scale-up to industrial levels, lowering energy use and costs. It could be a crucial factor for success where other techniques have failed.

Microbes in oceans and soils across the globe are evolving to eat plastic. 30,000 different enzymes have been found that could degrade 10 different types of plastic. The first bug that eats plastic was discovered in a Japanese waste dump in 2016.

First large-scale global assessment of the plastic-degrading potential of bacteria and found that one in four of the organisms analyzed carried a suitable enzyme. These molecules degrade plastics in ways that were previously unknown. Researchers found that the number and type of enzymes discovered matched the amount and type of plastic pollution in different locations.

Millions of tons of plastic are dumped in the environment every year. In addition, evidence exists of a measurable effect of plastic pollution on the global microbial ecology.

The explosion of plastic production in the past 70 years has given microbes time to evolve to deal with plastic. Soils are known to contain more plastics with phthalate additives than the oceans and the researchers found more enzymes that attack these chemicals in the land samples. Scientists revealed that the levels of microplastics known to be eaten by people via their food caused damage to human cells in the laboratory.

Many plastics are currently hard to degrade and recycle. Using enzymes to rapidly break down plastics into their building blocks would enable new products to be made from old ones, cutting the need for virgin plastic production.

Enzymes appeared to be breaking down plastic fully and processing it into basic nutrients.

Enzymes broke down tiny bits of plastic into its precursor liquids in about seven weeks. This was impressive but far too slow to have any meaningful impact on plastic waste at scale.

Enzymes work by helping chemical reactions happen at a microscopic scale. To improve natural enzyme performance, there are approaches that work in almost every case.

Chemical reactions tend to work better at higher temperatures, for instance; but most enzymes are most stable at the ambient temperature of their host organism. By rewriting the DNA that codes an enzyme, scientists can tweak its structure and function, making it more stable at higher temperatures, say, which helps it work faster.

Once an enzyme species has been genetically engineered, almost every country restricts its release back into the wild without special permission. Perturbing enzyme can have devastating consequences.

The enzyme recycling process is a series of biological and chemical reactions, and as they scale up. The various inputs required, and the carbon emissions, then heating and freezing it, come with a major energy cost. environmental costs and logistical friction.

Some scientists think the technology will remain limited. If there turns out to be an enzyme match for all the plastics that are theoretically susceptible to being broken down, just under half of all plastic waste could be processed.

https://www.theguardian.com/environment/2023/sep/28/plastic-eating-bacteria-enzyme-recycling-waste?utm_source=pocket_collection_story

Personal Existential Threats

These threats are those that apply to an individual and not to all of humanity. They include: wilderness, violence, accidents and illness.

Wilderness

If someone is lost in the wilderness, these actions can enhance the chance of surviving and buy enough time for search and rescue to assist.

Apply the “Rule of Three”: A person can live three minutes without breathing, three hours when exposed to freezing temperatures, and three days without water. With rare exceptions, sportsmen will be found within 72 hours of being reported missing.

Day 1: Form a Home Base

Step one is to stay put and begin building fire and a shelter. Calm those panicky voices in the head, stick to the plan.

Make camp, preferably in a lee with an overhead canopy. Start collecting fuel before it gets too dark, and build a teepee fire. When it is time to rest, build a bough bed to help provide insulation from the ground.

Day 2: Start Signaling for Help

The morning of day two the fire’s function shifts to signaling purposes. Search out a meadow or open ridgeline near home base and build a fire there where it can easily be spotted from a plane or helicopter. Gather green branches to pile onto the flames to make a smoke signal.

The next task is to build an S.O.S. sign from logs or rocks, with each letter at least 10 feet tall. Use the most visible materials available.

The universal signal for distress is three: three rifle shots, three whistle blasts, three fires. Practice aiming with a signal mirror if one is available.

By afternoon, turn attention to building a substantial shelter. And collect water.

In the winter, snow may have to be melted which can be a tedious process. If no way exists to boil or otherwise purify water by the evening of the second day, unpurified water may be best to avoid dehydration; any water borne illness can be treated later.

Day 3: Stay Patient and Positive

Focusing on the chores at hand: gather fuel, collect water, reinforce shelter, and signal. Studies show that survivors are the people who persist in doing one thing right, then the next thing right, and so on.

If there are storms, aircraft may have been grounded or were unable to see signals. But if skies were clear and no aircraft is heard or seen, then one may be beyond the search perimeter.

In the first case, it is wise to stay put, perhaps as long as a couple more days, and hope the weather breaks. In the latter, give serious consideration to trying to hike to safety or moving camp to a different location before becoming too weak to walk.

But heading into the unknown is the last option. With a few exceptions, the best plan is to stay put for at least 72 hours, and let the experts come.

Violence

Violence can be an existential threat for an individual. A general plan to respond to violence is to avoid getting caught in a dangerous situation by staying aware of surroundings.

Next, deny an attacker access – for example, by locking or barricading a door. Lastly, defend self if all else fails. Be aggressive and committed to actions.

Do not fight fairly. It is about survival.

Self-defense is a countermeasure that involves defending the health and well-being of oneself from harm. The use of the right of self-defense as a legal justification for the use of force in times of danger is available in many jurisdictions.

Homicides are in the top 10 leading causes of death for almost every age group, especially ages 15 to 24. Avoid potential danger spots.

Physical self-defense is the use of physical force to counter an immediate threat of violence. Such force can be either armed or unarmed. In either case, the chances of success depend on various parameters, related to the severity of the threat on one hand, but also on the mental and physical preparedness of the defender.

Unarmed

Many styles of martial arts are practiced for self-defense or include self-defense techniques. Some styles train primarily for self-defense, while other martial or combat sports can be effectively applied for self-defense.

Some martial arts train how to escape from a knife or gun situation or how to break away from a punch, while others train how to attack. To provide more practical self-defense, a combination of martial arts styles and techniques are used and will often customize self-defense training to suit individual participants.

Armed

A wide variety of weapons can be used for self-defense. The most suitable depends on the threat presented, the victim or victims, and the experience of the defender. Legal restrictions also greatly influence self-defense options.

While in some jurisdictions firearms may be carried openly or concealed expressly for this purpose, many jurisdictions have tight restrictions on who can own firearms, and what types they can own.

Knives, especially those categorized as switchblades, may also be controlled, as may batons, pepper spray and personal stun guns and Tasers – although some may be legal to carry with a license or for certain professions. Non-injurious water-based self-defense indelible dye-marker sprays, or ID-marker or DNA-marker sprays linking a suspect to a crime scene, would in most places be legal to own and carry.

Everyday objects, such as flashlights, baseball bats, newspapers, keyrings with keys, kitchen utensils and other tools, and hair spray aerosol cans in combination with a lighter, can also be used as improvised weapons for self-defense. Verbal self-defense uses words to prevent, de-escalate, or end an attempted assault.

There are three elements someone must demonstrate to successfully raise self-defense. First, the accused must demonstrate that she or he believed on reasonable grounds that force was going to be used against her or him or another person or that a threat of force is being made against her or him or another person. The reasonableness of the belief is assessed through both a subjective and objective lens.

Second, the act that constitutes the offence is committed for the purpose of defending or protecting themselves or the other person from that use or threat of force. Third, the act that constitutes the offence must have been reasonable in the circumstances.

9 crucial personal safety tips

1. Tip from Tae Kwon Do :The elbow is the strongest point on your body. If you are close enough to use it, do!

2. Learned this from a tourist guide. If a robber asks for your wallet and/or purse,..... DO NOT HAND IT TO HIM.

Toss it away from you... Chances are that he is more interested in your wallet and/or purse than you, and he will go for the wallet/purse.

AND RUN LIKE MAD IN THE OTHER DIRECTION!

3. If you are ever thrown into the trunk of a car, kick out the back tail lights and stick your arm out the hole and start waving like crazy.. The driver won't see you, but everybody else will. This has saved lives.

4. Women have a tendency to get into their cars after shopping, eating, working, etc., and just sit (doing their checkbook, or making a list, etc.)... DON'T DO THIS!

The predator will be watching you, and this is the perfect opportunity for him to get in on the passenger side, put a gun to your HEAD and tell you where to go.

AS SOON AS YOU GET INTO YOUR CAR, LOCK THE DOORS AND LEAVE..

If someone is in the car with a gun to your head

DO NOT DRIVE OFF..... Repeat: DO NOT DRIVE OFF!!!!

Instead gun the engine and speed into anything, wrecking the car. Your Air Bag will save you. If the person is in the back seat they will get the worst of it.

As soon as the car crashes.....BAIL OUT AND RUN!!!!

It is better than having them find your body in a remote location.

5. A few notes about getting into your car in a parking lot, or parking garage:

A.) BE AWARE... look around you, look into your car, at the passenger side floor and in the back seat.

B.) If you are parked next to a big van, enter your car from the passenger door.

Most serial killers attack their victims by pulling them into their vans while the women are attempting to get into their cars.

C.) Look at the car parked on the driver's side of your vehicle, and the passenger side.. If a male is sitting alone in the seat nearest your car, you may want to walk back into the mall, or work, and get a guard/policeman to walk you back out.

IT IS ALWAYS BETTER TO BE SAFE THAN SORRY.

(And better paranoid than dead.)

6. ALWAYS take the elevator instead of the stairs. Stairwells are horrible places to be alone and the perfect crime spot.

This is especially true at NIGHT!)

7. If the predator has a gun and you are not under his control, ALWAYS RUN!

The predator will only hit you (a running target) 4 in 100 times; and even then, it most likely WILL NOT be a vital organ. RUN!!!!

Preferably in a zig -zag pattern!

8. As women, we are always trying to be sympathetic: STOP!!!

It may get you raped or killed.

(Ted Bundy, the serial killer, was a good-looking, well educated man, who ALWAYS played on the sympathies of unsuspecting women. He walked with a cane, or a limp, and often asked 'for help' into his vehicle or with his vehicle, which is when he abducted his next VICTIM).

9. Another Safety Point:

Someone just told me that her friend heard a crying baby on her porch the night before last and because it was late and she thought it was weird..She called the police.

The police told her 'Whatever you do, DO NOT OPEN THE DOOR!

The lady then said that it sounded like the baby had crawled near a windrow and she was worried that it would crawl to the street and get run over. The policeman said, 'We already have a unit on the way, whatever you do, do not open the door.' He told her that they think a serial killer has a baby's cry recorded and uses it to coax women out of their homes thinking that someone dropped off a baby.. He said they have not verified it, but have had several calls by women saying that they hear baby's cries outside their doors when they're home alone at night.

10. Water scam!

If you wake up in the middle of the night to hear all your taps outside running or what you think is a burst pipe.....

DO NOT GO OUT TO INVESTIGATE!

These people turn on all your outside taps full blast so that you will go out to investigate and then attack.

Stay alert, keep safe, and look out for your neighbors!

Accidents

It is important to keep medications, cleaners and other poisons under control, especially when children are around. Unintentional poisonings were the No. 1 cause of death for those ages 25 to 64, according to the CDC.

On average, each day six people (mostly men) in the United States die of alcohol poisoning. Most of those poisonings result from binge drinking. Also the ability to respond quickly to dangerous situations declines with alcohol consumption.

Motor vehicle accidents are the No. 1 cause of death for those ages 5 to 24 and the No. 2 cause of death for all adults 25 and older. Using seat belts and practicing safe driving are vital.

The most dangerous hours to be on roads is between midnight and 3 a.m. Fridays and Saturdays. The National Highway Traffic Safety Administration released data showing 55 percent of fatal alcohol-impaired crashes occur during those hours.

About 25 percent of fatal falls at work occur from less than 10 feet. Whether at home or work, use extra care when on a step stool, ladder or other raised surface.

Illness

The best way to avoid fatal illness is prevention such as:

- Not smoking
- Limiting excessive drinking
- Cutting back on salt
- Getting blood pressure under control
- Address diabetes
- Reducing obesity
- Exercise
- Sleep

A Day in 2050

A hypothetical day in the year 2050, described below, indicates the impact of advancements in Culture on human experience.

You awaken to gently increasing lighting and music timed to optimize your sleep cycle

The sleep cycle is monitored by your wireless-connected electro-biometric finger ring

Based on your learned activity, your home controller starts the shower at your preferred temperature

Your security system, HVAC and lights adjust to your anticipated settings for the specific conditions of the day

Your coffee and breakfast are heated and you are notified when both are ready

An expert system-based service that matches interested investors to entrepreneurs alerts you to a new contact

You order an electric powered shared autonomous vertical takeoff and landing (VTOL) vehicle

You ask to be taken to your dentist

In route, you engage in a full sensory electronic “virtual teleportation” meeting with co-workers

You use augmented information controlled by voice, hand, eye movements and basic brain-machine signals

You and your colleagues manipulate and edit a virtual 3D image of prototype packaging for a new product

A message alerts you to a discounted price for a vase that you want for your home

You reply to have the item brought by the dental office for your approval and purchase

The VTOL arrives at a public recharging area and links to wireless inductive charging

At the dental office, an image of and other information about your teeth are analyzed by an autonomous expert system

The dental information automatically is uploaded to your standardized personal information application (SPIA)

The SPIA contains your personal key information for use as needed by your authorized services providers

The Human Condition - Year 2120

The one thing certain about a forecast of the future is that the forecast will not be accurate ... especially the future in 100 and more years. We won't be around to experience it, but considering the distant future can be interesting.

Our children's children and their children will experience it. How shall they live?

Think back only a hundred years. In 1920 in the USA:

- average life expectancy was 55 years (today it's almost 80 years, but recently is declining)
- the Model T was just making automobiles more common
- common commercial air travel had not begun
- one third of households in the U.S. had a telephone, most multi-party lines
- the first commercial radio broadcast occurred
- the first commercial TV broadcast was still 25 years and the Internet 75 years away
- eugenics beliefs and practices were widely accepted in academic and social communities
- the stock market crash and World War II still were years away

People in 1920 may have had a glimmer of life today but they hardly could imagine the technological, social, economic and other change since 1920.

As we move toward a future of super capable robots and a world managed by artificial intelligence systems, however, it is not unrealistic to contemplate an environment in which humans have little involvement in activities of manual labor. And, much non-manual work (e.g., tax preparation, medical diagnoses and treatments, writing books and music) also mostly may be done by these advanced technologies.

In a world where most work (including housework) no longer is performed by humans, what will be their existence? What will be the purpose of an individual?

Possible activities for humans in this future may be more self-directed interests including travel, learning, entertainment, social activities, sports, physical and mental challenges, and creative arts.

A question is how individuals will create value that in turn can be exchanged for other value.

They may oversee the design and building of new systems by existing systems, the results of highly automated systems production, and create highly original art that even very advanced machine systems cannot create. Will individuals own, and offer in exchange for other value, specialized robots much as technicians and craftsman today have specialized tools they use in providing their products and services?

In any case, humans likely will evolve and adapt to this future world as we have always. Whatever the future, we can hope and expect that humankind will continue its uneven but steady progress toward liberty and justice, better health and increased prosperity for more people.

PROCESSES

General

Most innovation comes from insightful and creative means of meeting Purposes more easily, economically, and broadly through making increasingly effective the following Processes.

- Inquiry - seeking information
- Planning - identify goals and actions
- Development - the creation of information or objects
- Acquisition - of goods and services
- Production - assembling goods or services
- Promotion - advocacy of ideas and other things
- Fulfillment - delivering goods or services
- Utilization - using an object or service to accomplish other Processes
- Assurance - support of goods or services
- Management & Maintenance - of physical and information assets
- Transportation – movement of people and items

Forecasting

Precisely predicting future development is, of course, not possible. Educated forecasts of trends, however, can be useful. In addition, the capability to apply forecasts successfully is a part of benefiting from vision.

Steve Jobs, Bill Gates, Jeff Bezos, Sergey Brin and Larry Page have had well-developed long-term foresights about applications of technology which helped ensure the success over extended periods of Apple, Microsoft, Amazon and Google.

Nikola Tesla is an example of a tech visionary. In a 1926 Collier magazine interview, he forecasted the following: “When wireless is perfectly applied, the whole earth will be converted into a huge brain ... We shall be able to communicate with one another instantly, irrespective of distance ... A man will be able to carry one [the communication and information device] in his pocket.” A century later, Tesla’s forecast now has been realized.

Another visionary who foresaw the migration to the world of on-line information was Vannevar Bush. In his 1945 article, “As We May Think”, he describes the emergence of the now existing worldwide network of information. Typically, however, his imagination was not rich enough to in specifics conceive of the actual breadth and depth of capabilities that today exist.

Bush and his article were a key influence on Douglas Carl Engelbart, an engineer, inventor and practical visionary, who in the 1950’s and 1960’s conceived and created some of the early

implementations of what today is the Internet and our access to it (such as the “mouse”, hypertext language and graphical user interfaces).

An article titled “Technological Forecasting” from the March 1967 issue of Harvard Business Review by Professor James Brian Quinn at Dartmouth College provides insights into the opportunities and the challenges of technology forecasting.

This half century old article describes interesting specific examples of emerging technologies and evaluations of their futures by Prof. Quinn using the forecasting techniques that he reviews.

Prof. Quinn’s forecasting examples include:

- Fuel cells
- Traffic control systems
- Shoe materials (most shoes were made of leather in 1967)
- Food sources of protein
- Supersonic passenger aircraft (the Concorde entered commercial service in 1976)
- Shale oil
- Lasers
- Underground highways (example: the “Big Dig” in Boston – construction began in 1991)
- Color TV’s (10% penetration of U.S. households in 1967)
- Commercial carrier jet aircraft (20% penetration of global fleet in 1967)
- Cloud computing

With our 50-year rear view, we can see that these example forecasts were accurate to varying degrees. Their eventual outcomes 50 years later provide confirmation of the observations from Prof. Quinn about forecasting:

Forecasts do not need to predict the future precisely to be useful.

The usefulness of forecasts is in evaluating the probability and significance of capabilities so that better decisions can be made now.

Developing capabilities must be evaluated systematically and on-going since they evolve from their initial conceptions to practical applications.

Avoid overly hyped forecasts and conclusions that can lead an individual or organization down an unproductive path.

Understand, not just the emergence of a capability, but also its expected diffusion in the marketplace.

Top leaders who should be involved in forecasting frequently do not take the time to be engaged.

A key benefit of forecasting is gaining a better understanding of potential opportunities and threats providing information needed to track and manage them.

Prof. Quinn's article provides an interesting and comprehensive review of the principles, limitations and techniques of forecasting. It is worth reading.

Physicist Dr. Arno Penzias is co-discoverer of the cosmic microwave background radiation which provides empirical support for the Big Bang theory of cosmology and for which he won the Nobel prize. In 1995, Dr. Penzias published the book, *Harmony*, which was a comprehensive forecast of emerging capabilities and their expected effects on our personal and business existence. It is enlightening to consider *Harmony*, looking back a quarter century, as we look forward to the next couple of decades.

Even with his exceptional prescience, however, Penzias could not escape the limits of his imagination to foresee the full expanse and richness of capabilities we have now. That limitation reinforces our experience that humans tend to be optimistic in the short term and pessimistic in the long term, something to consider with respect to any forecasting.

Dr. Penzias' predictions were based not on sci-fi imaginings but on extrapolation of specific developments which he describes in *Harmony*.

- The ubiquitous Internet
- Search engines
- Smart phones and watches
- Personal video calling (e.g., Apple's FaceTime)
- The Internet of Things
- Natural language control of electronic devices
- Machine vision (e.g., facial recognition)
- Bluetooth and Wi-Fi
- GPS-based mapping and direction services
- Home assistants (similar to Alexa, Google Home, etc.)
- Integration of independent systems (e.g., Alexa+Ring+iRobot+ADT+Pandora+Shopping)
- Social media including on-line customer reviews of products and services
- Uber-like ride sharing
- Business Intelligence coupled with Artificial Intelligence systems
- Web conferencing and collaborative applications

Two capabilities Penzias predicted, which are available only in very limited ways so far are:

- A single repository of electronic personal information in a standardized format under the control of each individual. This standard personal information application (SPIA) would be used for insurance, education, financial, medical and other records. It would save billions of hours people waste completing often confusing and otherwise poorly designed paper and web forms as well as improve their accuracy.
- A universal smart traffic management system to relieve the hundreds of billions of dollars of wasted productivity from traffic congestion.

Predictive analytics use data to create an outline of the future. Predictive systems use historical data to establish patterns and then use those patterns to give human users an idea of what's to come.

- Forecast models use multiple input types to estimate future outcomes.
- Classification models use data to sort information and are especially helpful in answering questions.
- Outlier models alert users to data points that do not correspond with predictions, since those could be reasons for concern.
- Time series models take regularly changing conditions into account.
- Clustering models sort data into smaller groupings so users can address them in targeted ways.

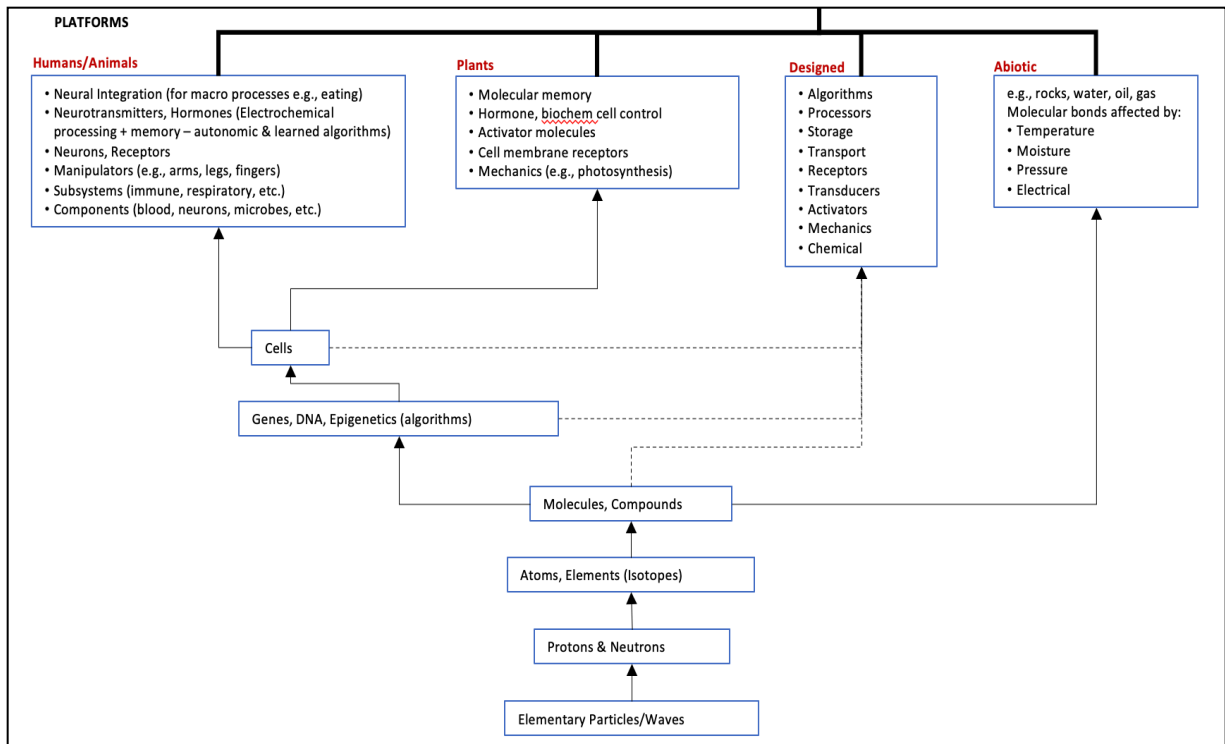
Predictive analytics are not a crystal ball, but their benefits are transforming industry.

Can forecasting really improve success? The answer is “Yes” ... if it is undertaken based on key principles and in a systematic and disciplined way.

PLATFORMS

Platforms have the general characteristics listed in the following graphics, many of which are experiencing continued enhancements from emerging Technologies:

As illustrated in these graphics, all living and non-living items are composed of the same fundamental components. These are combined in different ways that produce the various living and non-living items in our universe.



Platforms: Units and Functions

Units

Control & Analytic Algorithms

Processors/Storage

Inputs

- Sensors
- Receptors
- Transducers

Outputs

- Amplifiers
- Activators (elec., chem., mech.)
- Manipulators (pump, lever, etc.)

User Interface (Creature, Machine)

- Data (Digital or Analog)
- Image
- Audio
- Touch
- Pressure
- Taste
- Direct Brain

Functions

Illuminate

- Incandescent
- LED
- Charged Gas
- Flames

Stimulate

Power

- Electrical
- Optical
- Thermal
- Chemical
- Mechanical
- Radiant
- Nuclear
- Quantum

Cool/Heat

- Convection
- Conduction
- Passive
- Active

Modify

- Cut
- Mold
- Coat
- Grow

Measure

Search

Analyze

Package

Store

- Data (Electrical, Optical)
- Physical

Transport

Energy

- Wireline
- Wireless

Information

- Mode
- Analog
- Digital
- Quantum

- Category
- Content
- Control
- Connectivity

- Management Layers

Business

Service

Element

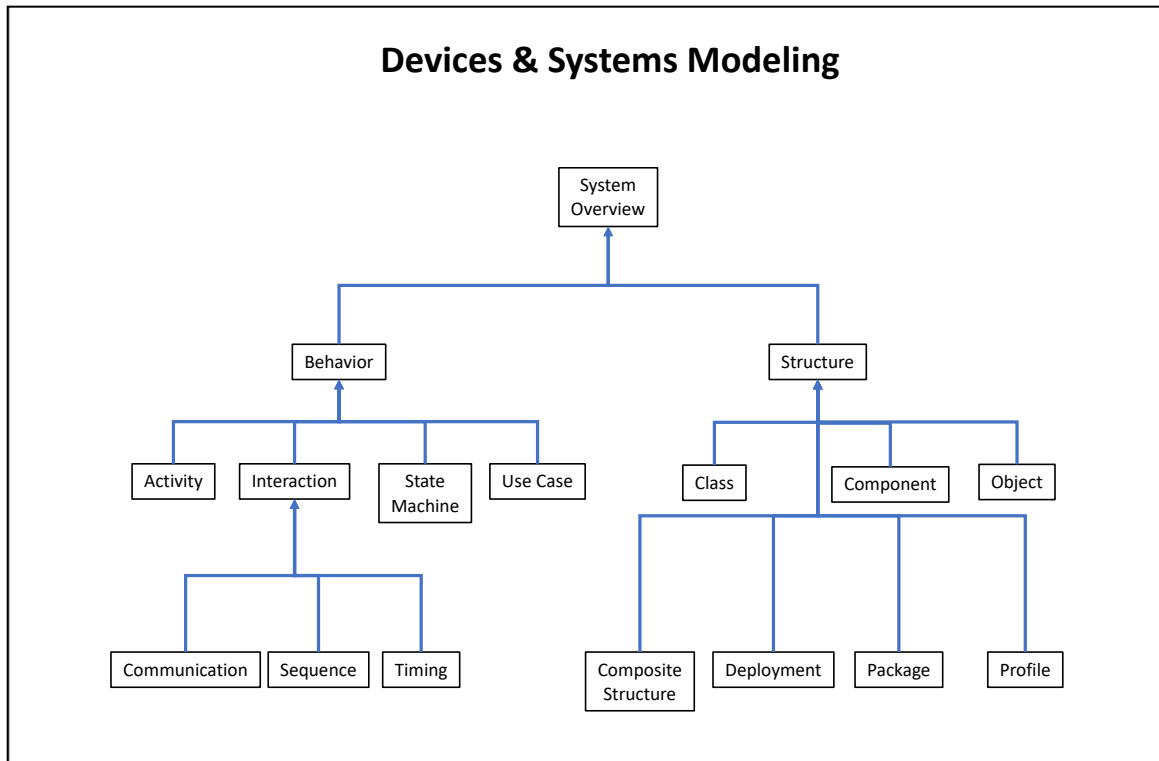
Network

Common Operations

Interoperation Layers

1. Application
 2. Presentation
 3. Session
 4. Network
 5. Link
 6. Physical
- Process
- Store
- Link
- User Interface

Devices and systems can be characterized in terms of their behavior and their structure. The “Universal Modeling Languages”, designed initially for software development, is a general model for defining behavior and structure. This type of model is useful in comprehensively describing devices and systems.



Open Systems Interconnection

A universal model for the transport of information, energy and matter could be derived from the existing Open Systems Interconnection (OSI) model for the transport of information. The OSI model includes a characterization of an information transfer system's fundamental functions of without regard to its underlying internal structure and technology. Its goal is the interoperability of diverse information systems with standard protocols.

For information systems, the model partitions the flow of data into seven fundamental abstraction layers. Each intermediate layer serves a class of functionality to the layer above it and is served by the layer below it.

This abstraction provides for modular design of the end to end systems. The modular design supports more effectively mixing capabilities from different providers in one of the layers while minimizing the need for changes in the other layers to accommodate a new capability. This architecture facilitates design of systems and accelerates the evolution of system designs.

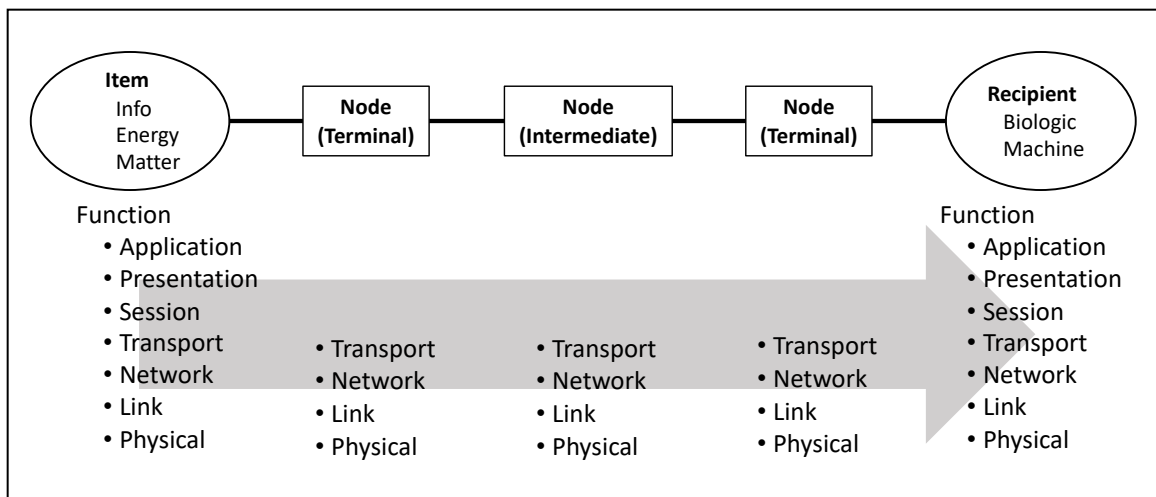
The OSI model could be extended to include the transport of energy and matter, in addition to information. The extended model would support the definition of standardized industry protocols for the more efficient and effective transport of energy and matter.

Existing standardized shipping containers are an example of this concept.

The existing information OSI model includes the following layers of functionality to which specific technical standard protocols and specific implementation are aligned.

- 7 Application: High-level APIs, including resource sharing, remote file access
- 6 Presentation: Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption
- 5 Session: Managing communication sessions, i.e., continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
- 4 Transport: Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing
- 3 Network: Structuring and managing a multi-node network, including addressing, routing and traffic control
- 2 Link: Reliable transmission of data frames between two nodes connected by a physical layer
- 1 Physical: Transmission and reception of raw bit streams over a physical medium

These modular functions could be generalized to encompass all forms of information, energy and matter describing the characteristics of any transport system as represented by the following graphic.



Common

Elementary particles (which appear to be point perturbations - i.e., excitations - of quantum fields) are the most fundamental irreducible component of everything in the universe. A particle never is destroyed and builds up through atoms, molecules, cells, compounds, organs, beings, objects to form everything in the universe ... thus providing a common connection of everything throughout the universe via the universal quantum fields.

Quantum Fields/Elementary Particles

Innovations in Culture include advancements in basic science comprising a better understanding of the universe at its largest and at its smallest. For example, atomic theory produced nuclear medicine (internal imaging, cancer radiation treatments), power, weapons, semiconductor developments, etc.

An elementary particle is a subatomic particle with no (currently known) substructure, i.e. it is not composed of other particles. The elementary particles are described by the so-called Standard Model.

12 known fundamental particles make up the universe. Each has its own unique quantum field.

To these 12 particle fields the Standard Model adds four force fields, representing the four fundamental forces: gravity, electromagnetism, the strong nuclear force and the weak nuclear force. It combines these 16 fields in a single equation that describes how they interact with each other. Through these interactions, fundamental particles are understood as fluctuations of their respective quantum fields and generate the physical world.

The elementary particles can be changed from one form to another, but they cannot be destroyed in the sense of being broken down. An electron and a positron can meet and “annihilate” each other, and the resulting matter will be two separate photons.

Everything apparently is made of “fields”. This concept is included in Quantum Field Theory (QFT).

A field occupies space. Elementary “particles” are excitations of quantum fields.

An electron, for example, is just an excitation of an electron field. Fields help make sense of particle physics.

Elementary particles (which appear to be quantized excitations and interactions of universe-wide "quantum fields") are the most fundamental irreducible component of everything in the universe. A concrete intuitive understandable description of a quantum field is not available so far.

An elementary particle never is destroyed and builds up through atoms, molecules, cells, compounds, organs, beings, objects to form everything in the universe ... thus providing a common connection of everything throughout the universe.

The energy and excitation of one field transfers to others as they vibrate against each other, making it seem like new types of particles are appearing. Particles that are smashed together do not result in things that were inside the original particles.

What really happens in particle collisions is that especially excited excitations of a field—the energetic protons—are vibrating together and transferring their energy to adjacent fields, forming new excitations seen as new particles—such as Higgs bosons.

Fields are mathematical constructs. It is not known where quantum fields come from. This is why quantum fields are considered to be “fundamental.”

To form a particle from a field, the field must be given energy. With enough energy, the field will go to a higher energy state. These states are interpreted as particles.

The point in the field where it was given energy will look like a particle, and as the energy propagates through the field, it will look like the particle is moving. Individual particle states are simply excitations of the fundamental fields ... one field for each type of particle.

For example, an electron is an excitation—a wave—in the universal electron-positron (e-p) field. This universal field comprises the e-p “vacuum field” that fills the universe, along with its excitations. Electrons are generated from this electron field, but it is not known of what the electron field is made.

These fields are present everywhere in the universe. The known quantum fields are in all space-time points in their ground states, and there are the specific couplings/interactions between fields.

Field interactions generate all known phenomena. Interactions between the quantum fields of electron and photon lead to the binding of an electron to the nucleus in an atom. The mediation of the photon binds an electron to a proton leading to an atom. From atoms come the molecules and compounds that form everything.

As the electron makes transition from a higher energy level to a lower one in an atom or a molecule, it emits a photon. The energy of this emitted photon corresponds to the difference in the energy levels that the electron transitioned. All the light seen comes from such transitions.

The masses of most objects comes from the interaction between a quark quantum field and gluon quantum fields.

99% of all observable mass (excluding so-called "dark matter" and "dark energy") in the universe comes from phenomena associated with the “strong force”, the fundamental force that binds smaller particles called quarks into larger particles called protons and neutrons which comprise the nucleus of the atoms of ordinary matter. Higgs bosons account for most of the remaining observable mass in the universe.

Dark energy is different than dark matter. They are both labeled dark because it is not known what they are. Dark matter does not absorb, reflect or emit any light.

Dark matter is inferred to exist only because of its gravitational effect on galaxies and galaxy clusters. It likely is matter in the form of particles (i.e., a field excitations).

Dark energy is theorized to power the accelerating expansion of the universe. It appears to be the most dominant energy form in our universe. It is possible that dark energy could also be due to some kind of particle.

Researchers at Thomas Jefferson National Accelerator Facility in Virginia, USA have experimentally extracted the strength of the strong force, a quantity that firmly supports theories explaining how most of the mass or ordinary matter in the universe is generated. This quantity, known as the coupling of the strong force, describes how strongly two bodies interact.

A gluon is an elementary particle that acts as the exchange particle for the strong force between quarks. Gluons bind quarks together, forming hadrons such as protons and neutrons.

Quarks gather a cloud of gluons, the particles that carry the strong force. As quarks move across larger distances this cloud accounts for most of the mass in the universe

As distance increases between affected bodies, strong force coupling grows quickly before leveling off and becoming constant. Because strong force coupling levels off at larger distances, it is not dependent on (spacetime) scale.

<https://www.jlab.org/news/releases/strength-strong-force>

Some physicists hypothesize that all the quantum fields are different aspects of a single unified quantum field, a field yet to be discovered and confirmed with experimentation.

Some elementary particles exist for an instant (for example, when generated, the Higgs boson particle decays in less than a sextillionth of a second) and are so small they can be detected only indirectly with tools such as at the Large Hadron Collider at CERN (Conseil Européen pour la Recherche Nucléaire) in Switzerland.

The Standard Model has been developed with theory and subsequently confirmed to a significant degree through experimentation. However, the elementary particle theory evolution and experimentation continue to reveal new questions.

There is nothing such as a "solid" particle. All fundamental particles have infinitesimal size. The deflection of a particle by a nucleus is not because it is solid, but because of the strength of the forces that a particle feels when is close to the nucleus.

“Wave–particle duality” is the concept that every elementary particle may be described as either a point particle or a wave. The concepts of "particle" or "wave" separately do not fully describe the behavior of elementary particles but instead both are required.

Several theories exist about the properties of elementary particles; none of the theories clearly are the actual description of these particles.

These include String Theory, Quantum Field Theory, Lattice Field Theory, Effective Field Theories, and Phenomenology based on the above theoretical tools. Predictions for upcoming experiments at the Large Hadron Collider (LHC) involve Supersymmetric Model building, Grand Unified Theories, Extra Dimensions, String Inspired phenomenology as well as high order calculations in the Standard Model (of strong weak and electromagnetic interactions) to sort out what new physics might be discovered at the next generation of accelerators and cosmic ray and neutrino detectors.

Quantum Field Theory (QFT) is a theory about particles. Everything is excitations in a continuous energy field. QFT = packets of energy (e.g., .5 Mev = electron). A particle is a specific measurement of an energy excitation.

String theory describes those point particles as 1-dimensional loops or threads or strings. M-theory describes them as higher dimensional objects (membranes) which collapse down to strings at low energies).

M-theory is a candidate for a theory of everything (TOE). M-theory unifies in a single mathematical structure all five consistent versions of string theory (as well as a particle description called supergravity).

A TOE has the challenge of fitting gravity into the quantum laws of nature in such a way that, on large scales, gravity looks like curves in the fabric of space-time, as described in the general theory of relativity. No empirical evidence exists, however, for M-theory or for any alternative ideas about how gravity might unify with the rest of the fundamental forces.

M-theory posits that gravitons, as well as electrons, photons and everything else, are not point-particles but rather imperceptibly tiny ribbons of energy, or “strings,” that vibrate in different ways. It holds that the various perturbative string theories fit together into a coherent nonperturbative theory dubbed M-theory.

AdS/CFT correspondence is a hologram-like relationship connecting gravity in a space-time region called anti-de Sitter (AdS) space to a quantum description of particles (called a “conformal field theory”) moving around on that region’s boundary. AdS/CFT gives a complete definition of M-theory for the special case of AdS space-time geometries, which are infused with negative energy that makes them bend in a different way than our universe does.

Many experts consider M-theory a leading TOE candidate, even as its exact definition in our universe remains unknown. Whether the theory is correct remains to be proven.

The strings it posits — as well as extra, curled-up spatial dimensions that these strings supposedly wiggle around in — are 10 million billion times smaller than experiments like the Large Hadron Collider can resolve. And some macroscopic signatures of the theory that might have been seen, such as cosmic strings and supersymmetry, have not been observed.

Another “theory of everything” involves the symmetry between order and disorder.

In the field of genetics, for example, scientists have demonstrated that rather than disorder being passively experienced by living organisms, they harness that randomness and use it as a tool with which they can generate many possible solutions to environmental challenges. As another example, a sand-pile maintains order by means of random and unpredictable avalanches, which is an indication of disorder being “harnessed” by the sand-pile as a means of maintaining order.

Existence seems to exist at this border between order and randomness. Whereas all the laws of Nature are built upon certain symmetries, symmetry alone is subject to itself.

In Nature’s laws, complexity never develops beyond necessity. The best designs are simple. Our universe is a place of infinite symmetries in which order and disorder beneficially co-exist.

<https://bigthink.com/hard-science/surprise-theory-of-everything-symmetry-order-disorder/>

Some feel progress is being made toward a unified theory of physics. With the discovery of the Higgs boson in 2012, every elementary particle predicted by the Standard Model of physics has now been found.

Higgs Boson

In 2012, scientists made one of the most momentous discoveries in physics: the Higgs boson. The particle, predicted 48 years earlier, was the missing piece in the Standard Model of particle physics.

The machine built in part to find this particle, the Large Hadron Collider (LHC) at CERN near Geneva, showed signals of a new fundamental bit of nature that matched expectations for the Higgs. The particle and its associated Higgs field turned out to be responsible for giving all other particles mass and, in turn, creating the structure of galaxies, stars and planets that define our universe and enable our species.

Mass is not something intrinsic to particles. It is a result of the whole cosmos. If the vacuum of space was completely empty, it would be less stable than if filled with the Higgs field.

When energy is added to an electromagnetic field, it can excite it into photons. Similarly, there is the Higgs field. If enough energy was applied to the Higgs field, in principle, it would produce Higgs bosons.

The Higgs boson and the Higgs field are analogous to photons and the electromagnetic field. Producing one Higgs boson, however, required concentrating 125 billion electron volts into one spot at the LHC, much more energy than required to produce a photon.

<https://www.scientificamerican.com/article/how-the-higgs-boson-ruined-peter-higgs-life/>

The Standard Model of particle physics has massless fields with the exception that the Higgs field which does have a mass characteristic of sorts. These fields, including the Higgs field, interact with each other

The Higgs field, however, has a unique property. Most fields are in their lowest state of energy when they are free of “excitations”; that is, no “elementary particles” are present. For instance, the electromagnetic field’s lowest energy state is when there is no radiation, no photons, present.

The Higgs field’s lowest energy state, however, is when some excitations are present. So the “no excitations present” state is unstable: it can decay into a “some excitations present”, lower energy state.

This process creates a nonzero energy vacuum. Particles interact with the vacuum, and this interaction manifests itself as an effective mass.

The vacuum of the Higgs field is not to be confused with the Higgs boson. The Higgs boson arises because even after the Higgs field has given masses to other particles, there is a remaining a possible excitation of the field. This excitation is the Higgs boson particle, which can be produced in particle accelerators, in collisions with sufficient energy.

Ref: Viktor T. Toth

Observations support the idea that a unified theory of subatomic forces can be achieved. Einstein was led to general relativity by thoughts of unifying disparate objects

Einstein recognized that the feeling of total weightlessness when in freefall, even in the presence of gravity, is because of the equivalence of inertial and gravitational masses. He elevated this observation to the principle of equivalence. Einstein concluded that any new gravitational theory that included his new concepts had to conform with the principle of equivalence.

Quantum theory explains how particles and fields work. General relativity explains how gravity generates the structure of the universe.

The two theories of physics are not compatible based on current knowledge. Both, however, describe reality. An understanding of quantum gravity may be the solution for unifying the two theories.

The unification of general relativity and quantum physics may have to occur at Planck levels (length, mass, time, temperature and derived units). At the Planck scale, the predictions of the Standard Model, quantum field theory and general relativity may not apply, and quantum effects of gravity may dominate.

Gravity is very weak compared to the other four fundamental forces (the strong, weak, electromagnetic, and gravitational forces). Its weakness may not lie in gravity itself but in the mechanics of the Higgs boson and the nature of space-time.

Gravity is a thousand billion billion times weaker than the strong nuclear force, the strongest of all the forces. No understanding currently exists of why gravity has the strength it does. Nothing in any theory of physics explains its strength.

Quantum mechanics can account for all the forces of nature, except gravity. There is not yet a quantum description of gravity.

Why is it important to quantize gravity? Because quantum mechanics works.

In general relativity, gravity is due to a warping, or curving of the background spacetime itself. There is no force-carrying particle in general relativity which mediates gravity among matter particles.

This does not mean that General Relativity is wrong, it is just incomplete.

But something does appear to explain the properties of the weak nuclear force, the Higgs boson.

The Higgs boson field pervades all of space-time and forces other particles, such as electrons, to interact with it. That interaction causes those electrons to acquire a mass.

The more something interacts with the Higgs, the bigger its mass. The mass of the W and Z bosons set the properties of the weak nuclear force.

Many physicists believe that a final theory of everything requires gravity to be quantized.

But is gravity quantum in nature, just like all the other particles and forces? Or is it fundamentally different?

Physicist Jonathan Oppenheim has proposed that gravity is classical and is coupled in some way in the quantum and classical realms. Such a hybrid theory could solve long-standing problems in physics but also lead to a conclusion that the universe is random.

The problems arise because gravity is a result of space-time itself, rather than something that acts on top of it. If gravity is quantized, that means space-time is also quantized. But quantum theory only makes sense against a classical space-time background - quantum states cannot be added and then evolved on top of an uncertain foundation.

Some physicists use string theory to describe that matter and space-time emerge from tiny, vibrating strings. The classical world somehow emerges from these fundamentally quantum building blocks.

All the other fields in nature are quantized. Many believe there is nothing special about gravity - it is just a field like any other - and therefore should be quantized.

Physicists define all the other forces in terms of fields evolving in space-time. Gravity alone describes the geometry and curvature of space-time itself. None of the other forces describe the universal background geometry as does gravity.

A potential problem exists if gravity is classical and not quantized. If gravity behaves classically, ideas from quantum mechanics, such as unpredictable superposition, may break down.

But if an interaction between a particle and space-time is random - or unpredictable - then the particle itself does not completely dictate the gravitational field. This means that measuring the gravitational field will not always determine the location of the particle because the gravitational field could be in one of many states.

Experiments eventually may resolve if gravity is quantized or not. There are proposed experiments that look for entanglement mediated by the gravitational field, but these experiments probably are decades away.

<https://www.quantamagazine.org/the-physicist-who-bets-that-gravity-cant-be-quantized-20230710/>

With QFT, fundamental particles are understood to be excitations of quantum fields. QFT is an umbrella term that encompasses several specific quantum field theories. The most prominent of these theories is the Standard Model.

A quantum field is a quantum measurement assigned to every point in space. 37 types of quantum fields have been identified.

Physics based on fields resolved some inconsistencies, ranging from issues regarding causality to the fact that particles do not exist forever. It also explained what otherwise appeared to be improbable consistency in the physical world.

Quantum fields are everywhere in the universe (often having quantum measurements, with some uncertainty, of near zero ... known as the "Vacuum State"). Particles exist only when there are excitations of quantum fields. Different quantum fields can interact.

All particles of the same type everywhere in the universe are the same. All protons, for example, are just fluctuations in the same underlying proton field

Efforts are underway to translate QFT into pure mathematics as already has been done with Newtonian physics and General Relativity. Basic objects in QFT must be turned into mathematical objects.

Quantum field theories are by far the most complicated items in mathematics,. Quantum field theory is mathematics that has not yet been invented by mathematicians.

There is little question that QFT really exists given its experimental success. But having strong evidence that something is correct and proving conclusively that it is are two different things.

So far, all of the quantum field theories that have been described in full mathematical terms rely on various simplifications, which make them easier to work with mathematically. The efforts are to remove these simplifications provide a precise mathematical description of a quantum field theory that better describes the physical world: the four-dimensional, continuous universe in which all interactions are possible at once.

There could be additional quantum fields arising from:
whatever is responsible for dark matter,
whatever phenomenon or field causes dark energy,
new fields or interactions arising from some sort of grand unification,
or any other exotic new physics (including, but not limited to, new forces or particles) that may exist beyond the Standard Model.

High precision simulations of quantum chromodynamics (QCD) processes using lattice gauge theory are also a crucial ingredient for understanding present and future experiments at various collider facilities. Supported research includes contributions to broad theoretical advances as well as model building and applications to experimental programs at facilities such as the Relativistic Heavy Ion Collider (RHIC) and Jefferson Laboratory, and to astrophysical phenomena. This includes formulating new approaches for theoretical, computational, and experimental research that explore the fundamental laws of physics and the behavior of physical systems; formulating quantitative hypotheses; exploring and analyzing the implications of such hypotheses analytically and computationally; and interpreting the results of experiments.

Current particle physics explains only about 5% of the composition of our universe. The remainder consists of what often is referred to as dark matter and dark energy.

Dark matter is thought to comprise up to 27% of the universe although it is yet to be detected. "Normal" or baryonic matter makes up just 5%. Dark energy, which cannot be detected either, makes up 68%.

Dark matter and energy have not yet been observed directly but is implied by effects that cannot be explained without their existence. Much is left to be learned about "dark" matter and energy.

By itself, however, dark matter appears to be insufficient to explain the yet-to-be specified characteristics of the universe. Some physicist conjecture that a combination of dark matter and "modified gravity" (a hypothesis that proposes a modification of Newton's laws to account for observed properties of galaxies) may provide a more complete understanding of these dynamics.

The mass-energy-information equivalence hypothesis combines several theories to offer an alternative to dark matter. This hypothesis states that information is the fundamental building block of the universe, and it has mass. This accounts for the missing mass within galaxies, thus eliminating the concept of dark matter entirely.

As we learn more, this basic science will result in advancements that are as unimaginable as today's technology was only a hundred years ago.

Modified Newtonian Dynamics

An alternative to the hypothesis of dark matter - in terms of explaining why galaxies do not appear to obey the currently understood laws of physics - is Modified Newtonian Dynamics (MOND). MOND is a hypothesis that proposes a modification of Newton's law of universal gravitation to account for observed properties of galaxies.

It is a theory that describes why the velocities of stars in galaxies were observed to be larger than expected based on Newtonian mechanics. This discrepancy could be resolved if the gravitational force experienced by a star in the outer regions of a galaxy was proportional to the square of its centripetal acceleration (as opposed to the centripetal acceleration itself, as in Newton's second law) or alternatively, if gravitational force came to vary inversely linearly with radius (as opposed to the inverse square of the radius, as in Newton's law of gravity).

MOND is an example of a class of theories known as modified gravity, and is an alternative to the hypothesis that the dynamics of galaxies are determined by massive, invisible dark matter halos. Proponents of MOND have claimed to successfully predict a variety of galactic phenomena that they say are difficult to understand as consequences of dark matter.

Newton's Laws predict that stellar rotation velocities should decrease with distance from the galactic center. Researchers instead found instead that they remain almost constant.

This observation necessitates at least one of the following:

1. There exists in galaxies large quantities of unseen matter which boosts the stars' velocities beyond what would be expected on the basis of the visible mass alone, or
2. Newton's Laws do not apply to galaxies.

Option 1 leads to the dark matter hypothesis; option 2 leads to MOND.

The 2006 observation of a pair of colliding galaxy clusters known as the "Bullet Cluster", poses a significant challenge for MOND's modified gravity solution to the missing mass problem. Astronomers measured the distribution of stellar and gas mass in the clusters using visible and X-ray light, respectively, and in addition mapped the inferred dark matter density using gravitational lensing.

With MOND, one would expect the "missing mass" to be centered on regions of visible mass which experience lower accelerations. On the other hand, one would expect dark matter to be significantly offset from the visible mass because the halos of the two colliding clusters would pass through each other while the cluster gas would interact and end up at the center.

An offset is clearly seen in the observations. A suggestion, however, is that MOND-based models may be able to generate such an offset in strongly non-spherically symmetric systems, such as the Bullet Cluster.

Other studies have noted observational difficulties with MOND. For example, versions of MOND predict that the speed of light is different than the speed of gravity; but in 2017 the speed of gravitational waves was measured with high precision to be equal to the speed of light.

Several additional observational and experimental tests have been proposed to help support either MOND or, instead, dark matter-based models.

https://en.wikipedia.org/wiki/Modified_Newtonian_dynamics

Quantum entanglement occurs when a pair of particles is generated in a way such that the quantum state of each particle cannot be described independently of the state of the other particle, even when the particles are separated by a large distance (and cannot be explained by communication between the entangled particles since the communication would have to be faster than the speed of light). Measurements of position, momentum, spin, and polarization performed on entangled particles are found to be perfectly correlated.

Any measurement, however, of a property of a particle results in an irreversible wave function collapse of that particle and will change the original quantum state. In the case of two entangled particles, such a measurement of one particle will affect the other entangled particle as well. According to some interpretations of quantum mechanics, the effect of one measurement occurs instantly. Other interpretations which do not recognize wave function collapse dispute that there is any effect. All interpretations, however, agree that entanglement produces correlation between the measurements and that the mutual information between the entangled particles can be exploited, but that any transmission of information at faster-than-light speeds is impossible.

The physicist Richard Feynman said, “I think I can safely say that no one understands quantum mechanics.” Despite the great usefulness of quantum mechanics, arguments continue about its meaning.

The lack of this clarity in quantum mechanics does not matter for most purposes. For example, physicists learned how to use it for precise calculations of the energy levels of atoms.

Several competing quantum interpretations exist

- a) The Copenhagen interpretation says that until a system’s properties are measured, they can encompass myriad values. This superposition only collapses into a single state when the system is observed, and physicists can never precisely predict that state.
- b) Decoherence, explains how superpositions break down without invoking consciousness.
- c) They “many worlds” view says that whenever you make a quantum measurement, reality fractures, creating parallel universes to accommodate every possible outcome.
- d) Other interpretations hold the position that there is no collapse at all.

- e) “Bohmian” theory (named for physicist David Bohm) says that at the fundamental level, quantum systems do have definite properties; we just do not know enough about those systems to precisely predict their behavior.
- f) QBists argue that a person can only use quantum mechanics to calculate how to calibrate his or her beliefs about what he or she will measure in an experiment. Measurement outcomes must be regarded as personal to the agent who makes the measurement.
- g) Retrocausality allows events in the future to influence the past. Experiences at the point of measurement can depend upon how to observe that experience later.

The trouble is that each interpretation is equally good at predicting the outcome of quantum tests, so choosing between them is an individual perspective. No one knows the correct solution. And, other potential solutions may exist.

According to the current paradigm, the properties of an object should exist and have definite values even when the object is not being observed; the moon should exist and have whatever weight, shape, size and color it has even when nobody is looking at it. Moreover, a mere act of observation should not change the values of these properties.

Operationally, all this is captured in the notion of “non-contextuality”. The problem is that, according to quantum mechanics, the outcome of an observation depends on the way another, separate but simultaneous, observation is performed. This happens with so-called “quantum entanglement”.

Some predictions of quantum mechanics are incompatible with non-contextuality. The differences between the anomalies and the current paradigm can only be accommodated by ignoring the anomalies.

This has been possible so far because the anomalies are only observed in laboratories. Yet we know that they are there; their existence has been confirmed beyond reasonable doubt. A new paradigm would accommodate the anomalies.

Scientists at the Large Hadron Collider (LHC) have recorded some highly unusual data that could point to an entirely new force of nature, which would mean a whole new area of physics. The secret lies in an elusive, unstable particle called a B meson, which is not biodegrading according to plan.

The Standard Model of particle physics predicts that decays involving different flavors of leptons, such as the one in the LHC study, should occur with the same probability. An anomaly is seen in B mesons, which are paired quarks. They disintegrate into muons and electrons at an uneven rate.

Muon g-2 is a set of experiments that uses powerful particle accelerators to explore the interactions of short-lived particles known as muons with a strong magnetic field in “empty” space. Scientists know that even in a vacuum, space is never empty. Instead, it is filled with an invisible sea of virtual particles that in accordance with the laws of quantum physics pop in and out of existence for incredibly short moments of time. Scientists can test the presence and nature of these virtual particles with particle beams traveling in a magnetic field.

The Muon g-2 experimenters examine the precession of muons that are subjected to a magnetic field. The main goal is to test the Standard Model's predictions of this value by measuring the

precession rate experimentally. If there is an inconsistency, it could indicate the Standard Model is incomplete and in need of revision.

First results from the Muon g-2 experiment fundamental particles called muons behaving in a way that is not predicted by the Standard Model. Muons could be interacting with yet undiscovered particles or forces.

Data analysis on the second and third runs of the experiment is under way, the fourth run is ongoing, and a fifth run is planned. Combining the results from all five runs will give scientists a more precise measurement of the muon's behavior, revealing with greater certainty whether changes to physics are forthcoming.

Despite its success at explaining the Universe, the Standard Model does have limits. For example, the Higgs boson gives mass to quarks, charged leptons (like electrons), and the W and Z bosons, however, we do not yet know whether the Higgs boson also gives mass to neutrinos. In addition, the strong evidence that muons deviate from the Standard Model calculation might hint at significant new physics with yet undiscovered particles or forces.

A quantum jump (or “quantum leap” in popular parlance) is the abrupt transition of a quantum system from one quantum state to another, from one energy level to another. When the system absorbs energy, there is a transition to a higher energy level, when the system loses energy, there is a transition to a lower energy level.

Many of the pioneers of quantum mechanics assumed the jumps were instantaneous. Recent research, however, has demonstrated that a quantum jump is a rapid but continuous process. A jump has randomness, but it is not an instantaneous change.

As part of their experimentation, the researchers detected when a quantum jump was about to appear, “catch” it halfway through, and reverse it, sending the system back to the state in which it started. In this way, what seemed to the quantum pioneers to be unavoidable randomness in the physical world, now is shown to be amenable to control.

To watch the quantum jump, the researchers had to retain coherence. Otherwise, they would “collapse” the wave function into one state or the other. In their experimental scheme, a measurement provides information about the state of the system without interrogating that state directly.

The capability developed by the researchers to spot precursors of quantum jumps might find applications in quantum sensing technologies. For example, in atomic clock measurements, one wants to synchronize the clock to the transition frequency of an atom, which serves as a reference. The capability might also find applications in error correction for quantum computing,

https://getpocket.com/explore/item/quantum-leaps-long-assumed-to-be-instantaneous-take-time?utm_source=pocket-newtab

General relativity theory has been supported with increasingly precise experimental tests, but open questions remain. For example, dark matter and dark energy seem to make up some 95% of the content of the universe but is not understood.

The problem is that general relativity is not general enough. To explain dark energy, this invisible energy that seems to be accelerating the universe's expansion, an extra component in the equation, called the cosmological constant is required.

Is there a theory that naturally can give dark energy without including this constant? It is possible that, in general relativity, gravity works differently than Einstein thought.

The dark energy theory, however, is being challenged by "lumpy" universe expansion

Recent scientific research suggests that the concept of "dark energy" might be debunked by a new model proposing a "lumpy" universe expansion, where the uneven distribution of matter across space could explain the observed accelerating expansion without the need for a mysterious dark energy force; essentially, the universe's expansion might appear to accelerate due to variations in density across different regions, rather than a uniform, pervasive force like dark energy.

This new model, called "timescape," suggests that the universe's expansion is not uniform but influenced by its "lumpy" structure, with denser regions expanding at different rates compared to emptier voids.

If the "lumpy" universe model is accurate, it could mean that the observed acceleration of the universe's expansion can be explained without invoking the existence of dark energy.

While intriguing, this model still needs further research and verification with more data to definitively confirm or refute the idea.

<https://www.google.com/search?q=Dark+Energy+Debunked+By+%22Lumpy%22+Universe+Expansion>

In addition, general relativity and quantum mechanics currently are incompatible. In general relativity, gravitational fields are continuous entities in nature. They also represent the geometric properties of 4-dimensional spacetime. In quantum mechanics, fields are discontinuous and are defined by 'quanta'.

So, there is no analog in conventional quantum mechanics for the gravitational field, even though the other three fundamental forces have now been described as 'quantum fields'. Quantum mechanics is incompatible with general relativity because in quantum field theory, forces act through the exchange of well-defined quanta, with probabilistic rather than definite outcomes.

To attempt finding answers, researchers are working on extended or modified theories of gravity. A new era of precision cosmology may help provide new information. In precision cosmology, many telescopes collect data of different types, from different parts of the universe. Machine learning, neural networks and supercomputers process all this data together.

General relativity explains a lot about nature, but it does not explain what happened at the Big Bang, or what happens inside black holes. The singularity of a black hole is mathematically very similar to the Big Bang singularity — it is a point where all the known laws of physics break. If general relativity is modified or extended, maybe this break can be explained.

General relativity also does not explain the future of the universe. There are theories that say the universe is going to collapse again into another Big Bang. But it is unknown because general relativity is incomplete. A complete theory could provide answers to these kinds of questions.

Scalar-tensor theories are more general than general relativity. General relativity describes space-time using a mathematical object called a tensor. In scalar-tensor theories, there also are objects called scalars. A scalar can be something physical, like mass or energy, and it permeates space-time.

Other alternative theories exist. Mathematically these theories are rich but are limited by lack of experiments that confirm them.

The recently launched James Webb Space Telescope may open a new door with observations closer to the origin of the universe. General relativity likely will not work at that time because the energy is so high.

Studying that era may test about which kind of theory of gravity is correct. Einstein worked on these theories in the last part of his life attempting to unify all of the forces but with no significant progress.

One of the theories is “teleparallel gravity”. It is elegant mathematically but no experiments have been completed to prove it.

Observations of the early universe with the James Webb will be the first tests of teleparallel gravity. If the formation of the first galaxies can be explained better than with general relativity, that will be a significant result

https://www.quantamagazine.org/in-mexico-cosmologist-hunts-for-cracks-in-einsteins-gravity-theory-20220223/?utm_source=pocket-newtab

What does quantum physics mean? What is it telling us about the true nature of reality?

There is no consensus on quantum reality.

The Schrodinger equation includes a mathematical function - the wave function, which encapsulates all that can be known about a quantum object. The object’s wave function has a value at all points in space.

This value depends on the state of that quantum object. If the wave function is known, Schrödinger’s equation determines where to find the particle in space, or how fast it is traveling, or how much energy it has.

But of what is the wave made? A water wave is made of water molecules. But a wave function for a quantum object is not really made of any substance other than information about the object.

The wave function does not indicate where the particle probably is at any point in time. It tells only the chance of finding it there if one looks.

But this also does not mean that nothing exists until one looks. A quantum world exists regardless.

Some theories attempt to define a real physical quantum process. These include gravitationally induced collapse, the Ghirardi–Rimini–Weber (GRW) model and Superdeterminism.

For example, superdeterministic theories are not interpretations of quantum mechanics. They are, instead, theories more fundamental than quantum mechanics, from which quantum mechanics can be derived.

The wavefunction of a single particle cannot really be seen, only the collapse. Standard quantum theory does not actually provide any description of the measurement process.

Some researchers say not much can be deduced about that “underlying reality”. If all quantum mechanics gives is probabilities about measurements, it must be accepted that is all that can be known.

Others say that at the most fundamental level, reality really is a wave function.

There is no good way to test which interpretation is correct. Quantum mechanics does not appear to show that there is a set reality.

But this does not mean that an objective reality does not exist.

<https://www.youtube.com/watch?v=-hxljpxTaiA>

Quantum biology examines quantum effects inside cells. This is a tricky field, as physicists are not comfortable working with messy biological systems, while biologists are not comfortable with complex (and seemingly irrelevant) particle physics equations.

But chemists, who straddle the space between physics and biology, know that biological molecules are part of the quantum world.

It is likely that there are quantum effects in several biological processes, such as those that generate mutations — which means that particle physics has played a role in the evolution of life on the planet.

Read the video transcript: <https://bigthink.com/the-well/>

Entangled Time

Entanglement seems to violate how the world ought to work. Information can't travel faster than the speed of light, for one.

But in a 1935 paper, Einstein and his co-authors showed how entanglement leads to what's now called quantum nonlocality, the eerie link that appears to exist between entangled particles. If two quantum systems meet and then separate, even across a distance of thousands of lightyears, it becomes impossible to measure the features of one system (such as its position, momentum and polarity) without instantly steering the other into a corresponding state.

Up to today, most experiments have tested entanglement over spatial gaps. The assumption is that the ‘nonlocal’ part of quantum nonlocality refers to the entanglement of properties across space. But what if entanglement also occurs across time? Is there such a thing as temporal nonlocality?

The answer, as it turns out, is yes. a team of physicists successfully entangled photons that never coexisted. They were the first to show entanglement between photons whose lifespans did not overlap at all.

The data revealed the existence of quantum correlations between ‘temporally nonlocal’ photons. That is, entanglement can occur across two quantum systems that never coexisted.

Perhaps the measurement of photon 1’s polarization at step II somehow steers the future polarization of photon 2, or the measurement of photon 2’s polarization somehow rewrites the past polarization state of photon 1. In both forward and backward directions, quantum correlations span the causal void between the death of one photon and the birth of the other.

Relativity may help. In developing his theory of special relativity, Einstein determined that simultaneity went from being an absolute property to being a relative one.

Precisely when something is occurring depends on your precise location relative to what you are observing, known as your frame of reference. So the key to avoiding strange causal behavior (steering the future or rewriting the past) in instances of temporal separation is to accept that calling events ‘simultaneous’ carries little metaphysical weight. It is only a frame-specific property, a choice among many alternative but equally viable ones – a matter of convention, or record-keeping.

Most contemporary philosophical accounts of the relationship between objects and their properties embrace entanglement solely from the perspective of spatial nonlocality. But there’s still significant work to be done on incorporating temporal nonlocality – not only in object-property discussions, but also in debates over material composition (such as the relation between a lump of clay and the statue it forms), and part-whole relations (such as how a hand relates to a limb, or a limb to a person).

For example, the ‘puzzle’ of how parts fit with an overall whole presumes clear-cut spatial boundaries among underlying components, yet spatial nonlocality cautions against this view. Temporal nonlocality further complicates this picture: how does one describe an entity whose constituent parts are not even coexistent?

Discerning the nature of entanglement might at times be an uncomfortable project. It’s not clear what substantive metaphysics might emerge.

Maybe “space” and “time” don’t really exist ... they just are human perceptions and inventions to describe change. An individual perceives he is at particular point in time and space ... but preceding and future points of time and space also exist. And thus two different points can be “entangled” at any different time or location.

https://getpocket.com/explore/item/you-thought-quantum-mechanics-was-weird-check-out-entangled-time?utm_source=firefox-newtab-en-us

Protons & Neutrons

The neutron is a subatomic particle, which has a neutral charge. Neutrons and protons constitute the nuclei of atoms.

Since protons and neutrons behave similarly within the nucleus, and each has a mass of approximately one atomic mass unit, they are both referred to as nucleons. Although a proton is not an elementary particle (it is comprised of quarks and gluons), it is the smallest thing for which we can measure physical size.

The neutron is classified as a hadron, because it is a composite particle made of quarks. The neutron is also classified as a baryon, because it is composed of three valence quarks. The finite size of the neutron and its magnetic moment both indicate that the neutron is a composite, rather than elementary, particle. A neutron contains two down quarks and one up quark.

Like protons, the quarks of the neutron are held together by the strong force, mediated by gluons. The nuclear force results from secondary effects of the more fundamental strong force.

A proton is a subatomic particle with a positive electric charge and a mass slightly less than that of a neutron. Protons and neutrons, each with masses of approximately one atomic mass unit, are collectively referred to as "nucleons".

Protons are fermions and are composed of three valence quarks, making them baryons (a sub-type of hadrons). The two up quarks and one down quark of a proton are held together by the strong force, mediated by gluons.

One or more protons are present in the nucleus of every atom; they are a necessary part of the nucleus. The number of protons in the nucleus is the defining property of an element, and is referred to as the atomic number. Since each element has a unique number of protons, each element has its own unique atomic number.

Atoms, Elements, Isotopes

An atom is the smallest unit of ordinary matter that forms a chemical element. Every solid, liquid, gas, and plasma is composed of neutral or ionized atoms. Atoms are so small that accurately predicting their behavior using classical physics is not possible due to quantum effects.

Every atom is composed of a nucleus and one or more electrons bound to the nucleus. The nucleus is made of one or more protons and a number of neutrons. Only the most common variety of hydrogen has no neutrons. More than 99.94% of an atom's mass is in the nucleus.

The protons have a positive electric charge, the electrons have a negative electric charge, and the neutrons have no electric charge. If the number of protons and electrons are equal, then the atom is electrically neutral. If an atom has more or fewer electrons than protons, then it has an overall negative or positive charge, respectively – such atoms are called ions.

The electrons of an atom are attracted to the protons in an atomic nucleus by the electromagnetic force. The protons and neutrons in the nucleus are attracted to each other by the nuclear force. This

force is usually stronger than the electromagnetic force that repels the positively charged protons from one another.

Under certain circumstances, the repelling electromagnetic force becomes stronger than the nuclear force. In this case, the nucleus splits and leaves behind different elements. This is a form of nuclear decay.

An Element is a pure substance consisting only of atoms that all have the same numbers of protons in their atomic nuclei. Unlike chemical compounds, chemical elements cannot be broken down into simpler substances by chemical means. The number of protons in the nucleus is the defining property of an element, and is referred to as its atomic number – all atoms with the same atomic number are atoms of the same element.

All of the matter of the universe is composed of chemical elements. When different elements undergo chemical reactions, atoms are rearranged into new compounds held together by chemical bonds.

Only a minority of elements, such as silver and gold, are found uncombined as relatively pure native element minerals. Nearly all other naturally-occurring elements occur in the Earth as compounds or mixtures. Air is primarily a mixture of the elements nitrogen, oxygen, and argon, though it does contain compounds including carbon dioxide and water.

Isotopes are variants of a particular chemical element which differ in neutron number, and consequently in nucleon number. All isotopes of a given element have the same number of protons but different numbers of neutrons in each atom.

The number of protons within the atom's nucleus is called atomic number and is equal to the number of electrons in the neutral (non-ionized) atom. Each atomic number identifies a specific element, but not the isotope; an atom of a given element may have a wide range in its number of neutrons. The number of nucleons (both protons and neutrons) in the nucleus is the atom's mass number, and each isotope of a given element has a different mass number.

For example, carbon-12, carbon-13, and carbon-14 are three isotopes of the element carbon with mass numbers 12, 13, and 14, respectively. The atomic number of carbon is 6, which means that every carbon atom has 6 protons, so that the neutron numbers of these isotopes are 6, 7, and 8 respectively.

A nuclide is a species of an atom with a specific number of protons and neutrons in the nucleus, for example carbon-13 with 6 protons and 7 neutrons. The nuclide concept (referring to individual nuclear species) emphasizes nuclear properties over chemical properties, whereas the isotope concept (grouping all atoms of each element) emphasizes chemical over nuclear.

The neutron number has large effects on nuclear properties, but its effect on chemical properties is negligible for most elements. Even for the lightest elements, whose ratio of neutron number to atomic number varies the most between isotopes, it usually has only a small effect although it matters in some circumstances (for hydrogen, the lightest element, the isotope effect is large enough to affect biology strongly).

Compounds

A chemical compound is a chemical substance composed of many identical molecules (or molecular entities) composed of atoms from more than one element held together by chemical bonds. A molecule consisting of atoms of only one element is therefore not a compound.

There are four types of compounds, depending on how the constituent atoms are held together:

- molecules held together by covalent bonds
- ionic compounds held together by ionic bonds
- intermetallic compounds held together by metallic bonds
- certain complexes held together by coordinate covalent bonds

A chemical formula specifies the number of atoms of each element in a compound molecule, using the standard abbreviations for the chemical elements and numerical subscripts. For example, a water molecule has formula H_2O indicating two hydrogen atoms bonded to one oxygen atom.

Many chemical compounds have a unique CAS number identifier assigned by the Chemical Abstracts Service. Globally, more than 350,000 chemical compounds (including mixtures of chemicals) have been registered for production and use.

A compound can be converted to a different chemical substance by interaction with a second substance via a chemical reaction. In this process, bonds between atoms may be broken in either or both of the interacting substances, and new bonds formed.

A molecule is an electrically neutral group of two or more atoms held together by chemical bonds. A molecule may be homonuclear, that is, it consists of atoms of one chemical element, as with two atoms in the oxygen molecule (O_2); or it may be heteronuclear, a chemical compound composed of more than one element, as with water (two hydrogen atoms and one oxygen atom; H_2O).

An ionic compound is a chemical compound composed of ions held together by electrostatic forces termed ionic bonding. The compound is neutral overall, but consists of positively charged ions called cations and negatively charged ions called anions.

These can be simple ions such as the sodium (Na^+) and chloride (Cl^-) in sodium chloride, or polyatomic species such as the ammonium (NH_4^+) and carbonate (CO_3^{2-}) ions in ammonium carbonate. Individual ions within an ionic compound usually have multiple nearest neighbors, so are not considered to be part of molecules, but instead part of a continuous three-dimensional network, usually in a crystalline structure.

Ionic compounds containing basic ions hydroxide (OH^-) or oxide (O^{2-}) are classified as bases. Compounds without these ions are also known as salts and can be formed by acid–base reactions.

Ionic compounds can also be produced from their constituent ions by evaporation of their solvent, precipitation, freezing, a solid-state reaction, or the electron transfer reaction of reactive metals with reactive non-metals, such as halogen gases.

Ionic compounds typically have high melting and boiling points, and are hard and brittle. As solids they are almost always electrically insulating, but when melted or dissolved they become highly conductive, because the ions are mobilized.

An intermetallic compound is a type of metallic alloy that forms an ordered solid-state compound between two or more metallic elements. Intermetallics are generally hard and brittle, with good high-temperature mechanical properties. They can be classified as stoichiometric or non-stoichiometric intermetallic compounds.

A coordination complex consists of a central atom or ion, which is usually metallic and is called the coordination center, and a surrounding array of bound molecules or ions, that are in turn known as ligands or complexing agents. Many metal-containing compounds, especially those of transition metals, are coordination complexes.

Molecules are distinguished from ions by their lack of electrical charge. In quantum physics, organic chemistry, and biochemistry, the distinction from ions is dropped and molecule is often used when referring to polyatomic ions.

In the kinetic theory of gases, the term molecule is often used for any gaseous particle regardless of its composition. This violates the definition that a molecule contain two or more atoms, since the noble gases are individual atoms.

Molecules as components of matter are common. They also make up most of the oceans and atmosphere. Most organic substances are molecules. The substances of life are molecules, e.g. proteins, the amino acids they are made of, the nucleic acids (DNA & RNA), sugars, carbohydrates, fats, and vitamins. The nutrient minerals ordinarily are not molecules, e.g. iron sulfate.

The majority of familiar solid substances on Earth, however, are not made of molecules. These include all of the minerals that make up the substance of the Earth, soil, dirt, sand, clay, pebbles, rocks, boulders, bedrock, the molten interior, and the core of the Earth. All of these contain many chemical bonds, but are not made of identifiable molecules.

No typical molecule can be defined for salts nor for covalent crystals, although these are often composed of repeating unit cells that extend either in a plane, e.g. graphene; or three-dimensionally e.g. diamond, quartz, sodium chloride. The theme of repeated unit-cellular-structure also holds for most metals which are condensed phases with metallic bonding. Thus solid metals are not made of molecules.

In glasses, which are solids that exist in a vitreous disordered state, the atoms are held together by chemical bonds with no presence of any definable molecule, nor any of the regularity of repeating unit-cellular-structure that characterizes salts, covalent crystals, and metals.

Forces

All of the known forces of the universe are classified into four fundamental interactions. The strong and the weak forces act only at very short distances, and are responsible for the interactions between subatomic particles, including nucleons and compound nuclei. The electromagnetic force acts between electric charges, and the gravitational force acts between masses. All other forces in nature derive from these four fundamental interactions.

Quantum mechanics led to understanding that three of the fundamental forces (all except gravity) are manifestations of matter (fermions) interacting by exchanging virtual particles called gauge bosons.

The “Pauli exclusion principle” determines that electrons of the same spin are kept apart by a repulsive exchange interaction, which is a short-range effect, acting simultaneously with the long-range electrostatic or Coulombic force (attraction or repulsion of particles or objects because of their electric charge). This effect is partly responsible for the everyday observation in the macroscopic world that two solid objects cannot be in the same place at the same time.

The Pauli exclusion principle helps explain a wide variety of physical phenomena. One particularly important consequence of the principle is the electron shell structure of atoms and the way atoms share electrons, explaining the variety of chemical elements and their chemical combinations.

The Pauli principle does not permit atoms to pass through each other. It is the quantum mechanical principle which states that two or more identical fermions (particles with half-integer spin) cannot occupy the same quantum state within a quantum system simultaneously. As such, the Pauli principle underpins many properties of everyday matter, from its large-scale stability, to the chemical behavior of atoms.

It has been shown that the Pauli principle is responsible for the fact that ordinary bulk matter is stable and occupies volume. Electrons of each atom cannot all fall into the lowest-energy orbital and must occupy successively larger shells. Atoms, therefore, occupy a volume and cannot be squeezed too closely together. Ordinary matter would collapse and occupy a much smaller volume without the Pauli principle.

Non-fundamental forces are consequences of the fundamental ones. For example, the “normal force” is due to repulsive forces of interaction between atoms at close contact. When their electron clouds overlap, Pauli repulsion (due to fermionic nature of electrons) follows resulting in the force that acts in a direction normal to the surface interface between two objects. The normal force, for example, is responsible for the structural integrity of tables and floors as well as being the force that responds whenever an external force pushes on a solid object.

Physicists are still attempting to develop a self-consistent unification model that would combine all four fundamental interactions into a theory of everything.

Relationships exist between elementary particles through the unification of certain forces that determine their interactions, known as the gauge forces. These three forces are electromagnetism, the weak force and the strong force.

A possibility exists that all three of the gauge forces can be unified into a single unified force. A type of mathematics known as group theory tells us that these forces are exactly the collection of charges that are needed to form a new single unified particle.

It did not have to be this way. The charges of the elementary particles in our universe could have been such that there was no way to unify any two or more of them into a single unified particle. The combination of observational data and mathematics which offers strong hints that the charges for elementary particles in the standard model are not arbitrary, but rather arise by virtue of being embedded into a unified theory framework.

To obtain ‘proof for all practical purposes’ would require experiments at the unification scale and observation of the production of new particles and new interactions directly through collisions. For example, some unified theory ideas require the existence of an additional unified gauge boson that could be directly produced in collisions, seen, and measured. Unfortunately, it does not appear possible in the foreseeable future to build a high-energy collider that could reach the energies where the unified theory resides.

Seeing a proton decay is one of the few hopes for more direct corroboration of the unified theory. Effort is going into watching protons to see if one disintegrates.

$$E=mc^2$$

This famous equation developed by Albert Einstein relates mass and energy.

“E”, or energy, represents the total energy of an object. “m”, or mass, is specifically the rest mass, or the mass for this object if it were not in motion in any way. And “ c^2 ”, is the speed of light squared ... the conversion factor that balances the equation.

Every object that has a rest mass to it, m , also has an equivalent amount of energy inherent to it, E . Mass and energy are different manifestations of the same thing.

Even small amounts of mass are storing large amounts of energy. Three considerations regarding mass and energy are:

- 1) Masses at rest have an inherent amount of energy to them. Types of energies include:
 - mechanical energy, such as the energy required to lift a heavy weight up to a certain height,
 - chemical energy, such as the energy stored in the interior of an acid battery,
 - electrical energy, such as the energy that flows through a light bulb and causes it to illuminate,
 - kinetic energy, such as the energy that a car moving along a highway possesses.

These all are energies inherent to moving or reacting objects, and these forms of energy can be used to perform work. This allows tasks such as running an engine.

- 2) Mass, under the right circumstances, can be converted into pure energy. For every 1 kilogram of mass turned into energy, 9×10^{16} joules of energy are produced, which is the energy equivalent of 21 Megatons of TNT, or one of the most powerful hydrogen bombs ever detonated on Earth.

- 3) Energy can be used to make mass out of literally nothing other than pure energy itself. In order to obey the conservation of energy, a particle’s energy is not just the “rest mass” portion of the equation, which is $E = mc^2$, but that there also are the other types of energy present, including gravitational energy and kinetic energy. The full equation relating energy to mass is $E^2 = m^2c^4 + p^2c^2$, where p is momentum of the particle or object in question.

Why matter appears solid

However small or big atoms are really makes no difference. What matters is that atoms, though electrically neutral overall, have a charge distribution that is never perfectly symmetric or uniform. Now when you try to bring atoms together, they might stick together, forming a molecule, or they might repel each other due to their electromagnetic properties. All this takes place over much greater distances than the sizes we associate with the atom or its constituent bits. So when you find, say, that you cannot push your hand through a solid wall, what really happens is electromagnetic interactions between the molecules of your body and the molecules of the wall, mostly as their electron “clouds” get close to one another and electrostatic repulsion kicks in.

Without interactions, there would be no resistance. Again, matter is not miniature cannonballs that collide or bounce off each other. Those “excitations” of quantum fields could happily travel through one another if the quantum fields in question do not interact, or only weakly interact, with each other. This is why neutrinos, for instance, have no trouble whatsoever traveling through solid matter even though the only essential difference between a neutrino and an electron is that the neutrino lacks the electron’s electrostatic charge.

Victor Toth – Quora

By generalizing the conception of reality to include energy, momentum, and gravity, the Universe can be fully described.

Matter, of all types, has an inherent amount of energy to it. Any particle with mass can be converted, under the right conditions, into energy that can be used for a variety of purposes. Energy alone is the only ingredient necessary for the creation of objects that did not exist previously.

This seems consistent with all phenomena being the result of the interaction of fundamental elementary particles ... which are theorized to be excitations (disruptions) in the various quantum fields ... fields that extend throughout the universe.

These particles combine to form larger compositions of matter and energy that in part generate the perception of Existence as objects, sensations and concepts by human, animal, plant, natural abiotic, and machine entities.

https://bigthink.com/starts-with-a-bang/3-lessons-einstein-equation-emc%C2%B2/?utm_source=pocket-newtab-en-us

Components & Control

Platforms consist of: a) Components; b) Control

Components consist of organic and/or inorganic matter and energy. A transistor, for example, is controlled by the electronic voltage or current applied to it (that is based on a predetermined Control pattern) and in turn switches on and off another flow of current. The transistors themselves can become “logic gates” that are part a Control process for a platform.

Control directs the Components to complete their intended functions. Computer “software” is used to develop Control capabilities and includes human language abstractions of the ultimate electronic signals that direct the platform’s Components.

Control also can be provided by mechanical, chemical and electrical processes and mechanisms, either natural or human designed. For example: the human brain uses logic stored in and transmitted via electrochemical signals (this logic genetically is built in at birth for involuntary functions such as breathing and later on for “learned” functions); a mechanical alarm clock uses the design of its physical mechanisms to display a representation of the time of day, ring an alarm bell at a designated time, etc. Furthermore, combined human and non-human Control systems include platforms such as fly-by-wire aircraft.

Abiotic

Origin

Several - not necessarily mutually exclusive - concepts about the origin of Existence include:

- the Big Bang, a finite (in time and space) universe
- infinite creation of new universes (e.g., a universe eventually collapses into a singularity followed by the next “big bang”)
- multiple parallel universes that have the same scientific laws
- multiple universes with different laws
- theistic genesis (which is not necessarily mutually exclusive with other origins)

Physicists have offered explanations based on quantum mechanics saying, that in a quantum vacuum state, particles spontaneously come into existence. However, others argue that this accounts merely for the existence of matter, but not the existence of quantum states, space-time or the universe as a whole.

Some physicists propose that the origin of life is an inevitable outcome of thermodynamics. Computer simulations indicate that under certain conditions, groups of atoms will naturally restructure themselves so as to burn more and more energy, facilitating the dispersal of energy and the rise of “entropy” or disorder in the universe. This restructuring effect, which called “dissipation-driven adaptation” (DPA), fosters the growth of complex structures, including living things.

Other scientists believe DPA is necessary but not sufficient to explain life, because it cannot account living things information-processing capacity. Life-forms take in and respond to information about their environment.

Aside from the thermodynamic properties and information-processing abilities of life-forms, they also store and pass down genetic information about themselves to their progeny. The origin of life, is not just emergence of structure, it is the emergence of a particular kind of dynamics.

It is the emergence of structures that reproduce. And the ability for the properties of those objects to influence their reproductive rates.

<https://www.quantamagazine.org/first-support-for-a-physics-theory-of-life-20170726/>

In the past, string theory (a theoretical framework for describing fundamental physics) was considered to be a possible explanation for a theory of everything - it would reconcile quantum theory with classical physics - but there has been less focus on that in recent year. Currently, string theory is more coupled with quantum field theory only, rather than a theory of everything.

On the other hand, “Nothing” might be just a human concept that is inappropriate for a description of a possible state, or absence of state.

One concept is that while the characteristics (e.g., laws, constants) of our universe are fine tuned for our particular existence, nothing is special about our universe. Any axiomatic system that can produce self-awareness will be real from the perspective of the self-aware beings.

For example, humans have demonstrated that silicon-based systems can be formed which very crudely mimic the human brain, are self-learning and can exhibit the traits of emotions. In other words, “artificial intelligence” (AI).

These systems likely will become more sophisticated and human-like (and super-human in some ways ... AI beats humans at chess) with additional development. Under different circumstances, an origin and evolution (without human participation) could have resulted in silicon-based creatures that are intelligent and self-aware. Their universe might have somewhat different laws and fine tuning than does our universe.

An infinite number of similar varied scenarios of Existence can be imagined. Somewhere in our or another universe, furthermore, other highly self-aware entities might exist but who would be unrecognizable as such by humans.

All things in our universe are thought to consist of the smallest particles, elementary particles (quarks, leptons, photons, gluons, bosons). Elementary particles are not solid objects in the physical sense. The only concepts of their size are abstractions such as electromagnetic energy.

At the other extreme, our universe is 93 billion light years (or 8.8×10^{26} meters) across and 14 billion years old. Humans have existed for about 200,000 years or .00001 the age of the universe.

The Milky Way contains over a trillion planets. 40 billion to 80 billion planets in our galaxy potentially could support our forms of life.

Images of the distant universe from the Hubble eXtreme Deep Field telescope extrapolated over the whole sky lead to estimate of 170 billion galaxies in the observable Universe. A detailed theoretical simulation predicted far more faint, small galaxies, upping the expected total to closer to 2 trillion. But recent observational evidence shows that even that estimate may be far too low. Instead, there appear to be between 6 and 20 trillion galaxies in the universe.
<https://bigthink.com/starts-with-a-bang/galaxies-in-universe/>

Scientific laws describe the behavior of this universe. The laws are descriptions of the results of repeated observation regarding specific conditions.

- Laws of physics (e.g., general relativity; second law of thermodynamics)
- Laws of chemistry (e.g., Hess's law, Raoult's law)
- Laws of biology (e.g., Schmalhausen's law, Van Valen's law)
- Laws of geology (e.g., Birch's law, Byerlee's law)
- Other fields such as math (e.g., law of quadratic reciprocity)

Laws are different from scientific theories. Theories are predictions that must be tested and are falsifiable ... and often result in the definition of new scientific laws.

How can a 14 billion-year-old universe be more than 90 billion light years in diameter? When the universe first came into existence in a period called “inflation”, spacetime itself began expanding and, through means that are not yet well understood, this expansion appears to be happening faster than the speed of light.

This speed of expansion is consistent with the theory of relativity. The theory states that objects cannot travel faster than the speed of light through spacetime but does not place any limits on spacetime itself.

Galaxies (and other objects in space) are not breaking any laws, because they are not traveling through space faster than light. Rather, every portion of space is expanding and stretching pushing matter apart. Matter is not really traveling through spacetime.

Due to this expansion and given the speed of light limit, older galaxies and other objects now forever are beyond human view (at least with current known physics).

The Speed of Light

Why is the speed of light 300 million meters/second? It is due to “permittivity” and “permeability”.

Permittivity is a property of materials. Permittivity indicates how susceptible that material is to storing an electric field.

Different materials can store different amounts of electric charge. Space is not a “material”, but space has some natural permittivity to it.

That amount is called the “permittivity of free space” and it is represented by the symbol ϵ_0 . ϵ_0 is approximately 8.85×10^{-12} F/meter (where F is force in Newtons; $F = \text{mass} \times \text{acceleration}$).

Permeability is yet another property of materials. Permeability tells you how much of a magnetic field some material will retain if a magnetic field is applied to it.

The magnetic permeability of free space is represented by the symbol μ_0 . $\mu_0 = 1.25 \times 10^{-6}$ 1.25×10^{-6} H/meter. (H = henry).

So, space itself has some propensity to “store” an electric field and some ability to “store” a magnetic field. That is, space itself can only “absorb” so much electrical field or so much magnetic field at any given time.

Light itself is the propagation of oscillating electric and magnetic fields. As any light wave propagates through space—the permeability and permittivity of that space do not allow changes in these fields to pass instantly. These two constants determine how fast light can be pushed through space.

<https://www.quora.com/What-determines-the-speed-of-light-Is-there-something-unique-about-299-792-458-km-per-second-or-is-it-an-arbitrary-value-My-intuition-says-that-there-is-something-unique-about-it-What-does-science-say>

Electric fields changing in time induce magnetic fields; magnetic fields changing in time induce electric fields.

This can happen even in empty space, far from any sources of electricity and magnetism. And in empty space, this mutual back-and-forth between the two fields takes the form of a plane wave, which travels in space at a set velocity.

The speed of light is constant, i.e., the same for all observers. One way to explain this has to do with permeability and permittivity.

Permeability is the ability of a medium to sustain magnetic fields; permittivity is the ability of a medium to sustain electric fields. Both fields can exist in a vacuum, so vacuum as a medium has non-zero permeability and permittivity.

The speed at which plane waves propagate is just the inverse square root of these two. If two observers, moving relative to each other, measured different values for the speed of light, that would mean that the properties of the vacuum would be different for these two observers.

The properties of the vacuum would be observer-dependent. To the best of knowledge, this is not the case.

So instead of predicting something that is not observed in nature (vacuum's properties depending on who is looking) special relativity predicts the same vacuum for all observers. This means the same speed of light for all observers.

According to special relativity, the energy of an object with rest mass m and speed v is given by γmc^2 , where γ is the Lorentz factor. When v is zero, γ is equal to one, giving rise to the famous $E = mc^2$ formula for mass–energy equivalence.

The γ factor approaches infinity as v approaches c , and it would take an infinite amount of energy to accelerate an object with mass to the speed of light. The speed of light is the upper limit for the speeds of objects with positive rest mass, and individual photons cannot travel faster than the speed of light. This is experimentally established in many tests of relativistic energy and momentum.

More generally, it is impossible for signals or energy to travel faster than c . One argument for this follows from the implication of special relativity known as the relativity of simultaneity.

If the spatial distance between two events A and B is greater than the time interval between them multiplied by c then there are frames of reference in which A precedes B, others in which B precedes A, and others in which they are simultaneous. As a result, if something were travelling faster than c relative to an inertial frame of reference, it would be travelling backwards in time relative to another frame, and causality would be violated.

In such a frame of reference, an "effect" could be observed before its "cause". Such a violation of causality has never been recorded, and would lead to paradoxes.

In classical physics, light is described as a type of electromagnetic wave. The classical behavior of the electromagnetic field is described by Maxwell's equations, which predict that the speed c with which electromagnetic waves (such as light) propagate in vacuum is related to the distributed capacitance and inductance of vacuum, otherwise respectively known as the electric constant and the magnetic constant.

In modern quantum physics, the electromagnetic field is described by the theory of quantum electrodynamics (QED). In this theory, light is described by the fundamental excitations (or quanta) of the electromagnetic field, called photons.

In QED, photons are massless particles and thus, according to special relativity, they travel at the speed of light in vacuum. Extensions of QED in which the photon has a mass have been considered.

In such a theory, its speed would depend on its frequency, and the invariant speed c of special relativity would then be the upper limit of the speed of light in vacuum. No variation of the speed of light with frequency has been observed in rigorous testing, putting stringent limits on the mass of the photon.

Another reason for the speed of light to vary with its frequency would be the failure of special relativity to apply to arbitrarily small scales, as predicted by some proposed theories of quantum gravity. In 2009, the observation of gamma-ray burst GRB 090510 found no evidence for a dependence of photon speed on energy, supporting tight constraints in specific models of spacetime quantization on how this speed is affected by photon energy for energies approaching the Planck scale.

Interplay exists between the forces of entropy and complexity that are represented, respectively, by the second law of thermodynamics and evolution. The second law of thermodynamics postulates that there is a finite amount of energy in the Universe that is slowly dissipating, but evolution shows that there are moments when a particular threshold is reached and overcomes entropy by the creation of new forms of complexity.

Some historians have identified eight 'threshold moments', when profoundly new forms of complexity appear in the past: (1) the Big Bang; (2) stars and galaxies; (3) new chemical elements; (4) the Earth and solar system; (5) life on Earth; (6) the human species; (7) agriculture; and, our currently proposed geological epoch, (8) the Anthropocene. The competing forces of entropy and complexity remain active, represented by the notion of 'energy flows'.

Energy flows are a process that connects all things, from the cosmic dust in space to the worms in the ground. Some relate these flows to quantum fields.

This concept includes a fair amount of speculation. There still is much that is unknown and much that is likely unknowable, particularly with regard to the threshold moments themselves.

In addition, humans are a species whose linguistic capabilities lead to collective learning capabilities (the ability to share knowledge over space and time) well beyond those of other species. As a result, humans are a product of nature but also capable of understanding and significantly shaping nature's processes.

Based on the observed facts of the Universe, it must have been born with the seeds of what would become its large-scale structure: an initial spectrum of over-dense and under-dense regions. The theory of cosmic inflation is a mechanism for generating those seed fluctuations, and not only would inflation explain the Universe's already-observed properties (same temperature everywhere, spatial flatness, large-scale homogeneity, etc.), but it would make new predictions as to what those fluctuations ought to look like.

Fluctuations in spacetime itself at the quantum scale get stretched across the Universe during inflation, giving rise to imperfections in both density and gravitational waves. While inflating space can rightfully be called 'nothing' in many regards, during both inflation and today, it possesses a positive, non-zero energy density.

Cosmic inflation posits that, prior to the hot Big Bang, where matter and radiation filled the hot, dense, largely uniform and rapidly expanding Universe, the Universe was instead completely empty. Only, instead of having no energy in it (or a very small amount, as in the case of today's dark energy), it possessed a tremendous amount of energy inherent to the fabric of space.

As the Universe expands, more space is created, and so the energy density remains constant. As a result, the Universe gets imprinted with the same properties everywhere and it gets stretched so that its curvature is flat.

According to the theory of inflation, those fluctuations should create the seeds of the structure we have today, and they would have possessed the properties of being:

- of almost the same magnitude on all scales,
- generated on scales larger than the cosmic horizon (i.e., larger scales than light could have traveled since the start of the hot Big Bang),
- 100% adiabatic (of constant entropy) and 0% isocurvature (of constant spatial curvature),

and it also predicts that the properties of the Big Bang's leftover glow should indicate a maximum temperature for the hot Big Bang that is substantially lower than the maximum possible temperature: the Planck temperature.

Unfortunately, that is as far back as one can go with the understanding of the Universe available today. Because of the nature of inflation, it by necessity wipes out any information that existed in the Universe before it happened.

In fact, it can only ever be hoped to access what occurred during the final $\sim 10^{-32}$ seconds or so of inflation; anything that occurred earlier will be inaccessible to us from here in the Universe. Although it can be stated with confidence where the observable Universe came from, and explain the origin of a great many phenomena within it, the questions of where things like space, time, energy, or the laws of physics came from in the first place, or whether they even began at all, remain unanswered.

Despite all that is known, we can be certain that all we ever will know is finite. There are a finite number of particles, encoding a finite amount of information, that have existed for a finite amount of time within our visible Universe.

While questions such as why the Universe is filled with matter and not antimatter, why it has dark matter and dark energy, and why the constants of nature have the values they do ... may someday be answered, there is no guarantee that what remains in the Universe, today, gives sufficient information to find the answers. Whether these questions ever will be answered remains unknown.

https://bigthink.com/starts-with-a-bang/where-did-the-universe-come-from/?utm_source=pocket-newtab

Magnetism's Role in the Galaxy

Magnetism is ubiquitous in our Universe, with interstellar gas, planets, stars and galaxies all showing the presence of magnetic fields. Generating magnetic fields on such large physical scales require densities, volumes or motions of electrically charged material, such as the gas that pervades the Milky Way or the outflows of material from the energetic centers of galaxies.

Cosmic magnetism spans an enormous range in its strength, varying by a factor of a hundred billion billion between the weak magnetic fields in interstellar space and the extreme magnetism found on the surface of collapsed stars. Because these cosmic magnetic fields are all-pervasive, they play a vital role in controlling how celestial sources form, age and evolve.

The challenge in studying cosmic magnetism is that, while stars and galaxies can be seen directly by the light they emit, magnetic fields are invisible even to the largest optical telescopes instead requiring the detection of polarized radiation, radiation which exhibits the effects of magnetic fields.

In the Milky Way, immense pockets of gas coalesce into clouds where stars are born. In this process, magnetism has a role.

How this fundamental force helps sculpt the galaxy has long eluded scientists, largely because measuring the galactic magnetic field is a considerable challenge. Unable to detect it directly, astronomers study dust that has been aligned by the magnetic field and the light that passes through this dust.

Researchers are attempting understand what role the magnetic field is playing in all the different physical processes that shape the diffuse gas between stars, called the interstellar medium, or ISM. They want to understand what that means for the transition of gas between phases in the ISM, and for turbulence in the ISM.

The gas in the galaxy spans a range of physical states. Very dense, cold molecular clouds exist and at the other extreme end, very hot plasma.

Star formation and the evolution of galaxies in general involves gas flowing between these different physical states. Researchers want to understand the whole life cycle of how gas gets converted into stars and spewed back out into the interstellar medium to seed future generations of star formation.

Filamentary molecular clouds prefer to orient orthogonally with respect to the local magnetic field. This may help with the understanding of how gas and the magnetic field interact to regulate this process of star formation.

The ISM has a large amount of dust in it, chunks of material that are micron-size or smaller that filters starlight. Astronomers can measure the polarization of the remaining starlight, and what is seen is an imprint of the magnetic field in the dust in between the telescope and the star.

Those dust grains also are radiating light, and that radiation has a polarization angle set by the orientation of the local magnetic field. These are two of the tools used.

Scientists want to understand the ultimate origin of magnetism in the universe as well as how these large-scale, coherent, organized magnetic fields started.

Different magnetic field structures exist with different types of galaxies. For example, antennae galaxies a pair of merging galaxies, and it is observed that in the interaction region between them has a very coherent magnetic field structure inferred from dust polarization.

Scientist want to know what is responsible for the “seed” magnetic field that was amplified during the formation of galaxies. It is possible that that field was primordial, meaning it originated during the universe’s birth. It seems, however, that measurements of the modern-day magnetic fields in galaxies on their own may tell us where the initial seed field came from.

https://www.wired.com/story/uncovering-magnetisms-mysterious-role-in-the-galaxy/?utm_source=pocket-newtab-en-us

Earth

The solar system established its existing configuration about 4.5 billion years ago. Earth was formed from gas and dust left over from the Sun. Similar to other planets, Earth has a core, a mantle and a crust.

Earth initially was molten but, over time, the outer layer of the planet cooled to form a solid crust. Water began accumulating in the atmosphere. The Moon formed soon after possibly from the impact of a large object with the Earth. Continents formed and re-formed across the Earth.

The existing cycle of ice ages began 40 million years ago, repeating approximately every 100,000 years. The last glacial period of the most recent ice age ended 10,000 years ago.

The Solar System experiences an approximate 200-million-year cycle of moving through the universe. The Solar System and the four spiral arms of the Milky Way galaxy are both spinning around the supermassive black hole at the galaxy's center but are moving at different speeds meaning the Solar System is moving into and out of the galaxy's arms.

A result of this 200-million year cycle is that of the Earth's surface is something shaped by processes entirely within Earth itself and the effects of this cosmic environment. This includes periodic changes in Earth's orbit, variations in the Sun's output, gamma ray bursts, and of course meteorite impacts.

As the Solar System periodically moves into a spiral arm, interaction between it may dislodge material from the cloud, sending it closer to the inner Solar System. Some of this material may strike Earth.

These periodic high-energy impacts are tracked by the record of crust production preserved in tiny mineral grains. Comet impacts excavate huge volumes of Earth's surface, leading to decompression melting of the mantle.

This molten rock, enriched in light elements such as silicon, aluminum, sodium and potassium, effectively floats on the denser mantle. While there are many other ways to generate continental crust, it is likely that impacting on the early planet formed buoyant seeds of crust. Magma produced from later geological processes would adhere to those early seeds.

Continental crust is vital in most of Earth's natural cycles. It interacts with water and oxygen, forming new weathered products, hosting most metals and biological carbon.

Large meteorite impacts are cataclysmic events that can obliterate life. Yet, impacts may very well have been key to the development of the continental crust.

Recent Fossil Discoveries Challenge Ideas About Earth's Start

A series of fossil finds suggests that life on Earth started earlier than anyone thought, calling into question a widely held theory of the solar system's beginnings. They are indeed fossil life, and they date to 3.5 billion years ago, imply that life diversified remarkably early in the planet's tumultuous youth.

Pieces of rock were found that may contain life dating to 3.7, 3.95 and maybe even 4.28 billion years ago. All of these microfossils — or the chemical evidence associated with them — are debated.

But they all cast doubt on the traditional view ... in the half-billion years after it formed, Earth was hellish and hot. Not until a particularly violent asteroid barrage ended some 3.8 billion years ago could life have evolved.

Many geologists now think Earth may have been tepid and watery from the outset. The oldest rocks in the record suggest parts of the planet's crust had cooled and solidified by 4.4 billion years ago.

Oxygen in those ancient rocks suggest the planet had water as far back as 4.3 billion years ago. And instead of an epochal, final bombardment, meteorite strikes might have slowly tapered off as the solar system settled into its current configuration.

Throughout this early era, ending about 3.8 billion years ago, Earth was molten and could not support a crust of solid rock, let alone life.

But starting around a decade ago, this story started to change, thanks largely to tiny crystals called zircons. The gems, which are often about the size of the period at the end of this sentence, told of a cooler, wetter and maybe livable world as far back as 4.3 billion years ago. In recent years, fossils in ancient rock bolstered the zircons' story of calmer climes.

Today, the oldest evidence for possible life — which many scientists doubt or outright reject — is at least 3.77 billion years old and may be a stunningly ancient 4.28 billion years old.

Earthen tubes and their surrounding chemistry suggest they are remnants of a microbial community that lived near a deep-ocean hydrothermal vents.

Researchers reported finding stromatolites, fossil remains of microbes, from 3.7 billion years ago. Basic chemistry, however, can form plenty of layered structures without any help from life, suggesting they may not be stromatolites but lifeless pretenders.

Some of the apparent fossils had the same carbon-isotope ratio as modern photosynthetic bacteria. Three other types of fossils had the same ratios as methane-eating or methane-producing microbes. Moreover, the isotope ratios correlate to specific species that had already been identified. The oldest samples look like fossils both physically and chemically.

They, also, are diverse. The life-forms must have had time to evolve into endless iterations. This means they must have originated even earlier than 3.5 billion years ago.

Zircons suggest the planet had a crust as far back as 4.4 billion years ago. Part of Earth's crust had cooled, solidified and harbored water at least 400 million years earlier than the earliest known sedimentary rocks.

One researcher said: “I was taught when I was young that it would take billions and billions of years for life to form. But I have not been able to find any basis for those sorts of statements”.

https://getpocket.com/explore/item/fossil-discoveries-challenge-ideas-about-earth-s-start?utm_source=firefox-newtab-en-us

Evidence For And Against The Existence of God or gods

Beliefs about the origin and existence of the universe is influenced by one's belief regarding supernatural forces. Following are arguments and evidence for and against theistic influences on existence.

In summary ...

There is no scientific evidence that definitively proves or disproves the existence of God. No scientific experiment can detect God. Some say that scientific evidence can point to God's existence, but it cannot conclusively demonstrate it.

However, people may arrive at their beliefs about God through a variety of ways, including:

- Personal experiences: People may have personal experiences that lead them to believe in God.
- Religious teachings: People may be taught about God through religious teachings.
- Philosophical reasoning: People may use philosophical reasoning to arrive at their beliefs about God.

Arguments: Some arguments for the existence of God include:

- The teleological argument: The universe's complexity and greatness suggests that it was created by an intelligent and powerful creator.
- The cosmological argument: God is the first cause.
- The argument from contingency: God is a necessary being.
- The argument from motion: God is the prime mover.
- Ontological: It is possible to imagine a perfect being.
- Causal: Everything must have a cause.
- Beauty of creation: Some believe that God's presence is made evident through the beauty of creation.
- Obedience: Some believe that obedience to God's Word is a proof that one knows God.
- Jesus: Some believe that Jesus' identity is evidence that he is God, including fulfilled prophecy, recorded miracles, and living a sinless life.

Some arguments against the existence of God include:

- The argument from evil: If God is all-knowing, all-powerful, and morally perfect, then the existence of evil in the world is logically inconsistent.

- The argument from divine hiddenness: If God existed, then the truth of his existence would be more obvious to everyone. Since it's not, then God probably doesn't exist.
- The multiplicity argument: The gods of different religions have different characteristics, so only one religion, or none, can be correct about God.
- Other arguments against the existence of God include: The argument from pain and the argument from injustice.

The following describes this information in more detail.

Arguments for the existence of God or gods

Thomas Aquinas developed five arguments for God's existence. Aquinas did not intend to fully prove the existence of God.

1. The unmoved mover argument: an event may or may not happen, so everything must be created by something that must exist
2. The first cause argument: nothing is self-existent, so everything must be created by something that is self-existent
3. The necessary being argument: reality is contingent, so everything must be created by something that is immutable
4. The degree argument: no good thing is supremely good, so everything must be created by something that is supremely good
5. The final cause argument: life has a purpose, so everything must be created by something that determines the purpose of life

The cosmological argument is an argument for a cause or reason for the cosmos. One type of cosmological, or "first cause" argument asserts that since everything that begins to exist has a cause, and the universe began to exist, the universe must have had a cause which was itself not caused. This ultimate first cause is identified with God.

Whatever is contained in a clear and distinct idea of a thing must be predicated of that thing; but a clear and distinct idea of an absolutely perfect Being contains the idea of actual existence; therefore since we have the idea of an absolutely perfect Being such a Being must really exist.

Thomas Aquinas criticized the argument for proposing a definition of God which, if God is transcendent, should be impossible for humans.

Immanuel Kant criticized the argument from a logical standpoint: he stated that the term "God" really signifies two different terms: both idea of God, and God. Kant concluded that the proof is equivocation, based on the ambiguity of the word God. Kant also challenged the argument's assumption that existence is a predicate (of perfection) because it does not add anything to the essence of a being. If existence is not a predicate, then it is not necessarily true that the greatest possible being exists.

A common rebuttal to Kant's critique is that, although "existence" does add something to both the concept and the reality of God, the concept would be vastly different if its referent is an unreal

Being. Another response to Kant is even if one were to grant that existence is not a real predicate, necessary existence, which is the correct formulation of an understanding of God, is a real predicate.

Empirical arguments include the following.

The argument from beauty (also the aesthetic argument) is an argument for the existence of a realm of immaterial ideas or, most commonly, for the existence of God, that roughly states that the elegance of the laws of physics or the elegant laws of mathematics is evidence of a creator deity who has arranged these things to be beautiful (aesthetically pleasing, or "good") and not ugly.

Plato argued there is a transcendent plane of abstract ideas, or universals, which are more perfect than real-world examples of those ideas. Later philosophers connected this plane to the idea of goodness, beauty, and then the Christian God.

Various observers have also argued that the experience of beauty is evidence of the existence of a universal God. Depending on the observer, this might include artificially beautiful things like music or art, natural beauty like landscapes or astronomical bodies, or the elegance of abstract ideas like the laws of mathematics or physics.

The argument from consciousness is an argument for the existence of God that claims that human consciousness cannot be explained by the physical mechanisms of the human body and brain, therefore asserting that there must be non-physical aspects to human consciousness. This is held as indirect evidence of God, given that notions about souls and the afterlife in Christianity and Islam would be consistent with such a claim.

The teleological argument (argument from design, or intelligent design argument) is an argument for the existence of God or, more generally, that complex functionality in the natural world which looks designed is evidence of an intelligent creator. Abrahamic religions have used the teleological argument in many ways, and it has a long association with them.

From its beginning, there have been numerous criticisms of the different versions of the teleological argument, and responses to its challenge to the claims against non-teleological natural science. Intelligent design proponents have used the teleological argument to argue against the modern scientific understanding of evolution, and to claim that supernatural explanations should be given equal validity in the public school science curriculum.

While the concept of an intelligence behind the natural order is ancient, a rational argument that concludes that we can know that the natural world has a designer, or a creating intelligence which has human-like purposes, appears to have begun with classical philosophy. Religious thinkers in Judaism, Hinduism, Confucianism, Islam and Christianity also developed versions of the teleological argument. Later, variants on the argument from design were produced in Western philosophy and by Christian fundamentalism.

The (rational) warrant argument is a statement that connects the premises to a conclusion. An example is mystical experiences which are life-transformative in a way that is significant, positive and lasting. In other words, they provide a framework for navigating life that is useful and effective.

Another argument for the existence of God is based on inductive reasoning. For example, the proofs for the existence of God present a fairly large probability though not absolute certainty. A number of obscure points always remain; an act of faith is required to dismiss these difficulties.

Subjective arguments, from testimony, rely on the testimony or experience of witnesses. These arguments are based on the principle that one should accept testimony unless there are strong reasons for not doing so.

The witness argument gives credibility to personal witnesses, contemporary and throughout the ages. A variation of this is the argument from miracles which relies on testimony of supernatural events to establish the existence of God.

The majority argument argues that the theism of people throughout most of recorded history and in many different places provides prima facie demonstration of God's existence.

Islam asserts that the revelation of its holy book, the Qur'an, and its unique literary attributes, vindicate its divine authorship, and thus the existence of God.

The Church of Jesus Christ of Latter-day Saints, also known as Mormonism, similarly asserts that the miraculous appearance of God, Jesus Christ, and angels to Joseph Smith and others and subsequent finding and translation of the Book of Mormon establishes the existence of God.

Christianity and Judaism assert that God intervened in key specific moments in history, especially at the Exodus and the giving of the Ten Commandments in front of all the tribes of Israel, posing an argument from empirical evidence stemming from sheer number of witnesses, thus demonstrating his existence. Christian arguments assert that certain events of the Christian New Testament are historically accurate, and prove God's existence.

The sincere seeker's argument, that every individual who follows a formulaic path towards guidance, arrives at the same destination of conviction in the existence of God. This apparent natural law for guidance and belief could only be consistent if the formula and supplication were being answered by the same Divine entity.

The argument from a proper basis argues that belief in God is "properly basic"; that it is similar to statements like "I see a chair" or "I feel pain". Such beliefs are non-falsifiable and, thus, neither provable nor disprovable; they concern perceptual beliefs or indisputable mental states. Religion consists solely in this inner perception, and dogmatic doctrines are not essential.

The evolutionary argument against naturalism, which argues that naturalistic evolution is incapable of providing humans with the cognitive apparatus necessary for their knowledge to have positive validated status.

Arguments against the existence of God or gods

The arguments below aim to show that a god or set of gods does not exist—by showing a creator is unnecessary or contradictory, at odds with known scientific or historical facts, or that there is insufficient proof that a god does exist.

Logical arguments deduce, mostly through self-contradiction, the non-existence of a God as "the Creator".

No lasting scientific evidence of God's existence has been found. Therefore, in the case of a worldview that relies solely on scientific evidence, whether or not God exists is unknown; or even, God does not exist (depending on the strength of such a worldview). It is reasonable to ask who or what created the universe, but if the answer is God, then the question has merely been deflected to that of who created God. It is possible to answer these questions purely within the realm of science, and without invoking any divine beings.

Some theists argue that evolution and abiogenesis are akin to a hurricane assembling a Boeing 747 — that the universe (or life) is too complex, cannot be made by non-living matter alone and would have to be designed by someone, who theists call God. The counter-argument is that such a God would himself be complex — the "Ultimate" Boeing 747 — and therefore require a designer. The burden of proof for the existence of God lies with the theist.

Some arguments focus on the existence of specific conceptions of God as being omniscient, omnipotent, and morally perfect.

The omnipotence paradox suggests that the concept of an omnipotent entity is logically contradictory by considering questions such as "Can God create a rock so big that He cannot move it?" or "If God is all powerful, could God create a being more powerful than Himself?" Similarly, the omniscience paradox argues that God cannot be omniscient because he would not know how to create something unknown to himself. Another argument points to the contradiction of omniscience and omnipotence arguing that God is bound to follow whatever God foreknows himself doing.

Argument from free will contends that omniscience and the free will of humanity are incompatible and that any conception of God that incorporates both properties is therefore inherently contradictory: if God is omniscient, then God already knows humanity's future, contradicting the claim of free will.

The anthropic argument states that if God is omniscient, omnipotent, and morally perfect, he would have created other morally perfect beings instead of imperfect ones, such as humans. The problem of hell is the idea that eternal damnation contradicts God's omnibenevolence and omnipresence.

The Transcendental Argument for the Non-existence of God contests the existence of an intelligent Creator God by demonstrating that such a being would make logic and morality contingent, which is incompatible with the assertion that they are necessary, and contradicts the efficacy of science.

The "no reason" argument states that an omnipotent and omniscient being would not have any reason to act in any way, specifically by creating the universe, because it would have no needs, wants, or desires since these very concepts are subjectively human. Since the universe exists, there is a contradiction, and therefore, an omnipotent god cannot exist.

A perfect being would have long ago satisfied all its wants and desires and would no longer be able to take action in the present without proving that it had been unable to achieve its wants faster—showing it imperfect.

The existential argument for the non-existence of a perfect sentient being states that if existence precedes essence, it follows from the meaning of the term sentient that a sentient being cannot be complete or perfect.

The following empirical arguments rely on observations or experimentation to yield their conclusions.

Religious pluralism is an attitude or policy regarding the diversity of religious belief systems co-existing in society.

Recognizing and tolerating the religious diversity of a society or country, promoting freedom of religion, and defining secularism as neutrality (of the state or non-sectarian institution) on issues of religion as opposed to opposition of religion in the public forum or public square that is open to public expression, and promoting friendly separation of religion and state as opposed to hostile separation or antitheism espoused by other forms of secularism.

Any of several forms of religious inclusivism. One such worldview holds that one's own religion is not the sole and exclusive source of truth, and thus acknowledges that at least some truths and true values may exist in other religions.

Another concept is that two or more religions with mutually exclusive truth claims are equally valid; this may be considered a form of either toleration or moral relativism. Perennialism or Traditionalism is the understanding that the exclusive claims of different religions turn out, upon closer examination, to be variations of universal truths.

The argument from parsimony (using Occam's razor) contends that since natural (non-supernatural) theories adequately explain the development of religion and belief in gods, the actual existence of such supernatural agents is superfluous and may be dismissed unless otherwise proven to be required to explain the phenomenon.

The argument from "historical induction" concludes that since most theistic religions throughout history (e.g. ancient Egyptian religion, ancient Greek religion) and their gods ultimately come to be regarded as untrue or incorrect, all theistic religions, including contemporary ones, are therefore most likely untrue/incorrect by induction.

An argument from nonbelief is a philosophical argument that asserts an inconsistency between the existence of God and a world in which people fail to recognize him. It is similar to the classic argument from evil in affirming an inconsistency between the world that exists and the world that would exist if God had certain desires combined with the power to see them through.

There are two key varieties of the argument. The argument from reasonable nonbelief (or the argument from divine hiddenness). This argument says that if God existed (and was perfectly good and loving) every reasonable person would have been brought to believe in God; however, there are reasonable nonbelievers; therefore, this God does not exist.

Arguments from the poor design of the universe asserts that the problem of evil contests the existence of a god who is both omnipotent and omnibenevolent by arguing that such a god should not permit the existence of evil or suffering. Similarly, the argument from poor design contends that an all-powerful, benevolent creator god would not have created lifeforms, including humans, which seem to exhibit poor design.

The universe itself seems to be very ill-designed for life, because the vast majority of the space in the universe is utterly hostile to it. This is arguably unexpected on the hypothesis that the universe was designed by a god, especially a personal god.

A god could have easily created a universe in the recent past, in which most of the volume of the universe is inhabitable by humans and other lifeforms - the kind of universe that most humans believed in until the rise of modern science.

While a personal god might have created the kind of universe we observe, this is not the kind of universe we would most likely expect to see if such a god existed. Observations about the nature of the universe are strongly expected, since the universe would have to be vast, very old, and almost completely devoid of life if life were to have arisen by sheer chance.

Similar to the subjective arguments for the existence of God, subjective arguments against God's existence mainly rely on the testimony or experience of witnesses, or the propositions of a revealed religion in general. The witness argument gives credibility to personal witnesses, contemporary and from the past, who disbelieve or strongly doubt the existence of God.

The conflicted religions argument notes that many religions give differing accounts as to what God is and what God wants; since all the contradictory accounts cannot be correct, many if not all religions must be incorrect.

Psychological or sociological explanations exist for belief in the existence of deities. Psychologists observe that the majority of humans often ask existential questions such as "why we are here" and whether life has purpose.

Some psychologists have posited that religious beliefs may recruit cognitive mechanisms in order to satisfy these questions. Some have noted the inner religious struggle between melancholy and happiness, fear and pain, the need for a powerful parental figure, the obsessional nature of ritual, and the hypnotic state a community that can induce as contributing factors to the psychology of religion.

One theory treats belief in God as the result of the human brain's tendency towards agency detection. Because of evolutionary pressures, humans err on the side of attributing agency where there is not any. Belief in supernatural entities spreads and becomes culturally fixed because of their memorability. The concept of "minimally counterintuitive" beings that differ from the ordinary in a small number of ways (such as being invisible, able to fly, or having access to strategic and otherwise secret information) leave a lasting impression that spreads through word-of-mouth.

A similar argument includes the socially coordinating aspects of shared belief. The universal human cognitive process naturally produces the concept of the supernatural. Humans suspect an agent behind every event. Natural events for which there is no obvious agent may be attributed to God.

https://en.wikipedia.org/wiki/Existence_of_God

Biotic

Life

Life is a concept that humans invented. On the most fundamental level, all matter that exists is an arrangement of atoms and their constituent particles. These arrangements fall onto an immense spectrum of complexity, from a single hydrogen atom to something as intricate as a brain.

In trying to define life, a line is drawn at an arbitrary level of complexity and everything above that border is declared alive and everything below it is not. This division does not exist outside of the mind.

There is no threshold at which a collection of atoms suddenly becomes alive, no categorical distinction between the living and inanimate. In reality, life is not defined because there was never anything to define in the first place.

Nobel laureate Paul Nurse, however, developed underlying principles to provide a particular definition for the term “Life” that are described as:

- Living organisms maintain themselves, grow, self-organize, reproduce, have heredity, and are diverse.
- Life evolves by natural selection through reproduction, heredity, and variability of the heredity system.
- The cell is the basic structural and functional unit of life. It is separate from but in communication with its environment.
- Life is based on carbon polymer chemistry. It produces nucleic acid information storage devices and protein chemically active machines.
- Life is based on information management, with inputs, processing, and outputs. Long term information storage is in a linear form compatible with polymers.
- Life is related and interconnected and dependent to varying extents on other life forms.

Defined in this way, the key to understanding scientifically how “life” first began appears to be determining how ribonucleic acid (RNA) first was formed and then how RNA established the capability to replicate. This understanding is being researched but no conclusive mechanisms have been identified so far.

Humans, so far, have not created life from non-life.

Researchers think evolution may not select for extra genetic and metabolic resources that make an animal that will never grow old. Animals evolve to live just long enough that they do not incur selection penalties for having life spans that are too short.

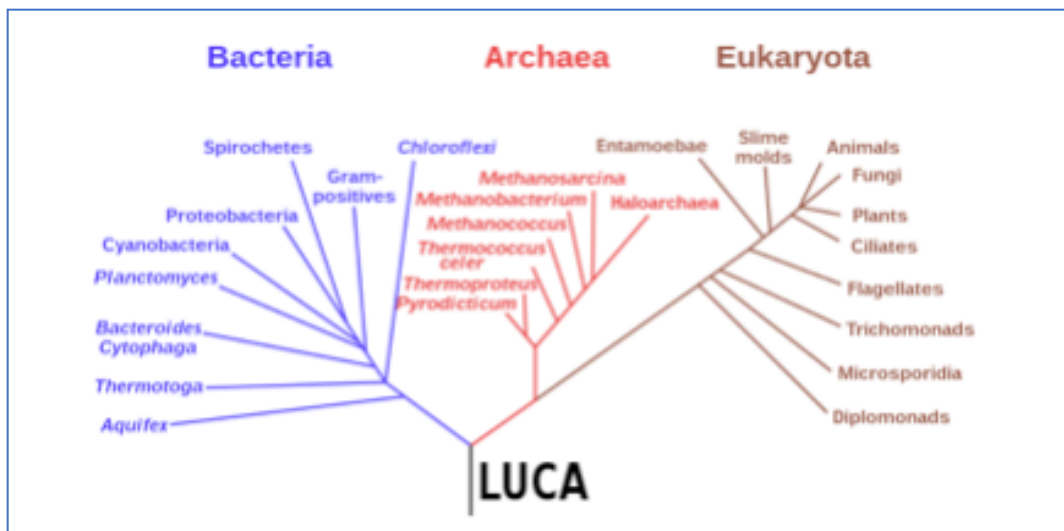
Some researchers think that if all forms of disease were eliminated from humans, including old age, average life expectancy could increase to about 600 years from the existing 80 years.

Evolutionary dynamics, however, act upon species to live long enough to reproduce. After the age of reproduction evolution no longer has “interest” in the survival of individual species members.

As long as the offspring can survive long enough to reproduce, whether through numbers, or intelligence, or some other adaptations that is sufficient for the survival of the species. Or, in the case of humans, the additional time needed to socialize offspring results in a few extra years beyond typical breeding age. This is the reason that diseases that primarily strike the elderly, like cancer or heart disease, never have been mitigated through evolution.

Evidence supporting the theory of evolution is found in DNA, in biochemistry, in the fossil records, in observations of evolving species today and in the lab. For example, polar bears are currently adapting to decreasing sea ice in some areas. Other animals change over the course of a few years in response to introduced predators.

Following is a depiction of the so-called phylogenetic tree showing the last universal common ancestor (LUCA) at the root. The major groups of organisms are the Bacteria, the Archaea and the Eukaryota.



Viruses have had a significant role in the evolution of all other organisms, from bacteria through vertebrates to humans. Viruses insert themselves into the host's DNA and in doing so can generate novel proteins and RNA molecules that might be valuable to the host.

Moreover, the virus can manipulate the host genomic structure itself. Although this ability could cause potential genetic damage, it might also trigger significant structural and functional changes in the host genome that could not occur through random mutation alone.

Viruses have the unique ability to incorporate themselves permanently into the genomes of their hosts (known as endogenization) and thus lose their ability to infect other individuals. As a result, they are passed down to successive generations of hosts.

An example is several healthy T cells that fuse together with an infected T cell to create a single large HIV-infected cell. This cell fusion process is involved in the AIDS disease and yet also had crucial roles in vertebrate and mammalian evolution.

Bacteria have had just as profound a role in evolution. Mitochondria in eukaryotic cells probably originated as endogenous bacteria that were compromised and retained by the host. Their incorporation facilitated one of the biggest accelerations in evolution.

Viruses and bacteria appear to have had a major role in the evolution of higher organisms by enabling the latter to make exceptional advancements that would be insurmountable by stepwise mutation. Viruses and bacteria are “missing links” in evolution, operating symbiotically with the host and providing sources of functional novelty and gene transcription control.

Life is a result of information stored in nucleic acids as polymers (DNA, RNA) converted to biochemical actions in proteins. Chemical feedback control is used to regulate genes.

Twenty different amino acid types generate complex three-dimensional structures that build up and break down molecules (e.g., metabolic activity).

Intelligent life evolved from organic biological components. Abiogenesis is the origin of life ... the natural process by which life has arisen from non-living matter, such as simple organic compounds.

While the details of this process are still unknown, the prevailing scientific hypothesis is that the transition from non-living to living entities was not a single event, but an evolutionary process of increasing complexity that involved molecular self-replication, self-assembly, autocatalysis, and the emergence of cell membranes.

Complex life had existed on the Earth long before significant oxygenation of the atmosphere or the sea starting about 500 million years ago. One theory suggests that the explosion of complex life coincided not with a rise in oxygen but with the first big boom in algae growth. Paul Niles, a geologist with NASA said that sometimes life “doesn’t need a nice atmosphere or temperate surface, but just rocks, heat, and water.”

“Living” organisms are thought to originally have formed in primordial pools or ocean hydrothermal vents, from extraterrestrial objects carrying organisms or some combination of these sources.

A NASA spacecraft brought samples from the asteroid Bennu back to Earth in 2023. The first in-depth analyses of that material have revealed organic molecules, including key building blocks of life. The results bolster the theory that asteroids that crashed into Earth may have delivered the ingredients for life on our planet.

The 4.5-billion-year-old asteroid is thought to have formed in the first 10 million years of the solar system’s existence. The samples included thousands of organic compounds and 14 of the 20 amino acids that life on Earth uses to form proteins. The samples also contained four “nucleobases” — the main components of DNA and RNA, which store and transmit genetic blueprints within our cells.

The findings could also mean that the chances life formed on other planets in the solar system could be higher than scientists previously thought.

Exceptionally high concentrations of ammonia were found — about 100 times more than the natural levels of ammonia that you find in soils on the Earth. Ammonia is an essential ingredient in many biological processes, including as a building block to form amino acids, which in turn can link together into long chains to make proteins.

Researchers also found traces of 11 minerals that were likely part of a briny mixture left behind after deposits of water evaporated off Bennu and its parent asteroid. The raw ingredients of life were combining in really interesting and complex ways on Bennu's parent body. We may have discovered that next step on a pathway to life.

https://www.nbcnews.com/science/space/nasa-asteroid-samples-organic-compounds-life-building-blocks-rcna189205?utm_source=firefox-newtab-en-us

A common theory holds that life emerged from a collection of chemicals in which RNA was the original self-replicator. Another theory, however, postulates that peptides and RNA might have been more the source.

Four billion years ago, the first molecular precursors to life emerged. Although the identity of these molecules remains a subject of debate, scientists agree that the molecules would have had to perform two major functions: storing information and catalyzing chemical reactions.

The modern cell assigns these responsibilities to its DNA and its proteins, respectively — but prevalent theory proposes that RNA was first to have that role, paving the way for DNA and proteins to take over later.

This prevalent theory is supported by more experimental evidence than any of its competitors.

Researchers argue that a single polymer, RNA, could not carry out all of the necessary processes now characterized as part of life. The main objection concerns catalysis; some research has shown that for life to take hold, the polymer would have had to coordinate the rates of chemical reactions that could differ in speed by as much as 20 orders of magnitude.

RNA-only could not explain the emergence of the genetic code, which nearly all living organisms today use to translate genetic information into proteins. The code takes each of the 64 possible three-nucleotide RNA sequences and maps them to one of the 20 amino acids used to build proteins.

RNA alone has no means of controlling its chemistry. A peptide-RNA complex may.

RNA and polypeptides as complementary structures imply an elementary kind of coding, a basis for the exchange of information between the RNA and the polypeptide. 20 “loading” molecules called aminoacyl-tRNA synthetases allow RNA to bond with specific amino acids in keeping with the rules of the genetic code.

RNA coded for peptides used a set of just two rules (or, in other words, using just two types of amino acids). The resulting peptide products ended up enforcing the rules that governed the translation process, thus forming the tight feedback loop required for the theory.

Thus, the peptide-RNA theory solves gaps in origin-of-life history that RNA alone cannot explain. It provides theoretical and experimental evidence that peptides and RNA were jointly involved in the origin of the genetic code. Metabolism, construction through transcription and translation, and replication must have coevolved.

This RNA-peptide theory leaves open questions about how that chemistry began and its process.

Another theory rests on assemblies of lipids that catalyze the entrance and exit of various molecules. Information is carried not by genetic sequences, but rather by the lipid composition of such assemblies. Similar to the RNA-peptide theory, this other theory involves not one type of molecule (e.g., RNA) but a variety of them.

<https://www.quantamagazine.org/the-end-of-the-rna-world-is-near-biochemists-argue-20171219/>

Some scientists have experimented with chemical reactions that form RNA, amino acids and biomolecules. Living objects are composed of proteins from amino acids that are composed of RNA and DNA generates from nucleotides. RNA plus peptides provide reproduction capability for living objects.

Recent experiments with 'origins of life' chemical reactions (using cyanide, ammonia and carbon dioxide -- all thought to be common on the early earth) generate amino acids and nucleic acids, the building blocks of proteins and DNA. These reactions worked at room temperature and in a wide pH range. They could have given rise to a large number of the molecules that are required for the key elements of life.

This reaction is similar to what occurs today inside cells -- except for being driven by cyanide instead of a protein. It could help explain the shift from prebiotic to biotic chemistry

Archea and bacteria combine to form hybrid organisms (aka, eukaryotes). Some believe that, in addition to bacteria, viruses as well combined archaea to the same effect. (Archea are a group of micro-organisms that are similar to, but evolutionarily distinct from bacteria.)

Before the existence of the first complex cells 3.5 billion years ago, simple cells lacking a nucleus and other detailed internal structure dominated earth. Then, a new type of cell, the eukaryote, emerged.

The eukaryotes evolved many complex internal modules or organelles, including the endoplasmic reticulum, the Golgi apparatus and the mitochondria, forming many diverse cell types - precursors to all subsequent plant and animal life on earth.

Prokaryotic cells, which include bacteria and archaea, are structurally simple organisms, lacking the complex internal structure found in eukaryotes. The transition from prokaryote to eukaryote has remains an unknown that biologists still are trying to untangle.

A theory is that the cell diversification occurred when free-living prokaryotic cells acquired other tiny organisms within the confines of their interiors. Through a process known as endosymbiosis, the new cell resident is taken up by this proto-eukaryote, supplying it with additional energy and enabling its transformation.

The endosymbiont it has acquired would eventually develop into mitochondria -- cellular power found only in eukaryotic cells. A series of tentative, gradual, step-wise changes over long timespans ultimately produced complex cells with sophisticated internal structures and capable of extensive diversification.

The Krebs Cycle

The Krebs cycle, which also is called the citric acid cycle (CAC) or the TCA cycle (tricarboxylic acid cycle), is a series of chemical reactions that release stored energy through the oxidation of acetyl-CoA derived from carbohydrates, fats, and proteins. The Krebs cycle is used by organisms that respire (as opposed to organisms that ferment) to generate energy, either by anaerobic respiration or aerobic respiration.

In addition, the cycle provides precursors of certain amino acids, as well as the reducing agent NADH, that are used in numerous other reactions. Its central importance to many biochemical pathways suggests that it was one of the earliest components of metabolism and may have originated abiogenetically. The net result is the oxidation of nutrients to produce usable chemical energy in the form of ATP.

https://en.wikipedia.org/wiki/Citric_acid_cycle

Some believe the Krebs cycle animates cells and gives life to lifeless matter. Genetics have dominated biology, however, no difference exists in the information content between a living cell and one that just died.

Some form of primitive metabolism may have arisen in deep-sea hydrothermal vents before the appearance of genetic information. The Krebs cycle of reactions uses energy to transform inorganic molecules into the building blocks of life.

All living cells power themselves by coaxing energetic electrons from one side of a membrane to the other. Membrane-based mechanisms for accomplishing this are, in a sense, as universal a feature of life as the genetic code.

But unlike the genetic code, these mechanisms are not the same everywhere: The two simplest categories of cells, bacteria and archaea, have membranes and protein complexes for producing energy that are chemically and structurally dissimilar.

Those differences make it hard to guess how the very first cells met their energy needs. This leads to an unorthodox hypothesis about the origin of life.

A theory is that life arose in a geological environment where electrochemical gradients across tiny barriers occurred naturally, supporting a primitive form of metabolism while cells as we know them evolved. A place where this might be possible suggested itself: alkaline hydrothermal vents on the deep seafloor, inside highly porous rock formations that are almost like mineralized sponges.

Metabolism is central to life, and genetic information emerges naturally from it rather than the other way around. Carbon and energy metabolism are driven by proton gradients, exactly what the vents provide.

Inside the porous inorganic material around deep hydrothermal vents, organic molecules could have been organized into cell-like entities that made more of themselves. It is a very rough form of growth, but it is lifelike.

The theory is one among many in the field of origin of life studies. Many if not most scientists stand by theories that life started with self-replicating mixtures of RNA and other molecules, and that it arose on or near Earth's surface, nurtured by sunlight.

Studies of hydrothermal vents as crucibles for life have increased in recent decades, but some of them favor volcanic vents in freshwater, not deep vents on the seafloor. The theory addresses how the energy-intensive synthesis of proteins and other essential biomolecules could have occurred.

The theory of the RNA first world is where some process in the environment makes nucleotides, and the nucleotides go through a process that makes them link up into polymer chains. Then those population of RNAs invent everything because they are capable of both catalyzing reactions and copying themselves.

But then how did the RNAs invent all of metabolism, cells, spatial structure and so on? Genes do not actually do that even today. Cells come from cells, and genes go along for the ride. So why would genes do it at the very beginning?

Life starts with hydrogen and carbon dioxide, which do not react very easily. Mitochondria and in certain bacteria, life uses an electrical charge on the membrane to transfer electrons from hydrogen onto iron sulfur proteins like ferredoxin.

These tiny clusters of iron ions and sulfur ions at the heart of ancient proteins are like little minerals. You get these minerals in hydrothermal vents, and you also get carbon dioxide and hydrogen, and there are even thin barriers in the porous rock with an electrical charge on them.

Findings in the last year or two in the lab indicate that this structure at the vents effectively drives the reaction between carbon dioxide and hydrogen. If nitrogen is added, then the same amino acids required for life are generated..

These first steps are recalcitrant, but the electrical charges on the hydrothermal vent seem to lower the barrier to the first steps, so the rest can happen. In effect it is a continuous flow of hydrothermal fluids going through this electrochemical reaction, converting gases in the environment into more organic molecules, which could enter into the cell-like pores, structuring themselves into cell-like entities and making more of themselves. It is a very rough form of growth but is lifelike in that sense. Speculation is that random sequences of RNA and the nucleotides polymerize producing little chains of nucleotides with random letters but no information encoded. This acts as a template for more RNA capable of templating an exact copy of the same sequence, even if that sequence has no information in it ... and, it can in principle act as a template for amino acids.

A random sequence of RNA generates a nonrandom peptide. And that nonrandom peptide could have some function in a growing proto-cell.

It has gone from a system without information to a system with information, with hardly any change in the system itself. All that occurred was the introduction of random RNA.

<https://www.youtube.com/watch?v=vBiDwBOqQA&t=23s>

Cellular Life, Death

Based on recent research, a new understanding about cellular life and death has begun to emerge.

After being perfused with a hemoglobin-based solution deteriorating and seemingly lifeless brain cells regained — at least temporarily — some of their normal structure and metabolic activity. The aim is that this type process might someday be used to restore brains threatened by strokes, oxygen

deprivation or other conditions, although years of further testing will be needed before that's possible.

Cells that are about to expire tend to shut down in a predictable way. Their internal generators slow, their organelles may fragment, and their DNA breaks down.

Cells must reverse these processes and attempt to repair the damage through a complex, tightly choreographed operation. They often can jump-start this intricate recovery on their own.

In an experiment, human tumor cells were immersed in ethanol to kick-start apoptosis. Afterwards, the dead cells were washed and put in a fresh culture medium.

Some of the cells had regained their normal, healthy appearance with intact membranes. Key organelles such as mitochondria were functioning normally again.

Studying the processes that allow dying cells to regain back toward life, scientists ultimately hope to restore diseased cells to health, limit overactive cell division and resuscitate expired organs.

https://getpocket.com/explore/item/cellular-life-death-and-everything-in-between?utm_source=firefox-newtab-en-us

Intelligent life just as well might have evolved from inorganic components. Neurons are the “devices” that enable human intelligence. Humans already have demonstrated that neuron-like devices can be fabricated in silicon-based technology and designed into “learning” systems.

An evolutionary process of increasing complexity that involved molecular self-replication, self-assembly, autocatalysis, and the emergence of inorganic “devices” that eventually aggregated into intelligent beings. Ironically, these beings may have attempted to create “artificial intelligence” using organic biological components.

Extraterrestrial life forms, if they exist and humans encounter them, could be so beyond comprehension that people would not realize they are seeing them. Presumably life does not have to be made of atoms and molecules, but could be assembled from any set of building blocks with the requisite complexity. If so, a civilization originally could exist or later transcribe itself and its entire physical realm into new forms.

At the extreme, our universe is one of the new forms into which some other civilization transcribed its world. For example, only about 5 percent of the mass-energy of the universe consists of ordinary matter: the protons, neutrons, and electrons that we’re composed of. A much larger 27 percent is thought to be unseen, still mysterious stuff.

Astronomical evidence for this dark, gravitating matter is convincing, albeit still not without question. Vast amounts of dark matter seem to lurk around galaxies, providing mass that helps hold things together via gravity. On even larger scales, the web-like topography of luminous gas and stars also hints at unseen mass.

Cosmologists usually assume that dark matter has no microstructure. They think it consists of subatomic particles that interact only via gravity and the weak nuclear force and therefore slump into tenuous, featureless swathes. Dark matter could contain real complexity, and perhaps it is where all technologically advanced life ends up or where most life always has been.

At present scientists have neither identified the dark-matter particles nor come up with a compelling alternative to our laws of physics that would account for the behavior of galaxies and clusters of galaxies. Would an explanation in terms of life be any less plausible than a failure of established laws?

The universe does other unexpected things. Notably, it began to expand at an accelerated rate about 5 billion years ago. This acceleration conventionally is chalked up to dark energy. But cosmologists don’t know why the cosmic acceleration began when it did.

Life always looks for ways to lower its existential risk. A species can mitigate risk by spreading, decentralizing, and seeding as much real estate as possible. In this context, advanced life is going to look for ways to get rid of physical locality and to maximize redundancy and flexibility.

The quantum realm offers options. The cosmos is already packed with electromagnetic energy.

Today, at any instant, about 400 photons of cosmic microwave radiation are streaming through any cubic centimeter of free space. They collectively have less energy than ordinary particles such as protons and electrons, but vastly outnumber them.

That is a lot of potential data carriers. Furthermore, it is imaginable that these photons are quantum-mechanically entangled to help with error control.

That's one way that life could disappear into ordinary physics.

If the universe began again, would life exist as it does? Nearly all animals alive today can trace their lineages back to the creatures that lived in the Cambrian, but not every animal that lived in the Cambrian period has descendants that live today.

Some theorize that life today would have been different had history unfolded in another way. Random mutations and chance extinctions—events called “historical contingencies”—would build on each other driving the evolution of life down one path or another. The existence of every animal, including humans, was a rare event that would have been unlikely to re-occur if evolution from the Cambrian period occurred again.

Others disagree with this viewpoint. They believe that over time, natural selection leads organisms to evolve a limited number of adaptations to the finite number of ecological niches on Earth.

This causes unrelated organisms to gradually converge on similar designs. If humans' ancestors had not evolved big brains and the intelligence that goes with them, another branch of animals might have, and filled the niche that humans now occupy.

Most scholars recognize that convergence and contingency exist in evolution. The debate instead revolves around how repeatable or unique key adaptations, like human intelligence, are. Understanding the interplay of these two forces could reveal whether every living thing is the result of a several-billion-year-long chain of lucky chances, or whether existing things are inevitable.

Laboratory experimentation over decades with *E. coli* lineages watch convergence and contingency unfold in real time in the controlled environment of a laboratory. The experiment was set up to test how reproducible was evolution. In this experiment, contingency has won out over convergence.

So-called “adaptive peaks” represent the highs and lows of reproductive potential. Which mutation occurs first—which adaptive peak an organism begins to climb—is an historical contingency that convergent evolution can have a very difficult, if not impossible, time overcoming.

The timing of mutations matters in overcoming the limitations of adaptive peaks. Bad mutations were essential to improving the fitness of later generations, perhaps because they added to the genetic variation that later random mutations could act upon.

Some scientists believe that humans represent a very improbable evolutionary event. Human-like intelligence has evolved only once in 2.5-billion years of life on Earth.

Humans Still are Evolving

All living organisms that are in a population are evolving all the time. Every person is born with about 70 new genetic mutations on average, which are not derived from their parents'.

Evolution is a process, not an outcome, and it does not always happen linearly. In biological terms, evolution is a change in gene variant (a.k.a. “allele”) frequency in a population over time.

Once emerged, mutations can be passed onto subsequent generations, thereby changing population-level allele frequency. There is drift, where randomness influences what gene variants are passed on in what proportions—this unfolds the quickest in small populations.

There is gene flow, where individuals and populations migrate, bringing their genetic material to new places. Natural selection—often conflated with evolution itself—is where environmental conditions that impact survival and reproduction dictate what alleles are most likely to persist through future generations. Counter to drift, natural selection happens faster in larger populations.

Humans evolved from our last common ancestor with our two closest living relatives—chimpanzees and bonobos. Humans did not evolve from these great apes, but rather from a lineage of now extinct primates which diverged from the predecessor of chimpanzees and bonobos from a shared point.

Human societal organization and sheer numbers may have altered which ones are acting the quickest, in what populations, and in what ways. Drivers of human evolution likely are unique to the species, at least in their intensity.

Emergence and spread of alleles that enable adult lactose digestion in some Middle Eastern, European, and African populations, followed the spread of herding. Even within the past 1,000 years, lactase persistence as an allele is increasing.

Despite the fact that many differences in health are genetic, there were relatively few identifiable, harmful single gene variants. The removal of harmful mutations from a population occurs over time. Compared to selection that favors beneficial traits, it is much more common.

Another common form of selection is stabilizing selection, where extremes remain rare, in favor of a tendency towards the middle ground. Birth weight and human height are standard examples of where stabilizing selection occurs.

Many human traits somehow are kept at some optimum, indicating that both forms of natural selection remain ongoing.

Genetics are going to continue to change, probably at an accelerated rate, but we do not have a good basis for predicting how.

<https://www.popsoci.com/science/are-humans-still-evolving/>

Extraterrestrial Life

Extraterrestrial life, if it exists, may not have DNA or RNA or other nucleic acids. Their components (“cells”) may get instructions in some other way.

This concept of agnostic biosignatures does not count on other life having specific biochemistry at all. More fundamental markers are considered, such as evidence of complexity—intricately arranged components that are unlikely to assemble themselves without some kind of forcing—and disequilibrium.

Part of the difficulty in searching for life of any sort is that scientists do not agree on how life started in the first place—or what even is life. One definition is that life is “self-reproducing with variations.” Another definition is that life “is a self-sustaining chemical system capable of evolution.”

Neither of those definitions requires a particular chemistry. On Earth, life runs on DNA, deoxyribonucleic acid. DNA can replicate, and DNA from different organisms can mix and meld to form a new organism that can replicate itself in turn.

Scientists assume all forms of life would need some way to pass down instructions whose shifts could also help the species evolve over time. But it is conceivable that alien life forms might not make these instructions out of the same chemicals as life on Earth.

Biology off-Earth may never be found. RNA, DNA, proteins, typical amino acids may be found only on Earth.

A broad definition of life includes any system that fulfills all four processes of the living state. That means that it dissipates energy (by, say, eating and digesting), uses self-sustaining chemical reactions to make exponentially more of itself, maintains its internal conditions as external conditions change, and takes in information about the environment that it then uses to survive.

As noted previously, that life becomes life at all is perhaps the most central question. There are two main hypotheses for this process called “abiogenesis”.

One holds that RNA arose able to make more of itself, because that’s what it does, and that it could also catalyze other chemical reactions. Over time that replication led to beings whose makeup relied on that genetic code.

The second, the “metabolism-first” framework, on the other hand posits that chemical reactions organized in a self-sustaining way.

No one, so far however, understand how biological life started. If the events that led to life are supremely uncommon, the many solar systems might still not be enough, statistically, to have resulted in abiogenesis.

Complexity as a proxy for biology. Molecules whose shapes fit physically together like lock and key rarely happens in random collections of chemical compounds but occurs all over living cells.

More binding sites exist on something complicated like a cell than on a small particle. Something alive, in other words, should have more complexity.

Scientists scrutinize another key difference they suspect divides life and not-life. Things that are not alive tend to be at a kind of equilibrium with their environment.

In contrast, something that is alive will harness energy to maintain a difference from its surroundings. It is using power to keep separate from the environment, defining a boundary.

As an example: when a branch is part of a tree, it is alive, and different - in a bordered way - from its environment. If you remove that life from its energy source - pluck the branch - it dies and stops using power.

In a matter of time, the dead branch disintegrates and becomes indistinguishable from the environment. In other words, it goes to equilibrium. The disequilibrium of living should show up as a chemical difference between an organism and its surroundings - regardless of what the surroundings, or the life, are made of.

Another concept is called chemical fractionation, which is how life preferentially uses some elements and isotopes and ignores others. Scaling is related and is how the chemistry inside a cell changes predictably with its size and how the abundance of different-sized cells follows a particular pattern.

The bigger cells will be more and more different from the environment. Small things look like their surroundings, with progressively larger things looking less like their environments and that might indicate a biological system.

Assembly theory is a way of identifying if something is complex without knowing anything about its origin. The more complex a molecule is, the more likely it is to have come from a living process.

It generally is agreed that life results from the complexification of matter. A complex molecule would show more distinct peaks of energy, in part because it was made of many bonds.

Based on our current knowledge, life may have happened tens or hundreds or thousands or millions or billions of other times on other planets. Or, maybe, it has only happened here.

<https://www.scientificamerican.com/article/the-search-for-extraterrestrial-life-as-we-dont-know-it/>

Aging & Longevity

Aging is the primary limitation to individual human existence. It is among the greatest known risk factors for most human diseases and accounts for about two thirds of human deaths.

Lopez-Otin and colleagues propose nine metabolic indications of aging in mammals:

- genomic instability (mutations accumulated in nuclear DNA, in mtDNA, and in the nuclear lamina)
- telomere attrition (the authors note that artificial telomerase confers non-cancerous immortality to otherwise mortal cells)
- epigenetic alterations (including DNA methylation patterns, post-translational modification of histones, and chromatin remodeling)
- loss of proteostasis (protein folding and proteolysis)
- deregulated nutrient sensing (relating to the growth hormone/Insulin-like growth factor 1 signaling pathway, which is the most conserved aging-controlling pathway in evolution and among its targets are the FOXO3/Sirtuin transcription factors and the mTOR complexes, probably responsive to caloric restriction)
- mitochondrial dysfunction
- cellular senescence (accumulation of no longer dividing cells in certain tissues, a process induced especially by p16INK4a/Rb and p19ARF/p53 to stop cancerous cells from proliferating)
- stem cell exhaustion (caused by damage factors such as those listed above)
- altered intercellular communication (encompassing especially inflammation but possibly also other intercellular interactions)

Three main metabolic pathways exist which influence the rate of aging:

- the FOXO3/Sirtuin pathway, probably responsive to caloric restriction
- the Growth hormone/Insulin-like growth factor 1 signaling pathway
- the activity levels of the electron transport chain in mitochondria (similar to chloroplasts in plants).

Research and development to mitigate these hall mark pathways address each individually as well as interrelated parts of an overall system.

Certain diets are associated with lowering the risk of heart disease and early death. The major contributors to mortality risk reduction appear to be a higher consumption of vegetables, fish, fruits, nuts and monounsaturated fatty acids. Optimal body weight above age 65 corresponds to a body mass index of 23 to 27.

People who live the longest report sleeping for six to seven hours each night. Lack of sleep (<5 hours) more than doubles the risk of death from cardiovascular disease, but too much sleep (>9 hours) also is associated with a doubling of the risk of death.

Sleep monitoring of remote tribes from Africa and from South America has shown similar sleep patterns across continents. Their average sleeping duration is 6.4 hours (with a summer/winter difference of 1 hour), afternoon naps (siestas) are uncommon, and insomnia is very rare (tenfold less than in industrial societies).

People who participate in moderate to high levels of physical exercise have a lower mortality rate compared to individuals who are not physically active. Moderate levels of exercise have been correlated with preventing aging and improving quality of life by reducing inflammatory potential.

The majority of the benefits from exercise are achieved with around 3500 metabolic equivalent (MET) minutes per week. For example, climbing stairs 10 minutes, running 20 minutes, and walking or bicycling for 25 minutes on a daily basis would together achieve about 3000 MET minutes a week.

A brief 15 minute session of moderate intensity exercise can improve the efficiency of certain cognitive processes through increases in feelings of energy. Aerobic exercise improves perceptual speed/visual attentional control through increases in self-reported feelings of vigor-energy.

The cause of improved cognition after exercise may be a boost in energy which leads to improved mood and better brain function. Relaxing, on the other hand, actually can significantly decrease energy and mood.

https://getpocket.com/explore/item/what-a-brief-jog-can-do-for-your-brain?utm_source=pocket-newtab

Following guidelines for exercise:

At least 150 minutes per week of moderate intensity (cardio) exercise like walking or easy jogging, or 75 minutes per week of vigorous exercise like running, or a combination. (If you can easily meet that, more is better.)

At least two days per week of muscle strengthening activity, like lifting weights or doing other strength training like pushups, resistance band exercises, or even heavy manual labor like shoveling.

https://lifehacker.com/how-much-exercise-do-you-really-need?utm_source=firefox-newtab-en-us

Exercise's true power has to do with improving mental and emotional well-being. When we exercise, we trigger our body's chemical reward system, releasing a cascade of feel-good hormones. Exercise has been shown to decrease anxiety and depression, and to fill us with a sense of purpose and hope.

Motivations for exercising matter. When we work out mostly because we feel like we should, the guilt and pressure can interfere with the body's reward system, blunting some of the positive effects, some of the benefits.

Do physical activity that you enjoy. Finding a workout you enjoy doesn't necessarily mean finding one that's easy or gentle. Nor does it mean you have to enjoy every moment of the experience itself. We often derive the greatest satisfaction from physical activities that encourage us to challenge ourselves.

https://www.romper.com/life/how-to-reframe-your-relationship-with-exercise?utm_source=pocket-newtab

Avoidance of chronic stress (as opposed to acute stress) is associated with a slower loss of telomeres in most but not all studies and with decreased cortisol levels. A chronically high cortisol level compromises the immune system, causes cardiovascular damage and is associated with facial aging, and the latter in turn is a marker for increased morbidity and mortality.

A meta-analysis indicates that loneliness carries a higher mortality risk than smoking. Stress can be countered by social connection, spirituality, and (for men more clearly than for women) married life, all of which are associated with longevity.

Some drugs and interventions have been shown to slow or reverse the biological effects of aging in animal models but has not yet been proven in humans. These include:

- Resveratrol
- Metformin
- Rapamycin
- Mitochondria-targeted antioxidant SkQ1

There is a debate as to whether or not the pursuit of longevity and the postponement of senescence are cost-effective health care goals given finite health care resources. It has been estimated that population aging only explains 0.2 percentage points of the annual growth rate in medical spending of 4.3% since 1970.

Positive self-perceptions of aging are associated with better mental and physical health and well-being. Positive self-perception of health has been correlated with higher well-being and reduced mortality among the elderly.

While some generalizations exist about growing older, it is a different experience for everyone. People are very diverse in terms of their aging rates.

Aging cannot be stopped but lifestyle choices make a difference. Internal functions matter for health and life span.

Biological age is a measurement focusing on biological markers that show how systems actually are aging. And research is focusing on what else can be done

Between early adulthood and middle age, a compound in cells called nicotinamide adenine dinucleotide (NAD+) begins a gradual decline. An hypothesis is that NAD+ levels are a better measure of aging than chronological age.

NAD+ helps power hundreds of metabolic processes and keeps a group of proteins called sirtuins active. They must stay active, since they can contribute to overall health and longevity.

New research makes a molecular connection between the brain and aging — and shows that overactive neurons can shorten life span. Higher levels of neural excitation are linked to shorter life spans in people and other animals.

A thousand seemingly insignificant things change as an organism ages. Beyond the obvious signs like graying hair and memory problems are myriad shifts both subtler and more consequential: Metabolic processes run less smoothly; neurons respond less swiftly; the replication of DNA grows faultier.

But while bodies may seem to just gradually wear out, many researchers believe instead that aging is controlled at the cellular and biochemical level. They find evidence for this in the throng of biological mechanisms that are linked to aging but also conserved across species. If scientists can pinpoint which of the changes in these processes induce aging, rather than result from it, it may be possible to intervene and extend the human life span.

Research has suggested that severely limiting calorie intake can have a beneficial effect, as can manipulating certain genes in laboratory animals. More recently another controller of life span has been suggested: the activity level of neurons in the brain.

A protein called REST, which controls the expression of many genes related to neural firing, also controls life span. Boosting the levels of REST would lengthen lives by making neurons fire more quietly and with more control.

How exactly overexcitation of neurons might shorten life span still is being studied, but the effect is real and its discovery suggests new avenues for understanding the aging process. Processes involved in aging appear connected to processes that act earlier in an organism's lifetime.

Aging is not separate from the processes that control an organism's development before the age of sexual maturity; it makes use of the same biochemical machinery. Certain genes are important in early life, helping to resist stressful conditions during youth.

A network of signal transduction pathways exists — where one protein binds another protein, which activates another, which switches off another and so on — that, if disturbed, can fundamentally alter life span. The pathway in mammals has a protein called FoxO, which binds to the DNA in the nucleus, turning a group of genes on and off.

That it all comes down to the regulation of genes is perhaps not surprising, but it suggests that the processes that control aging and life span are vastly complex, acting on many systems at once in ways that may be hard to pick apart. REST, which turns genes off, was mainly known for its role in the development of the fetal brain: It represses neuronal genes until the young brain is ready for them to be expressed. REST also is reactivated in the aging brain.

A neuron is covered with proteins and molecular channels that enable it to fire and pass messages. When one neuron fires, it releases a flood of neurotransmitters that excite or inhibit the firing of the next neuron down the line. REST inhibits the production of some of the proteins and channels involved in this process, reining in the excitation.

Brains of long-lived humans have unusually low levels of proteins involved in excitation, at least in comparison with the brains of people who died much younger. Perhaps drugs that suppress excitation could extend life spans.

The master transcription factor that keeps the brain at a homeostatic or equilibrium level — it does not let it get too excitable — and that prolongs life span. When that gets out of equilibrium, it is deleterious physiologically.

Aging may fundamentally involve a loss of biological stability; many things in aging and life span somehow have to do with homeostasis. What is perceived as the body slowing down may in fact be a failure to preserve various equilibria. Keeping the levels in check, closer to what they might have been when younger, could extend lives.

In the meantime, however, it is not clear that people can do anything to put the new findings about REST to work in extending their longevity.

Why exactly overexcited neurons lead to death still is a mystery. The answer probably lies somewhere downstream of the proteins and the genes they turn on and off.

They may be increasing an organism's ability to deal with stress, reworking its energy production to be more efficient, shifting its metabolism into another gear, or performing any number of other changes that together add up a sturdier and longer-lived organism.

Does the human lifespan have a limit?

Researchers used the Gompertz model to estimate a maximum human lifespan of around 120 years — a reasonable ceiling, given that only one person is believed to have reached that age. (The Gompertz function is a type of mathematical model for a time series originally designed to describe human mortality).

Some experts have speculated that medical advances in controlling senescence and treating chronic disease could instead make that limit a routine life expectancy in the future. Major advances in preventing infant and child mortality, and in the treatment of chronic and infectious diseases, have already produced considerable improvement in life span. A continued sharp growth in mortality rate has been observed.

Critics contend that models of survival at extreme ages run into the inevitable problem of sharply dwindling numbers. If the plateau is real, the number of living 110-year-olds required to produce a survivor beyond that age would roughly double for each successive year of longevity. This means the odds of anybody getting to be more than about 120 or 125 are vanishingly small.

A phenomenon known as compression of mortality may exist, in which populations are generally surviving to older ages without meaningfully pushing the outer limits of longevity. There may be much better survival to age 100, but the remaining life expectancy at age 100 is the same, with no documented progress in the last 80 years. In other words, the exceptionally elderly are still at the mercy of inherent biological limitations.

Gerontologists have identified nine cellular and molecular features that are strongly associated with ageing and mortality. These range from shortening of the telomeric structures that cap the chromosomes and prevent genetic damage, to the accumulation of defective proteins and toxic metabolites and the loss of regenerative stem cells.

These breakdowns in the cellular machinery likely are natural and inevitable outcomes of running a complicated biological entity for many years on end. There may simply be too many breakdowns to live beyond a certain age. https://www.nature.com/articles/d41586-022-00070-1?utm_source=pocket-newtab

The leading cause of death worldwide is heart disease. Moderate to vigorous exercise may be the best way to delay major heart disease in adults.

Recent research indicates that 20 to 40 minutes of daily physical activity led to the greatest decrease in heart disease and heart failure. The research suggests a way to keep arteries physiologically “young.”

The study considered that every human has different-sized arteries, and found that the smaller arteries rely on fewer days of exercise per week than larger ones to maintain overall health. Medium-sized arteries need two to three days a week of 30-minute exercising to minimize artery stiffening. But to minimize the stiffening of equally important larger arteries, people should be exercising four to five days a week.

A lifelong history of ‘casual exercise’ (2-3 times per week) resulted in more youthful middle-sized arteries, which supply oxygenated blood to the head and neck. However, people who exercised 4-5 times per week also had more youthful large central arteries, which provide blood to the chest and abdomen, in addition to healthier middle sized ones.

<https://www.yahoo.com/news/scientists-figured-exactly-much-exercise-210450270.html>

Disease and Causes of Death

It is important to know why people die to improve how people live. Measuring how many people die each year helps to assess the effectiveness of our health systems and direct resources to where they are needed most. For example, mortality data can help focus activities and resource allocation among sectors such as transportation, food and agriculture, and the environment as well as health.

Below are the top causes of death in the USA:

Deaths per 100,000 people

2023

2022

Heart disease

162.1

167.2

Cancer

141.8

142.3

Accidents

62.3

64.0

Stroke

39.0

39.5

Chronic lower respiratory diseases

33.4

34.3

Alzheimer’s disease

27.7

28.9

Diabetes mellitus

22.4

24.1

Kidney disease

13.1

13.8	Covid
Chronic liver disease and cirrhosis	11.9
13.0	44.5
13.8	

The top 10 causes of death account for 55% of the deaths worldwide. The top global causes of death, in order of total number of lives lost, are associated with three broad topics: cardiovascular (ischemic heart disease, stroke), respiratory (chronic obstructive pulmonary disease, lower respiratory infections) and neonatal conditions – which include birth asphyxia and birth trauma, neonatal sepsis and infections, and preterm birth complications.

Causes of death can be grouped into three categories: communicable (infectious and parasitic diseases and maternal, perinatal and nutritional conditions), noncommunicable (chronic) and injuries.

At a global level, 7 of the 10 leading causes of deaths are noncommunicable diseases. These seven causes accounted for 44% of all deaths or 80% of the top 10. However, all noncommunicable diseases together account for 74% of deaths globally.

The world's biggest killer is ischemic heart disease, responsible for 16% of the world's total deaths. Since 2000, the largest increase in deaths has been for this disease, rising by more than 2 million to 8.9 million deaths in 2019. Stroke and chronic obstructive pulmonary disease are the 2nd and 3rd leading causes of death, responsible for approximately 11% and 6% of total deaths respectively.

Lower respiratory infections remained the world's most deadly communicable disease, ranked as the 4th leading cause of death. However, the number of deaths has gone down substantially: in 2019 it claimed 2.6 million lives, 460,000 fewer than in 2000.

Neonatal conditions are ranked 5th. However, deaths from neonatal conditions are one of the categories for which the global decrease in deaths in absolute numbers over the past two decades has been the greatest: these conditions killed 2 million newborns and young children in 2019, 1.2 million fewer than in 2000.

Deaths from noncommunicable diseases are on the rise. Trachea, bronchus and lung cancers deaths have risen from 1.2 million to 1.8 million and are now ranked 6th among leading causes of death. In 2019, Alzheimer's disease and other forms of dementia ranked as the 7th leading cause of death.

Women are disproportionately affected. Globally, 65% of deaths from Alzheimer's and other forms of dementia are women.

One of the largest declines in the number of deaths is from diarrheal diseases, with global deaths falling from 2.6 million in 2000 to 1.5 million in 2019.

Diabetes has entered the top 10 causes of death, following a significant percentage increase of 70% since 2000. Diabetes is also responsible for the largest rise in male deaths among the top 10, with an 80% increase since 2000.

Other diseases which were among the top 10 causes of death in 2000 are no longer on the list. HIV/AIDS is one of them. Deaths from HIV/AIDS have fallen by 51% during the last 20 years, moving from the world's 8th leading cause of death in 2000 to the 19th in 2019.

Kidney diseases have risen from the world's 13th leading cause of death to the 10th. Mortality has increased from 813 000 in 2000 to 1.3 million in 2019.

The World Bank classifies the world's economies into four income groups – based on gross national income – low, lower-middle, upper-middle and high.

People living in a low-income country are far more likely to die of a communicable disease than a noncommunicable disease. Despite the global decline, six of the top 10 causes of death in low-income countries are communicable diseases.

Malaria, tuberculosis and HIV/AIDS all remain in the top 10. However, all three are falling significantly. The biggest decrease among the top 10 deaths in this group has been for HIV/AIDS, with 59% fewer deaths in 2019 than in 2000, or 161 000 and 395 000 respectively.

Diarrheal diseases are more significant as a cause of death in low-income countries: they rank in the top 5 causes of death for this income category. Nonetheless, diarrheal diseases are decreasing in low-income countries, representing the second biggest decrease in fatalities among the top 10 (231 000 fewer deaths).

Deaths due to chronic obstructive pulmonary disease are particularly infrequent in low-income countries compared to other income groups. It does not appear in the top 10 for low-income countries yet ranks in the top 5 for all other income groups.

Lower-middle-income countries have the most disparate top 10 causes of death: five noncommunicable, four communicable, and one injury. Diabetes is a rising cause of death in this income group: it has moved from the 15th to 9th leading cause of death and the number of deaths from this disease has nearly doubled since 2000.

As a top 10 cause of death in this income group, diarrheal diseases remain a significant challenge. However, this category of diseases represents the biggest decrease in absolute deaths, falling from 1.9 million to 1.1 million between 2000 and 2019.

The biggest increase in absolute deaths is from ischemic heart disease, rising by more than 1 million to 3.1 million since 2000. HIV/AIDS has seen the biggest decrease in rank among the previous top 10 causes of death in 2000, moving from 8th to 15th.

In upper-middle-income countries, there has been a notable rise in deaths from lung cancer, which have increased by 411,000; more than double the increase in deaths of all three other income groups combined. In addition, stomach cancer features highly in upper-middle-income countries compared to the other income groups, remaining the only group with this disease in the top 10 causes of death.

One of the biggest decreases in terms of absolute number of deaths is for chronic obstructive pulmonary disease, which has fallen by nearly 264,000 to 1.3 million deaths. However, deaths from ischemic heart disease have increased by more than 1.2 million, the largest rise in any income group in terms of absolute number of deaths from this cause.

There is only one communicable disease (lower respiratory infections) in the top 10 causes of death for upper-middle-income countries. Notably, there has been a 31% fall in deaths from suicide since 2000 in this income category, decreasing to 234,000 deaths in 2019.

In high-income countries, deaths are increasing for all top 10 diseases except two. Ischemic heart disease and stroke are the only causes of death in the top 10 for which the total numbers have gone down between 2000 and 2019, by 16% (or 327,000 deaths) and by 21% (or 205,000 deaths) respectively.

High-income is the only category of income group in which there have been decreasing numbers of deaths from these two diseases. Nonetheless ischemic heart disease and stroke have remained in the top three causes of death for this income category, with a combined total of over 2.5 million fatalities in 2019.

In addition, deaths from hypertensive heart disease are rising. Reflecting a global trend, this disease has risen from the 18th leading cause of death to the 9th.

Deaths due to Alzheimer's disease and other dementias have increased, overtaking stroke to become the second leading cause in high-income countries, and being responsible for the deaths of 814,000 people in 2019. And, as with upper-middle-income countries, only one communicable disease, lower respiratory infections, appears in the top 10 causes of death.

COVID-19 has highlighted the importance for countries to invest in civil registration and vital statistics systems to allow daily counting of deaths, and direct prevention and treatment efforts. It has also revealed inherent fragmentation in data collection systems in many countries.

The routine collection and analysis of high-quality data on deaths and causes of death, as well as data on disability, disaggregated by age, sex and geographic location, is essential for improving health and reducing deaths and disability across the world.

Fifty years ago, life expectancy in the U.S. and wealthy European countries was relatively similar. That began to change around 1980. As European life expectancy steadily increased, the U.S. struggled to keep pace — and its life expectancy even began declining in 2014.

Today, the wealthiest middle-aged and older adults in the U.S. have roughly the same likelihood of dying over a 12-year period as the poorest adults in northern and western Europe,

Issues are not just within the U.S. health care system, but with the typical American lifestyle of overconsuming junk food, not getting enough exercise and facing loneliness or other stresses. The set of stressors that are harming the health of Americans is very widespread, to the point where even being wealthy or rich, you're not going to be able to escape them.

In both Europe and the U.S., the group with the most assets — the wealthiest — had a 40% lower mortality rate than the poorest group. The wealthiest group in northern and western Europe had mortality rates about 35% lower than the wealthiest group in the U.S.

Experts say social and economic factors — such as loneliness or stress — are more likely to affect mortality rates in wealthier adults.

Health care must have something to do with it, but it cannot be even a dominant part of the story if we're seeing wealthier Americans having similar or worse outcomes than poor individuals in other wealthy countries.

People in the U.S. also consume more ultra-processed foods and have higher rates of obesity compared with Europeans, which can increase their risk of diabetes or heart disease

Americans now live six years shorter than Europeans. We are the sickest nation in the world and we have the highest rate of chronic disease.

https://www.nbcnews.com/health/health-news/not-even-wealth-saving-americans-dying-rates-seen-poorest-europeans-rcna198929?utm_source=firefox-newtab-en-us

Post-COVID Illness

About half a billion people worldwide may have suffered “Post-COVID”, also called “Long COVID” (and formally known as post-acute sequelae SARS-CoV-2 infection or PASC). It has become the major health issue in the world.

Post-COVID is complex and usually debilitating ... affecting several different parts of the body and changing over time. Post-COVID symptoms are lasting months and years for those affected. Medical professionals currently are challenged with how best to treat Post-COVID for each individual sufferer.

Post-COVID appears to be in part a result of acute COVID causing vascular damage which can affect many parts of the human body. Some researchers believe that Post-COVID is a result of persistent long-term SARS-CoV2 virus (detectable only with post-mortem autopsy, but not with standard PCR testing) and ongoing damage by the virus.

If you have Post-COVID symptoms, you likely will have try various treatments and behaviors to determine what best helps you specifically at different points in its progression. While often difficult to maintain, a healthy lifestyle (sleep, diet, exercise, etc.) and a positive attitude about your Post-COVID recovery seems to be an essential part of recovery.

Although the exact cause of Post-COVID symptoms is not fully clear and still is under investigation, some evidence has suggested that symptoms and conditions could be related to one or more of the following:

- Chronic inflammation
- Small blood clots (micro clots) in several organs including the brain
- Dysregulation of the immune and nervous systems
- Generation of auto-antibodies
- Organ damage
- Viral persistence
- Reactivation of other viruses (e.g., Epstein-Barr virus)
- Sequelae of critical illness
- Exacerbations of underlying health conditions

Despite Post-COVID being the most significant global health issue at this time, those suffering from Post-COVID unfortunately are having to manage for the most part their own treatment of the condition, since they currently are receiving inadequate solutions from the medical establishment and public health authorities.

Incurable Diseases

Diseases that currently do not have cures are challenges that research continues addressing to improve health and life span.

These incurable diseases include the following:

Allergic Diseases

Arachnoiditis

Asthma

Adrenocortical carcinoma

Alzheimer's Disease

Alopecia

Ankylosing Spondylitis

Amyotrophic lateral sclerosis (ALS)

Arthritis

Ataxia

Cancer

Cerebral amyloid angiopathy

Chronic Kidney Disease

Common cold

Complex Regional Dystrophy Syndrome (CRPS/RSD)

Coronavirus

Creutzfeldt–Jakob Disease

Crohn's Disease

Coeliac Disease

Cystic fibrosis

Corneal ulcer

Desmoplastic small-round-cell tumor

Diabetes

Dupuytren's Disease

Dengue

Depression

Ebola

Endometriosis

Epilepsy

Factor V Leiden

Fatal familial insomnia

Fetal alcohol spectrum disorder

Fibrodysplasia ossificans progressiva

Fluoroquinolone toxicity syndrome

Gastroparesis

Genetic Disease

Glioblastoma

Graves Disease

Hepatitis B

Herpes simplex

HIV/AIDS

Huntington's Disease

Hearing loss (sensorineural)

Hereditary multiple exostoses

Interstitial cystitis or Bladder Pain Syndrome

Irritable bowel syndrome

Immune Thrombocytopenia

Joint pain

Leukemia

Lichen planus

Systemic lupus erythematosus

Lymphedema

Macular degeneration

Marburg virus

Multiple sclerosis

Muscular dystrophy

Myasthenia gravis

Norovirus

Naegleria fowleri

Narcolepsy

Obesity

Osteoporosis

Osteogenesis imperfecta

Parkinson's Disease

Paraphilia disorder

Pityriasis rubra pilaris

Prion Diseases

Progeria

Polio

Polycystic Ovary Syndrome

Pre-eclampsia

Psoriasis

Pulmonary hypertension

Pulmonary fibrosis

Postural Orthostatic Tachycardia Syndrome

Rheumatoid arthritis
Rabies
Rett syndrome

Schizophrenia
Scleroderma
Scoliosis
Spinocerebellar ataxia

Severe acute respiratory syndrome

Trigeminal neuralgia
Toxoplasmosis

Ulcerative colitis
Urethral stricture

Xeroderma pigmentosum

Plants

Plants are mainly multicellular organisms. Plants exclude the fungi and some algae, as well as the prokaryotes (the archaea and bacteria).

Green plants obtain most of their energy from sunlight via photosynthesis. Some plants are parasitic or mycotrophic and have lost the ability to photosynthesize, but still have flowers, fruits, and seeds. Plants are characterized by sexual reproduction and alternation of generations, although asexual reproduction is also common.

There are about 320,000 species of plants, of which some 260–290 thousand, produce seeds. Green plants provide a substantial proportion of the world's molecular oxygen and are the basis of most of Earth's ecosystems.

Plants that produce grain, fruit, and vegetables form basic human foods and have been domesticated for millennia. Plants also are the source of medicines and psychoactive drugs.

Animals

Animals are multicellular organisms. With few exceptions, animals consume organic material, breathe oxygen, are able to move, can reproduce sexually, and grow from a hollow sphere of cells during embryonic development. Over 1.5 million living animal species have been described—of which around 1 million are insects—but it has been estimated there are over 7 million animal species in total.

Unlike plants and algae, which produce their own nutrients animals feed on organic material digesting it internally. With very few exceptions, animals respire aerobically. All animals are able to spontaneously move their bodies during at least part of their life cycle, but some animals, such as sponges, corals, mussels, and barnacles, later become immobile.

All animals are composed of cells, surrounded by a characteristic extracellular matrix composed of collagen and elastic glycoproteins. During development, the animal extracellular matrix forms a relatively flexible framework upon which cells can move about and be reorganized, making the formation of complex structures possible. This may be calcified, forming structures such as shells, bones, and spicules.

In contrast, the cells of other multicellular organisms (primarily algae, plants, and fungi) are held in place by cell walls and develop by progressive growth. Animal cells uniquely possess the cell junctions called tight junctions, gap junctions, and desmosomes.

With few exceptions - for example, sponges - animal bodies are differentiated into tissues. These include muscles, which enable locomotion, and nerve tissues, which transmit signals and coordinate the body. Typically, there is also an internal digestive chamber with either one or two openings.

Animals have complex interactions with each other and their environments, forming intricate food webs. Animals include humans.

Life forms interpreted as early animals were present in the late Precambrian, about a million years ago. Many modern animals became clearly established in the fossil record as marine species during the Cambrian explosion, which began around 500 million years ago. More than 6000 groups of genes

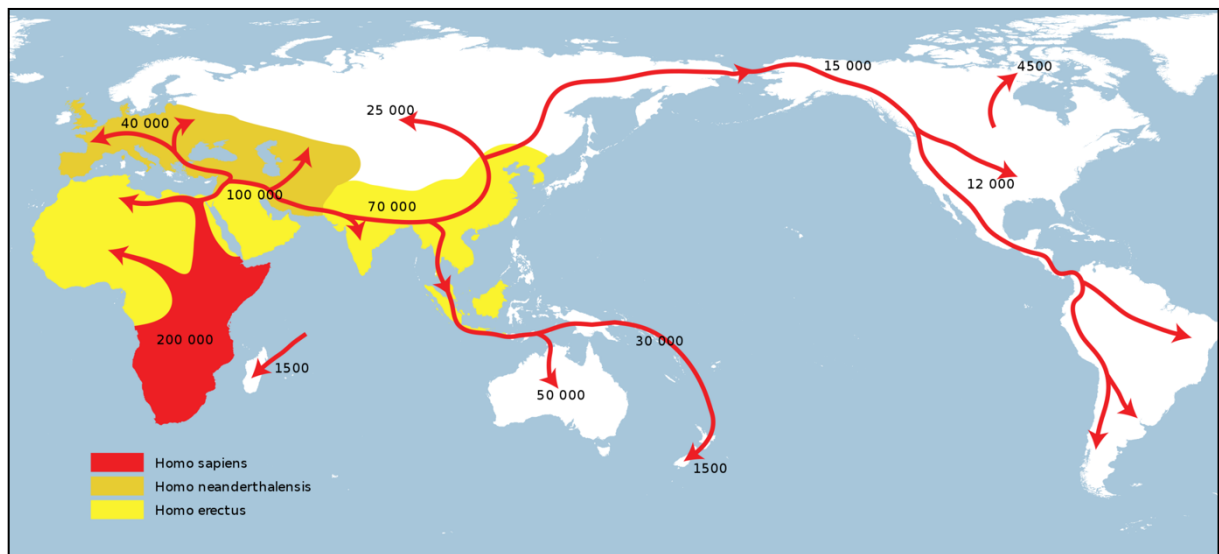
common to all living animals have been identified; these may have arisen from a single common ancestor that lived 650 million years ago.

In modern times, the biological classification of animals relies on advanced techniques, such as molecular phylogenetics, which are effective at demonstrating the evolutionary relationships between classifications.

Humans

Initial migration of human ancestors began with the movement of *Homo erectus* out of Africa across Eurasia almost two million years ago. *Homo sapiens* (humans) appear to have originated in and occupied Africa about 150,000 years ago; some members of this species moved out of Africa between 270,000 and 70,000 years ago and had settled across Australia, Asia and Europe by 40,000 years ago.

Migration to the Americas took place 20,000 to 15,000 years ago.



Footprints discovered at an ancient lake bed in White Sands National Park date back to between 21,000 and 23,000 years ago challenging once-conventional wisdom regarding humans migrating to the New World from Russia 15,000 to 20,000 years ago. The new discovery suggests that the first people actually arrived in the Americas much earlier than previously believed.

Controversy around the dates, however, does exist. Questions concern whether the seeds of aquatic plants used for the original dating may have absorbed ancient carbon from the lake — which could have thrown off radiocarbon dating by thousands of years.

Researchers look to affirm the dates by presenting two additional lines of evidence for the older range. They have used two entirely different materials found at the site: ancient conifer pollen and accumulated damage in the crystal lattices of ancient quartz grains to produce an age estimate.

While other archaeological sites in the Americas point to similar date ranges — including pendants carved from giant ground sloth remains in Brazil — scientists are not certain whether such materials

really indicate human presence. White Sands is unique, because there's no question these footprints were left by people; it's not ambiguous.

<https://www.foxnews.com/us/footprints-found-ancient-lake-new-mexico-challenges-old-belief-first-humans-america>

By 2000 years ago humans had settled in most of the Pacific Islands.

During that time, humans developed more capable brains than did other creatures. Human brains manage significant abstraction, complexity, language, and dexterity.

50,000 years ago, the first human art appeared (e.g., on the walls of caves) including fictional and supernatural figures. Art likely was instrumental in the completion of language and cognition evolution. 10,000 years ago, farming and herding began.

New genetic analysis suggests that Neanderthals may have had an out-of-Africa migratory experience similar to humans. Two major lines of evidence provide insights ... archaeological and, more recently, genomic data and inferences drawn from statistical models.

The archaeological record suggested that very roughly 150,000 individuals spanned Europe and Asia, living in small groups of 15 to 25 — and that their total numbers fluctuated greatly during the several climate cycles (which included harsh glacial periods) which occurred during the half a million years they inhabited Earth, before going extinct 40,000 years ago.

Genetic sequencing tells a different story. Some gene-based estimates put the Neanderthals' effective population at a few thousand. Two hypotheses might account for these results: that the population was indeed that low, even at its peak, or that the population was perhaps larger but had been decreasing for a very long time. In either case, the Neanderthals were always on the decline; their extinction seemed to have been inevitable from the beginning.

A proposed new genetic model may reconcile those differences. It concludes that Neanderthals were more numerous than previous genetic studies often supposed, aligning genomic findings with the larger populations extrapolated from artifacts and fossils.

It also clarifies the Neanderthals' evolutionary history between when they first separated from our ancestors in Africa and when they began to encounter modern humans again during the latter's own diaspora. In population genetics, effective population size is not a direct measure of the total number of people that lived at a given time. It is rather a measure of genetic diversity.

In African individuals today, approximately 11 of every 10,000 nucleotides are heterozygous, meaning they differ between two copies of a chromosome. In non-African individuals, only eight of every 10,000 sites are. That figure seemed to drop to two of 10,000 for Neanderthals, as well as for their sister species, the Denisovans.

Population genetics theory might indicate a small population size for these archaic humans, not the far larger population inferred from the density of stone tools and fossils the Neanderthals left behind. But genetic evidence suggests that Neanderthals had a much more diverse gene pool that was divided into small, isolated, inbred groups of genetically similar individuals.

A recent model has been designed to estimate how much modern humans and Neanderthals interbred. Denisovans were added into the mix and significantly increase the number of ways different populations could combine and mingle.

This increase in genetic diversity corresponds to a roughly tenfold increase in effective population size. It is more consistent with estimates from fossil data.

The model provides new insights into how Neanderthal, Denisovan and modern human populations grew, shrank, separated and periodically merged through prehistory. The relationships are complicated.

Approximately 750,000 years ago, the forerunners of Neanderthals and Denisovans left the ancestors of modern humans behind in Africa to make their way across Eurasia. Once on their own, something nearly wiped them out entirely according to genetic data.

744,000 years ago, they separated into two separate lineages, the Neanderthals and the Denisovans. The former then split further into the smaller regional groups.

The Neanderthals' early history appears to resemble that of the populations of modern humans who first spread into Europe and Asia. Nearly 50,000 years ago, Eurasians separated from Africans, experienced a period during which their population was very low, and then splintered into regional populations throughout Eurasia. Apparently, the same thing happened 600,000 or 700,000 years ago with the Neanderthals and Denisovans.

The Neanderthals struggled. The glacial periods they endured and the fragmentation of their population left them unable to support robust social or technological growth. It is unclear how they lived at such low population densities for hundreds of thousands of years.

A question about interbreeding between modern humans and Neanderthals is whether there were any sexual biases in that gene flow. Were equal amounts of maternal and paternal Neanderthal DNA incorporated or was the scale tilted?

Among other things, a better understanding could help with understanding some genetic diseases. Neanderthal genes have been linked to increased risks of depression, diabetes, heart disease and other disorders.

As local cultures evolved, each became relatively more individualistic or collectivist based in large part on the geographic-specific environmental characteristics and on the historical age of the culture

Neanderthals are a specie that died out likely due in part to competition from humans. Humans and Neanderthals interbred when humans arrived into Europe from Africa. Humans carry some Neanderthal DNA today.

Neanderthals became inbred, and it appears that their fertility was declining, perhaps due to a lack of food. Their population may have become so small that eventually they reached a point of no return.

Evidence exists in the human DNA of undiscovered species who no longer exist in addition to Neanderthals.

Everything that lives is a bundle of chemicals and electrical signals in dialogue with the environment in which it exists. A memory, such as of the heat of summer on last year's beach vacation, is a biochemical marker registered from a set of external inputs. A plant's epigenetic memory, of the cold of winter months, on a fundamental level, is not so different.

These components increasingly will be engineered to create items that otherwise occur naturally (e.g., artificial human organs) and combine items into integrated systems (e.g., electronic sensors implanted at the individual neuron level in human brains).

The Human Genome Project, which began in the 1990s, attempted to map out the entirety of human DNA. It produced the human reference genome that is used for genetics research and genetics testing services. Important as it has been, researchers discovered that the reference genome is missing 296.5 million base pairs of DNA.

The reference genome is used as a basis for comparison. When an individual's DNA is sequenced for insight into health, family history, and disease risk, the sequence is divided into pieces and compare stretches of it to the reference genome, looking for areas of difference.

The fundamental problem is that the reference genome is based largely on a single person. The myriad genetic differences among the 7.7 billion people alive today creates issues with the use of the reference.

Experts argue that this single reference genome does not capture the diversity of human genetics. Some populations differ too much from this reference genome. If the differences are disregarded, key insights into the health and history of specific populations may be missed.

Instead of a single universal reference genome, a number of reference genomes may be best ... perhaps one for each population of interest. Some countries are attempting to create their own reference genomes.

Significant work is required to create a reference genome as advanced as the current reference, known as GRCh38. One group plans to build several additional reference genomes; this would begin creation of a library of reference genomes.

The Human Genome Project was a major breakthrough in medicine, but simply having a list of genes is not enough to fully understand how they interact, and crucially, how our bodies work. Network science — which studies complex patterns and interactions between our cells — can fill in this gap by creating a biological map from which we could develop new cures, and even predict diseases.

Disease genes often have mutations that result in a missing interaction within the sub-cellular network, which then causes problems in the functioning of a cell. Traditional medicinal interventions can lead to unwanted side effects, as they also affect other cellular processes in the network; network medicine has revealed that these complex systems, though robust, are also fragile to attacks, and removing a few major hubs can break the network into pieces.

Understanding the structure of the network within our cells can allow for precise interventions that cure the problem without causing other issues. The ideal future of medicine would involve individualized network diagrams being adopted as a standard tool for doctors to show patients where mutations are, how they impact the rest of the cell, and how interventions can stop their effects.

To have only minimal interventions, the more we know about the network, the more precise we can be that an intervention is only curing a problem, and not causing other ones. That is next level of personalized medicine. Doctors would look at not only at your genome but also map out the interactions within the cell between the molecules, and then look at the lack of interaction, and say that lack of interaction is the source of the potential disease that you may get. The intervention would be designed to bypass that lack of interaction and only cure the disease.

The way we think about medicine will change. Currently, if you have a disease, you go to a separate hospital depending on what tissue and what organ you have the disease. You go to neurologists to treat brain disease. You go to a cardiologist to treat heart disease.

But in each of your cells, you have the same genome, and you have the same underlying network. A mutation that is in your heart is not only in your heart but also in your brain, and it is in your toe as well.

Sooner or later, the cardiologist and the neurologist will have to be replaced by a 'network-ologist'. Your doctor will show you a network diagram which includes your mutations, how they will affect the rest of you, and where and how intervention will stop the impact of those mutations. This approach could lead to curing many more diseases.

https://bigthink.com/the-well/the-cure-for-everything/?utm_source=youtube&utm_medium=video&utm_campaign=youtube_description

Human Body

Related to the electrochemical processes, a holistic systematic understanding of the human body will help with maximizing health and Satisfaction. As two of many examples, whole grain reacts differently and more beneficially in the body than do processed grain. Aging it appears may be slowed and body and brain function enhanced with exercise, caloric restriction, drugs such as Rapamycin, blood transfusion, resveratrol and in the future epigenomic engineering.

But an integrated understanding of the very complex interactions of body systems and external factors is work that will continue for decades.

The typical human mix of receptors, neurons and neurotransmitters evolved to help promote survival and satisfaction. Experiences of people with imbalances of this typical mix and of feral children (who do not develop the typical mix) tend to confirm this description of most humans.

Babies' brains are equipped with billions of neurons, but they have to be developed. Over as many as 25 years, neurons form hundreds of thousands of connections as people learn and make memories.

Shortly after the brain finishes fully forming, though, it starts to wear down. There's some disagreement about exactly when the brain starts to show signs of wear.

Some of the limited research available suggests it happens around middle age, some suggests the 30s, and some even in the 20s. But the consensus is that some shrinkage is inevitable and normal.

Resilient brains are those that seem to be able to cope with hyperactivation or buildups of protein that should impair their function or, possibly, somehow resistant to these changes in the first place.

The brain has a lot of redundant systems. If one system is knocked out, other parts will compensate over time.

Scientists are not sure how, but it appears that experiences earlier in life which involve connecting more networks of neurons—classroom learning is a classic example—make it easier for brains to adapt to physical changes that occur later in life.

Why do humans strive for accomplishment and recognition? They are seeking meaning and relevancy as a way of measuring competency and value. Perceived higher value by one's self and by others enhances the probability of survival and satisfaction.

It is more satisfying to serve others in ways meaningful to the others. That optimizes the mix of neurotransmitters that provide feelings of satisfaction.

Humans are autonomous information processing bundles of energy packets or quanta (“elementary particles”) assembled into the entities we are. We exist in a sea of energy quanta that comprise our environment including the atmosphere that surrounds us and the other items that we experience with all of our senses.

These energy quanta, are components of everything. For example, a human is a particular collection of these particles moving through a sea of identical particles - but configured differently - which compose the air, electrical waves, aromas, precipitation, sun and electrical light, and everything else that we touch. This sea of elementary particles, in varying concentrations, extends seamlessly to the edge of the Universe.

For those who believe in an additional “spiritual” component for existence generally and humans specifically, these observations does not preclude that belief.

The principles of Existence which best serve humans and other entities are consistent with the beliefs and values of most spiritual and religious groups. People of all beliefs can co-exist and thrive if they practice those common principles.

The human brain and rest of the body are complex in both their components and processes. It appears that a very long time will be required to build machines that mimic in detail the human brain and other parts body.

The much simpler, and yet powerful, machine learning systems being developed will help accelerate understanding of the massive quantity of data being collected about the body and the design of artificial systems to replicate parts of the body.

In addition, biological elements may be integrated with artificial devices to create more capable systems. For example, a donated human cadaver brain potentially could be used in such a system.

Complexity extends to human genetics. Human traits are the result of thousands of genetic variants, working in concert. The vast majority of the genes have only tiny effects, but together, they can significantly determine bodies and health.

Understanding the role of one gene in one disease is a major accomplishment. Understanding how combinations of hundreds or thousands of genes work interoperating currently is not possible.

The human microbiome is another complex area in the early stages of understanding. It has been influenced by layers of evolutionary histories and varies by individual.

Although they are alive, plants typically are thought of as objects. They are seen as things that simply react to stimuli. Everything, however, that lives is a collection of chemicals and electrical signals that communicates with the environment in which it exists.

A memory is an electrochemical unit generated by external inputs. A plant's epigenetic memory, of the seasonal temperatures for example, is not fundamentally different.

Plants have a combination of genetics and proteins that respond to light, temperature and hormones and help plants flower and otherwise adjust to seasonal changes. Epigenetic regulation provides the memory and software control of these processes.

This genetic memory and control are inherited in plants. Certain plants can store information about their experiences and use it to guide how they grow and behave.

The epigenetic regulation of plants is similar to that in other living things including humans. Because of these similarities plant processes are beginning to be used for modeling human processes.

This common genetic process connection among all living things is an emerging area of research and development. It layers on top of the few elementary particles that compose everything in the universe.

The human body is composed of many different types of cells that together create tissues and subsequently organ systems. It comprises a head, neck, trunk (which includes the thorax and abdomen), arms and hands, legs and feet.

The body varies anatomically in known ways. Many systems and mechanisms interact in order to maintain balance, with safe levels of substances such as sugar and oxygen in the blood.

The body is composed of elements including hydrogen, oxygen, carbon, calcium and phosphorus. These elements reside in trillions of cells and non-cellular components of the body.

The adult male body is about 60% water for a total water content of some 42 liters. This is made up of about 19 liters of extracellular fluid including 3.2 liters of blood plasma and 8.4 liters of interstitial fluid, and 23 liters of fluid inside cells.

The content, acidity and composition of the water inside and outside cells is carefully maintained. The main electrolytes in body water outside cells are sodium and chloride, whereas within cells it is potassium and other phosphates.

Cells in the body function because of DNA. DNA sits within the nucleus of a cell.

Parts of DNA are copied and sent to the body of the cell via RNA. The RNA is then used to create proteins which form the basis for cells, their activity, and their products.

Proteins dictate cell function and gene expression, a cell is able to self-regulate by the amount of proteins produced. Not all cells, however, have DNA; some cells such as mature red blood cells lose their nucleus as they mature.

The body consists of many different types of tissue, defined as cells that act with a specialized function. The body consists of four main types of tissues. These are lining cells (epithelia), connective tissue, nerve tissue and muscle tissue.

Cells that lie on surfaces exposed to the outside world or gastrointestinal tract (epithelia) or internal cavities (endothelium) come in numerous shapes and forms – from single layers of flat cells, to cells with small beating hair-like cilia in the lungs, to column-like cells that line the stomach. Endothelial cells are cells that line internal cavities including blood vessels and glands. Lining cells regulate what can and cannot pass through them, protect internal structures, and function as sensory surfaces.

Organs, structured collections of cells with a specific function, mostly sit within the body, with the exception of skin. Examples include the heart, lungs and liver.

Many organs reside in cavities within the body. These cavities include the abdomen (which contains the stomach, for example) and pleura, which contains the lungs.

No universally standard definition exists of what constitutes an organ, and some tissue groups' status as an organ is debated. Since there is no single standard definition of an organ, the number of organs varies depending on how one defines an organ.

Functions and components of the body are grouped into several “systems”.

Circulatory system

The circulatory system consists of the heart and blood vessels (arteries, veins and capillaries). The heart propels the circulation of the blood, which serves to transfer oxygen, fuel, nutrients, waste products, immune cells and signaling molecules (i.e. hormones) from one part of the body to another. Paths of blood circulation within the human body can be divided into two circuits: the pulmonary circuit, which pumps blood to the lungs to receive oxygen and leave carbon dioxide, and the systemic circuit, which carries blood from the heart off to the rest of the body. The blood consists of fluid that carries cells in the circulation, including some that move from tissue to blood vessels and back, as well as the spleen and bone marrow.

Digestive system

The digestive system consists of the mouth including the tongue and teeth, esophagus, stomach, (gastrointestinal tract, small and large intestines, and rectum), as well as the liver, pancreas, gallbladder, and salivary glands. It converts food into small, nutritional, non-toxic molecules for distribution and absorption into the body. These molecules take the form of proteins (which are broken down into amino acids), fats, vitamins and minerals (the last of which are mainly ionic rather than molecular). After being swallowed, food moves through the gastrointestinal tract by means of peristalsis: the systematic expansion and contraction of muscles to push food from one area to the next.

Digestion begins in the mouth, which chews food into smaller pieces for easier digestion. Then it is swallowed, and moves through the esophagus to the stomach. In the stomach, food is mixed with gastric acids to allow the extraction of nutrients. What is left is called chyme; this then moves into the small intestine, which absorbs the nutrients and water from the chyme. What remains passes on to

the large intestine, where it is dried to form feces; these are then stored in the rectum until they are expelled through the anus.

Endocrine system

The endocrine system consists of the principal endocrine glands: the pituitary, thyroid, adrenals, pancreas, parathyroids, and gonads, but nearly all organs and tissues produce specific endocrine hormones as well. The endocrine hormones serve as signals from one body system to another regarding an enormous array of conditions, and resulting in variety of changes of function.

Immune system

The immune system consists of the white blood cells, the thymus, lymph nodes and lymph channels, which are also part of the lymphatic system. The immune system provides a mechanism for the body to distinguish its own cells and tissues from outside cells and substances and to neutralize or destroy the latter by using specialized proteins such as antibodies, cytokines, and toll-like receptors, among many others.

Integumentary system

The integumentary system consists of the covering of the body (the skin), including hair and nails as well as other functionally important structures such as the sweat glands and sebaceous glands. The skin provides containment, structure, and protection for other organs, and serves as a major sensory interface with the outside world.

Lymphatic system

The lymphatic system extracts, transports and metabolizes lymph, the fluid found in between cells. The lymphatic system is similar to the circulatory system in terms of both its structure and its most basic function, to carry a body fluid.

Musculoskeletal system

The musculoskeletal system consists of the human skeleton (which includes bones, ligaments, tendons, and cartilage) and attached muscles. It gives the body basic structure and the ability for movement. In addition to their structural role, the larger bones in the body contain bone marrow, the site of production of blood cells. Also, all bones are major storage sites for calcium and phosphate. This system can be split up into the muscular system and the skeletal system.

Nervous system

The nervous system consists of the body's neurons and glial cells, which together form the nerves, ganglia and gray matter which in turn form the brain and related structures. The brain is the organ of thought, emotion, memory, and sensory processing; it serves many aspects of communication and controls various systems and functions. The special senses consist of vision, hearing, taste, and smell. The eyes, ears, tongue, and nose gather information about the body's environment.

From a structural perspective, the nervous system is typically subdivided into two component parts: the central nervous system (CNS), composed of the brain and the spinal cord; and the peripheral nervous system (PNS), composed of the nerves and ganglia outside the brain and spinal cord. The CNS is mostly responsible for organizing motion, processing sensory information, thought, memory, cognition and other such functions. It remains a matter of some debate whether the CNS directly gives rise to consciousness. The peripheral nervous system (PNS) is mostly responsible for gathering information with sensory neurons and directing body movements with motor neurons.

From a functional perspective, the nervous system is again typically divided into two component parts: the somatic nervous system (SNS) and the autonomic nervous system (ANS). The SNS is

involved in voluntary functions like speaking and sensory processes. The ANS is involved in involuntary processes, such as digestion and regulating blood pressure.

Human reproductive system

The reproductive system consists of the gonads and the internal and external sex organs. The reproductive system produces gametes in each sex, a mechanism for their combination, and in the female a nurturing environment for the first 9 months of development of the infant.

Respiratory system

The respiratory system consists of the nose, nasopharynx, trachea, and lungs. It brings oxygen from the air and excretes carbon dioxide and water back into the air. First, air is pulled through the trachea into the lungs by the diaphragm pushing down, which creates a vacuum. Air is briefly stored inside small sacs known as alveoli before being expelled from the lungs when the diaphragm contracts again. Each alveolus is surrounded by capillaries carrying deoxygenated blood, which absorbs oxygen out of the air and into the bloodstream.

For the respiratory system to function properly, there need to be as few impediments as possible to the movement of air within the lungs. Inflammation of the lungs and excess mucus are common sources of breathing difficulties. In asthma, the respiratory system is persistently inflamed, causing wheezing and/or shortness of breath. Pneumonia occurs through infection of the alveoli, and may be caused by tuberculosis. Emphysema, commonly a result of smoking, is caused by damage to connections between the alveoli.

Urinary system

The urinary system consists of the kidneys, ureters, bladder, and urethra. It removes toxic materials from the blood to produce urine, which carries a variety of waste molecules and excess ions and water out of the body.

Organs of the body (listed by the system of which each is a part) include:

Muscular system

- Human skeleton
- Joints
- Ligaments
- Muscular system
- Tendons

Digestive system

- Mouth
- Teeth
- Tongue
- Salivary glands
- Parotid glands
- Submandibular glands
- Sublingual glands
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Duodenum
- Jejunum
- Ileum
- Large intestine
- Cecum
- Ascending colon
- Transverse colon
- Descending colon
- Sigmoid colon
- Rectum
- Liver
- Gallbladder
- Mesentery
- Pancreas
- Anal canal

Respiratory system

- Nasal cavity
- Pharynx
- Larynx
- Trachea
- Bronchi
- Bronchioles and smaller air passages
- Lungs & muscles of breathing

Urinary system

- Kidneys
- Ureter
- Bladder
- Urethra

Reproductive system

- Ovaries
- Fallopian tubes
- Uterus
- Cervix
- Vagina
- External reproductive organs
- Vulva
- Clitoris
- Placenta
- Testes
- Epididymis
- Vas deferens
- Seminal vesicles
- Prostate
- Bulbourethral glands
- External reproductive organs
- Penis
- Scrotum

Endocrine system

- Pituitary gland
- Pineal gland
- Thyroid gland
- Parathyroid glands
- Adrenal glands
- Pancreas

Circulatory system

- Heart
- Patent Foramen Ovale
- Arteries
- Veins
- Capillaries

Lymphatic system

- Lymphatic vessel
- Lymph node
- Bone marrow
- Thymus
- Spleen
- Gut-associated lymphoid tissue
- Tonsils
- Interstitium

Nervous system

- Brain
- Cerebrum
- Cerebral hemispheres
- Diencephalon
- The brainstem
- Midbrain
- Pons
- Medulla oblongata
- Cerebellum

• The spinal cord

- Choroid plexus
- Cranial nerves
- Spinal nerves
- Ganglia

Integumentary system

- Skin
- Subcutaneous tissue

Microbiome

The microbiome is a characteristic microbial community occupying a reasonably well-defined habitat which has distinct physio-chemical properties. The term not only refers to the microorganisms involved but also encompasses their theatre of activity.

The theatre of activity includes the formation of specific ecological niches. The microbiome, which forms a dynamic and interactive micro-ecosystem prone to change in time and scale, is integrated in macro-ecosystems including eukaryotic hosts, and here crucial for their functioning and health.

The microbiota consists of the assembly of microorganisms belonging to different kingdoms (Prokaryotes [Bacteria, Archaea], Eukaryotes [e.g., Protozoa, Fungi, and Algae]), while their theatre of activity includes microbial structures, metabolites, mobile genetic elements (such as transposons, phages, and viruses), and relic DNA embedded in the environmental conditions of the habitat.

Microbes occur within complex assemblages in which species interactions and communication are critical to population dynamics and functional activities. DNA, the development of sequencing technologies, PCR, and cloning techniques enable the investigation of microbial communities using cultivation-independent, DNA and RNA-based approaches.

Analysis of genomes and metagenomes in a high-throughput process provides efficient methods for addressing the functional potential of individual microorganisms as well as of whole communities in their natural habitats.

The 'gut microbiome' has large significance for human health. The gut microbiome likely is the most important scientific discovery for human healthcare in recent decades.

At this time, little is known about how gut microbiome works.

The gut microbiome weighs about 2kg and is bigger than the average human brain. It has trillions of bacteria, archaea, fungi and viruses, containing at least 150 times more genes than the human genome.

Humans are filled with microbes, which form microbiomes on our skin, in our mouths, lungs, eyes, and reproductive systems. These have co-evolved since the beginning of human history.

The gut microbiome is the largest and most significant for short- and long-term health. It is complex and its composition significantly varies from person to person.

Whether the gut microbiome can be considered an organ is debated. Many microbiome scientists call it an organ, given that it is both inherited and essential.

Things including depression or anxiety, are modified by the gut microbes as are appetite and ability to digest food. The gut microbiome affects the immune system, sending signals; much of the immune system is in the gut, helping fight infections, such as Covid and early cancers.

Studies suggest having a diverse population of gut microbes is associated with better health. But when human populations urbanize, microbial diversity declines.

Over the past 80 years and since the introduction of antibiotics, there has been multi-generational loss of microbes that appear to be important for human health. It is not entirely clear if the cause was lifestyle, diet, cleanliness, or the use of antibiotics. People in developed countries also are missing certain immune stimulants of which people in the developing world have plenty.

This situation may be underlying a large proportion of the chronic diseases our society is suffering from – asthma, food allergies, atopic diseases and auto-immune disorders. It is difficult to prove epidemiologically. But over the past 50 years of good scientific record keeping, a significant increase in those disorders has occurred alongside this loss of microbial diversity in human guts.

Gut microbes do things the gut cannot, liberating or synthesizing nutrients from food, especially from plants and their polyphenols, living off non-digestible substrates, producing thousands of metabolites – useful chemicals –and making vital short-chain fatty acids that are involved with immunity, with keeping the gut and colon healthy, with moderating the body's inflammatory responses and with the metabolism of glucose. To do this, microbes need about 30g of fiber a day, but the average intake in developed countries is about half that amount.

Is this why modern, low fiber, ultra-processed, high-sugar diets seem so problematic for human gut health? It is likely that ultra-processed foods are bad for gut microbes and humans should avoid eating them regularly.

The opportunity – but also the difficulty – of gut microbiome science is that poor gut health is associated with a wide range of conditions, from obesity and degenerative brain diseases to depression, inflammatory bowel disease and chronic inflammation. The microbiome is like a convergent science – an ecologist, a geneticist, a bioinformatician, a clinician and an epidemiologist, are needed to try to make sense of it.

Even genetically identical people respond to the same foods very differently (microbiomes are so variable that twins share only 30% of the same gut microbes). Microbiome tests would help to treat patients but current tests cannot be translated in useful clinical applications.

Trials are underway to quantify microbiome tests and treatment, and initial results are exciting. Participants report weight loss and improved energy levels without any calorie counting or traditional weight loss methods.

State of the art sequencing provides detection of species and strains and finds strong associations between these microbes and both foods and health. An algorithm combines machine learning with the microbiome science. 30 key microbes are indicators of health and linked to specific foods.

Precision in probiotics is needed. A growing interest exists in what are now called live bio-therapeutics – probiotics designed and tested to be used clinically.

For example, the microbiome of people with acute Covid can be altered severely. A small Italian study using a commercial probiotic, Sivomixx, suggested acute Covid patients treated with it might be less likely to end up in ICU or to die, and eight times less likely to suffer respiratory failure.

Other research includes gut microbiome relationship with human brains. The gut has its own nervous system, the enteric nervous system, and contains 100 million neurons. We also know the gut-brain axis, via the vagus nerve, conveys neurotransmitters produced within the gut around the body and to the brain.

Neuronal diversification happens in all the organisms that have neurons. Similar to stem cells, neurons develop first as more generic “blanks” and then into functional specialties.

The human brain has types like sensory and motor neurons, each of which has subtypes. Neurons of the same superficial type are different in the brain versus the brain stem versus the digestive tract.

Twelve neuron classes were related to previously discovered molecular characteristics of functional enteric neuron types.

Researchers are working on finding out what each of the 12 ENS neuron types is responsible for

This research could lead to new treatments that use stem cells or RNA to control the expression of harmful genes.

https://getpocket.com/explore/item/hey-there-s-a-second-brain-in-your-gut?utm_source=firefox-newtab-en-us

Following are ways to help maintain a good balance in the gut microbiome:

- Eat more fiber, colorful fruits & vegetables, rich in polyphenols, fermented, omega 3
- Avoid processed foods; cut back on salt and sugar
- Let kids play with dirt and pets

Human Evolution

Human evolution continues and may be accelerating. The rate of our DNA’s evolution may be faster than ever.

Evolution is a gradual change to the DNA of a species over many generations. It can occur by natural selection, when certain traits created by genetic mutations help an organism survive or reproduce.

Such mutations are thus more likely to be passed on to the next generation, so they increase in frequency in a population. Gradually, these mutations and their associated traits become more common among the whole group.

Natural selection has recently made changes and continues. Though modern healthcare frees us from many causes of death, in countries without access to good healthcare, populations are continuing to evolve. Survivors of infectious disease outbreaks drive natural selection by giving their genetic resistance to offspring.

Humans also are adapting to their environment. Mutations allowing humans to live at high altitudes have become more common in populations in geographic areas at high elevations.

Diet is another source for adaptations. Studies show that natural selection favoring a mutation allowing adults to produce lactase – the enzyme that breaks down milk sugars – is why some groups of people can digest milk after weaning.

Natural selection, however, affects only about 8 percent of our genome. According to neutral evolution theory, mutations in the rest of the genome may freely change frequency in populations by chance. If natural selection is weakened, mutations it would normally purge are not removed as efficiently, which could increase their frequency and so increase the rate of evolution.

Some genes are evolving much faster than others. The speed of gene evolution is measured by comparing human DNA with that of other species, which also helps determine which genes are fast-evolving in humans alone.

Though scientists can see these changes, it still is not fully understood why fast evolution happens to some genes but not others. Originally thought to be the result of natural selection exclusively, this now is known not to always be true.

The human mutation rate itself may also be changing. The main source of mutations in human DNA is the cell division process that creates sperm cells. The older males get, the more mutations occur in their sperm. If their contribution to the gene pool changes – for example, if men delay having children – the mutation rate will change too.

Since evolution does not only happen by natural selection, the process likely will never stop. Genomes separated more from natural selection makes them open to other evolutionary processes – making it more difficult to predict future human characteristics.

Interbreeding of humans with other hominins (human, directly ancestral to humans, or very closely related to humans) indicate that human evolution was not linear but a web. Genetic studies show that primates diverged from other mammals about 85 million years ago. The hominoids (humans, their fossil ancestors, and the anthropoid apes) are descendants of a common ancestor.

8 and 4 million years ago, first the gorillas, and then the chimpanzees split off from the line leading to the humans. Human DNA is approximately 98.4% identical to that of chimpanzees. Anatomically modern humans appeared in Africa approximately 300,000 years ago.

The most significant evolutionary adaptations are bipedalism, increased brain size, lengthened ontogeny (gestation and infancy) and a powerful precision grip. Primitive bipedalism arose some 6 to 7 million years ago. A full biped, arose approximately 5.6 million years ago.

Bipedalism was favored because it freed the hands for reaching and carrying food, saved energy during locomotion, enabled long-distance running and hunting, provided an enhanced field of vision, and helped avoid hyperthermia by reducing the surface area exposed to direct sun.

Anatomically, the evolution of bipedalism has been accompanied by a large number of skeletal changes. The most significant changes occurred in the pelvic region.

Additionally, studies suggest that bipedality without the ability to use fire would not have allowed global dispersal.

Humans have brain size three times the size of a chimpanzee or gorilla brain. This human brain size allowed for extended periods of social learning and language acquisition in juvenile humans, beginning as much as 2 million years ago. Neanderthals brains were larger even than modern humans.

Changes in the structure of human brains may be even more significant than the increase in size. The temporal lobes, which contain centers for language processing, have increased disproportionately, as has the prefrontal cortex, which has been related to complex decision-making and moderating social behavior.

The increase in volume of the neocortex also included a rapid increase in size of the cerebellum. Its function has traditionally been associated with balance and fine motor control, but more recently with speech and cognition. The cerebellum may have underpinned human technological adaptations, including the preconditions of speech.

Evidence suggests that the genus *Homo* (modern humans and their close extinct relatives) have migrated out of Africa at least three and possibly four times (e.g. *Homo erectus*, *Homo heidelbergensis* and two or three times for *Homo sapiens*).

Modern humans speciated in Africa approximately 200,000 years ago and the subsequent migration through Eurasia resulted in the nearly complete replacement of other *Homo* species. Evidence from autosomal DNA supports a recent African origin.

The migration out of Africa is estimated to have begun about 70–50,000 years ago. Humans, however, may have left Africa half a million years earlier than previously thought.

Evidence for archaic admixture in modern humans, both in Africa and later, throughout Eurasia has recently been suggested by a number of studies. All modern human groups outside Africa have 1.5–2.6% Neanderthal in their genome and some Melanesians have an additional 4–6% of Denisovan genes. Hybridization between substantially diverged lineages is the rule, not the exception, in human evolution.

Recent genetic evidence suggests that all modern non-African populations, including those of Eurasia and Oceania, are descended from a single wave that left Africa between 70 and 50,000 years ago. By

comparing mitochondrial DNA which is inherited only from the mother, geneticists have concluded that the last female common ancestor whose genetic marker is found in all modern humans, the so-called mitochondrial Eve, must have lived around 200,000 years ago.

Variation in superficial human characteristics, such as the evolution of different skin tone and hair texture, are attributed to differences in climate.

Increased tool use allowed hunting for energy-rich meat products, and enabled processing more energy-rich plant products. Researchers have suggested that early hominins were thus under evolutionary pressure to increase their capacity to create and use tools.

Precisely when early humans started to use tools is difficult to determine. Many species make and use tools, but it is the human genus that dominates.

Modern human behavior to include cultural and behavioral traits such as specialization of tools, use of jewelry and images (such as cave drawings), organization of living space, rituals (such as grave gifts), specialized hunting techniques, exploration of less hospitable geographical areas, and barter trade networks, as well as more general traits such as language and complex symbolic thinking.

Around 50,000 years ago, human culture started to evolve more rapidly.

Modern humans started burying their dead, making clothing from animal hides, hunting with more sophisticated techniques (such as using pit traps or driving animals off cliffs), and cave painting. As human culture advanced, different populations innovated existing technologies: artifacts such as fish hooks, buttons, and bone needles show signs of cultural variation, which had not been seen prior to 50,000 years ago.

Humans still are undergoing natural selection for many other traits. Some of these are due to specific environmental pressures, while others are related to lifestyle changes since the development of agriculture (10,000 years ago), urbanization (5,000 years ago), and industrialization (250 years ago).

Human evolution has accelerated since the development of agriculture 10,000 years ago and civilization some 5,000 years ago. The developments and innovations of human culture have driven a new form of selection that coexists with, and in some cases has largely replaced, natural selection.

https://en.wikipedia.org/wiki/Human_evolution

Ancestry DNA Tests

Across the industry, estimates of where an individual's ancestors lived can differ significantly from company to company.

Discrepancies in ancestry testing do not mean that genetic science is a fraud, and that the companies are just making up these numbers. They have more to do with the limitations of the science and some key assumptions companies make when analyzing DNA for ancestry.

The reports are based on estimates that can vary from company to company and have built-in sources of error. Results from one company can even change over time as the company signs up more users and gathers more data.

Even though genetic ancestry tests deliver precise percentages about heritage, the reports are best thought of estimates, based on imperfect data.

There are about 3 billion base pairs — the individual letter instructions of genetic code — that make up the human genome. A company does not look at every single letter.

All humans have about 99.9 percent of their DNA in common. So instead, to speed up the process, the tests look out for the locations on the genome where people commonly vary from one another.

These single-letter changes in DNA can help explain why one person is taller than another, or why one has brown eyes and another green.

These variations are called single nucleotide polymorphisms, or SNPs (pronounced “snip”). Companies can analyze half a million SNPs or more in an ancestry test.

The chunks are then fed into a machine called a genotyping array. The determine which versions of SNPs have been inherited and at what location in the genome.

Like everything else in a genome, SNPs are passed down through the generations. The more SNPs shared in common with another person, the more likely is shared a similar, and more recent, ancestry. Ancestry is estimated by comparing SNP results with a genetic database of people with known ancestries

About 99.9 percent accuracy exists for these arrays. But even with that high level of accuracy, when 1 million places in the genome are processed, there may be 1,000 errors. Those small errors alone can help explain why one twin might have slightly different results from another.

How companies analyze that raw data varies. That is why one company’s ancestry results might look a bit different from another’s.

The reference group each company uses can be different. And the reference groups are changing all the time.

Another limitation: These reference groups are largely based on people who are self-reporting their ancestry. These people may be pretty confident that they know where their families come from, but it is not a perfect measure.

These companies do not just match a person to ancestors; they assign very specific percentages. So an ancestry DNA test might reveal someone as 23 percent European, 24 percent Chinese, and so on.

A computer program puts ancestors together in different combinations to get a similar variation of SNPs. It looks for a best fit, not a perfect match.

It is especially imperfect in differentiating among ancestries that look very genetically similar. There is very little genetic variation in Europe. People from England, for instance, are not that genetically different than people from Ireland. So the computer is more likely to make the mistake that a person's ancestors were English (and not Irish), than to make the mistake that a person is English (and not Taiwanese).

In addition, the programs have to make some guesses about how far back in time ancestors in a particular place lived. This also is imperfect with a range of error.

The computer programs are also sensitive to the small errors built into the genotyping process. And, again, the program's output depends on the reference DNA the company has in its database.

Ancestry DNA tests do not indicate where each member on your family tree lived. Instead, they tell you how much DNA is inherited.

That is why siblings can get different reports from DNA ancestry services (even though they share the exact same relatives). It is possible that a brother might have inherited a piece of DNA from an ancestor that a sibling did not.

DNA is not the same as heritage. DNA ancestry tests sort DNA by the geographic regions likely inherited from. But not everything about family histories is geographic.

Human history is a complex, migratory affair, much too complicated to track simply using DNA. It is just a small door, an imperfect guide. It is interesting information, but, on its own, is not definitive.

https://getpocket.com/explore/item/the-limits-of-ancestry-dna-tests-explained?utm_source=pocket-newtab-en-us

Gender and Sex

In this document the distinction for "Sex" is: a Male never can get pregnant and birth a child; a Female (barring atypical physical limitations) could get pregnant and birth a child at some interval during the Female's life span.

The word "Gender" has the connotation of cultural or attitudinal characteristics as opposed to physical characteristics distinctive to the sexes. Gender is to sex as feminine is to female and masculine is to male. Depending on the context, this may include sex-based social structures (i.e. gender roles) and gender identity.

Life originated without sex (as best we can tell) so sexual reproduction is something that had to evolve. There are two parts to the evolution of sex: 1) the origin of sexual reproduction (cellular evolution) and 2) the evolution and maintenance of sexual reproduction and recombination (recombination is like sex in that it reassorts genetic material).

Recombination probably evolved about 3 billion years ago as a mechanism of DNA repair; sex evolved about 1-2 billion years ago in the early eukaryotes; the reason is unclear but it is likely that it is maintained currently by selection.

Observations suggest that sex might evolve by group selection based on: 1) genetically isolated "groups" (sexual and parthenogenetic strains), 2) disadvantage to the individual, and 3) advantageous to the long-term survival of the group.

Parasites may also have played a role in the evolution of sex. Various data suggest that more genetically diverse organisms can mount a more effective defense against parasites than less diverse hosts. Sexual reproduction might again have a short term advantage in terms of sexually produced organisms having a greater defense system against parasites and other infectious agents.

The distinction between males and females is one of the oldest facts of biology. Except for bacteria, nearly all life reproduces sexually at least some of the time, and two distinct sexes are generally necessary to do this.

Why sex is such a common method for transferring genes to the next generation is still an enigma, but it is clear that distinct male and female sexes emerged multiple times throughout evolutionary history. It happened in the ancestors of plants and animals more than a billion years ago. That is too far back to recover even sketchy details about how the original distinction between males and females evolved.

The oldest and most fundamental way that males and females differ is in their reproductive cells. Once you have sex-specific reproductive cells, new sex-specific evolutionary strategies come into play.

These drive the development of even more physical and behavioral differences between males and females. New genes become sex-specific genes.

The Mind & Metabolism

One way to describe the human "mind" is the combination of brain function plus sensory and other inputs to and outputs from the brain via nerves and other means plus the physical phenomena generating the inputs and influenced by the outputs.

The human brain consists of about one billion neurons. Each neuron forms about 1,000 connections to other neurons, amounting to more than a trillion connections.

The human brain is much more advanced and efficient and has more raw computing power than the most advanced supercomputers. The fastest supercomputer globally has a maximum processing speed of 55 petaFLOPS. A petaFLOP is a quadrillion (one million billion) floating-point calculations per second.

Brains operate on the next order higher. Although impossible to calculate precisely, scientists have postulated that the human brain operates at one exaFLOP (equivalent to a billion billion calculations per second).

In addition to its processing speed, the human brain has only a few gigabytes of memory storage space. The brain's exact storage capacity for memories is difficult to calculate.

First, it is not known how to measure the size of a memory. Second, certain memories involve more details and thus take up more space; other memories are forgotten and thus free up space.

If each neuron could only help store a single memory, running out of space would be a problem. However, neurons combine so that each one helps with many memories at a time, exponentially increasing the brain's memory storage capacity to around 2.5 petabytes (or a million billion bytes, aka gigabytes). For reference, if your brain worked like a digital video recorder, 2.5 petabytes would be enough to hold three million hours of TV shows.

Brains are very different from computers. Computers have some parts for processing and others for memory; the brain does not have this separation, making it more efficient.

The same interconnected brain areas, connected by billions of neurons and perhaps trillions of glial cells, can simultaneously perceive, interpret, store, analyze, and distribute. The same calculations and processes that a computer might take a few million steps can be accomplished through a few hundred neuron transmissions, which require much less energy and are much more efficient.

It is not known the level in the brain where memories are stored—from inside neurons to long brain circuits. Synapses between neurons in the brain are critical, but how those chemical changes create a specific memory remains to be determined.

The amount of energy required by the world's fastest supercomputer would be enough to power a building. The human brain would achieve the same processing speed from the same energy needed to charge a dim light bulb.

One of the things that really distinguish brains is their flexibility. Essentially, the human brain can rewire itself, formally known as “neuroplasticity”. Neurons can separate and reconnect with others and even change their basic properties, which a computer cannot.

This neuroplasticity is evident in a wide variety of brain functions, such as the formations of memory, knowledge acquisition, physical development, and even recovery from brain damage. When the brain identifies a more efficient or effective way to compute and function, it can morph and alter its physical and neuronal structure, hence the term “plasticity”.

Until computers are able to re-wire themselves, neuroplasticity likely will keep the human brain ahead of conventional “static” supercomputers. Biological processes have taken billions of years to develop perfect, efficient organs that outpace existing technology.

Some have a view that brains are not like a computer at all. The brain does not process information, retrieve knowledge, or store memories.

There are not copies of words, pictures, grammatical rules or any other kinds of environmental stimuli. It does not contain most scientists think it does – not even simple things such as ‘memories’.

Consider the brains of babies. Humans, like the newborns of all other mammalian species, enter the world prepared to interact with it effectively.

A baby's vision is blurry, but it pays special attention to faces, and is quickly able to identify its mother's. It prefers the sound of voices to non-speech sounds, and can distinguish one basic speech sound from another. Humans are built to make social connections.

A healthy newborn is also equipped with more than a dozen senses, reflexes and learning mechanisms – ready-made reactions to certain stimuli that are important for its survival. If humans lacked any of these capabilities at birth, they probably would have trouble surviving.

Humans are not born with: information, data, rules, software, knowledge, lexicons, representations, algorithms, programs, models, memories, images, processors, subroutines, encoders, decoders, symbols, or buffers – design elements that allow digital computers to behave somewhat intelligently. Humans also don't develop them ever.

Computers do all of these things, but organisms do not. Computers operate on symbolic representations of the world. They store, retrieve, process and have physical memories. They are guided in everything they do, without exception, by algorithms.

The information processing (IP) metaphor of human intelligence now dominates. But the IP metaphor cannot account for intelligent human behavior. Historical hydraulic and mechanical metaphors ultimately were proven to be inaccurate.

An example of the difference in humans and computers can be seen with the image of common currency (such as a one dollar bill in the USA). A computer can process, store and retrieve a precise image of a dollar bill. A human when asked to sketch the image of a dollar bill from memory (in spite of seeing these bills thousands of times) is able only to produce a very crude inconsistent depiction of the bill.

Neuroscience will never locate a representation of a dollar bill stored inside the human brain simply because it is not there to be found. Humans are much better at recognizing than recalling.

Brain studies indicate that multiple and sometimes large areas of the brain are often involved in even the most mundane memory tasks. When strong emotions are involved, millions of neurons can become more active.

It is not understood how the brain changes after someone learns to sing a song or recite a poem. But neither the song nor the poem has been 'stored' in it.

The brain has simply changed in an orderly way that now allows one to sing the song or recite the poem under certain conditions. When called on to perform, neither the song nor the poem is in any sense 'retrieved' from anywhere in the brain; it simply sung or recited – no retrieval necessary.

To catch a baseball, a player simply needs to keep moving in a way that keeps the ball in a constant visual relationship with respect to the surroundings. This might sound complicated, but actually is simple ... and free of computations, representations and algorithms.

If two people attend the same concert, the changes that occur in one brain will almost certainly be completely different from the changes that occur in the other's brain. Those changes are built on the unique neural structure that already exists, each structure having developed from unique experiences.

It has been demonstrated that no two people will repeat a story they have heard the same way and, over time, their recitations of the story will diverge more and more. No ‘copy’ of the story is ever made; rather, each individual, upon hearing the story, changes to some extent – enough so that when asked about the story later they can re-experience hearing the story to some extent, although not as accurately.

For any given experience, orderly change could involve a thousand neurons, a million neurons or even the entire brain, with the pattern of change different in every brain. If a snapshot of all of the brain’s 86 billion neurons were possible and then the state of those neurons were simulated in a computer, that vast pattern would mean nothing outside the body of the brain that produced it.

Whereas computers do store exact copies of data – copies that can persist unchanged for long periods of time, even if the power has been turned off – the brain maintains human intellect only as long as it remains alive. There is no on-off switch.

To understand even the basics of how the brain maintains the human intellect, not just the current state of all 86 billion neurons and their 100 trillion interconnections must be known, not just the varying strengths with which they are connected, and not just the states of more than 1,000 proteins that exist at each connection point, but how the moment-to-moment activity of the brain contributes to the integrity of the system. Add to this the uniqueness of each brain, brought about in part because of the uniqueness of each person’s life history.

https://getpocket.com/explore/item/the-empty-brain?utm_source=pocket-newtab

The book, “Overload” by Ginny Smith, provides a comprehensive overview of the human brain’s physiology, function and related behavior.

Often, processes are not controlled by a single brain area, or even a single network of areas, but by competing networks which interact and inhibit each other. The balance between these networks and controlled by the chemicals that allow them to communicate and this balance is delicate.

By activating different receptors, the same chemical can have seemingly opposing effects, even within one brain region. The rate at which it is released, and how long for, can also change its impact on our brains. One brain chemical rarely is responsible for one type of feeling or behavior.

While too little of a chemical might be bad, too much can be just as damaging. Low serotonin levels might, in some cases, be linked with depression, but high levels are associated with anxiety.

Currently, most drugs target the brain as a whole, having their effect wherever there are receptors for the chemical they affect. This means they can be a bit of a blunt tool, but still can be beneficial.

Treatments for most mental health conditions include medications, and while we might not understand exactly how one works, they can be effective. In the future, drugs may precisely target the network that is malfunctioning, which should reduce the risk of side effects.

In another area of healthcare it already has become possible. Traditionally chemotherapy for cancer involves giving the patient drugs that damage cancer cells, but because these are usually delivered via the bloodstream, they travel throughout the body and damage healthy cells as well. This is why

chemotherapy can cause so many side effects. Other treatments for cancer, such as radiotherapy, target the tumor precisely.

Newer chemotherapy drugs have been developed which target tumors directly. Even when given in the blood, these bypass healthy cells and attach to the faulty ones.

A more personalized approach to medicine will be possible. For example, one could scan the brain of someone with depression and determine exactly where their treatment should be targeted. There may be a number of different mechanisms that can lead to depression, so this personalized approach could help diagnose exactly why someone is suffering, and select the most appropriate treatment for their underlying cause.

Other treatments are in use which do target particular brain areas. Tiny electrodes, for example, can be implanted in the brains of patients with Parkinson's disease. These deliver electrical impulses, like a pacemaker for the brain, and often are effective in reducing the motor symptoms associated with the illness. These implants also have been trialed for chronic pain, OCD and severe depression, and although only small numbers.

Alternatives, using electrical or magnetic pulses delivered through the scalp, now are starting to be investigated. These can be targeted to different parts of the brain, just like the implants, but are non-invasive, making them cheaper and easier to use, and less risky. These techniques manipulate internal networks, activating neurons and changing the ways natural chemicals are released.

There are other ways of doing this as well ... by changing behavior which changes the activation of brain regions and the release of chemicals. Brains are adaptable chemically and this is why behavioral techniques can be effective. And for more serious conditions, where drugs or surgery might be needed, these behavioral techniques can add to their effectiveness, working together to restore the brain's balance.

Using logical, forward-thinking prefrontal regions, the desires and instincts initiated by the impulsive reward networks can be overridden. Brain chemicals may cause these underlying tendencies, but they also give the chance to change and adapt them to improve the way we live.

From moods to pain, brain chemicals affect every aspect of life, and dysregulation of these chemicals can cause problems. But they allow us to change, grow and adapt, shaping our brains through our actions.

Experiments with fish indicate that the brain does not encode a memory by slightly tweaking its neural architecture. Instead, the researchers found significant widespread changes in the connections.

These observation reinforce that memory is a complex phenomenon involving a number of disparate encoding pathways. They further suggest that the type of memory may be critical to how the brain chooses to encode it — which may hint at why some kinds of deeply conditioned traumatic responses are so persistent, and so hard to unlearn. While the brain records some types of memories in a volatile, easily erasable form, fear-ridden memories may be stored more permanently.

https://www.quantamagazine.org/scientists-watch-a-memory-form-in-a-living-brain-20220303/?utm_source=pocket-newtab

Neuroscientists have tried to map various categories of mental function to specific regions of the brain, but recent work has shown that the definitions and boundaries of those regions are complex and context-dependent.

Neuroscientists generally agree about how the physical tissue of the brain is organized: into particular regions, networks, cell types. But when it comes to relating those to the task the brain might be performing — perception, memory, attention, emotion or action — things are less clear.

For example, the visual cortex enables sight, the auditory cortex enables hearing, and the hippocampus is essential for memory. Damage to those regions impairs those abilities, and researchers have identified mechanisms underlying them in those areas.

But memory also requires brain networks other than the hippocampus, and the hippocampus is turning out to be key to a growing number of cognitive processes other than memory. Sometimes the degree of overlap is so great that the labels start to lose their meaning. One such overlap revealed an unexpected link between memory formation and metabolic regulation.

Understanding has increased of the neural foundations of perception, attention, learning, memory, decision-making, motor control and other classic categories of mental activity. Evidence exists that those categories and the neural networks that support them do not work as expected.

It is not just that the architecture of the brain disrespects the boundaries between the established mental categories. So much overlap is parent that a single brain network is difficult to describe.

For instance, two-thirds of the brain is involved in simple eye movements; meanwhile, half of the brain gets activated during respiration. Most of the neural activity in “perception” areas such as the visual cortex was encoding information about animals’ movements rather than sensory inputs.

The cerebellum, a structure in the brains of all vertebrates, was thought to be dedicated almost exclusively to motor control, but scientists have found that it is also instrumental in attention processes, the regulation of emotions, language processing and decision-making. The basal ganglia, another ancient part of the brain usually associated with motor control, has been similarly implicated in several high-level cognitive processes.

Previous indications were that feelings of fear are generated in the amygdala. The amygdala, however, is not involved in generating fear.

Instead, fear is a cognitive interpretation of a situation, a subjective experience tied up in memory and other processes. The psychological phenomena that some people experience as fear may be experienced as something very different by others. Research shows that the feeling of fear arises in the prefrontal cortex and related brain areas.

The amygdala, on the other hand, is involved with processing and responding to threats — an ancient, subconscious behavioral and physiological mechanism. Evidence shows that it is not always fear that causes the behavior.

Identifying the significance of different brain areas is further complicated by the discovery that the involvement of neural systems in particular functions is not simply all or nothing. Sometimes it is contingent on the details of what is being processed.

Instead of categorizing cortical areas in terms of their specialized visual, auditory, somatosensory or executive functions, researchers are studying the different combinations of information they represent. One region might be involved in representing simple combinations of features, such as “orange” and “square” for an orange square. Other regions might have evolved to represent more complex combinations of visual features, or combinations of acoustic or quantitative information.

The basal ganglia plays a key role in some decision-making tasks but not others. Neither the term ‘decision-making’ nor the term ‘attention’ actually corresponds to a thing in the brain. Instead, there are certain circuits in the brain, and they do certain things like “approach” or “avoid”. Some of those things are going to look a bit like attention.

For instance, memories, future planning and imagination are all partly encoded by the same neural mechanisms, which makes sense from an evolutionary perspective because the same system can be recycled for different purposes. By considering whole-brain neural activity and an assortment of behaviors at the same time, its parts interact, functional categories such as memory, perception and attention can better be understood.

Ongoing work in model-free, data-driven searches may help to define new categories of brain structure and function. Mental concepts could potentially be rewritten in computational terms — perhaps as a simplified version of the mathematical descriptions that define layers in artificial neural networks.

Criticality and the Human Brain

The ability of the phenomenon of criticality to explain the sudden emergence of new properties in complex systems has been studied by scientists in recent decades. When systems are balanced at their “critical point,” small changes in individual units can trigger outsized events, just as falling pebbles can start an avalanche.

That abrupt shift in behavior describes the phase changes of water from ice to liquid to gas, but it is also relevant to many other situations, from flocks of starlings on the wing to stock market crashes. Some scientists have suggested that the brain might be operating near its own critical point.

Neuroscientists have been searching for evidence of fractal patterns and power laws at work in the brain’s networks of neurons. Researchers are searching for mechanisms that are capable of tuning brains toward criticality.

<https://www.youtube.com/watch?v=hjGFp7lMi9A>

A “second brain” of autonomous neurons exists in the human digestive tract. Scientists have catalogued 12 different kinds of neurons in the enteric nervous system (ENS) of mice.

The gut brain greatly affects how the human body works. The digestive system works as part of metabolism, but it is subject to fluctuations in functionality and is related to emotions.

Digestive symptoms and anxiety can be comorbid, and the gut is affected by stress. A better understanding of what happens in the ENS could lead to better medicines and treatments for a variety of conditions.

Similar to stem cells, neurons develop first as more generic “blanks” and then into functional specialties. The human brain has types like sensory and motor neurons, each of which has subtypes. There are many subtypes.

Neurons of the same superficial type are different in the brain versus the brain stem and the digestive tract. They are classified into excitatory and inhibitory motor neurons, interneurons, and intrinsic primary afferent neurons.

Researchers now are working on determining for what each of the 12 ENS neuron types is responsible. This work could lead to new treatments that use stem cells or RNA to control the expression of harmful genes.

Metabolism is a biological term that refers to all the chemical reactions needed to maintain life in an organism. Metabolism in humans accomplishes three main jobs: converting food into energy; breaking down food into its building blocks for protein, lipid, nucleic acid and some carbohydrate; and eliminating nitrogen wastes.

Caloric needs can be divided into two categories: resting energy expenditure plus energy expenditures for other activities. Total energy expenditure combines the two.

Basal metabolic rate is the minimum amount of calories required for basic functions at rest. Resting energy expenditure is the amount of calories a body uses while resting or sleeping – about 60%-65% of total energy expenditure. The second category is calories needed to power everything else – moving around, or activity energy expenditure (25%-30%), thinking, and digesting food (5%-10%).

The estimated daily caloric intake needs for an adult woman of 126 pounds (57 kilograms) range from 1,600 to 2,400 calories per day. For a man of 154 pounds (70 kilograms), daily calorie needs can range from about 2,000 to 3,000 calories per day. That’s about 11-14 calories per pound of body weight (25-30 calories per kilogram).

In contrast, infants burn about 50 calories per pound of weight per day (120 calories per kilogram). This requirement continuously decreases as the child ages. So infants have the highest metabolism of all. This extra calorie requirement is necessary for growth.

Metabolic rate and calorie requirements vary from person to person depending on factors such as genetics, gender, age, body composition and amount of exercise.

Health status and certain medical conditions may also influence metabolism. For example, one regulator of metabolism is the thyroid gland. The more thyroxine a person’s thyroid gland produces, the higher is that person’s basal metabolic rate.

Having a fever can affect a person's basal metabolic rate. Other medical conditions that influence basal metabolic rate can include muscle wasting (atrophy), prolonged starvation, low oxygen levels in the body (hypoxia), muscular disorders, depression and diabetes.

It takes more energy to maintain muscle than fat. The easiest way to increase metabolism is to increase muscle mass and activity level.

Some brain cognitive functions will decline over time and others get stronger. Cognitive processes are any of the mental functions assumed to be involved in the acquisition, storage, interpretation, manipulation, transformation, and use of knowledge.

Basically, cognitive functions are how humans think and use their brains. They involve processes like attention, perception, learning, and problem-solving.

Thinking abilities are at their best around age 30, and then they begin to decline. Some cognitive decline is expected and considered a normal part of the aging process, including short-term memory loss, slower thinking, and the inability to multitask.

The reason for the decline is structural. Brains shrink or atrophy slowly over time, primarily in the white matter, where connections between brain areas are located. The more connections are lost, the more cognition is lost.

Three cognitive functions (alerting, orienting, and executive inhibition), however, remain strong with aging. Alerting, as the name suggests, refers to being ready to receive some kind of stimuli or information. Orienting is how information is moved around in different areas of the brain and attention is shifted. Executive inhibition is the ability to control attention so focus is maintained on what is important.

While alerting decreases with age, orienting and executive inhibition actually increases until at least the mid-to-late 70s. Certain information becomes resistant to degradation because of its interconnectivity over time, often referred to as "crystallized" intelligence. It is possible that executive inhibition improves with age because of high interconnectivity with regions frequently activated in executive function inhibition.

Cognition is subject to "use it or lose it." Keeping the mind active and challenged keeps connections in the brain strong.

New connections should be created. Exposure to a wide variety of new and different topics, experiences, and activities has evidence for building cognitive reserve. The greater the cognitive reserve, the better one is able to avoid the unwanted consequences of an aging brain.

Keeping the brain higher functioning is not just about learning and doing new things. Lifestyle also impacts how the brain ages.

Seven ways have been identified to keep to keep the brain healthy as aging occurs.

1. Be a lifelong learner
2. Be social
3. Exercise

4. Manage stress
5. Sleep
6. Keep heart healthy
7. Don't drink too much

A method for improving memory is to transform something which is difficult to remember into a proxy (e.g., an image) that is easier to remember. Humans remember what is sensory, what is visual, what is tactile, what evokes an emotion.

To remember several things, a backbone of space on which to project images is helpful. The advantage of a memory space over a simple “story” is that stories are more vulnerable to breaks in the sequential chain.

A memory journey around a familiar place such as a house includes placing each item to remember in each of the rooms. As more items are added, this spatial memory seems to scale more easily relative to other methods.

Research indicates that the things humans see is an optimization of the brain's last 15 seconds of visual information ensuring what is seen stable and continuous. Eyes are continuously exposed to an enormous amount of visual information – millions of shapes, colors and ever-changing motion.

The brain automatically smooths visual input over time. Instead of analyzing every single visual snapshot, a person perceives in a given moment an average of what was seen in the past 15 seconds.

Mechanisms within the brain continuously bias visual perception towards past visual experience known as continuity fields. Visual system sometimes sacrifices accuracy for the sake of a smooth visual experience. Judgements made every day are not totally based on the present, but strongly depend on what was seen in the past.

https://getpocket.com/explore/item/everything-we-see-is-a-mash-up-of-the-brain-s-last-15-seconds-of-visual-information?utm_source=pocket-newtab

Breathing

Research indicates that certain breathing technique is beneficial for humans. Nasal breathing is more healthy and efficient than breathing through the mouth.

One of the many benefits is that the sinuses release a significant increase of nitric oxide, a molecule that plays an essential role in increasing circulation and delivering oxygen into cells. Immune function, weight, circulation, mood, and sexual function can all be heavily influenced by the amount of nitric oxide in the body.

Nasal breathing alone can boost nitric oxide sixfold and oxygen absorption more than by just breathing through the mouth. Keeping the nose constantly in use trains the tissue inside the nasal cavity and throat to flex and stay open.

Nasal breathing can expand lung capacity. With that extra capacity life span can be lengthened. Moderate exercise like walking or cycling also has been shown to boost lung size by up to 15 percent.

Full nasal inhalation and exhalation both are important. Over time, shallow breathing will limit diaphragm and lung capacity. The optimum breath seems to be about a 5 second inhalation and a 5 second exhalation.

Nasal breathing helps stretch lungs and straighten bodies, boost blood flow, balance moods, and excite the electrons in molecules to sleep and exercise better and live longer.

Proper breathing one of the most significant overlooked benefits for humans. Most people survive on shallow breaths that can result in unnecessary tension and anxiety.

Deep breathing comes naturally to children, but adults lose the ability because they often are in a state of low-level stress. Breathing migrates up the body making one more anxious.

Living in a state of tension means living in a zone of depletion where people are more susceptible to burnout, anxiety, or depression. Controlled breathing is the fastest, most effective way to trigger the relaxation response, enabling one to think more clearly and perform better under pressure.

Two breathing techniques force the body into a more relaxed state when in a high-pressure situation.

“Tactical breathing” is a technique to use when a person feels themselves having a fight-or-flight response. It involves all breathing muscles—from chest to belly.

Place the right hand on the belly, pushing out with a big exhale. Then breathe in through the nostrils, slowly drawing the breath upward from the belly to the upper chest.

Pause and exhale, starting from the chest and moving downward to the air in the belly. Imagine the belly button touching the spine.

Once comfortable with a full, deep breath, repeat it, this time making the exhale twice as long as the length of the inhale. For example, inhale to the count of four, pause briefly, and exhale to the count of eight. Repeat three times.

The second is called “box breathing” and is meant to ground a person, sharpen concentration, and leave one feeling alert but calm. It uses the tactical breathing technique over a longer period of time in a “box” pattern. Inhale, hold, exhale, hold—each for the same duration.

Start by pushing the air out of the chest, keeping the lungs empty for the count of four. Then start the tactical breathing, inhaling through the nose for a count of four, drawing air into the belly and moving up into the chest. Hold the air in the lungs for a count of four.

The movement should feel fluid and open; don't clamp down at the back of the throat. Exhale smoothly, starting at the chest and moving to the belly, for four slow counts. Complete the box with a pause of four before beginning another repetition.

Continue this technique for five minutes, building the breath strength by using the full range of breathing muscles, drawing in and pushing out breath.

It can be helpful to sprinkle in small breaks to focus on breathing using these techniques which can energize and minimize feelings of depletion.

<https://getpocket.com/explore/item/these-navy-seal-tricks-will-help-you-perform-better-under-pressure>

Sleep

Humans spend about one third of their lives sleeping. For a 90 year old that is of course 30 years spent sleeping.

Why do we sleep?

We understand some of the mechanisms and the beneficial aspects of sleep. But, no one knows why sleep is required to realize these benefits versus them occurring while awake.

It is apparent why we need to eat and to reproduce ... but it is not clear at all why we need to sleep. Just 24 hours of sleep deprivation can cause healthy people to have hallucinations and other schizophrenia-like symptoms.

Interesting insight is provide by developing artificial intelligence (AI) systems.

AI “neural” mimicking systems become overloaded with information input and processing becoming unstable and requiring “sleep” analogous processes to re-stabilize them. This issue only arises when training biological mimicking processors, not arithmetic logic processing ones.

These AI “neural” systems become unstable after continuous periods of learning images. These systems spontaneously generate images that are analogous to hallucinations.

When the networks, however, are exposed to states that are representative of the waves which living brains experience during sleep, stability is restored. Electrical noise, with a wide range of frequencies and amplitudes, mimics the input received by the neurons in a human brain during slow-wave sleep, which is the deep sleep humans cannot live without

A conventional computer that is in “sleep” mode effectively is in suspended animation, with all computational activity frozen in time. Powering a computer off and then on again is tantamount to exposing the machine to a brief period of “brain death”, not sleep.

Sleep is distinguished from wakefulness by a decreased ability to react to stimuli, but more reactive than a coma or disorders of consciousness, with sleep displaying very different and active brain patterns. The internal circadian clock promotes sleep daily at night.

Sleep occurs in repeating periods, in which the body alternates between two distinct modes: REM sleep and non-REM sleep. Although REM stands for "rapid eye movement", this mode of sleep has many other aspects, including virtual paralysis of the body.

Another feature of sleep is dreaming, an experience typically recounted in narrative form, which resembles waking life while in progress, but which usually can later be distinguished as fantasy.

During sleep, most of the body's systems are in an anabolic state, helping to restore the immune, nervous, skeletal, and muscular systems; these are vital processes that maintain mood, memory, and cognitive function, and play a large role in the function of the endocrine and immune systems.

A promising theory of sleep so far is that it plays a major role in the brain's connectivity and plasticity. Plasticity is involved in learning and memory.

Although it is unclear exactly how, plenty of evidence suggests that losing sleep can cause problems with memory, particularly working memory, the process that allows people to hold information in an easily accessible way while working out a problem. People who are sleep-deprived also struggle with choosing what to pay attention to and regulating their emotions.

During slow-wave sleep (SWS), humans secrete bursts of growth hormone. All sleep, even during the day, is associated with secretion of prolactin.

The brain may be doing two different things during the two major stages of sleep. As the night wears on, sleepers cycle through non-rapid eye movement (non-REM) and rapid-eye-movement (REM) sleep.

Non-REM sleep is marked by slow brain waves called theta and delta waves. In contrast, the brain's electrical activity during REM sleep looks much like it does when a person is awake, but the muscles of the body are paralyzed.

There is some evidence, in fact, that sleep is just something that neurons do when they are joined in a network. Even neuron networks grown in lab dishes show stages of activity and inactivity that sort of resemble waking and sleeping. That could mean sleep arises naturally when single neurons begin to work together. This could explain why even the simplest organisms show sleep-like behaviors.

Birds sometimes sleep in one hemisphere of their brains at a time while they were soaring over the ocean. They sometimes even sleep in both hemispheres simultaneously while in flight.

Studies of short-sleeping animals is that none are completely sleepless. This preservation of a little sleep suggests that there is a minimum amount of sleep that is essential, even in these remarkable short sleepers.

A gene appears to be responsible for that unusual circadian rhythm of human “short sleepers”. A mutation in the gene DEC2 which causes short sleepers to stay awake longer. In addition, two more genes -- an ADRB1 mutation and a NPSR1 mutation -- alter neurotransmitters in the human brain to create short sleep.

Many short sleepers were ambitious, type A personalities, but also incredibly positive, outgoing and optimistic. In studies, 90% to 95% of short sleepers had these common characteristics, including phenomenal memories.

Sleep is the time when the body consolidates memories, and cleanses the brain of neurotoxins. Without the necessary REM and deep wave sleep that eight hours of slumber brings, most people struggle with memory recall. It is yet to be determined if these short sleepers have a mechanism for incorporating more of the healing benefits of sleep into less actual sleep time.

Some societies today display a fragmented sleep pattern in which people sleep at all times of the day and night for shorter periods. In many nomadic or hunter-gatherer societies, people will sleep on and off throughout the day or night depending on what is happening. Plentiful artificial light has been

available in the industrialized West since at least the mid-19th century, and sleep patterns have changed significantly everywhere that lighting has been introduced.

For millennia, most people slept in two shifts – once in the evening, and once in the morning. Why and how did that behavior disappear?

In the Middle Ages, communal sleeping was entirely normal – travelers who had just met would share the same bed, as would masters and their servants.

Biphasic sleep was widely practiced throughout the preindustrial world. In France, the initial sleep was the "premier somme"; in Italy, it was "primo sonno". There is evidence of the practice in Africa, South and Southeast Asia, Australia, South America and the Middle East.

Its existence dated to the early 20th Century, before it ended.

Sleep involved a number of strict social conventions, such as avoiding physical contact or too much fidgeting, and there were designated sleeping positions. For example, female children would typically lie at one side of the bed, with the oldest nearest the wall, followed by the mother and father, then male children – again arranged by age – then non-family members.

The first waking happened entirely naturally, just as it does in the morning. Under the weak lighting of the Moon, stars, and oil lamps or candles - people would tend to ordinary tasks, such as adding wood to the fire and taking care of other personal needs.

For peasants, waking up meant getting back down to more serious work – whether this involved venturing out to check on farm animals or carrying out household chores, such as patching cloth, combing wool or peeling rushes for candlelight and attending to religious activities. The first waking also including socializing and sexual activity. People often would just stay in bed and chat.

Once people had been awake for a couple of hours, they would go back to sleep. This next stage of sleep might last until dawn, or later.

Humans are not the only animals who have experienced multi-phasic sleep. Many species resting in two or even several separate stretches. This helps them to remain active at the most beneficial times of day, such as when they are most likely to find food or avoid becoming prey.

A recent experiment by a sleep scientist from the National Institute of Mental Health involved 15 men. After an initial week of observing their normal sleeping patterns, the men were deprived of artificial illumination at night to shorten their hours of light – whether naturally or electrically generated – from the usual 16 hours to just 10.

The rest of the time, they were confined to a bedroom with no lights or windows, and fully enveloped in its velvety blackness. They were not allowed to play music or exercise.

At the start of the experiment, the men all had normal nocturnal habits – they slept in one continuous shift that lasted from the late evening until the morning. After four weeks of the 10-hour days, their sleeping patterns had been transformed – they no longer slept in one stretch, but in two halves roughly the same length. These halves were divided by a one-to-three-hour period in which they were awake.

Measurements of the sleep hormone melatonin showed that their circadian rhythms had adjusted too. Their sleep was altered at a biological level.

In addition, volunteers from the remote community of Manadana in northeastern Madagascar were studied. The location is a large village with no infrastructure for electricity, so nights are almost as dark as they would have been for millennia.

Researchers found that there was a period of activity right after midnight until about 01:00-01:30 in the morning. Then volunteers would drop back to sleep and to inactivity until they woke up at about 06:00 AM, usually coinciding with the rising of the Sun.

Much of humanity abandoned the two-sleep system, starting from the early 19th Century. As with other recent shifts in our behavior, such as a move towards depending on clock-time, the change in sleep coincided with the Industrial Revolution.

Artificial illumination became more prevalent, and more powerful – first there was gas lighting and then electric lighting toward the end of the century. In addition to altering people's circadian rhythms, artificial illumination also naturally allowed people to stay up later. The Industrial Revolution did not just change technology, but biology, as well.

Dreams

What are dreams for? A handful of theories predominate.

These theories include: a) reveal hidden truths and wishes, b) help process intense emotions, c) sort through and consolidate memories, d) make sense of random neuron activity, e) rehearse responses to threatening situations. Others argue that dreams have no evolutionary function, but simply dramatize personal concerns. Just about all mammals are thought to dream, as are birds, and some lizards.

The majority of dreams occur during REM sleep cycles, of which the average person has four or five a night. Eight percent of dreams are about sex, a rate that holds for both women and men. Anxiety is also common along with school, falling, being chased, and arriving too late for something. An individual's dreams are influenced by time - people who grew up watching black-and-white TV are more likely to dream in black and white - and culture.

Negative dreams can have positive effects. Many probably are meaningless. With others, however, the brain might be practicing so the dreamer will be ready when needed.

<https://getpocket.com/explore/item/bad-dreams-are-good>

A person dreams for two hours every night. Technology like fMRIs lets researchers record and visualize activity in the brain.

Dreams seem to rely on many of the same mental processes we use while awake. They tap memories stored in connections between brain cells, which the hippocampus tracks as they form. At night it directs neurons to replay recollections, facilitating long-term storage.

The most vivid dreams occur during the REM phase of sleep. Activity increases in brain regions that control movement and process optical inputs, like the visual and motor cortices, which likely create what people “see” and “do” in slumber. It is not clear what triggers these areas at night.

The amygdala helps generate feelings like fear, anger, and anxiety. It and other emotional domains are more active during REM sleep, which could explain why strong reactions happen frequently when we doze. This process may dull difficult memories.

Despite their disjointed nature, dreams still contain semi-rational thoughts, likely thanks to areas supporting conscious cognition. The anterior, or front, portion of the cingulate, a semicircle in the brain’s center, influences motivation and decision-making—and can switch on during sleep.

During REM, neuroscientists see suppression of the dorsolateral prefrontal cortex, which is critical for executive functions like directing attention, solving problems, and reasoning. This might help explain why people rarely realize they are asleep, despite some strange dream scenarios.

<https://getpocket.com/explore/item/how-your-brain-conjures-dreams>

Consciousness

“Consciousness is the normal mental condition of the waking state of humans, characterized by the experience of perceptions, thoughts, feelings, awareness of the external world, and often in humans (but not necessarily in all other animals) self-awareness,” according to the Oxford Dictionary of Psychology.

'Self-awareness' is the mental activity that reflects back on itself, the mental process of being aware of oneself being aware. Self-awareness does not appear to be a uniquely human trait based on experiments with certain types of animals. The significance of self-awareness is how physical processes in physical brains can generate self-awareness.

Consciousness is the state of being aware of one's surroundings. It is awareness and feelings (emotions) that result from sensory inputs transmitted through the body to the brain where they eventually are processed and integrated through the prefrontal lobes, cerebral cortex, insula, and the brain stem (aka reticular activating system ... which is essential to any state of consciousness). The brain stem helps determine the mix of key neuromodulators (dopamine, serotonin, noradrenalin) that control human emotions (feelings, affect).

Humans simply sense actual electromagnetic and physical pressure waves and then with neurological systems convert them to perceptions of color, sound, temperature, etc. These immediate senses plus memories stored in and retrieved from the neurological system “predict” into existence consciousness and “self”.

A human’s awareness of existence is present in the neural status (thoughts, memories, pain, pleasure, sensory, etc.) of the brain. Sensory neural information is derived from energy reflected from or

emitted by objects which in turn are unique collections of fundamental energy packets. The objects generate and reflect energy even if no human (animal or plant) is within range to sense that energy, so the objects exist even if not sensed.

Research indicates that the things humans see is an optimization of the brain's last 15 seconds of visual information ensuring what is seen stable and continuous. Eyes are continuously exposed to an enormous amount of visual information – millions of shapes, colors and ever-changing motion.

The brain automatically smooths visual input over time. Instead of analyzing every single visual snapshot, a person perceives in a given moment an average of what was seen in the past 15 seconds.

Mechanisms within the brain continuously bias visual perception towards past visual experience known as continuity fields. Visual system sometimes sacrifices accuracy for the sake of a smooth visual experience. Judgements made every day are not totally based on the present, but strongly depend on what was seen in the past.

https://getpocket.com/explore/item/everything-we-see-is-a-mash-up-of-the-brain-s-last-15-seconds-of-visual-information?utm_source=pocket-newtab

At any particular time, there are neural states of which a human has an awareness (“consciousness”) and states with no awareness (“subconsciousness”). “Time” (past, future) is perceived as changes in neural status.

Human awareness results from information processed by receptors and neurons. Facts and logic are both epigenetic (“built in”) and learned and are retained in neurons.

The metaphor of the brain as a computer is limited at best. At this time, however, describing it other terms is difficult.

If a brain is thought of as a computer, its components are highly distributed and parallel (sensing, processing, memory, communication), dynamic, inconsistently accessible and each brain is unique in its design. It is complex with 86 billion neurons and 100 trillion interconnections,

To extend the computer metaphor, humans are born with a built in operating system (BIOS). We are built to make social connections. A newborn also is equipped with more than a dozen reflexes and powerful learning mechanisms that allow them to change rapidly so they can interact increasingly effectively with their world.

Multiple and sometimes large areas of the brain are often involved in even the most mundane memory tasks. Specific memories are not stored in individual neurons.

Humans are much better at recognizing than recalling. Visualizing something (that is, seeing something in its absence) is far less accurate than seeing something in its presence.

We do not understand how the brain changes after we have learned to sing a song or recite a poem. Neither the song nor the poem has been ‘stored’ in the brain. The brain has simply changed in an orderly way that now allows us to sing the song or recite the poem under certain conditions.

To catch a ball, the player simply may need to keep moving in a way that keeps the ball in a constant visual relationship with respect to the surrounding scenery (technically, in a 'linear optical trajectory'). The action is free of computations, representations and algorithms.

Because all that is required for us to function in the world is for the brain to change in an orderly way as a result of our experiences, there is no reason to believe that any of us are changed the same way by the same experience. No two people will repeat a story they have heard the same way and why, over time, their recitations of the story will diverge more and more.

Some believe it will take centuries just to figure out basic neuronal connectivity.

In a human, information is acquired, stored in and communicated among receptors and neurons which act as very small biologic information processing, storage and networked communication devices. These facts and logic comprise the information humans use for autonomic activity and deliberate activity, for thinking and for self-awareness.

Information (data and logic) in the body is stored and processed by the various highly-interconnected receptors and neurons, a variety of dopants such as neurotransmitters, along with the extracellular matrix (that provides structural and biochemical support of surrounding cells and contains DNA and RNA).

Electrochemical processes occur among these elements, the reactions influencing emotions. The physiological effects triggered by recalling a memory (increased blood pressure, faster breathing, etc.) trigger emotional effects (anger, fear, anxiety, excitement) which in turn reinforce the memory itself.

A person feels mental emotions (including "moods") and physical sensations (pain, temperature, etc.). Feelings and physical sensations are controlled by neurotransmitters, including endogenous opioids which can be manipulated by health practices (sleep, exercise, diet), medications, and mental control (attitudes, meditation, biofeedback, autosuggestion).

Memories reside in RNA stored in synapses. Research is ongoing to determine the possibility of repairing deteriorated neurons that could find their way back to otherwise lost memories with the guidance of DNA.

General good feelings (enjoyment, joy, interest, excitement), however, appear to be a result of high levels of dopamine and serotonin while general bad feelings (anxiety, rage, shame) are a result of low levels of dopamine and/or serotonin. Interest and excitement are added by higher levels of noradrenaline (aka, norepinephrine).

All things, including humans, are composed of subatomic particles (energy quanta) that combine into larger forms of matter/energy. Humans interact with the particles of things in our vicinity (e.g., the air that surrounds us) and at longer distances (telecommunications, quantum interactions, etc.).

All known cellular life and some viruses contain DNA. Every neuron, the extracellular matrix and most cells contain DNA.

The main role of DNA in the cell is the long-term storage of information. This information includes a blueprint that contains the instructions to construct other components of the cell, such as proteins and RNA molecules.

DNA contains the genetic instructions for the development and function of living things. DNA contains the instructions needed for an organism to develop, survive and reproduce. To carry out these functions, DNA sequences are converted into messages used to produce proteins, the complex molecules that do most of the work in our bodies.

Recent research with macaque monkeys indicates the forebrain's central lateral thalamus seems to be one of the "minimum mechanisms" necessary for consciousness. Macaque brains closely mirror human brains, making them an ideal model for studying the drivers of consciousness.

The goal of the research was to identify the minimum mechanisms necessary to produce consciousness. Past research has suggested that certain brain areas, like the parietal cortex and thalamus, are critical to consciousness.

The researchers stimulated this tiny brain area and could wake up the monkeys and reinstate all the neural activity that normally is seen in the cortex during wakefulness. When the stimulation was switched off, the monkeys went straight back to being unconscious.”

This area of the brain may function as an “engine for consciousness”. Researchers are trying to reveal which specific neural interactions appear to be minimally necessary for consciousness. This work could help people with disorders of consciousness to live better lives.

In the future, clinicians may be able to use these kinds of deep-brain stimulating electrodes to bring people out of comas and develop new ways to monitor patients under clinical anesthesia, to make sure they are safely unconscious.

<https://bigthink.com/health/consciousness-study/>

Facts and logic are made up of,

- first, the epigenetic “built in operating system” of all humans that includes autonomic functioning (e.g., breathing, heartbeat) before birth and,
- second, the facts and logic learned as a human matures.

Human Consciousness is affected by neurotransmitters and other endogenous elements.

Consciousness is the self-awareness of Existence. The universe existed for billions of years before any creature existed on Earth that was “aware” of the existence of the universe.

Consciousness is the experience of pleasures, pain, visual, auditory, and other sensations.

Awareness of an individual’s surrounding environment is achieved by the human body’s reception of photons of light in visible wavelengths (sight); of air pressure (hearing); contact pressure (touch); the relative activity level of molecules acting on the skin (temperature sensation); airborne molecules of a

chemical compound bind to specific sites on olfactory receptors located in the nasal cavity (smell); and chemical reactions to a substance in the mouth (taste).

The brain, nerves and receptors are very complex and not fully understood. In general, however, receptor and neuron processed information and feelings are how a person knows who they are and their situation within their environment.

The self-awareness that is part of consciousness is a result of the information elements stored in groupings of interconnected interoperating neurons in the body. This information includes facts (e.g., your name) and logic patterns (e.g., multiplication tables).

Emotions and physical sensations are controlled by neurotransmitters (chemical substances that is released at the end of nerve fibers by the arrival of nerve impulses and, by diffusing across synapses or junctions, cause the transfer of an impulse to another nerve fiber, a muscle fiber, or some other structure.). Consciousness is the combination of emotions, physical feelings, other information.

Based on limited experience with feral children, it appears that an individual must have some exposure to human behavior between birth and 4 or 5 years or they can never behave as human beings (including the Consciousness of a human) regardless of the extent of training. In other words, a limited time period after birth exists for humans to be programmed with non-autonomic learned human behavior. Maximum human competency is achieved when learning starts at birth.

Consciousness seems to depend on how different parts of the brain communicate with each other, in specific ways. Consciousness simply is integrated information.

During dreamless sleep and general anesthesia, measured brain signals are very simple. But during conscious states, a typical signal ranges widely over complex patterns.

What we see beyond our bodies is the brain's best guess of what is out there. The specific experience of being you is nothing more than the brain's best guess of the causes of self-related sensory signals.

We are conscious selves because we are autonomous machines programmed to maximize our satisfaction levels and our own persistence.

These mental and physical feelings plus the other information stored and processed in the body, along with inferences about future outcomes based on this information, comprise an individual's consciousness.

By directing your attention to sensations, do you make them conscious or does it simply cause you to experience the extra quality of knowing that the sensations were conscious? Attention plays an important role in re-representation ... that is, the conscious knowledge of an experience, which underlies introspection.

Subjects cannot report—not even to themselves—experiences that are not re-represented. Nothing, however, stops conscious experience from occurring without re-representation. Dreams, for instance, have been shown to lack re-representation, despite the undeniable fact they are experienced in consciousness.

Consciousness in the context of evolution is contained in The Attention Schema Theory (AST). The theory suggests that consciousness arises as a solution to one of the most fundamental problems facing any nervous system: too much information constantly flows in to be fully processed. Michael Graziano, a professor of psychology and neuroscience at Princeton University, describes AST.

The brain evolved increasingly sophisticated mechanisms for deeply processing a few select signals at the expense of others, and in the AST, consciousness is the ultimate result of that evolutionary sequence. If the theory is correct, then consciousness evolved gradually over the past half billion years and is present in a range of vertebrate species.

Even before the evolution of a central brain, nervous systems took advantage of a simple computing trick: competition. Neurons act like candidates in an election, each one shouting and trying to suppress its fellows.

At any moment only a few neurons win that intense competition, their signals rising up above the noise and impacting the animal's behavior. This process is called selective signal enhancement, and without it, a nervous system can do almost nothing.

The split between the ancestors of hydras and other animals, according to genetic analysis, may have been as early as 700 million years ago. Selective signal enhancement probably evolved after that close to the beginning of complex, multicellular life.

Selective signal enhancement does not require a central brain. The eye, the network of touch sensors on the body, and the auditory system can each have their own local versions of attention focusing on a few select signals.

The next evolutionary advance was a centralized controller for attention that could coordinate among all senses. In many animals, that central controller is a brain area called the tectum. The human cerebral cortex is like an upgraded tectum.

The most important difference between the cortex and the tectum may be the kind of attention they control. The tectum is the master of overt attention—pointing the sensory apparatus toward anything important.

The cortex adds something called covert attention. One does not need to look directly at something to covertly attend to it.

The cortex needs an internal model for something abstract. According to the AST, it does so by constructing an attention schema—a constantly updated set of information that describes what covert attention is doing moment-by-moment and its consequences.

Covert attention is not intangible. It has a physical basis, but that physical basis lies in the microscopic details of neurons, synapses, and signals.

The brain has no need to know those details. The attention schema is therefore strategically vague.

It depicts covert attention in a physically incoherent way, as a non-physical essence. And this, according to the theory, is the origin of consciousness.

In the AST, the attention schema was further adapted to model the attentional states of others, to allow for social prediction. Not only could the brain attribute consciousness to itself, it began to attribute consciousness to others.

Language is perhaps the most recent big leap in the evolution of consciousness. Nobody knows when human language first evolved.

Certainly we had it by 70 thousand years ago when people began to disperse around the world, since all dispersed groups have a sophisticated language. The relationship between language and consciousness is often debated, but we can be sure of at least this much: once we developed language, we could talk about consciousness and compare notes.

The AST covers a lot of ground, from simple nervous systems to simulations of self and others. It provides a general framework for understanding consciousness, its many adaptive uses, and its gradual and continuing evolution.

Consciousness is scent, the sense of the color, romantic memories, the memory of an exceptional performance—all of the qualitative experiences that make up life knitting one moment to the next. Why it exists or how it arises from physical and biological processes is the challenge.

Perceptual experiences of the world are products of the brain governed by a system of predictions; consciousness is intimately tied to the interior of the living body. Consciousness, which evolved from primordial feelings such as pain and hunger, is interactive processes that pair the physical with the mental and arise from a chemical orchestra in the body.

Feelings, such as hunger, thirst, pain, or well-being, are naturally and spontaneously conscious and knowing comes out of feeling. This spontaneous knowledge helps manage life.

Consciousness arises through a comingling of signals from the interior of the body with signals from the nervous system. Consciousness relies on neural processing and interaction between neural and body processes.

Brains receive signals from the interior of the body and from the environment and then make predictions about what these signals mean based on prior experience. This predictive system involves the brain encoding a model of its world and body—a model that is capable of generating predictions about sensory signals that can be calibrated against sensory data.

Humans perceive the world and themselves within it with through and because of their living bodies.

People are given anesthetics and consciousness goes away and then it comes back. People are given psychedelics, and consciousness changes, and then it changes back.

Humans need peripheral nerves, spinal and brain stem ganglia (such as the trigeminal ganglion), and a variety of nuclei in the brain stem core (such as the parabrachial nucleus). The fundamentals of feeling appear to be obtained from processes generated by those components of the nervous system.

What else specifically is needed to describe Consciousness?

Some say that the “mind” and consciousness is more than the brain and the inputs and outputs that it integrates.

The easy problem is understanding how the brain processes signals, makes plans and controls behavior. The hard problem is explaining how this feels or why it should feel like anything at all, assuming we are right in thinking that it truly does feel like something (Dennett's consciousness illusionism says this is an illusion).

Human information processing is easy to explain, however, human subjective experience is difficult to explain. For example, it is easy to imagine a color-blind person who has learned to identify which objects in their field of view are red, but it is not clear what would be required for the person to know what red looks like.

For example, relationships with others are essential to the satisfaction of most humans.

This satisfaction, however, is realized in the neurochemical balance in the brain as it integrates senses, actions, and stored and predicted information. Injury and diseases of human brains demonstrate that the “mind”, “self”, “consciousness” are impaired and lost as a result of the damage.

The brain is the essential core of a human’s consciousness.

It seems plausible to view the entire Universe as a complicated quantum field that, itself, contains all of physics. Quantum fields can describe an arbitrarily large number of particles that interact in all ways our theories can conceivably allow.

If elementary particles are really just excitations of a cosmic-wide quantum field, those excitations in a human brain would be connected physically via that field to the farthest, unseeable, edges of the universe.

A resonance theory of consciousness suggests that the way all matter vibrates, and the tendency for those vibrations to sync up. Resonance is another word for synchronized vibrations.

All things in our universe are constantly in motion, vibrating. Even objects that appear to be all matter are just vibrations of various underlying fields.

A phenomenon of spontaneous self-organization exists. Large-scale neuron firing occurs in human brains at measurable frequencies; electrical patterns sync in the brain to produce different types of human consciousness.

Groups of neurons produce these oscillations as they use electrochemical impulses to communicate with each other. The speed and voltage of these signals, when averaged, produce EEG waves that can be measured at signature cycles per second. Each type of synchronized activity is associated with certain types of brain function.

Gamma waves are associated with large-scale coordinated activities like perception, meditation or focused consciousness; beta waves with maximum brain activity or arousal; and theta waves with relaxation or daydreaming.

Synchronization, in terms of shared electrical oscillation rates, allows for smooth communication between neurons and groups of neurons. Without this kind of synchronized coherence, inputs arrive at random phases of the neuron excitability cycle and are ineffective, or at least much less effective.

All things may be viewed as at least a little conscious. An electron or an atom, for example, enjoys just a tiny amount of consciousness.

But as matter becomes more interconnected and rich, so does the mind. Biological organisms can quickly exchange information through various biophysical pathways, both electrical and electrochemical.

Non-biological structures can only exchange information internally using heat/thermal pathways – much slower and far less rich in information. Far more is “going on” in biological structures than in a boulder or a pile of sand.

As a particular shared resonance expands to more and more constituents, the new conscious entity that results from this resonance and combination grows larger and more complex. Resonance theory of consciousness attempts to provide a unified framework that includes neuroscience, as well as more fundamental questions of neurobiology and biophysics.

An example of an incident of Consciousness is listening to music. The waves of air pressure generated by the instrument or device “playing” the music are received by the eardrums and translated into neural signals.

These signals communicated via neurotransmitters are compared to others stored in neurons to identify the song, determine that it is one that is appealing to the listener based on comparisons to neural stored information about the song and/or similar songs. These neural signals in turn activate other neurotransmitters that recall specific experiences as well as produce particular emotional (enjoyment, sadness, etc.) and sometimes physical feelings (muscle relaxation, etc.).

The musical experience influences, and is influenced by, other factors (e.g., lighting, temperature, companions) external and internal to the person (and their correlated neurotransmitter activity) combining with those factors to establish an overall state of Consciousness at a particular point in time for the person.

Alternate activation of two brain systems appear to be tied to consciousness. Imaging has revealed how cyclical patterns of brain activity differ between conscious and unresponsive individuals.

Research confirms that consciousness balances self-awareness with awareness of surroundings. This condition is represented in the brain by the alternating activation of two neural networks.

These networks are but two of a larger set; the conscious brain cycles through this set, activating each network independently, in a preferred pattern. In the brains of unresponsive individuals, the two awareness networks are activated far less often than the others.

The two networks appear to correlate respectively the default mode network (DMN), the activity of which tends to associate with restfulness and self-directed thoughts ... and the dorsal attention network (DAT), which becomes activated when a person is focused on a task.

Conversely, these two networks anticorrelate with each other. That is, when one is active the other is not. This behavior indicates a temporal characteristic of consciousness.

In subjects who were either anesthetized or unresponsive due to neuropathological conditions, both DMN and DAT were active less often, meaning the number of times they were activated within the cycling patterns of networks was reduced. This is consistent with the fact that under anesthesia there is a loss of awareness including dreaming.

It is unclear whether such diminished DMN and DAT activation is a cause or consequence of reduced consciousness. Assessing DMN and DAT activation might serve as a useful clinical marker of unconsciousness and might also help with refining dosages of anesthetic drugs.

Awareness minimally entails the ability of knowing that one knows. Meta-consciousness involves an explicit re-representation of consciousness in which one interprets, describes or otherwise characterizes the state of one's mind.

Children's brains are affected both by Nature and by Culture and two influence each other. For example, brain scan research has shown that growing up without any siblings will change the brain. A study concluded that number of children affects not only the environment in which children grow up, but also the architecture of their brains.

Standard tests of intelligence, creativity, and personality type measured creativity, IQ, and agreeableness in child test subjects. Their brains also were studied, to determine if growing up as an only child affects the structure of the brain (it did).

On the behavioral tests, only children displayed no differences in terms of IQ, but higher levels of flexibility—one measure of creativity—and lower levels of agreeableness than kids with siblings.

Brain scans then confirmed these findings, showing significant differences between only children and non-only children in the brain regions associated with flexibility, imagination, and planning (supramarginal gyrus) and with agreeableness and emotional regulation (medial prefrontal cortex). The scans also revealed differences in the parahippocampal gyrus, which helps manage emotional and mood regulation.

Newborns seem to experience their own bodies, environment, the presence of their parents, etc. — albeit in an unreflective, present-oriented manner. Children begin to recognize themselves in the mirror at age 18 to 24 months.

They also start to demonstrate theory of mind (an important social-cognitive skill that involves the ability to think about mental states, both your own and those of others. It encompasses the ability to attribute mental states, including emotions, desires, beliefs, and knowledge) at roughly around the same time that they start to recognize themselves in the mirror.

Some scientist posit that human consciousness is non-algorithmic and a product of quantum effects. An algorithm is a series of predictable steps to reach an outcome. Are our brains simply cranking out algorithm-like processes or is more spontaneous activity occurring?

The theory is that consciousness is not strictly causal because, on the tiniest level, it is a product of unpredictable quantum phenomena that do not conform to classical physics.

Other scientists theorize that the human mind is a combination of physical matter and electromagnetic field. “Integrated information”, including neuronal information processing and conventional computing, are only temporally integrated in the sense that outputs are correlated with multiple inputs: the information integration is implemented in time, rather than space, and thereby cannot correspond to physically integrated information. Only energy fields are capable of integrating information in space.”

Physical structures inside the brain cannot account for how information extends through human “minds” and forms integrated ideas. That must be happening within the added medium of the brain’s electromagnetic field.

On the other hand, some believe consciousness is not generated by the brain and that the origin of mental experiences is not physical. They believe consciousness is not an “emergent property ... a property which is just a simplified and approximate description of underlying processes. Emergence itself is just a phenomenon imposed by a mind, so the mind cannot itself be explained as emergent.

Most animals may be self-aware to some degree. Put a chimp in front of a mirror, and he will reach out to touch the other chimp. When he realizes the other chimp is not there and begins touching himself, he will express curiosity or frustration.

Emotions may related to self-awareness. The higher mammal species seem to express emotion. Apes cling to their dead babies for days.

A female dog will bury her dead pup. That act, however may be just instinct to bury anything that recently has died, or a bone, etc.

Studies do seem to have shown that dogs can feel grief. If a pet loses its owner, it may react by not eating, sleeping more and being lethargic. Some dogs might even try to stay with the deceased person.

Research indicates that some animals (chimps, elephants and others) are self-aware in ways similar to humans. Not only can they suffer, for example, but they can think to themselves that they are suffering.

This self-awareness does not appear to be a matter of learning abilities, with some species being slower than others. It, instead, is an issue of higher intellectual capacity.

Evidence suggests these animals have a kind of self-awareness or even consciousness, to the exclusion of other animals. Chimps appear to understand both the goals and intentions of others as well as the perception and knowledge of others, and they can predict the action that will result.

Scientists continue to search for a physical basis in the brains of humans and animals for these abilities. No one unified theory of consciousness exists. No experimental confirmation yet has demonstrated that other organisms, and even inanimate objects, do not have a level of consciousness.

Crows, like most other species from the corvid family (ravens, rooks, etc.), are some of the most intelligent animals on the planet, actually rivaling apes and dolphins. But do they have true consciousness?

Research shows that crows and other corvids know what they know and can ponder the content of their own minds. This is considered a cornerstone of self-awareness and shared by just a handful of animal species besides humans.

Scientists measured activity in different kinds of neurons with the goal of tracking how crows were sensing and reasoning through their work. They sought to study a specific kind of thinking called sensory consciousness, and they chose birds in particular as an evolutionary history pivot.

Sensory consciousness, the ability to have subjective experience that can be explicitly accessed and thus reported, arises from brain processes that emerged through evolutionary history. Today, the neural correlates of consciousness are primarily associated with the workings of the primate cerebral cortex, a part of the telencephalic pallium. Birds, by contrast, have evolved a different pallium since they diverged from the mammalian lineage 320 million years ago.

The crows performed in a way that affirms their sensory consciousness, which scientists say could mean the neural correlates of consciousness date back to at least the last time birds and mammals shared that brain section. To reconcile sensory consciousness in birds and mammals, one scenario would postulate that birds and mammals inherited the trait of consciousness from their last-common ancestor. If true, this would date the evolution of consciousness back to at least 320 million years when reptiles and birds on the one hand, and mammals on the other hand, evolved from the last common ancestor.

Crows remember and respond to people's faces akin to humans themselves. Tool use is common among these birds, but where they excel is in their social and emotional intelligence.

Ravens point at things with their beaks to relay and communicate insights and intentions with their peers. Eurasian Jays, another corvid, can infer the desire of another bird and bring it food that it considers treats.

Crows can recognize, respond and adapt to specific human faces. Crows have learned to differentiate between people who are just strolling by them and people who are actually heading their way.

In an experiment, all the crows in a group responded to the sight of a researcher in a group that previously tried to trap one or more of them by immediately mobbing the individual and shrieking. They learned from individual experience, observed it happening to other individuals and inferred it could happen to each crow.

This capability is how teaching is passed on. Crows, like humans, seem to communicate with abstract information or symbols.

PET scans reveal that when crows viewed human faces that they associated with threat or with care, the birds had increased activity in the amygdala, thalamus and brain stem—areas related to emotional processing and fear learning. In response to threatening faces, areas that regulate perception, attention and fleeing also lit up. Similarities to the human brain in this case are most striking.

Consciousness is the cognitive state of experiencing one's own existence. Some researchers think it is an illusion; others say it pervades everything. Some hope to see it reduced to the underlying biology of neurons firing; others say that it is an irreducibly holistic phenomenon.

A rigorous new way to test competing theories of consciousness is planned. A suite of experiments funded by the Templeton World Charity Foundation will have researchers collaborate and agree to publish in advance how discriminating experiments might be conducted — and then respect the outcomes.

The Process and Timeline for the experiments are:

Launch Date: November 22, 2021

Announcement of finalists: March 22, 2022

Announcement of awards: June 6, 2022

Earliest start date: August 6, 2022

Project duration: 12 - 24 months

Experiments on consciousness must be preceded by a definition of consciousness. In general, consciousness refers to a capacity to experience one's existence rather than just recording it or responding to stimuli.

As artificial intelligence (AI) grows increasingly sophisticated, it might become impossible to tell whether one is dealing with a machine or a human merely by interacting with it.

A distinguishing feature of a human mind is that it can hold on to a piece of information, an idea or an intention as a motivation for subsequent decisions and behaviors.

Brain-imaging studies suggest this capability is a distributed network of neurons in the brain's prefrontal cortex. This picture of consciousness is called global workspace theory (GWT). Consciousness is a form of computation.

A competing theory is that consciousness is not something which arises while turning inputs into outputs but rather an intrinsic property of the right kind of cognitive network, one that has specific features in its architecture. This is called the integrated information theory (IIT).

In contrast to GWT, which starts by asking what the brain does to create the conscious experience, IIT begins instead with the experience.

Essential features of these experiences include that they are: subjective (they exist only for the conscious entity), structured (their contents relate to one another: "the blue book is on the table"), specific (the book is blue, not red), unified (there is only one experience at a time) and definitive (there are bounds to what the experience contains). These are properties that a physical system must possess if it is to have some degree of consciousness.

The Templeton funded experiments are starting with IIT and GWT because they appear to make testable and contrasting predictions. The experiments will deploy a battery of brain-monitoring techniques, such as functional magnetic resonance imaging (fMRI), electrocorticography and magnetoencephalography.

One test will be the location of consciousness in the brain. According to GWT, the “neural correlates of consciousness” — the patterns of neuron activity that reflect the conscious state — should show up in parts of the brain that include the parietal and frontal lobes of the cortex. According to IIT, the seat of consciousness is instead likely to be in the sensory representation in the back of the brain.

Another prediction of GWT is that a characteristic electrical signal in the brain, arising about 300-400 milliseconds after a stimulus, should correspond to the “broadcasting” of the information that makes us consciously aware of it. In IIT, the neural correlate of a conscious experience is instead predicted to persist continuously while the experience persists.

In the end, it may not be possible to find rigorous, definitive ways of testing and adjudicating these two theories. Regardless of the outcome, however, the tests likely will teach us some things new and useful about the brain.

<https://www.quantamagazine.org/neuroscience-readies-for-a-showdown-over-consciousness-ideas-20190306/>

A Science of Consciousness

“Consciousness” is described in a diversity theories from consciousness is something that does not even exist to saying conscious is the only thing that exists and everything in between.

The Neurophysiological Theory Of Consciousness is a theory of awareness; how we get to be aware of something so that particular component of consciousness and awareness is the brain's way of describing to itself what it means to focus attention on something. It is a simple Theory at its heart with attention as a way of focusing on some signals and processing them deeply.

The brain has to not only do that but it has to know that it is doing it and has to know what that means to do that and what are the consequences. It builds this construct or this model to itself that says attention is like this and that is the brain's description of awareness.

Integrated information theory of awareness is fundamentally a theory in which you link different kinds of information together. To be aware of something such as an apple in front of someone, they need rich information about the Apple. They also need this rich information about what it means to pay attention to the apple and information on themselves all of which is balanced together into one large informational chunk.

Nothing mysterious about consciousness is needed ... no new force in nature or something irreducible in some sense or any special consciousness particle or quantum physics or extra spaces or phases.

It is about how information computed in different regions of the brain links up and forms a single entity or a single accessible chunk of information a single model such that we can look at something and say that is an apple it is green it is round and I have an awareness of it. All of that needs to be pulled together into one accessible unit which is so-called “binding”.

The binding by itself or the integrated information is not sufficient to explain awareness. There is another part to it because to be aware of the apple requires not only building a model representation

of the apple but building a model or representation of the person and the special relationship between the person and the apple and the fact that the person is attending to it.

Attending is the key that awareness is the brain's way of describing what attention is and that pulls it all together.

<https://www.youtube.com/watch?v=tWc79RDGO1M&t=3s>

Total Recall

The brain's ability to recall stored memories is limited for most individuals. Hyperthymesia, however, is a condition that leads people to be able to remember an abnormally large number of their life experiences in vivid detail (so-called "total recall"). Understanding its biological mechanisms could be helpful for enhancing memory in general and treating brain abnormalities such as dementia.

Hyperthymesia is extraordinarily rare, with only about 60 people in the world having been diagnosed with the condition as of 2021. Due to the small number of people diagnosed with hyperthymesia, relatively little is known about the processes governing this memory ability.

Hyperthymestics have a sense of both 'knowing' (semantic memory) and 'remembering' (episodic memory) during recollection. Hyperthymestic abilities possibly stem from atypical neuro-development.

An MRI study provides a plausible argument as to the neurological foundation of Hyperthymesia. Both the temporal lobe and the caudate nucleus were found to be enlarged. The hippocampus, located in the medial temporal lobe, is involved in the encoding of declarative memory (memory for facts and events), while the temporal cortex is involved in the storage of such memory.

Scientists now need to ascertain if and how these brain areas are connected to establish a coherent neurological model for this enhanced autobiographical memory.

Research suggests that becoming more self-aware can be beneficial in a variety of ways. It can increase confidence and acceptance of others. It can lead to higher job satisfaction and more effective leaders. It can also help to exercise more self-control and make better decisions aligned with long-term goals.

Writing can be helpful in increasing self-awareness. Three types of writing can improve self-awareness.

Expressive writing is often used in therapeutic settings where people are asked to write about their thoughts and feelings related to a stressful life event. This type of writing aims to help emotionally process something difficult.

Reflective writing is used in professional settings, often as a way to workers become more effective at their jobs. Reflective writing aims to give people a way to assess their beliefs and actions explicitly for learning and development. Writing reflectively requires a person to ask themselves questions and continuously be open, curious, and analytical. It can increase self-awareness by helping people learn

from their experiences and interactions. This can improve professional and personal relationships as well as work performance,

Creative writing employs the imagination as well as, or instead of, memory, and uses literary devices like imagery and metaphor to convey meaning.

Writing creatively offers a unique way to explore thoughts, feelings, ideas, and beliefs. Writing creatively about challenging experiences, like grief, can also offer a way to communicate to others something which you feel is too complicated or difficult to say directly.

Dying

Some people fear death (and some fear life more than they fear death). Others do not fear death itself but do fear the dying process.

Every person experiences a different sequence of feelings when they die, but there are some common things reported by people who have had near death experiences. The first feelings of death are the loss of sensation. First hunger and then thirst are lost. Speech is lost next, followed by vision. The last senses to go usually are hearing and touch.

A study of 66 hospitalized patients showed that many terminally-ill people experience dreams or visions, especially about their deceased and living loved ones. As they moved ever closer to death, the dreams became even more vivid and frequent. It was almost as though they were headed to sleep, rather than towards death.

The popular image of seeing a bright light at the end of a tunnel may have an explanation in biology. When the heart stops, the brain loses its supply of oxygen from the blood, while carbon dioxide starts to build up in the body. Increased levels of carbon dioxide can lead to stress responses and visual hallucinations, which may include flashing lights. In fact, mountain climbers suffering from low-oxygen altitude sickness have reported seeing flashing lights as well.

While the notion of dying might seem terrifying, the actual experience of dying does not feel that way.

While dying might evoke a stress response, the act itself may be very peaceful ... a dying experience is not so bad. A study of people who have had near death experiences shows that few people have negative experiences in the moments leading up to death, and most have in fact felt an overwhelming feeling of peacefulness.

Others who have experienced clinical death reveal similar sentiments. One said it was the most amazing feeling she has ever experienced. It was blank black nothing, but that was perfectly fine, and she felt a comfort she cannot explain. She remembers thinking when she finally came back to her body that she “wanted to stay there.”

Near-death experiences (NDEs) have common themes. These include seeing radiant light, feelings of wonder, mental clarity and bliss, a long tunnel; entities thought to be God or Allah or long-dead

family members; some feel time bend and warp, a state of timelessness, and some a silent euphoria. NDE experiencers feel calm and at ease.

Those who have NDEs often struggle to find the right language. One person said that it is like trying “to draw an odor with crayons”.

Are feel good chemicals, like endorphins, released into the body at the point of death creating euphoria? Does the brain become starved of oxygen, prompting real-seeming fantasies? Do various areas of the brain suddenly begin to work in concert to create strange, altered states? No one knows for sure.

To help formalize NDE research in the 1980s, a survey, the Greyson Scale, was developed. It has been used to collect and describe NDE experiences in a more consistent manner.

The impact near-death experiences have on people’s lives usually are dramatic. NDEs transform attitudes, values, beliefs, and behaviors.

Often, these changes persist over decades. In most instances, experiencers realize they are no longer afraid to die and lose fear of life as well.

Those near to a person dying will often experience common events. The dying lose their strength and energy. They sleep more than they are awake. It is not painful or horrible but can be frustrating for those with them.

The dying can find it helps to try and plan in advance, saving up their energy for the things that really matter. The dying person knows those around them but withdraw from being interactive with them.

Often, at the end, there are not dramatic changes. The sleepiness continues, sleeping nearly all of the time. The dying stop feeling hungry and do not want to eat. They may stop feeling thirsty, too.

Then, one day, rather than sleeping, they slip into unconsciousness. It is not much of a distinction; the brain is just more deeply unresponsive. This may be the body’s way of protecting the mind from being afraid. If a dying person is in physical or mental distress, those feelings can be taken away with drugs.

Terminal lucidity frequently occurs but it is not well understood. These are brief period shortly before death in which the dying person is very aware and energetic. Such experiences can have a profound effect on the person’s loved ones.

Doctors studying a patient’s brain during a seizure captured brain scans as the man suffered a fatal heart attack and died during the scan. The man’s brain data reveals that people might indeed have their whole life flash in front of their eyes when they die.

Experimental animal studies have shown increased activity after cardiac arrest, particularly in the gamma waves band, resulting from hypercapnia prior to and cessation of cerebral blood flow after cardiac arrest. An increase of absolute power in gamma wave activity and a decrease in theta wave power is seen after suppression of bilateral hemispheric responses.

After cardiac arrest, delta, beta, alpha and gamma wave power were decreased but a higher percentage of relative gamma power was observed when compared to the inter-seizures intervals. Cross-frequency coupling revealed modulation of left-hemispheric gamma activity by alpha and theta rhythms across all windows, even after cessation of cerebral blood flow.

This evidence from a dying human brain in a non-experimental, real-life acute care clinical setting indicate that the human brain may possess the capability to generate coordinated activity during the near-death period. While typical neuronal activity patterns occur during daily behavioral tasks, it has been undetermined if such a process is present during the transition phase to death. Overall similarity between a highly controlled experimental rodent study and results from the dying patient suggests that the brain may pass through this observed series of typical activity patterns during death.

https://www.youtube.com/watch?v=pWoG_Bul1cE

Hallucinatory Thoughts of the Dying Mind

As death nears, delirium often results in a slow and fading dialogue between the person and others.

As you die, unless you die very suddenly in an instant, your various bodily systems start to work differently until they stop working at all. And that includes the way that you think and communicate.

Delirium presents as either quiet, listless, apathetic, and “pseudo wakeful,” or as a restlessness in which patients are “muttering” and “talkative” ... and a mix of the two. The exact biological mechanisms behind delirium aren’t well understood, but it appears to stem from neuronal dysfunction, probably due to neurotransmitter fluctuations.

Delirium is very common among the dying, particularly in the later stages, where that lethargic type shows up often. doctors don’t reliably recognize delirium. It’s often mistaken for dementia, depression, or psychosis. don’t have a uniform method for recognizing delirium or dealing with it therapeutically.

Some find it traumatizing and distressing, others less so. In either case, what seems to help is when delirium is described as a normal part of dying, in the same way that baby babbling is described as a normal feature of language acquisition.

Encourage family members to enter the hallucinatory world—or at least not to fight it. Affirm the experience of the dying person. Any insult isn’t responsibility of the dying person.

Religious practices keep dying people occupied, authoring for them what to utter, chant, or pray. Sharing linguistic agency in this way looks like a cultural adjustment to the prevalence of delirium. In those traditions, only the prescribed words matter—everything else becomes noise, harmless and inconsequential.

https://nautil.us/the-hallucinatory-thoughts-of-the-dying-mind-1189807/?utm_source=firefox-newtab-en-us

Feelings

The ability to sense the physical state of the body helps to survive. But how does someone know how they feel?

Often, a person cannot see, hear, touch, smell or taste information about the internal state of their body. Instead, a sense known as ‘interoception’ is used (in contrast to ‘exteroception’, which is how a sense the outside of the body is determined via vision, taste, smell, touch and hearing).

Interpreting your emotional feelings has a surprising amount in common with interpreting bodily states. Perceiving and interpreting these physical changes in both cases involves interoception.

The overlap between bodily and emotional feelings goes further. If someone is feeling unwell, this often involves changes in both physical and mental health.

The same is true in the other direction. Mental health conditions can profoundly change the sense of the physical condition of the body. In panic disorder, for example, the majority of symptoms are physical.

People with anorexia report how much better it feels to experience hunger rather than satiety. Bodily or ‘somatic’ symptoms are also commonly experienced in depression.

Anything felt is a subjective sense, heavily influenced by other factors. A brain uses clues from other factors: location, recent actions, sensations the body has experienced before, and so on.

That means that what one feels is a representation in the brain, only partly in response to actual input from the body. Anything felt is a subjective sense, heavily influenced by other factors.

Interoception is experienced differently by people with various mental health diagnoses, which has led scientists to theorize recently that there might be a basic difference in how the brains of people with mental health conditions process bodily sensations.

Studies have discovered many brain regions that appear to function differently – being either over- or underactive during interoception. Patients with depression, bipolar disorder, anxiety, anorexia and schizophrenia all showed ‘abnormal’ activity in one specific brain region called the insula, compared with healthy control volunteers.

People with anorexia showed decreased activity in this region, while people with substance use problems exhibited increased activity. Results suggest that this one key region (other studies might discover more) shows an atypical amount of activation during interoception across patients with different kinds of mental health conditions.

Research has not revealed why this region is commonly disrupted in psychiatric disorders, just that it is; nor what causal role it might or might not play in people’s symptoms. Additional work may find out whether mental health treatments could try to ‘normalize’ the function of the insula as a way to alleviate people’s difficulties.

In fact, this might already be the basis for some established exercises and interventions. Both mindfulness treatments generally and slow breathing specifically are known to increase insula activation.

Thus, there are therapeutic routes to target this brain region in mental health disorders. There was, however, no overlap between mid-insula activation and the change in brain activation following antidepressant medication or psychological therapy.

It is increasingly apparent that interoception is essential for more than just survival. It is the filter through which we feel mentally and physically well, or unwell.

The brain basis of interoception can help explain the interconnectedness of physical and mental health. Furthermore, differences between people in their neural interoceptive processes could help to explain why we all experience our bodily states differently.

New ways to improve interoception, raise the hope of improving the treatment of mental health for some.

https://psyche.co/ideas/the-brains-reading-of-the-bodys-state-is-key-to-mental-health?utm_source=pocket-newtab

Emotions and Mental Health

So called “mental” and “emotional” aspects of humans actually are physical manifestations of the human brain and other parts of the body. Electrochemical neurotransmitters triggered by various sensors and stored information create “feelings” that have evolved to, in part, help influence actions which optimize the comfort (socialization, safety, wellness, etc.) and interests (curiosity, entertainment, etc.) of a human. These neurotransmitters sometimes become unbalanced, suboptimizing the individual’s comfort and interests.

Although someone may assume their senses are telling the truth, they actually are fabricated to an extent. Considering senses are unique from person to person and through our unique senses we can only interpret a fraction of what is real, there is no all-encompassing perspective one can have. Because of this, perceptions should be taken seriously, but not literally. Multiple perspectives have to be taken, as each will have some part of truth within it. Seeing partial truth in multiple perspectives is fundamental to navigating the world and making informed decisions.

A concept (developed by Hugo Lövhelm MD, PhD.) describes the relationship between human neurotransmitters and human emotions. The concept may help advance the control of emotions in humans as well as help with developing so-called affective (emotion sensitive) machines.

Each human emotion is generated by varying levels of the three monoamine neurotransmitters: serotonin, dopamine and noradrenaline.

The emotion – neurotransmitter relationships are summarized in this table:

Basic emotion	Serotonin	Dopamine	Noradrenaline
Shame/humiliation	Low	Low	Low
Distress/anguish	Low	Low	High
Fear/terror	Low	High	Low
Anger/rage	Low	High	High
Contempt/disgust	High	Low	Low
Surprise/startle	High	Low	High
Enjoyment/joy	High	High	Low
Interest/excitement	High	High	High

For example, Fear is produced by the combination of low serotonin, low dopamine and high noradrenaline (also known as norepinephrine). The Lövhelm concept may help better understand the role of chemical transmitters in the human body and how to treat emotional disorders related to them. This model is referred to as the Lövhelm “cube of emotions”.

Another example is that “seeking” by humans triggers a dopamine reward cycle. When new things are tried, a rush of dopamine floods the reward pathway, which makes one feel good and reinforces that pleasure.

A brain adapts, however, and this increase is followed by a dopamine deficit state, which makes one crave and seek more. It is a craving that drives motivation to restore baseline levels or to go even higher. The brain processes pleasure quickly, tells us that we should get more of it, and has us move on to the next thing.

Dopamine rewards experiencing something new. Interests that tend to be long-lasting have a sense of unlimited learning or a community around them that provides a social benefit (such as crafting or sports). One always could get better, always learn something new, and that always is pulling people in deeper.

Endogenous opioids are opioid peptides (e.g. endorphin, enkephalin, dynorphin, nociceptin, endomorphin) produced by the body that act on opioid receptors throughout the central nervous system to cause a variety of effects, including pain relief, reduced anxiety, and enhanced mood (effects similar to those of opiate drugs).

Neurotransmitter levels and activity must be maintained in a range of balance to avoid unpleasant and sometimes dangerous mood extremes in an individual. This balance is maintained by:

- Inherent individual physiology
- Fitness: diet, exercise, sleep, etc.
- Medications (e.g., “Haldol” rebalances dopamine in schizophrenics)
- Attitude including actions such as deliberate positive thinking and meditation.

Another possible method for maintaining neurotransmitter balance is the intentional mental direct control of neurotransmitter levels and balance. For example, during waking hours an individual would think specifically of maximizing serotonin, dopamine and noradrenaline levels to keep interest and energy high. For sleeping hours, thoughts are to maximize only serotonin and dopamine for relaxation and good mood.

This direct neurotransmitter control method is similar to autosuggestion, biofeedback and meditation all of which can generate emotional (and even physiological) changes which themselves probably produce corresponding changes in neurotransmitter activity levels.

This control technique is unique in that an individual directly tells his/her body, for example, to “increase and balance serotonin, dopamine and noradrenaline” and as a result achieves a mood of interest and excitement.

No known rigorous experimentation has been completed to validate this method of direct neurotransmitter control. Individual non-rigorous ad hoc experiments with the method, however, seemingly have produced deliberate direct changes in neurotransmitter activity and related emotions.

Rigorous experimentation (that includes measurement of changes in actual neurotransmitter levels) may confirm direct mental control of neurotransmitter levels as a useful addition to the other means of neurotransmitter rebalancing outlined above.

Using an MRI machine, for example, a researcher exposed a subject to cold and confirmed that he can activate a part of the brain that releases opioids and cannabinoids into the body. These components inhibit the signals responsible for telling the body it is feeling pain or cold, and trigger the release of dopamine and serotonin. The result is a euphoric effect on the body that lasts for several minutes.

This effect will last only for a few minutes. For the subject to continue his ability to resist the feeling of cold, his body apparently needs to anticipate the continued effect, which in turn helps his body

maintain the state it is in. This anticipation triggers the release of more opioids, serotonin, and dopamine in a continuing cycle. The longer this method is practiced, the easier it could become.

These electrochemical processes can result in emotional and intellectual excess. Mindfulness of different types can help relax this excess and sometimes is useful.

This mental control of emotions can be extended to the concept of “Balance”.

Since psychological and emotional status affect physical status and vice versa for a human, both must be considered in achieving maximum homeostasis (the condition of optimal functioning for the person and includes many variables ... such as body temperature and fluid balance ... being maintained within certain limits).

A person can attempt to use their thought to help enhance their homeostasis by thinking “balance my body” while contemplating that, from head to foot, all internal and surface physical and mental (chemical and electrical) elements adjusting to optimal integrated functioning. Among other feelings of homeostasis, this should lead to a state of increased relaxation and calmness (which also can be enhanced with diaphragmatic breathing, meditation and other techniques).

Balancing can help but often does not work 100%. Some physical ailments simply require healing and will not be resolved fully with this balancing technique; however, the technique can help the healing.

Psychological status (negative and positive feelings), however, affects the body’s chemical and electrical process and vice versa. That psychological status can influence physical healing negatively or positively.

Balancing can help mitigate a cycle of physical distress and psychological distress that can feed on each other creating ever increasing or decreasing distress both physically and psychologically.

Efforts have been made to bridge the Lövheim concept to computational processes. The neuro-simulation is accomplished via re-implementation of dopamine (DA), serotonin (5-HT) and noradrenaline (NA) subsystems of a rat brain to replicate 8 basic psycho-emotional states according to the Lövheim cube of emotions.

Results of neuro-simulations indicate the incremental influence of DA and NA over computational resources of a psycho-emotional state while 5-HT decreases the computational resources used to calculate a psycho-emotional state. In this way, the feasibility of the bio-plausible re-implementation of psycho-emotional states in a computational system are demonstrated. This approach could be a useful extension of decision making and load balancing components of modern artificial agents as well as intelligent robotic systems.

There may be several dimensions of mental illness. An individual might be more prone to some disorders than to others.

Psychopathology is complex. People often have a mix of symptoms from different disorders based on genetics and neuroanatomy.

Individual symptoms such as mood alterations or impairments in reasoning can be diagnosed reliably, but assigning patients to an overall diagnosis such as ‘bipolar disorder’ is difficult. Traits for autism and ADHD appear strongly correlated and partially under genetic control.

Clusters of symptoms cross boundaries of disorders. One theory includes two dimensions of disorders. The first dimension includes ‘internalizing’ disorders, such as depression, in which the primary symptoms affect a person’s internal state. The second dimension is ‘externalizing’ disorders, such as hyperactivity and antisocial behavior, in which a person’s actions are affected.

Studies indicate that no individual gene significantly determines the risk of a psychopathology. Hundreds of genes each have a small influence.

Many gene variants appear to be risk factors for multiple disorders. The same genes, however, are not involved in all brain disorders.

Diagnosis and treatment is a challenge. People with similar symptoms but different sets of mutations or neuroanatomical alterations may be diagnosed and treated differently.

Research indicates that generalized treatments may work as well as targeted therapies. A study group of people with anxiety disorders, such as panic disorder or obsessive–compulsive disorder received either a therapy for their specific disorder or a generalized approach. Both therapies worked equally well.

Others are researching for neuroanatomical (physical brain) changes that occur in multiple psychopathologies. Studies have found that the brain’s grey matter shrank in various regions of the brain for patients with disorders. Consistent patterns of shrinkage have not yet been identified.

The brain can generate phantom physical disorders. An example is Tinnitus. Tinnitus is the perception of noise or ringing in the ears. Tinnitus affects about 15 to 20 percent of people.

The sources of Tinnitus are not well understood but recent research indicates impaired signaling in portions of the brain, particularly hyperactivity in the nucleus accumbens a structure in the middle of the brain and unbalanced regulation by dopamine and serotonin.

Mind-set shift can be a powerful tool

Even if you engage in self-care, you still can have a sense of stagnation and emptiness and often “fogginess”.

You can feel motivated and get unstuck. When languishing and feeling exhausted — emotionally, physically, socially or spiritually — the best thing we can do is rest. But at a certain point, rest creates inertia.

You can benefit from deploying a psychological concept called “behavioral activation”. It’s not about trying to think positive thoughts; you cannot always control your thoughts or feelings.

Behavioral activation is mustering enough energy to start acting on the things that matter to you. It is simple but that does not mean it is easy.

But a mind-set shift can be a powerful tool. When you feel down, unmotivated or apathetic, you can give yourself permission to feel those feelings but not dwell on them. Instead, you shift the focus to getting started with what you have planned in front of you, taking your feelings, whatever they may be, along for the ride. Doing so gives you the best chance at improving your mood.

Think of this initial activity as activation energy. Sometimes we need more, and sometimes we need less. The more we get going, the easier it becomes.

Just as rest and languishing can create inertia that builds on itself, action and energy can be self-reinforcing. It just takes some extra work to overcome the initial stasis and friction.

https://getpocket.com/explore/item/what-to-do-when-you-re-tired-of-being-tired?utm_source=firefox-newtab-en-us

Laughter

Laughter is a physical reaction in humans consisting usually of rhythmical, often audible contractions of the diaphragm and other parts of the respiratory system. It is a response to certain external or internal stimuli.

Laughter can arise from positive emotional states or it may be caused by contrary emotional states such as embarrassment, surprise, or confusion such as nervous laughter or courtesy laugh. Some other species of primate (chimpanzees, gorillas and orangutans) show laughter-like vocalizations in response to physical contact such as wrestling, play chasing or tickling.

Laughter is a part of human behavior regulated by the brain, helping humans clarify their intentions in social interaction and providing an emotional context to conversations. Laughter is used as a signal for being part of a group—it signals acceptance and positive interactions with others.

Laughter is a mechanism everyone has and probably is genetic; laughter is part of universal human vocabulary. There are thousands of languages, hundreds of thousands of dialects, but everyone laughs in much the same way.

Babies have the ability to laugh before they ever speak. Children who are born blind and deaf still retain the ability to laugh.

Researchers speculate that noises from infants as early as 16 days old may be vocal laughing sounds or laughter, however the weight of the evidence supports its appearance at 15 weeks to four months of age.

Laughter is linked with the activation of the ventromedial prefrontal cortex, that produces endorphins. Scientists have shown that parts of the limbic system are involved in laughter. This system is involved in emotions and helps us with functions necessary for humans' survival. The structures in the limbic system that are involved in laughter are the hippocampus and the amygdala.

Laughter probably come into synaptic relation in the reticular core of the brain stem. So while purely emotional responses such as laughter are mediated by subcortical structures, especially the hypothalamus, and are stereotyped, the cerebral cortex can modulate or suppress them.

Some drugs are well known for their laughter-facilitating properties (e. g. ethanol and cannabis), while the others, like salvinorin A (the active ingredient of *Salvia divinorum*), can even induce bursts of uncontrollable laughter.

A link between laughter and healthy function of blood vessels is based on the theory that beta-endorphin like compounds released by the hypothalamus activate receptors on the endothelial surface to release nitric oxide, thereby resulting in dilation of vessels. Laughter leads to reductions in stress hormones such as cortisol and epinephrine.

When laughing the brain also releases endorphins that can relieve some physical pain. Laughter also boosts the number of antibody-producing cells and enhances the effectiveness of T-cells, leading to a stronger immune system.

Contrary to notions that it is spontaneous and involuntary, research documents that laughter is sequentially organized and precisely placed relative to surrounding talk. Far more than merely a response to humor, laughter often works to manage delicate and serious moments. More than simply an external behavior “caused” by an inner state, laughter is highly communicative and helps accomplish actions and regulate relationships. Laughter can be used as a coping mechanism when one is upset, angry or sad.

Laughter can also be brought on by tickling. Although most people find it unpleasant, being tickled often causes heavy laughter, thought to be an (often uncontrollable) reflex of the body.

Laughter is not always a pleasant experience and is associated with several negative phenomena.

Laughter has been used as a therapeutic tool for many years because it is a natural form of medicine. Laughter is available to everyone and it provides benefits to a person's physical, emotional, and social well-being.

An open-label randomized controlled trial evaluated the effects of laughter therapy on quality of life in patients with cancer. The study used laughter yoga, comedy, clown and jokes. The result showed that laughter therapy was helpful in improving quality of life and cancer symptoms in some areas for cancer survivors. Improvements were seen in the area of depression, anxiety and stress levels.

A research study found the subjects laughed an average of 18 times per day. The study, however, found a wide range, with some people laughing as many as 89 times per day, and others laughing as few as 0 times per day.

Crying

Crying emotional tears is uniquely human. The act of emotional crying, however, is poorly understood. Little consensus exists about the purpose of crying, its underlying physiology, and its impact on human moods.

Processing, feeling, and sharing emotions is a good thing; crying may be less about physiology and more a social signal to others that someone needs help. Current research indicates no conclusive evidence that the act of shedding emotional tears intrinsically makes one feel better, nor that crying's main function is to excrete toxins

The exact physical mechanisms of crying are not yet agreed upon. We know now that tears are produced by the lacrimal gland, whose main job is to keep the eye clean and moist.

Three kinds of tears are identified: basal tears, reflexive tears, and emotional tears. Basal tears moisten and protect the eyes from tiny particles. Reflexive tears are produced at higher volumes when larger particles or other irritants enter the eyes, even bright light. Eating something spicy or throwing up can also produce reflexive tears. Emotional, or psychogenic, tears are produced in the absence of a physical irritant but in response to a wide variety of emotional states.

Having a visual signal of distress is beneficial ... not only a noisy, vocal one that could attract unwanted attention. Tears may have evolved to be such a communicative signal at close range to tell others that we are vulnerable and in need of assistance. This is the leading explanation for tears: that they signal to others that we need help, and facilitate bonding and connection with others.

Studies have found that people are better able to recognize others' emotions when they have visible tears. They also have feelings of kindness, empathy, and connectedness to people in the teary photos. In general, crying brings about positive reactions from others.

Why you cry, and who you cry around, makes probably the biggest difference as to whether crying feels good. When people have support from others, or if crying helps them resolve an issue, or understand it better, they are more likely to feel better after. If people are shamed for crying, or embarrassed, then they feel worse.

People cry more in more developed and individualistic countries—indicating that crying behaviors relate to freedom of expression rather than to suffering.

How much control you have over a situation can influence whether you feel better after crying or not. The most common emotional trigger for crying is feeling powerless or hopeless, which is often accompanied with sadness, fear, anger, or disappointment.

These findings do not fully cover all of crying's mysteries—how some people report feeling better when they cry by themselves, for example, or why studies continue to show that women cry more than men (it could be sociocultural, or have a hormonal influence). What is happening in the body during crying still is being discovered, but huge levels of physiological arousal are measured that seem to be counterintuitive to the idea that it makes you feel better. For the most part, rather than calming down it is accelerating in arousal.

Studies over decades have not found any large differences in the overall well-being cry more frequently than those who do not. It cannot be concluded that crying is either cathartic or inherently good for one's health.

Criers were found to be more empathic, they felt more connected to others, and they also received more social support from others. When people who cry are seen as having a valid reason to cry, they

are perceived as warm and reliable, the kinds of people that others want as friends, neighbors, or co-workers.

In addition to garnering social support, crying might force us to think about what is bothering us.

It can be hard to manage emotions. Threats such as when one feels insulted or left out simulate similar brain networks to those that are triggered when primary survival needs are threatened.

This activates the limbic system, which houses emotional reactions. This seeks to minimize the perceived threat by avoiding a person or situation, or by attacking back.

This is an unconscious reaction, and one that is fairly easily triggered. The limbic system is more tuned to threats than rewards. As a result, the ability to respond rationally or fairly is inhibited. Acknowledging the stressors that trigger that threat response is one of them helps to manage the response.

Five key social threats that act as potential stressors. These include having competence undermined, feeling of being micro-managed, and believing a situation to be unfair.

Recognizing these trigger points as the threats to social standing that they are helps manage how to deal with the 'fight or flight' response kicking in. Being aware of the stressors helps as a reminder that there is no overt threat to wellbeing or safety.

Re-engaging the 'thinking brain' at times of emotional reaction takes time and practice. A brief pause, for example, in the midst of a heated conversation enables consciously choosing what to do or say next.

The point of evolution is to pass along genes. Love is so important that evolution has seen fit to engage every mechanism in your body to make sure you're as close and bonded as you can be. Studies of the genetics and neurochemistry of love relationships from a variety of scientific perspectives seek to explain the nature of love.

Animals do not use love to manipulate others. Humans do.

The reason love evolved was to motivate and reward humans for taking part in relationships, critical to survival. That goes for reproductive partners, children, and extending to friends. Humans are highly cooperative because they have to be.

Many things that go into whether a relationship will last—oxytocin levels, genetics, upbringing, attachment profile, the support of family. When one falls in love for the first time is the activation of various areas of the limbic system and the neocortex. These activations may remove some of the hurdles that might otherwise inhibit trying to start a relationship.

There also are deactivations. These deactivations occur mainly in the brain area linked to "mentalizing." Mentalizing is the ability to make judgments about someone's intentions.

Lust is an unconscious emotion. It takes place entirely in the limbic area of the brain. It happens within the first nanoseconds of seeing somebody.

Then the algorithm in a brain will decide if this is somebody or this is not somebody attractive. If the algorithm registers positive then oxytocin and dopamine are released and that lustful feeling develops. The conscious brain kicks in quickly after that, but the first moments are completely unconscious.

Attachment is a deep, psychological bond between two people. A mother's attachment is based mainly on nurture.

For a father, nurture is important, but there is an added element that comes from the cortical area of the brain. It pushes a child's developmental boundaries to increase resiliency and sociability.

These are culturally gendered roles but also have an evolutionary explanation. It does not cause two individuals who have input into something to have the same role if that is not required because that is a waste of energy.

Research has shown changes in the brains of a single parent or a parent in a same-sex couple. The human brain is incredibly plastic. All parents have the ability to nurture, to challenge, to build resilience. These changes enable the brain in a single individual to behave in ways like a mom or dad.

If a child had sensitive parents who were aware of emotional and physical needs, and met those needs, the child was secure and did not suffer anxiety or abandonment. The child's brain was infused with oxytocin and dopamine and beta endorphin, and low levels of cortisol producing this highly efficient brain.

With neglect, brains have an increase in cortisol. Active neuronal death occurs, which sees reductions in gray and white matter in those pro-social areas of the brain.

They do not go forward with those abilities to do all that, to do the reciprocity, the trust, the empathy. The behavior they have watched, which is relationship behavior, is not good and that is something that they often will replicate going forward. They also do not have the biological underpinnings to enable them to be able to have good relationships.

Humans tend to privilege romantic relationships and maybe parental relationships and take friendships for granted. But they are important.

Research shows much more similarity to friends than to a lover. A woman, for example, typically is more emotionally intimate with her friends than her lover.

Humans neglect friendships at our peril because often friendships outlast romantic relationships. Friendships are important for mental health, physical health, longevity, and well-being.

https://nautil.us/love-is-biological-bribery-14058/?utm_source=pocket-newtab

Venting

Neuroscience explains that venting reinforces negative emotions. The more people vent, the more likely they are to vent in the future.

Venting can be like scratching a mosquito bite. It feels like it works at first. It feels like anger or frustration is released, but it is not.

Realizing one is angry (always OK) is different from telling someone “I’m angry” (sometimes OK), and it is further from berating a loved one for causing anger (not OK). Another impetus for reinforcing the “catharsis hypothesis” is media messaging. Yet it often does not make these distinctions clear.

Exercising restraint is hard. Protecting other people from the full brunt of frustration—which is almost always driven by underlying fear, insecurities, and anxiety—takes work.

Venting usually does not work to enhance intimacy. People feel less empowered and more out of control.

None of this means emotions should be repressed. Talking with friends can bring closure when they help reconstrue an event, rather than just recount it. Asking why, prodding to see whether there is anything to be learned, and just generally broadening perspective can help emotional recovery.

<https://slate.com/technology/2022/03/venting-makes-you-feel-worse-psychology-research.html>

A Guide to Anger Management

Engage in preemptive meditation: think about what situations trigger your anger, and decide ahead of time how to deal with them.

Check anger as soon as you feel its symptoms. Don't wait, or it will get out of control.

Associate with serene people, as much as possible; avoid irritable or angry ones. Moods are infective.

Play a musical instrument, or purposefully engage in whatever activity relaxes your mind. A relaxed mind does not get angry.

Seek environments with pleasing, not irritating, colors. Manipulating external circumstances actually has an effect on our moods.

Don't engage in discussions when you are tired, you will be more prone to irritation, which can then escalate into anger.

Don't start discussions when you are thirsty or hungry, for the same reason.

Deploy self-deprecating humor, our main weapon against the unpredictability of the Universe, and the predictable nastiness of some of our fellow human beings.

Practice cognitive distancing – 'delaying' your response – by going for a walk, or retire to the bathroom, anything that will allow you a breather from a tense situation.

Change your body to change your mind: deliberately slow down your steps and breathing, lower the tone of your voice, impose on your body the demeanor of a calm person.

Above all, be charitable toward others.

https://getpocket.com/explore/item/anger-is-temporary-madness-the-stoics-knew-how-to-curb-it?utm_source=pocket-newtab-en-us

Demeanor

A useful personal demeanor can be summarized as: Calm + Think + Act (CTA).

1. Calm yourself especially in a stressful situation.
2. Think then about options and determine a best course of action.
3. Act decisively based on the determination and adjust as need using again the CTA process.

Use CTA when anticipating events. Humans are in the habit of exaggerating the anticipation of potentially unpleasant events.

As the Roman, Seneca, wrote: There are more things that frighten us than actually harm us, and we suffer more in imagination than in reality. One will suffer soon enough if something bad happens without dreading it in the meantime. Misplaced worry keeps us tensed against an imagined catastrophe; it prevents us from fully living.

How to know what you really want

Desires are fundamentally different from needs. Desire (as opposed to need) is an intellectual appetite for things that one perceives to be good and has no physical, instinctual basis for wanting.

Desire will not necessarily cause physical pleasure. They might spill over into physical enjoyment, but they are not dependent on it. Rather, the pleasure is primarily intellectual.

For most people such pleasure is fleeting. There always is something else to strive for – and this keeps most of us in a constant, sometimes painful, state of never-satisfied striving.

That striving for something that we do not yet possess is called desire. Desire does not bring us pleasure because it is, by definition, for something we feel we lack.

Understanding the mechanism by which desires take shape, though, can help us avoid living our lives in an endless merry-go-round of desire. We would like our desire to come from our deepest selves, our personal depths, but if it did, it would not be desire since desire is for something we think we lack.

Mimetic desires are the desires that we mimic from the people and culture around us. If one perceives some career or lifestyle or vacation as good, it often is because someone else has modelled it in such a way that it appears good.

To become more aware of the models influencing desire, do these:

- Identify the people influencing wants
- Categorize models as internal and external

Mimetic desire often leads people into unnecessary competition and rivalry with one another in an infernal game of status anxiety. The solution involves learning a new way of entering into non-rivalrous relationships with other people – a new kind of relationship in which your sense of self-worth is not derived from them. This helps one stop accepting currently dominant desires at face value and from defaulting into important life choices instead of choosing them with intentionality.

Desires have history. Know where desires come from.

That involves understanding how one has evolved as a person, and seeing which desires have been prevalent for a long time and which ones have come and gone. Take ownership of desires

Things that have traditionally been called virtues, or habits of being, such as prudence, fortitude, courage and honesty keep one grounded in something deeper even while the mimetic waters swirl around. In other words, there are certain perennial human values and desires that are worth pursuing no matter what because they have been proven not to disappoint.

Perhaps the most anti-mimetic attitude of all is an openness to wonder and a desire to let reality surprise you. It rarely disappoints.

Some learn how to live with a minimal amount of material things. Love people, use things. There are some enduring values – such as health, creativity or the opportunity to share meals with other people – that never go out of style, and there are as many ways to pursue them.

From the standpoint of mimetic desire, material things are also talismans for some deeper desire. All desire is a desire for being.

Before pursuing a specific kind of material possession, ask what kind of person it is helping you to become – and, if you do not like the answer, reconsider the purchase. It is likely that if you cannot be satisfied right where you are now, then you probably will not be satisfied anywhere. Lifestyle is something that emerges from one's values and discipline, not something found in a particular possession.

Resilience

Resilience is a key useful attribute for human existence. It is the capacity to recover quickly from difficulties ... an emotional and physical “toughness”.

Resilience means being able to adapt to life's misfortunes and setbacks. When something goes wrong, do you tend to bounce back or fall apart?

When you have resilience, you harness the inner strength that helps you rebound from a setback or challenge, such as a job loss, an illness, a disaster or a loved one's death. If you lack resilience, you might dwell on problems, feel victimized, become overwhelmed or turn to unhealthy coping mechanisms, such as substance abuse, eating disorders or risky behaviors.

Resilience does not make your problems go away — but resilience can give you the ability to see past them, find enjoyment in life and better handle stress. When stress, adversity or trauma strikes, you still experience anger, grief and pain, but you are able to keep functioning — both physically and psychologically.

When stress, adversity or trauma strikes, you still experience anger, grief and pain, but you are able to keep functioning — both physically and psychologically.

Resilience, however, is not about putting up with something difficult, being stoic or figuring it out on your own. In fact, being able to reach out to others for support is a key part of being resilient.

Resilience can help protect you from various mental health conditions, such as depression and anxiety. Resilience can also help offset factors that increase the risk of mental health conditions, such as being bullied or previous trauma. If you have an existing mental health condition, being resilient can improve your coping ability.

Tips to improve resilience:

Get connected. Building strong, positive relationships with loved ones and friends can provide you with needed support, guidance and acceptance in good and bad times. Establish other important connections by volunteering or by joining a faith or spiritual community.

Make every day meaningful. Do something that gives you a sense of accomplishment and purpose every day. Set clear, achievable goals to help you look toward the future with meaning.

Learn from experience. Think of how you've coped with hardships in the past. Consider the skills and strategies that helped you through difficult times. You might even write about past experiences in a journal to help you identify positive and negative behavior patterns — and guide your future behavior.

Remain hopeful. You can't change the past, but you can always look toward the future. Accepting and even anticipating change makes it easier to adapt and view new challenges with less anxiety.

Take care of yourself. Tend to your own needs and feelings. Participate in activities and hobbies you enjoy. Include physical activity in your daily routine. Get plenty of sleep and create consistent bedtime rituals. Eat a healthy diet. Practice stress management and relaxation techniques, such as yoga, meditation, guided imagery, deep breathing or prayer.

Be proactive. Don't ignore your problems. Instead, figure out what needs to be done, make a plan and take action. Although it can take time to recover from a major setback, traumatic event or loss, know that your situation can improve if you work at it.

<https://www.mayoclinic.org/tests-procedures/resilience-training/in-depth/resilience/art-20046311>

Depression

Historically, depression has often been blamed on low levels of serotonin in the brain. That answer, however, is insufficient, and alternatives are changing our understanding of the disease.

Many think of depression as a “chemical imbalance” in the brain. The primary unbalanced brain chemical in question is serotonin, an important neurotransmitter with fabled “feel-good” effects.

Serotonin helps regulate systems in the brain that control everything from body temperature and sleep to sex drive and hunger. Medications like Prozac (fluoxetine) are designed to treat chronic depression by raising serotonin levels.

The role of serotonin and the premise of the chemical-imbalance in depression may be incomplete, despite the relief that Prozac seems to bring to many patients. Research seems to have found no convincing evidence that lower levels of serotonin caused or were associated with depression.

Genetic studies also seemed to rule out any connection between genes affecting serotonin levels and depression. The evidence suggests that there may not be a simple answer for what causes depression.

During the late 1980s, selective serotonin reuptake inhibitor (SSRI) drugs, like Prozac, were introduced. The drugs raise levels of serotonin activity by slowing down the neurotransmitter's absorption by neurons. Today, the serotonin hypothesis is still the explanation most often given to patients with depression when they are prescribed SSRIs.

But doubts about the serotonin model arose by the mid-1990s. SSRIs often fell short of expectations and did not improve significantly on the performance of older drugs like lithium. By the early 2000s, few experts believed that depression is caused solely by lack of serotonin.

SSRIs change the relative concentrations of chemicals other than serotonin. Some clinical psychiatrists believe that one of the other compounds may be the true force inducing or relieving depression.

For example, SSRIs increase the circulating levels of the amino acid tryptophan, a serotonin precursor which helps regulate sleep cycles. This chemical has emerged as a strong candidate in its own right for staving off depression.

Both tryptophan and serotonin may contribute to the regulation of bacteria and other microbes growing in the gut, and chemical signals from these microbiota could affect mood. While the exact mechanisms linking the brain and gut are still poorly understood, the connection seems to influence how the brain develops.

Other neurotransmitters like glutamate, which plays an essential role in memory formation, and GABA, which inhibits cells from sending messages to one another, may be involved in depression as well. It's possible that SSRIs work by tweaking the amounts of these compounds in the brain.

Serotonin has such widespread effects in the brain that we may have trouble disentangling their direct antidepressant effect from other changes in our emotions or sensations that temporarily override feelings of anxiety and despair. Not all theories of depression hinge on neurotransmitter deficiencies.

Researchers have identified genes that underlie a large spectrum of disorders, including about 200 genes that have been linked to a risk of depression. Several hundred more genes have been identified as possibly raising the risk.

Simply having the genes for depression does not necessarily guarantee that someone will become depressed. The genes also need to be activated in some way, by either internal or external conditions. Both genetic and environmental factors play a critical role.

Individuals with different genetic profiles respond differently to changes in their environment. Different genetic variations can affect whether individuals respond to certain types of stress, such as sleep deprivation, physical or emotional abuse, and lack of social contact, by becoming depressed.

In the brains of people with chronic depression, the “white matter” areas that are rich in nerve fibers have fewer connections. The cause for this difference is uncertain.

Environmental influences like stress can also sometimes give rise to “epigenetic” changes to a genome that affect subsequent gene expression. An example is changes in the caps on the ends of chromosomes, known as telomeres, which affect cell division.

Other changes in chemical tags called methylation groups can turn genes on or off. Epigenetic changes can sometimes even be passed down through generations.

Studies of these genes may someday help identify the form of treatment a patient would respond to best. Some genes may predispose an individual to better results from cognitive behavioral therapy, while other patients might fare better with an SSRI or therapeutic ketamine.

Differences in a person's genes may predispose them to depression; so, too, may differences in the neural wiring and structure of their brain. Individuals differ in how the neurons in their brains interconnect to form functional pathways, and that those pathways influence mental health.

Chronically depressed people have fewer connections in their brains. Possible explanations include neuroplasticity and inflammation.

The brains of depressed differ structurally from those of non-depressed people. For example, people experiencing depression showed fewer connections within the “white matter” of the nerve fibers in their brains.

After several weeks of treatment, the general level of neural connectivity in depressed patients' brains increased as their symptoms lessened. It does not seem to matter what kind of treatment the patients received, so long as their mood improved.

A possible explanation for this change is the phenomenon of neuroplasticity. Neuroplasticity means that the brain is able to create new connections. If depression occurs when a brain has too few interconnections or loses some, then harnessing neuroplastic effects to increase interconnectedness might help lift a person's mood.

Another possible explanation is that depressed patients' brain connections are impaired by inflammation. Chronic inflammation impedes the body's ability to heal, and in neural tissue it can gradually degrade synaptic connections. The loss of such connections is thought to contribute to mood disorders.

Treatments for depression may be tailored to individual patients by a more nuanced understanding of their risk factors. People with chronic inflammatory diseases like lupus and rheumatoid arthritis have higher-than-average rates of depression. Of course, knowing that they have an incurable, degenerative condition may contribute to a patients' depressed feelings, but researchers suspect that the inflammation itself is also a factor.

If overlooked chronic inflammation is causing many people's depression, researchers still need to determine the source of that inflammation. Autoimmune disorders, bacterial infections, high stress and certain viruses, including the virus that causes Covid-19, can all induce persistent inflammatory responses.

Viral inflammation can extend directly to tissues in the brain. Researchers are trying to understand whether depression causes inflammation or inflammation leads to depression. Devising an effective anti-inflammatory treatment for depression may depend on a better understanding.

“Depression” can be an umbrella term for a suite of related conditions. Treatments for depression may need to be tailored to the individual.

If there are different types of depression, they may present similar symptoms — such as fatigue, apathy, appetite changes, suicidal thoughts, and insomnia or oversleeping — but they might emerge from completely different mixes of environmental and biological factors. Chemical imbalances, genes, brain structure and inflammation could all play a role to varying degrees.

To treat depression effectively, medical researchers may therefore need to develop a nuanced understanding of the ways it can arise. Treatments may include a set of diagnostic tools that can determine the best therapeutic approach to an individual patient's depression, be it cognitive behavioral therapy, lifestyle changes, neuromodulation, avoiding genetic triggers, talk therapy, medication or some combination thereof.

https://www.quantamagazine.org/the-cause-of-depression-is-probably-not-what-you-think-20230126/?utm_source=pocket-newtab

Strategy for Overcoming Fears

Instead of letting fear control your actions, be methodical about your reaction and decision-making process by using this method. It's possible to train your brain to think differently when events make you feel stymied and you don't know what to do.

Use a "quadrant" system to harness the strengths of the brain's hemispheres. Certain tasks are localized in specific areas of the brain. Understanding how the hemispheres work together, you can better know how to move forward.

Improve your reaction and decision-making process by graphing out an unexpected event on an X and Y axis. X is your left hemisphere. It's logical, objective, and scientific. It's what we can all agree on in materialistic way. Y is your right hemisphere. It's big picture and subjective, where things have meaning.

When you experience an unexpected, stressful event, ask yourself, what are the objective unmistakable facts, and what does the event subjectively mean to you? And do you perceive the facts and thoughts to be positive or negative?

If the subjective thoughts and objective facts are both negative, you are in the lower left-hand quadrant.

If the objective facts are positive but your subjective thoughts are negative, you are in the bottom-right quadrant with anxiety about the future.

If subjective thoughts are positive, but the objective facts are negative, you are in the upper-left quadrant,

When the subjective and objective are both positive, you are in the upper right-hand quadrant. You experience a feeling of everything is working in concert with what we believe and is of meaning in our lives.

This feeling is referred to as "flow". It is a journey you go through to get back to flow.

You're always going to be in one of quadrants. You can train your brain to use cognitive dominance, overcoming the situation to get into new quadrant.

Look at the situation ask yourself: “I’m in this quadrant. How do I get to where I want to go?” Identify one micro-goal that you can take. Make decisions that move in a positive direction on the Y-axis. Even one step can give you a jolt of dopamine that can create a new network in the brain.

Knowing where you are is comforting and is the starting point for adapting to change, You can see the big picture and know that something will pass. You can also see what you need to do to climb up that Y-axis.

https://getpocket.com/explore/item/a-neurosurgeon-shares-his-effective-strategy-for-overcoming-fears?utm_source=firefox-newtab-en-us

Microbiomes Affect Fear

There is evidence that microbiomes can influence the fear responses of their hosts, possibly by releasing compounds that affect the brain’s neuroanatomy and function. The intestinal microbiome has been shown to influence cognition and emotion, affecting moods and the state of psychiatric disorders, and even information processing.

In the medial prefrontal cortex, an area of the outer brain that processes fear responses, researchers noticed distinct differences in mice with impoverished microbiomes: the mice without healthy microbiomes could not learn to be unafraid, and the researchers could see it on a cellular level.

Snipping the vagus nerve did not alter the behavior of the mice. The immune system may affect the brain, but the numbers and proportions of immune cells in all the mice were similar.

Four metabolic compounds with neurological effects were far less common in the blood serum, cerebrospinal fluid and stool of the mice with impaired microbiomes. Some of the compounds were already linked to neurological disorders in humans. The microbiome might produce certain substances in abundance, with some molecules making their way into the brain,

Although the intestinal microbiome is clearly altered in many people with brain conditions, it is often unclear if that change is a cause or an effect. Differences in the microbiome might give rise to neurological problems, but the conditions could also change the microbiome. Research on other disorders like depression has also pointed to the involvement of particular compounds created by microbes, but no consensus exists about which ones contribute to any condition.

Our environments may affect our nervous systems by way of the microbiome, adding new layers of complexity to the study of health and disease in the brain.

https://getpocket.com/explore/item/how-microbiomes-affect-fear?utm_source=firefox-newtab-en-us

Thriving

“Thriving” is a psychological term to describe the state in which people experience a sense of both vitality and learning. The news, social media, and conversations with our family, friends, and others can generate stress which limits thriving..

Survey respondents reported their top three emotions were frustration, worry, and anger. The number of respondents choosing anger as one of their top emotions has risen recently.

Negativity can have toxic effects. Research indicates that people falter when exposed to negativity or rudeness.

Mere exposure to rude words reduces the ability to process and recall information. People tend to shut down, stop communicating, and cease being helpful to others.

A productive way to counter those effects is through thriving. Thriving individuals are growing, developing, and energized rather than feeling stagnated or depleted.

People who experience a state of thriving are healthier, more resilient, more able to focus And less burned out. They also are more confident

To increase thriving ...

Avoid negativity. Make choices away from negativity and toward positivity with your thoughts, the information to which you are exposed and those with whom you associate..

Watch out for what you say out loud. Negative language is particularly insidious and potent. It is several times more damaging to our sense of thriving if we verbalize a thought than if we just think it.

Think about how you are framing and speaking about a situation. Acknowledge the truth, while minimizing its power to drag you down.

Adopt a neutral mindset. Focusing on what we can control and what we should do next.

Neutral thinking is a nonjudgmental, nonreactive way of assessing problems and analyzing crises. This includes staying in the moment, reacting to each moment as it unfolds, and keeping your focus on how you can influence your next action..

Practice gratitude. Gratitude reduces our stress, makes us happier, and helps us reach our goals.

Manage your energy. Exercise, eat well, and get enough sleep. Spend time outside and with others; listen to music.

In summary, make smart choices about who and what you surround yourself with, the mindset you adapt, and the information you consume.

https://getpocket.com/explore/item/how-to-thrive-when-everything-feels-terrible?utm_source=pocket-newtab

There are ways for even pessimists to change their mindset.

One method is the ABC theory, which stands for “an activating event, your belief about what it means, and the consequences of how you react to it.” For example, when somebody cuts you off in traffic, you can believe that they are a jerk or you can believe that they possibly could be rushing because they have an emergency.

Another tactic is the “three blessings” exercise. Each day, write down three things that went well for you. The idea is that most people complain a lot and often don’t recognize they’re doing it, and the antidote to complaining is gratitude.

Flip concerns about risks to a positive question. “What’s the worst that can happen?” becomes, “What are the best possible outcomes?”

Share your optimistic view with others. When we repeat things out loud, we override the negative pessimistic views.

Surround yourself with optimistic people and news. Challenge negative comments and viewpoints when you encounter them.

Being optimistic often is challenging. But, when you consider the benefits of being optimistic, it makes it worth the effort.

https://www.fastcompany.com/91127499/how-to-become-more-optimistic?utm_source=pocket-newtab-en-us

Be Curious, Not Anxious

A recent study may even offer a new way to think about anxiety. Certain brain areas tend to process uncertainty as curiosity in ambiguous situations. The study’s findings indicate how deeply the two elements are interrelated.

As uncertainty rose in the study subjects, so did curiosity. Brain scan data seemed to confirm high activity in two regions: the occipitotemporal cortex, known to be involved in vision and recognizing types of objects; and the ventromedial prefrontal cortex, which helps determine a person’s perception of value and confidence about a situation.

The scans observed uncertainty driving curiosity in participants’ brains. The study’s implications may extend to how we deal with forms of uncertainty—perhaps even the intrusive, existential kind that keeps some of us up at night.

Most people seem to hate uncertainty. It signals a lack of control, along with a sense of trouble looming.

To the human mind, uncertainty equals danger. Humans assume the worst, over-personalize threats, and jump to conclusions.

Uncertainty is a critical driver of stress. In fact, a scientific study concluded that uncertainty is even more stressful than situations with predictable negative outcomes.

A way people can deal with forms of uncertainty might be as simple as a matter of reframing. For instance, with nervousness reframe it as excitement, since the two feelings resemble each other ...that way you acknowledge the physical feelings without putting a negative spin on them.

The same goes for uncertainty and curiosity. Another way to process uncertainty is as an opportunity for discovery.

Something unclear in one's life likely can be broken down into its component parts for further analysis. Practically all possibilities have potential for research and exploration, rather than mere dread.

The shift to an attitude of curiosity will not just magically resolve the issue at hand, but it can help prepare for, or deal with, whatever awaits. The shift can feel better and be more constructive.

https://www.fastcompany.com/91159221/science-your-brain-wants-you-to-be-curious-not-anxious?utm_source=pocket-newtab-en-us

Job Happiness and Satisfaction

To assess your job situation start by distinguishing between happiness and satisfaction and exploring which aspects of your job relate to each of these. From there, figure out which parts of your job are the ones that bring you the most of each.

That way, as you think about your future, you can best strategize about new positions you might want to aim for. To help you along the way, here are three questions that will provide you with valuable insight into the best parts of your work life.

1. Where do I find the most satisfaction? Is it in the process of doing my work or in the final outcome?

We often use the words happiness and satisfaction without reflecting on the differences between them. Happiness is a momentary experience that reflects the positive feelings that result from pursuing some desirable outcome. Satisfaction is a positive feeling that reflects a longer time horizon in which you're pleased with what you've achieved over a period of time. The process of your work affects your daily happiness with what you do, while the outcome is typically associated with your sense of satisfaction.

Because the process of your work is associated with happiness, it affects your day-to-day interest in the work you are doing. When you like the particular tasks that are part of your job, you look forward them. There is a good feeling that comes from performing well on elements of your job that you find intrinsically rewarding.

The outcome of your work relates to the mission of the organization for which you are working. Do you believe in that mission? Do you believe your efforts are making the world a better place?

When you work toward a significant outcome and make progress on it, you feel a sense of satisfaction with your work. Research suggests that taking pride in the outcome of your work provides long-term satisfaction.

If you engage in tasks you do not enjoy in service of an important goal, you still may feel a lot of satisfaction in your work, even though it does not bring you much happiness. Ultimately, however, it is best to have both the happiness as well as the long-term satisfaction.

2. How do my values align with my work?

After you identify the aspects of your job that you like, try to understand why those aspects of work are appealing. This evaluation is rooted in your values.

Values reflect key aspects of what people think is important about their life and work. Your work should align with your values.

If you value helping others, then the mission of the work may be a critical component to whether you appreciate your job. If you value pleasure in life, then your daily happiness at work (reflected in the particular tasks you do) will be central to helping you to live up to that value. If you value

achievement or power, then your personal accomplishments at work will influence your satisfaction with your job.

10 core human values have been identified that are consistent across many cultures: self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, benevolence, and universalism.

A person's values can evolve over time. For example, early in your career you may value achievement, so you might enjoy aspects of your job that bring you individual recognition, while later in your career, you may value benevolence and derive more satisfaction from aspects of your job that enable you to help others.

3. What do I want to be able to say I've accomplished?

Alignment of your work with your values means considering not just the particular tasks you do daily, but also the accumulated influence of those tasks over time (or what you might think of as your legacy). To think about legacy, project yourself mentally to the end of your working period and look back. Focus both on whether you currently feel like your work aligns with those values, but also to explore what future positions might also help you to be satisfied with your work.

If you feel like your work and current trajectory will enable you to continue feeling that alignment between your job and your values, then focus on your current career trajectory. But, if you have a significant mismatch, that is a good indicator that it may be time to think about alternatives.

https://hbr.org/2023/01/what-do-you-like-about-your-job?utm_source=pocket-newtab

Parents' Trauma Leaves Biological Traces in Children

Adverse experiences can change future generations through epigenetic pathways. This is another important reason for civilized humans to prevent - or to end early - traumatic events.

Research has confirmed that adverse experiences may influence the next generation through multiple pathways. The most apparent route runs through parental behavior, but influences during gestation and even changes in eggs and sperm may also play a role.

And all these channels seem to involve epigenetics: alterations in the way that genes function. Epigenetics potentially explains why effects of trauma may endure long after the immediate threat is gone, and it is also implicated in the diverse pathways by which trauma is transmitted to future generations.

The implications of these findings suggest that parental trauma predisposes offspring to be vulnerable to mental health conditions. On the other hand, there is some evidence that the epigenetic response may serve as an adaptation that might help the children of traumatized parents cope with similar adversities.

In the classic fight-or-flight response, a threatening encounter triggers the release of stress hormones such as adrenaline and cortisol. The hormones prompt a cascade of changes, such as quickening the pulse and sharpening the senses to enable the threatened person or animal to focus on and react to the immediate danger. These acute effects were believed to dissipate once the danger receded.

Neuroscientists reported that veterans with PTSD had high levels of adrenaline but lower levels of cortisol than patients with other psychiatric diagnoses. Because stress usually causes stress hormones, including cortisol, to rise, many researchers were skeptical of these observations.

Among stress hormones, cortisol plays a special, regulatory role. High levels of stress hormones, if sustained for a long time, harm the body in multiple ways, weakening the immune system and increasing susceptibility to problems such as hypertension.

But in a context of acute trauma, cortisol may paradoxically also have a protective effect. It shuts down the release of stress hormones—including itself—reducing the potential damage to organs and the brain. Such a trauma-induced feedback loop could conceivably reset the cortisol “thermostat” to a lower level.

Vietnam veterans were more likely to develop PTSD if they’d been abused as children. Slowly a shape was emerging that connected intense childhood adversity—a period of “freeze” because a child usually cannot fight or flee—with low cortisol and the possibility of future PTSD.

People who had been raped or who had been in auto accidents when they came into emergency rooms found that those with lower cortisol levels were more likely to develop PTSD after the attack or accident.

If someone with low cortisol was subjected to a traumatic experience, the cortisol levels in their bodies might be too low to tamp down the stress reaction. Adrenaline levels might then shoot way up, searing the memory of the new trauma into the brain. Perhaps low cortisol marked a vulnerability to developing PTSD.

Vietnam veterans with PTSD had a greater number of glucocorticoid receptors. These are proteins to which cortisol binds to exert its diverse influences. That suggested a greater sensitivity to cortisol: a small increase in the hormone’s concentration would precipitate a disproportionate physiological reaction.

Understanding the molecular underpinnings of cortisol functioning—in part by examining epigenetics – we can understand how exposure to trauma might reset the cortisol feedback loop.

The output of our genes is sensitive to factors not written directly into our genetic code. Genes provide the templates for producing proteins. But how much of those proteins gets produced, or “expressed,” depends on the environment.

Epigenetics is the study of what influences gene expression and how. It is crucial to understanding both the neurobiology of PTSD and the intergenerational effects of trauma.

Epigeneticists explore the switches that turn gene expression on and off. One such mechanism, called methylation, involves a methyl group—a methane molecule that is missing one of its four hydrogen atoms, leaving a chemical bond free to attach to another atom or molecule.

Methylation is a process by which, in the presence of specific enzymes, methyl groups attach to key sites on a strand of DNA or within the complex of DNA and proteins known as chromatin. By occupying these sites like roadblocks on a highway, methyl groups can alter transcription, a basic step in gene expression where a piece of RNA is made from a DNA template.

Increased methylation generally impedes RNA transcription, whereas less methylation enhances transcription. These changes are enduring in that they survive normal cell division and require specific enzymes for their removal.

Epigenetic changes on stress-related genes of veterans with PTSD have been identified. These alterations partially explained why trauma's effects were so persistent, lasting for decades. Specifically reduced methylation in an important region of NR3C1 was observed, a gene that encodes the glucocorticoid receptor, likely increasing the sensitivity of these receptors.

This epigenetic modification suggests a potential explanation for how trauma might reset cortisol levels. The body regulates the stress response through a complicated feedback mechanism.

A rise in cortisol levels will prompt the body to produce less of the hormone, which may drive up the numbers and responsiveness of glucocorticoid receptors. Given the epigenetic and other changes occurring with sustained responses to trauma, the feedback loop might become recalibrated. In people who have already endured trauma, their stress systems might be sensitized and their cortisol levels diminished—increasing their adrenaline response to further trauma and leading to PTSD.

Epigenetic Inheritance

Some of these epigenetic changes in trauma survivors also are found in the children of trauma survivors. The uterine environment played a role as did the sex of the traumatized parent.

Those whose mother (or both parents) had PTSD tended to exhibit lower cortisol levels and showed evidence of more sensitive glucocorticoid receptors. In contrast, those whose fathers, but not mothers, had PTSD showed the opposite effect.

Lower methylation was discovered within the glucocorticoid receptor gene, NR3C1, in offspring whose mothers, or both parents, had PTSD. These changes mirrored what was observed in the maternal survivors themselves.

But in offspring with only paternal PTSD, more methylation was observed - the opposite effect. These findings raised the possibility that PTSD in mothers and fathers might lead to different epigenetic changes on the glucocorticoid receptor in children.

Methylation was examined within another gene, FKBP5, which encodes a protein involved in regulating the ability of the glucocorticoid receptor to bind cortisol. The findings showed related methylation patterns within the FKBP5 gene in both parents and their children.

Lower levels of FKBP5 methylation are observed in the adult children whose mothers - and not fathers - were exposed to the trauma during childhood. This effect was independent of whether the mother had PTSD. It suggested that trauma might have affected the mothers' eggs decades before her children were conceived, while she was herself a child.

Researchers discovered that the combined effects of extreme stress and nutritional deprivation, such as deficits in metabolism and susceptibility to cardiovascular illness, depended on the trimester of exposure.

Babies were also impacted in the womb, with those in the third trimester having significantly lower cortisol levels. Mothers who had PTSD (and low cortisol) were more likely to report that their nine-month-olds were unusually anxious and afraid of strangers.

How might the uterine environment leave a trauma trace in the offspring? Survivors had lower levels of the enzyme than those who had not lived through trauma - and such effects were particularly pronounced in those who were the youngest.

The enzyme is normally concentrated in the liver, kidneys and brain. Under conditions of food deprivation, however, the body can lower levels of 11β -HSD2 to increase metabolic fuel in the interest of promoting survival.

In adults, the enzyme level will return to what it had been originally when there is no more starvation, but in children, the level may remain low. Findings suggested that 11β -HSD2 levels might have been altered during childhood when survivors were exposed to long periods of malnourishment; the change persisted well into old age.

In the children of women who were survivors, however, the opposite was found: 11β -HSD2 levels were higher than in control subjects. The result might seem contradictory, but there is a logic to it. During pregnancy, 11β -HSD2 also acts in the placenta, protecting the fetus from exposure to circulating maternal cortisol, which can be toxic to the developing brain.

The enzyme, which is particularly active in the third trimester, converts maternal cortisol into an inactive form, creating a kind of chemical shield in the placenta that protects the fetus from the hormone's harmful effects. The high levels of this enzyme in the offspring of survivors may thus reflect an adaptation, an effort to protect the fetus from the lowered 11β -HSD2 levels in their mothers.

All of this means that offspring are not always passive recipients of their parents' scars. Just as a parent was able to survive trauma by means of biological adaptations, offspring can sometimes adapt to the biological impact of their parents' trauma.

How traumatized parents interact with their children, of course, also influences their development. Many psychologists and neuroscientists have examined the traumatized family, finding ever more subtleties, and the story will continue to unfold for decades to come.

An important question is whether epigenetic alterations in stress-related genes, particularly those reflected in the offspring of traumatized parents, are necessarily markers of vulnerability or whether they may reflect a mechanism through which offspring become better equipped to cope with adversity.

It is tempting to interpret epigenetic inheritance as a story of how trauma results in permanent damage. Epigenetic influences might nonetheless represent the body's attempts to prepare offspring for challenges similar to those encountered by their parents.

As circumstances change, however, the benefits conferred by such alterations may wane or even result in the emergence of novel vulnerabilities. Thus, the survival advantage of this form of intergenerational transmission depends in large part on the environment encountered by the offspring themselves.

Moreover, some of these stress-related and intergenerational changes may be reversible. Combat veterans with PTSD who benefited from cognitive-behavioral psychotherapy showed treatment-induced changes in FKBP5 methylation.

The finding confirmed that healing is also reflected in epigenetic change. Such findings represent an important frontier in psychiatry and may suggest new avenues for treatment.

Source: Scientific American July 1, 2022

https://getpocket.com/explore/item/how-parents-trauma-leaves-biological-traces-in-children?utm_source=pocket-newtab-en-us

Creativity

If humans are the sum of the facts and logic stored in their brains and bodies, how is the creation of new concepts, music and objects accomplished? This creation includes dreams while sleeping that contain places, things and people that seem to never have been experienced before.

An example of conceptual creativity are Einstein's thought experiments to develop the theories of Special Relativity and General Relativity. He used common items (a person, a closed room, the beam of a flashlight, etc.) that he had experienced and stored in his brain to think about how they behaved relative to each other in conditions of acceleration (which is equivalent to gravity). The theories later were demonstrated and proven with empirical tests.

Human brains need downtime for processing and learning new things — and they do this during sleep. Evidence indicates that sleep makes learning and memory storage possible.

Dreaming may play a role in that process. Research suggests that experiences appear in our dreams.

Dreaming helps solve problems. Physical changes in the brain during sleep and during dreaming support this conclusion.

During dreaming, the visual and emotional processing areas of the brain are active. Other parts of the brain which are involved with our ability to plan, think through things and apply logic and order are less active during dreaming.

Humans dream for two hours every night. Only in the past few decades, with the advance of technology like MRIs that lets us record and visualize activity in the brain, have neuroscientists begun to figure out how and why we dream.

Dreams tap memories stored in connections between brain cells, which the hippocampus tracks as they form. At night it directs neurons to replay recollections, facilitating long-term storage. That could be why reality seeps into our visions—but not why they tend to warp reality.

Our most vivid imaginings occur during the REM phase of sleep. Activity increases in brain regions that control movement and process optical inputs, like the visual and motor cortices, which likely create what we “see” and “do” in slumber. It's not clear what triggers these areas at night.

The amygdala helps generate feelings like fear, anger, and anxiety. It and other emotional domains are more active during REM sleep, which could explain why strong reactions happen frequently when we doze. We may rely on this process to dull the sting of difficult memories.

Despite their disjointed nature, dreams still contain semi-rational thoughts, likely thanks to areas supporting conscious cognition. The anterior, or front, portion of the cingulate, a semicircle in the brain's center, influences motivation and decision-making—and can switch on while we're snoozing.

During REM, neuroscientists see suppression of the dorsolateral prefrontal cortex, which is critical for executive functions like directing attention, solving problems, and reasoning. This might help explain why we rarely realize we are asleep, despite some outlandish scenarios.

Humans visually and emotionally process things, but certain executive processing functions (such as planning or considering the past) do not happen during dreaming. When awake, the input comes from the environment; when asleep, the input comes from within. During dreams, recent and older stored memories and logic are accessed at the time when the processing functions of the brain are less active resulting in the creation of seemingly novel and often odd situations and associations.

Humans are capable of abstract thinking. Abstraction is considered to be one of the key traits in modern human behavior, and developed between 50,000 and 100,000 years ago. It likely was closely connected with the development of human language, which involves and facilitates abstract thinking. Language dynamics (priming, expectations, momentary confusion, etc.) are subtle but critical to understanding and response.

Abstract thinking draws upon associations that exist due to overlap in the distributed neural cell assemblies that participate in the encoding of experiences in memory. Abstraction is a process that integrates separate specific facts and logic into a more general concept. For example, individual animals with similar characteristics are collected into the single concept, or abstraction, of “dog”.

Abstractions include forms of language (spoken and written), mathematics, and objects (such as drawings). These forms then are combined to define abstract concepts such as scientific theories (e.g., the theory of general relativity). Research has indicated that the same person will exhibit similarities in different abstractions they develop regardless of the form of the abstractions.

Why do living things have an instinct to survive and to reproduce? No definitive answer exists but several theories offer explanations.

One theory is that early organisms which managed to survive carried forward their genetic characteristics which helped accomplish that survival. These characteristics compounded with ongoing evolution resulted in plants and animals with an instinct to survive. Reproduction assisted in survival and thus became a related instinct.

Other instincts such as pain minimization and curiosity developed since they contribute to survival. In addition, a human generally strives to optimize overall Satisfaction level.

IQ often is considered as a crucial driver of success, particularly in fields such as science, innovation and technology. But other qualities such as creativity, imagination, curiosity and empathy also are important.

Many of these traits are embedded in what scientists call “cognitive flexibility” – a skill that enables switching between different concepts, or adapting behavior to achieve goals in a novel or changing environment. It is essentially about learning to learn and being able to be flexible about the way to learn.

Flexible thinking is key to creativity – in other words, the ability to think of new ideas, make novel connections between ideas, and make new inventions. It also supports academic and work skills such as problem solving.

Unlike working memory – how much you can remember at a certain time – cognitive flexibility largely is independent of IQ, or “crystallized intelligence”. Creativity is important in science and innovation. For example, researchers have discovered that entrepreneurs who have created multiple companies are more cognitively flexible than managers of a similar age and IQ.

Cognitive flexibility is also associated with higher resilience to negative life events. The opposite of cognitive flexibility is cognitive rigidity, which is found in a number of mental health disorders including obsessive-compulsive disorder, major depressive disorder and autism spectrum disorder.

Neuroimaging studies have shown that cognitive flexibility is dependent on a network of frontal and “striatal” brain regions. There are a number of ways to objectively assess people’s cognitive flexibility.

It seems cognitive flexibility can be trained. Cognitive behavioral therapy (CBT), for example, is an evidence-based psychological therapy which helps people change their patterns of thoughts and behavior. In CBT, the goal is to reconstruct their thinking to consider more flexible options.

Structural learning – the ability to extract information about the structure of a complex environment and decipher initially incomprehensible streams of sensory information – is another potential way forward. Researchers are working on determining whether structural learning can actually lead to improved cognitive flexibility.

People can learn to be cognitively flexible in their thinking. This will provide them with greater resilience and wellbeing in the future.

Cognitive flexibility is essential for society to flourish. It can help maximize the potential of individuals to create innovative ideas and creative inventions.

Relationships

Relationships refine human immune systems. Emotional stress affects susceptibility to burnout and disease. Interpersonal relationships play a significant role in the experience of stress — either contributing to it and or alleviating it.

Experiences of bonding, train limbic pathways via a cognitive origin of these formative patterns. Somewhere human brains carry a map of personal relationships. This map is available even when alone.

Psychologists call this sense embeddedness. The opposite is perhaps a more familiar term — called loneliness.

The emotions that relationships evoke are among the greatest forces that affect hormonal, nerve chemical, and immune responses — and through these, health and resistance to disease.

These emotions are encoded early and carried forward through symbol and ritual, using physical experiences and objects as memory-anchors. Relationships are also inherently alive — they grow and change via evolution — and sometimes revolution.

A relationship is built of moments that a mind has pulled out from where they were stored in memory, moments and memories that come with emotions attached. Memories, spliced together like this in a seamless thread, make a relationship seem continuous and whole.

So, after not seeing a childhood friend for years, people can pick up where they left off, as if no time at all had intervened. In this way, too, relationships can be sustained.

This chain of memory can lead to difficulties in a relationship if one member evolves past where the other's memory left off. A period of adjustment may be needed to reset the relationship.

At times, one small corner of that relationship memory map can swell and grow, reverberate and suddenly seem to take over a person's entire world. With effort, or simply through gradual erosion of time, they recede again to a less significant place and size.

The social world can activate the stress response, or it can tone it down. The effects of these personal connections can be soothing or they can be stressful.

In fact, of all the sensory signals from moment to moment throughout the day, it is the ones connected in some way to another person that can trigger emotions most intensely. In one way or another, most of popular culture strives toward sealing or healing these social connections.

The social self is central to neurobiological experience of stress. Social conflict brings out an additional and unique hormonal response that is not stimulated by other forms of stress.

When stressed – perhaps with lack of sleep and too much work, but especially with prolonged anxiety over personal or workplace situations – a person is predisposed to disease. The role of psychological patterning in physiological predisposition to disease, and how it can begin to rewire response to stress is a continuing discovery.

One of the longest-running studies of adult life ever conducted concludes the most satisfied and healthiest people are those who have warm connections with others. These others are those who make you feel more open and more inclusive.

<https://www.youtube.com/watch?v=ISsehNAOL8>

Partner Relationship

What's the best way to get to know a potential partner better? It's good to let things unfold naturally, but it's also important to have intentional conversations to clarify if you're a good match and whether there may be a future together.

Understand what's important to you and how you show up in a relationship. Following are questions for yourself and your significant other.

First, consider how it feels to be with your potential partner,

Is it easy to be around this person? Why or why not?
How do I behave when I'm around them?

Are there parts of myself or my life I'm not sharing or holding back? Why?
How do I feel about our relationship so far?
Is there anything that feels like a red flag.

What has the other person already shared with you?

If the other person keeps their answers superficial, they may not be ready to have a full-on heart-to-heart talk.

What information are they choosing to share and not share with me?
What topics cause them a lot of excitement and to share many details?
What topics do they avoid?
How do they talk about relationships with friends and family?
How do they talk about past romantic relationships?
How do they talk about failed relationships of any kind?
Do they blame others or show self-awareness about how they may have contributed and what they have learned?

Understand what they value about their relationships in general..

Who are you closest to?
What friendships matter most to you?
What do you value in a friendship?
What do you find challenging or get tired of in relationships?
What do you enjoy about your relationships?

If you encounter resistance to questions about previous romantic relationships, asking what exactly about the subject makes the person uncomfortable is perfectly acceptable.

What went well in your past relationship?
What did you find frustrating?
How did you try to work through your problems?
What did you learn from that relationship?
Do you still have any unresolved feelings?

One of the most common problems is disagreement about a partner's involvement in the partnership or marriage versus other priorities like work. And, check in with your partner about alone time and time together is a good idea in any relationship phase since needs can fluctuate.

How do you like to balance time together?
What kind of physical space do you need?
How important is touch, cuddling, and sex?
Is it easier to relax with others or when you're alone?
What do you enjoy doing by yourself? Do you ever go to a movie or take a trip alone?

Core values and beliefs?

How often do you like to see friends and family?
What are your thoughts about community in your city, your country, and beyond?

What are your values and beliefs around work? How do you prioritize family, work, health, and other values?

What mistakes do you tend to make with these priorities? (For example, working at the expense of health, etc.)

What aren't you willing to give up?

You won't get through all of these questions in one conversation. Sometimes, you need to discuss things multiple times to really come to an understanding, plus feelings and priorities change.

If you decide to take your relationship to the next level and move in together or get married, there are some specific questions that are good to consider before that step. Ask open-ended questions. The more information you have, the better you will be at making household decisions together.

How do you feel about this commitment? What are you excited about, and what do you worry about?

What little things are coming up, like chores, schedules, and other life details?

How important is it to you to design and decorate your physical space the way you want?

How do we plan to divide things up financially?

What are your financial priorities?

How does the way you grew up affect your financial choices now?

How important is it to entertain and have guests?

How do you feel about pets?

What are your feelings about having children?

What does happy cohabitation or marriage look like?

But these questions are just to get you started. You'll never be able to ask all the questions. The important thing is developing the ability to communicate and talk about difficult things.

https://www.wellandgood.com/couples-questions-know-better/?utm_source=firefox-newtab-en-us

Long-Term Marriages Usually Get More Satisfying

Recent longitudinal studies show a U-shaped pattern of satisfaction in lengthy marriages with higher satisfaction in the early years, declining during the middle, and increasing again later on. The first few years of a marriage frequently are rife with conflicts, but the emotional situation eventually changes.

In time, humor becomes more prevalent, and bickering and criticisms decline. Men demonstrated less anger, and women less contempt.

Older couples were not more affectionate with each other. Passionate love morphs into "companionate" love in time.

Humor is arguably an expression of the second kind of devotion. A main takeaway is that couples may take themselves a bit too seriously. It is worth considering when in a spat with a significant other - to look for humor in the situation.

Research has found that things such as socializing, being with friends is very important to short-term happiness. Being with a romantic partner is even more important.

Many think that a good time will be just lying on a couch and browsing the internet, or using social media or playing an iPhone game. But, in fact, people are not particularly happy doing that.

Intimacy and Sex are the happiest activity. Others near the top are going to a museum or an exhibition.

Gardening ranks high along with theater, dance shows, sports, running, exercise, singing, performing, talking, chatting, socializing, bird-watching, nature-watching, walking, hiking, hunting, and fishing.

Most of the activities providing more happiness do not require a lot of money. There is no point at which money stops giving people happiness. But it levels off. It always is increasing but at a smaller and smaller rate.

Going from \$40,000 to \$80,000 of income gives the same happiness boost as going from \$80,000 to \$160,000 of income, which gives the same happiness boost of going from \$160,000 to \$320,000 of income. Generally, doubling income provides the same happiness increase.

There's an additional boost if a person's net worth gets above \$8 million. One of the reasons for that is that activities that are at the bottom of the happiness activity chart are the annoying things of modern life. Once net worth gets to \$8 million, one can stop doing them.

Work is the second most miserable activity. This is counter to a common belief that work is a source of a lot of fulfillment and purpose.

Another area of interest is parenting. Extensive research indicates that parents matter less than expected. With respect to financial well-being as an adult, genetics play two to three times a bigger role than do parents.

What makes or what predicts a happy marriage? Researchers used machine learning models to predict variables that correlate with levels of happiness in romantic relationships.

The results were that it is very difficult to predict marital happiness. Relationships may be chaotic systems.

If relationships get a little off track, they just keep getting off track. And if they are on a good track, they stay on that track, or even get better over time. But a slight change in initial conditions can lead to vastly different outcomes.

A happy couple is more likely to be happy in the future. An unhappy couple is more likely to be unhappy in the future. Everything else adds almost nothing predictive power to changes in relationships.

Conventional potential partner traits include attractiveness, sexual taste, shared values, hobbies, and similarity to oneself. Those traits, however, tend to have very little correlation with how happy are partners. The most important predictor of happiness in a romantic relationship is whether partners are happy outside the relationship.

Finally, physical attractiveness is the most predictable determinant of success, on average, in almost every sphere of life. Of course, that trait does not necessarily determine outcomes for a particular individual.

<https://www.vox.com/even-better/23338680/instincts-happiness-data-seth-stephens-davidowitz>

Get What you Want

Most people who seem to get what they want have something about the way they make others feel about them. They have behaviors that make it easier and more likely for them to get what they want.

1. Seek to support

Their words and actions are offered in a way that seem to support others not themselves. The more it's the former over the latter, the better they'll feel about you, even if they don't realize it.

2. Watch their language

They are very intentional in their word choices and reactions. They do not say "I know how you feel."

One can try, but it is difficult to truly understand another person's experience. It matters that the person they are talking with believes that they hear.

3. Don't assume

Are they assuming something that is not actually proved? How would they react differently if they admitted that they did not know?

4. Embrace silence

A good problem is one that solves itself if you leave it alone. When they embrace silence, others often will solve the problem in a very beneficial way.

5. Focus ... when it is time to focus on others

Assuming they welcome the attention, it tells others: they are important. They will be a receptive audience.

6. Admit shortcomings

They admit them to themselves. They use their strengths, admit their shortcomings and ask for help.

7. Don't assume the worst.

They avoid assumptions and are comfortable with the fact that there is a temporary gap in their knowledge base.

https://getpocket.com/explore/item/7-powerful-habits-of-people-with-high-emotional-intelligence?utm_source=pocket-newtab

Likeability

Likability's benefits are pretty obvious. People can do several things to improve their likability:

1. Show Genuine Enthusiasm For Meeting

Just be natural. Give your best, authentic smile. Open up your posture so your legs are at a wide stance but you're relaxed. Make eye contact, offer a firm handshake.

2. Offer A Compliment

Notice something about the person you've just met about which you can compliment them and do it right away. Ask a question or two that can lead to information you can later compliment them on.

Likeable people are great listeners right from the moment they make acquaintances. See how much you can find out about the new acquaintance.

3. Ask Open-Ended Questions

When someone starts talking about something they enjoy, use that as an opening to ask more. Don't just ask yes/no or simple factual questions that might cut off their chance to really dig into it.

4. Find Something You Share

Find an interest or belief you both share. It's easiest to connect with people they've found something in common with. These commonalities might not always be obvious, though; you have to look for them.

5. Say Their Name Before You Leave, And Commit Key Facts To Memory

Say it when you first meet someone; then sprinkle it throughout the conversation whenever you get the chance. At a minimum, make sure to say their name when you're about to leave.

People reinforce their likability by remembering a few key details later on. Try to remember useful information to refer back to the next time you see them.

https://getpocket.com/explore/item/do-these-5-emotionally-intelligent-things-within-5-minutes-of-meeting-someone?utm_source=firefox-newtab-en-us

Feedback vs. Advice

The best way to get people to coach you is, instead of asking for feedback, seek advice.

Compared to those asked for feedback, those asked to provide advice suggested 34% more areas of improvement and 56% more ways to improve.

https://www.cnbc.com/2025/02/11/wharton-psychologist-adam-grant-successful-people-ask-for-advice-not-feedback.html?utm_source=firefox-newtab-en-us

Communications

Effective communications has been found to have several attributes. Language can influence perception in communication but, trustworthiness and even attractiveness are highly dependent on facial expressions.

According to research, as a face becomes happier, it also becomes more trustworthy. A person even can override quickly a negative first impression made based on appearance.

Making such a judgement may seem superficial might seem rash, but it is done frequently. And can have significant implications.

For example, studies have demonstrated that facial appearance can be used to predict the outcome of political elections. In an experiment, borrowers who were perceived as looking less trustworthy were less likely to get loans in spite of having supportive information about the borrowers employment status and credit history.

Being likeable can have its benefits in business. Workers with better social skills are more likely to be successful and those who are well liked are better at getting their way at work. This has become even more important with the needed ability to work in teams and to influence with or without an actual title.

Several mannerisms can help with more effective communication.

A flash of the eyebrows. Brains are always surveying the environment for friend or foe signals. The three major things we do when we approach somebody that signal we are not a threat are: an eyebrow flash - a quick up and down movement of the eyebrow that lasts about a sixth of a second - a slight head tilt, and a smile.

Make interaction about the other person. That means not talking about yourself.

Make people feel good about themselves by showing a genuine interest in what they are saying. Learning more about them helps generate that interest. Maintain a natural level of eye contact to indicate interest.

Make empathic statements that might reflect some of what the other person is feeling. Instead of direct flattery, allow people to flatter themselves by indirect praise of what they have accomplished (such as: "the people I know with that college degree are very successful").

Find common ground ... even when your opinions diverge. When you disagree, try to really listen to the other person rather than thinking about your response.

Watch their body. Mirror the body language of the other person. When people are conversing and they begin to mirror one another, it can be a signal that they have a good rapport. A good way to test how the conversation is going is to change your own position; if the other person copies you, it is probably going well.

Revealing details about yourself little by little. A common mistake that many make is to overwhelm new people with too much information about themselves, which can put them off.

Research has found that the quicker someone will answer personal questions, the quicker a relationship is going to advance. And, simply spending time near someone (proximity and duration) can build rapport.

Enhance harmony between body language, tone, and words.

Posture matters. Chin slightly up, ears over the shoulders, shoulders rolled back with chest out, pull your belly button in gently as you breathe and keep your knees slightly bent with weight on the balls of your feet - take three deep, slow, controlled breaths to set your posture.

Establishing and maintaining eye contact is crucial. Eye contact is key for building connections and credibility.

A friendly gaze is important when greeting someone new, start with soft eyes that match a gentle smile; when seeking buy-in, open your eyes wide while connecting with your audience. Be careful, however: there is a delicate balance between connecting with intensity and staring with intimidation.

Avoid pointing. Instead, use open-palm gestures while ensuring your arms remain uncrossed.

Facing, with squared shoulders, the other person and leaning in to show attention send listening signals. Shift your bodyweight onto the balls of your feet, you subtly lean in towards them.

Acknowledging people's contributions, hard work, or creativity can be expressed through a simple salute. It doesn't have to be a formal military salute; lifting your right hand to your head shows respect and can indicate your comprehension of their message. Seek opportunities to "salute" others frequently and promptly. How you deliver your salute with words, tone, and arm movement can send a friendly message of appreciation and gratitude.

Improving communication is more art than science. While science guides our efforts, our unique communication style, body language, and tone determine its impact.

https://www.fastcompany.com/91016143/best-jobs-2024-good-salaries-flexible-wfh-indeed-list?utm_source=pocket-newtab-en-us

For difficult conversation about problems or differences of positions, several approaches are useful.

Prepare by envisioning doing things right. For example, plan to use a calm tone of voice.

The brain functions more effectively in a positive frame of mind. As an example, gratitude is highly positive.

Have a goal. Get the other person to say: "That's right." Do this by listening and then summarizing their perspective for them. Especially focus on articulating any negative thoughts they have. Do not dispute or deny them (avoid the word "but").

Once their perspective is articulated, they feel understood. And a person who feels understood is getting a feel-good wave of chemicals in their brain including oxytocin, the bonding chemical. If they feel bonded, that is advantageous.

When people have arguments, they raise their voices because they do not feel heard. Acknowledging how someone is upset does not incentivize them to dig in more; it does the opposite.

Start out articulating their negative thoughts about the situation. It is like a shortcut to a positive outcome.

Brain science shows that every time a negative emotion is identified, that negative feeling diminishes. Then it is easier to talk.

Do not be sarcastic. It does not matter whether you think their perception is fair or accurate.

The process of working to make them feel heard creates calmness. The anger circuitry in the brain will not get triggered.

Listen, reflect, and observe. The more you listen, the more likely it is that they will. And you get more of an opportunity to listen by asking fair questions rather than thinking of the next statement you are going to make.

A common derailment is trying to explain something. Explaining something makes the other side perceive condescension. Once they feel heard, there is really good chance no explanation is required.

Explaining comes across as a veiled form of fighting back. It introduces unnecessary tension into the discussion. You are better off asking questions.

And as you listen to their answers, show empathy and try to understand, not judge. Talking less and listening more helps you to stay calm. Slow the conversation down, it gives the other person (and yourself) the chance to think rather than just react.

Once the person feels heard, put it back on them: "How do we move forward?" The answer is not necessarily as important as the thought process, and without seeming combative.

If the other person becomes irate, use a supportive tone of voice, this will have a neurochemical impact on them that will calm them down.

People better can handle bad news when they are given the slightest opportunity to be prepared, rather than blindsided. It allows the person to prepare.

If the discussion ends in a stalemate, the last impression is the lasting impression. If the last word is something positive, it leaves the possibility that the other person will think more about the situation and come back with a proposed resolution.

Diversity of individual thought and belief is a fact of life and can be harnessed to unite rather than divide. Humans tend to react defensively to opposing views. Five key skills promote constructive conversations.

These skills include 1) taking deep breaths to facilitate rational thinking, 2) intentionally establishing common ground, 3) genuinely inquiring about the other person's perspective, 4) actively listening to learn rather than to win, and 5) encouraging further dialogue by asking "Tell me more."

Adopting these skills can lead to more constructive outcomes in contentious conversations and foster collaboration. Ultimately, an individual's ability to engage in productive discussions depends on their motivation. Reflect on your intentions ... choosing between a genuine desire to solve problems or a need to assert superiority. Make the choice that supports your intentions.

<https://www.youtube.com/watch?v=RyKbSXkdmP4>

It is important to listen, reflect, and observe. The more you listen, the more likely it is that they will.

And you get more of an opportunity to listen by asking fair questions rather than thinking of the next statement you're going to make..

Avoid too much explaining. Explaining comes across as a veiled form of fighting back

Talking less and listening more allows you to stay calm. If you start escalating the volume and voracity of your words, the other person will too. Slow the conversation down, it gives the other person (and yourself) the chance to think rather than just react.

Try to read the other person and what they were really trying to say. Let them have the last word and resist the temptation to insert a last second barb that will literally undo all the progress you will have just made.

https://getpocket.com/explore/item/want-to-make-difficult-conversations-easy-try-this-1-counterintuitive-trick-according-to-psychology?utm_source=pocket-newtab-en-us

Negotiation takes rapport. Listen first. Listening is the most powerful negotiation tool.

Resist the urge to fire back right away. If you are feeling kind of worked up, someone's pushing your buttons, and you're getting triggered, it lasts an average of about 20 minutes.

During this time, you cannot take in any disconfirming information, any information that disagrees with your emotions, even an apology. If you're feeling triggered, pause, recognize it, and wait for the state to pass when possible.

Demonstrating listening helps defuse tension.

The other person may say things that don't make sense. They might be intentionally trying to make it confusing, so get clarity. Ask questions. For example, "What do you mean by that? How would that play out?"

Let them get it all out. Genuinely listen with curiosity.

Once the person exhausts themselves and you've learned everything you can, ask, "Is there anything else?" Usually that gets you the most important information. Only then, when you finally get a 'no' to the 'Is there anything else question,' is it your turn. This triggers reciprocity, so they now listen to you.

Demonstrate empathy. Listen to the other person and make it about them first.

Empathy for the other person will likely impact your story. Instead of being focused on winning or being right, share your story. You're unlikely to change someone else's mind, but by sharing your story, they might change their own mind.

https://www.fastcompany.com/91116266/how-to-negotiate-with-a-bully?utm_source=pocket-newtab-en-us

With disagreements, even in the worst-case scenario, each party should feel heard, even if disagreements linger. One of the biggest mistakes people make in disagreements is fighting to win — to prove the other person wrong and persuade - rather than to understand.

It can be tempting to levy personal attacks and blame the other person. We might dismiss and interrupt them. We may play the victim or completely shut down.

Understand what you're really disagreeing about. Regardless of your desired outcome, there is often a deeper meaning.

To determine the meaning behind the other person's argument, ask questions like, "Tell me why this is so important to you," or, "Is there a story behind this for you?" One partner should do all the listening at first and then be given the space to answer the same questions, uninterrupted.

Ask yourself if you disagreeing over a difference in worldview or in values. Some different choices may be annoying but ultimately don't impact you. Other times, major gaps in core values may threaten the relationship.

People want one of three things out of an argument: to make a point, make a difference, or be heard.

Wanting to make a point, to be right, or to prove the other person wrong is not an effective strategy. People just don't respond well to that tactic.

Why is so important for you to express this point, and why is getting the other person to change their mind the right way forward. Crucial reasons may exist to change someone's mind; maybe they're at risk.

Making a difference means transforming the relationship or the outcome in some way: hearing what motivates them, collaborating on how to move forward, and growing closer in the process.

Making your voice heard includes understanding that sometimes our goals aren't necessarily realistic. The more detached you can be about it, the better your perspective and your recommendation.

Truly hearing someone better enables you to come up with a solution.

Take breaths while the other person is speaking. Take notes. Repeat what you heard to signal you're paying attention to their concerns. Avoid interrupting

Ask: "Do you have anything more to add?" before recapping

Be objective as possible when hearing. Focus on areas of agreement and negotiate where you don't agree

Fight the urge to counter every detail and start by addressing where you agree. Agreement is an olive branch. Acknowledging their points makes them more receptive to points you have.

Invite them to imagine other people's perspectives. Expand the other person's thinking about what's possible.

Restrain from tearing down the other person or insulting their intelligence. Attacking the person and not the argument is not useful.

You might have a physiological reaction called flooding, where your heart rate rises, your muscles tense, and you go into fight, flight, or freeze mode. Step away, take a break.

Think of yourself as a consultant: to provide recommendations and leave it up to the client not so invested because you're not part of their day-to-day. Front-load the conversation with reassurances that your goal is to strengthen even highlight your trepidation.

If the discussion escalates, try saying: "Can we slow this down? I really want a chance to finish what I'm saying before I hear your response," or, "I really want to understand you. Can you say it another way?"

If the other person resorts to lies, avoid going tit-for-tat. Pick a representative lie that demonstrates how their other arguments are untrue. Say: "I think we're disagreeing in a way that's not going to help us understand each other or to reach a good outcome.

In the end, you may just need to agree to disagree. The relationship can continue so long as there is mutual respect. It's not always bad. It's not about who's right. It's just acceptance.

<https://www.vox.com/even-better/24153561/fight-argue-without-ruining-relationships-conflict-disagreement-compromise>

Women and men are somewhat different (but that by itself prevents no one from doing what they can).

Generally, in the priority shown:

Women want: #1 Love (is caring, fun, freedom, support, intimacy ... not control) #2 Respect

Men want: #1 Respect (is admiration, support, kindness ... not fear) #2 Love

Typically, a woman should pick the man she wants; if he is not interested, then move on. A man, generally, should not pursue women, but instead determine if he wants to consider a woman who first shows an interest in him.

A rule of thumb is to spend at least “four seasons” (i.e., about a year) with someone before initiating a long-term commitment. This provides an adequate amount of time to experience the relationship.

In a relationship, not being negative is much more important than being positive, although being positive is important. A long-term marriage or partnership has u-shaped satisfaction curve ... meaning do not give up easily on a relationship (if it is not abusive).

All children regardless of gender need love, time, guidance, rules, freedom, and consequences for actions.

Online dating is changing the nature of relationships. Match.com went live in 1995. The way people meet their partners has changed dramatically since then.

Researchers have studied the nature of the networks that link people to each other. People are strongly connected to a relatively small group of neighbors and loosely connected to much more distant people. These loose connections turn out to be extremely important.

Those weak ties serve as bridges between our group of close friends and other clustered groups, allowing us to connect to the global community. Loose ties traditionally have played a key role in meeting partners.

While most people were unlikely to date one of their best friends, they were highly likely to date people who were linked with their group of friends. Online dating has changed that.

Today, online dating is the second most common way for heterosexual couples to meet. For same-sex couples, it is by far the most popular.

Research indicates high levels of racial integration upon the emergence of online dating. It also indicates that marriages created in a society with online dating tend to be stronger including lower rates of marital breakup.

People may think they know what they are looking for in a life partner, but evidence indicates otherwise.

One group argues that compatibility is predictable or follows some patterns. Another group argues that such attraction develops unpredictably, even chaotically — and can be built between people who do not expect to be compatible.

Some in the second group think it will never be possible to accurately predict couples before they form. It is just too chaotic of a system. Small changes in starting conditions can lead to widely divergent paths later on.

Attraction is not discovered between two people but grown. People have preferences that need to be explored to reveal core values they want to share in a partner.

Initial chemistry is hard to predict. Ultimately, it might not matter as much as these shared values.

One cannot get an entire person's life story and values and what they are looking for in a few hours or less. But after 6 to 12 months, a good understanding can develop.

A good relationship takes time. If one feels like a person shares values and has the things in common that are important, give it a chance.

https://www.vox.com/science-and-health/2022/2/9/22914378/the-science-and-mystery-of-love?utm_source=pocket-newtab

Giving Advice

People seeking advice are generally not interested in being told what to do, but rather in gathering information so that they will have more alternatives and perspectives to consider. Advice seekers viewed the purpose of a request for advice to be more information-focused, while advisors often viewed it as more guidance-focused.

Advisors often fail to truly understand the perspective and concerns of advice seekers. Frequently, advisors give different recommendations to others than they would give to themselves. Leaders advise lower level management to model the right behaviors for employees, like inviting them to contribute their ideas or giving them more opportunity for personal growth, but then fail to do the same.

If advisors think more like novices, their advice ends up being more helpful. Before offering recommendations, ask advice seekers questions aimed at better understanding why they are seeking advice and how the advisor can be most helpful to them.

https://getpocket.com/explore/item/how-to-give-better-advice?utm_source=pocket-newtab

Social Interactions and Loneliness

Social interactions are essential for good mental and physical health, and social isolation can be devastating. In addition to intimate relationships with friends and family, weak social ties are also necessary to the sense of wellbeing.

People who seek out weak social ties ultimately feel more life satisfaction and have a greater sense of belonging. Be assertive but respect people's boundaries and do not force conversation with someone who clearly wants to be alone.

Chronic loneliness is damaging to health. Three in five American adults report feeling lonely and 18% (roughly 46 million people) report that they have just one person or nobody that they can trust or turn to for help in their personal lives.

Loneliness contributes to symptoms of anxiety and depression. It has also been linked to a lowered immune response and cognitive functioning and an increased risk of chronic health conditions including high blood pressure. Loneliness seems to be one of the strongest predictors of morbidity and mortality – how sick we are and how long we live.

Loneliness has less to do with being alone and much more to do with the experience of feeling unheard and unseen. It is the quality, not quantity, of relationships that fulfills the need for connectedness.

People should learn to ask and to listen, both to others and to themselves. This is what will help sort out the difference between being alone and feeling lonely.

<https://getpocket.com/explore/item/it-s-time-to-rethink-what-loneliness-is>

Talking to strangers is good for mental health. Talk purely for the sake of connecting with another human person.

It is effective at pulling one out of a bad mood. Mood-lifting effects of breaking social silences have been demonstrated in a number they consistently underestimated two things: How glad to talk their fellow passengers would be, and how much more chipper a casual chat would make both themselves and their targets feel to create connections where one might otherwise choose isolation. It can help protect against long-term feelings of loneliness.

When conversation advances are rejected, it's important to remember that it is not necessarily about the initiator. Most people are pleased to have someone help them pass the time. So, move on to the next person.

https://getpocket.com/explore/item/why-talking-to-strangers-is-the-best-thing-you-can-do-for-your-mental-health?utm_source=pocket-newtab

Having a variety of different types of social interactions seems to be important for Satisfaction. Research found that people with more diverse social networks were more satisfied with life than those with less diverse networks—regardless of how much time they would spend socializing overall.

This pattern held even after taking into account things like a person's gender, age, employment status, and other potential influences of Satisfaction including better physical health. These results seemed to apply to people from all stations of life and from many cultures.

Across many measures, many populations, and many different studies, the same kind of positive association between a greater social portfolio and well-being was observed. When someone experienced greater-than-average social diversity one week, they were more satisfied that week and the week after—independent of how active or social they were overall.

Other research supports the importance of “weak ties” in social networks—and how interacting with a stranger can be more pleasurable than we predict. It could be that being with different people elicits different kinds of emotions and that emotional variety may be a driving force in Satisfaction.

https://greatergood.berkeley.edu/article/item/a_healthy_social_life_goes_beyond_friends_and_family

Most men do not have enough close friends. A discomfort around vulnerability and lack of prioritization may be partly to blame for many men feeling like they do not have deep enough friendships.

Making and retaining deep, meaningful friendships as an adult is hard, especially for men, according to research. Less than half of men report being satisfied with their friendships,

Those who do maintain friendships with other men say they tend to have lower levels of emotional intimacy than women report. All humans have the innate capacity and desire for close, emotionally intimate connections

Research has shown close friendships protect our mental and physical health. Men should prioritize developing friendships as adults.

Heterosexual men seeking closeness might turn to those they see as better at building relationships and feel comfortable exploring their vulnerability with: the women in their lives and their romantic partners. But it works neither for the men nor the women they look to.

Putting everything on a romantic partner can strain a relationship, whether it is going to a female partner exclusively for emotional support or depending on her to cultivate friendships. It is important to have multiple people to go to for support for different perspectives.

A place to start is one where connections can be made through a shared purpose such as a volunteer activity.

<https://www.cnn.com/2022/11/29/health/men-friendships-wellness/index.html>

Parenting

The role of children in life-long Satisfaction is complex. People who have children are pouring much of their emotional and financial capital into an “investment” they cannot fully control, nor withdraw from.

Based on research, the impact on Satisfaction of parenting (versus not parenting) varies by country, culture, religiosity, age, gender, and financial status. When these variables are controlled for in the research, however, parents and non-parents seem to experience about the same levels of Satisfaction.

In contrast, parents experience more intense emotional highs and lows than do non-parents over the course of their lives. In the end, the experiences of parenting or not parenting are highly individual as is the impact on life-long Satisfaction.

Research has found that having children is relatively negative for quality of life, but the truth about what parenthood means for Satisfaction is more complicated. The majority of people seem to want children at some point.

General things happen in the brain when one has children including release of oxytocin, the “cuddle hormone”. Every human brain is hard-wired to respond to babies positively. The highs are higher, the lows are lower, and whether that sounds like a good deal to someone solely is their choice entirely.

Rewards of having children seem to be different from, and deeper than, Satisfaction. Most describe parenthood as the “best thing they’ve ever done.”

One possibility is a phenomenon called memory distortion. When humans think about their past experiences, they tend to remember the positives and forget the negatives.

Researchers are told that no one and nothing provides so much joy as one’s children. It may not be happiness and Satisfaction day to day, but it is the happiness thought about and remembered.

Other theories about why people do not regret parenthood have nothing to do with happiness, at least not in a simple sense. One involves attachment.

Most parents love their children and would never profess being better off if someone loved did not exist. They prefer a world with their kids in it.

There is more to life than happiness. When parents say that raising their children is the best thing they have ever done, they are not saying that their children gave them pleasure in a simple day-to-day sense or that they necessarily were good for a marriage.

It is something deeper, having to do with purpose and meaning. When people are asked about their life’s meaning and purpose, parents say that their lives have more meaning than those of nonparents. A study by the social psychologist Roy Baumeister and his colleagues found that the more time people spent taking care of children, the more meaningful they said their life was even though they reported that their life was no happier.

If someone has children because they wanted children, they are likely just as Satisfied with their life as a friend who does not have children because he or she did not want to have them.

Likeability

Being liked by those one interacts with can help enhance personal Satisfaction. Several characteristics can help increase a person’s likeability.

Don’t blame. People make mistakes and don’t meet expectations. Instead, focus on doing things better or smarter next time.

Don't try to control. The only thing you really control is you. Control is short term at best, because it often requires force, or fear, or authority, or some form of pressure ... none of which creates mutual Satisfaction. Associate with people who want to go where you're going. This results in better relationships.

Don't try to impress. People may like your things, but that doesn't mean they like you. You'll form more genuine relationships when not trying to impress.

Don't cling. Holding on to someone or something just for security won't make you more Satisfied. Let go so you can reach for and try to earn what you want which will enhance Satisfaction.

Don't interrupt. Listen to what others say. Focus on what they say. Ask questions to make sure you understand what they say.

Don't whine. It makes you feel worse, not better. Put effort into making the situation better.

Don't talk about what's wrong. Talk about how you'll make things better, even if that conversation is only with yourself.

Don't criticize. Everyone is different. Appreciate the differences instead of the shortcomings and you'll see people—and yourself—in a better light.

Don't preach. When you speak with more finality than foundation, people may hear you but they don't listen and won't like you.

Don't live in the past. The past is valuable experience. Learn from your mistakes. Learn from the mistakes of others. Then let it go.

Don't let fear hold you back. Whatever you've been planning, whatever you've imagined, whatever you've dreamed of, get started on it today. Today is your most precious asset—and is the one thing you should fear ... wasting.

https://getpocket.com/explore/item/10-things-incredibly-likable-people-never-ever-do-and-why-you-love-them-for-it?utm_source=pocket-newtab

Trust

Mutual trust is the primary driver of individual and community Satisfaction.

Can you trust me?

Can I trust you?

In every way?

Mutual trust never is achieved 100% ... but the closer to 100%, the greater the level of Satisfaction by all in particular relationships.

Trust means, can you trust me and can I trust you to:

- Support liberty and justice for every individual
- Freely serve the self-interest of others ... as they define their own self-interests (thus, self-interest is self-limiting)
- Be responsible for improving your own health, wealth and wisdom
- Have a purpose at which you do your best and that supports others self-interest
- Understand that your level of Satisfaction ultimately is your choice

These elements and benefits of mutual trust apply to individuals (can you trust yourself), to pairs (e.g., spouses, partners, siblings) and communities (families, neighborhoods, businesses, etc.).

Bias and Bigotry

The term “Race” often is used inaccurately.

Science has demonstrated that any two humans are 99.5% or more identical genetically. We all are members of the same human race.

The remaining 0.5 percent of genetics can vary in ways that correlate with geographical ancestry, however, these correlations do not strictly map to common “ethnicity” categories. Your genome indicates something about the geographical locations of your ancestors, but cannot tell you what “ethnicity” you are.

Simply nothing in the genome is an unambiguous marker of “ethnicity”. Scientists have not found any meaningful biological definition of “ethnicity”.

Yet, many continue to use “ethnicity” as a biological category. The popular misconception that DNA ancestry tests prove “ethnicity” has helped reinforce the assumption of innate biological differences between what are, in fact, socially defined categories.

Observable human differences mostly are superficial or artificial (e.g., skin tone, slight feature variations, nationality). These differences are, however, the basis for varying degrees of bias by some.

A bigot is someone intolerant of others' ethnicity (a social group that has a common national or cultural tradition), physical appearance, opinions or other differences.

Research that includes direct measure of ethnic bigotry is not available. Indirect measures (such as by Pew Research) indicate that about 10 to 20 percent of any fairly large group are bigots to varying degrees about a particular item.

Since in the USA there are five times more white than black people, five times more white than black bigots exist. This means that about one white bigot exists for every black person; one black bigot exists for every 25 white people.

So, each black person on average experiences about 25 times more ethnic bigotry than does a white person. That blacks experience more bigotry than whites is not surprising.

In the 1960's, actions were taken to end the Jim Crow laws of the South as well as other impediments to ethnic liberty, justice and opportunity throughout the U.S. While acts of violence against individual blacks happened, they were not an everyday occurrence.

The larger problem was the daily lack of economic and social opportunity for blacks and of equal consistent justice. That never ending oppression was debilitating and not only detrimental for blacks but for the white community as well.

The experience of history has demonstrated that an individual's selfish self-interest is best served by serving the self-interests of others (as the others define their own self-interests). Bigots, however, have strong beliefs that are not consistent with this principle of self-interest.

Opposition to all bigotry, therefore, by the non-bigoted majorities of each group is in best interest of all those majorities. This opposition often is not easy. The "foot soldiers" of the 1960's civil rights movement are examples.

Prominent leaders such as Martin Luther King were instrumental in taking the ground of liberty (primarily through peaceful means). Many of their followers were critical to holding the ground that had been won.

Following are brief stories about four of those foot soldiers. All were from three nearby towns in Alabama. Sports, which have naturally equalizing qualities, is at the center of each of these stories.

Isaac L, who went by "Ike", attended the black high school on the other side of town from the two white high schools. He was a very good basketball player and played on his school team.

He seemed to be the natural leader of a small group who came to the public outdoor basketball courts near one of the white high schools. A few white players who played for the white high school chose up sides with them for a pick-up game.

For the white players, it was an opportunity to play against others of equal skill which was difficult to find. Such a challenge was more fun. It was in their selfish self-interest. For the black players, it was that ... and more.

It seemed apparent that coming to the courts was a deliberate occurrence by Ike and his group. Also, Ike no doubt was aware that the white high school players received much better coverage and recognition in the local press than did the black school although Ike and his team mates were equally talented.

During one of the outdoor pick-up games, two young white police officers approached the group and said that the black guys would have to leave. The group of blacks and whites then walked away until they all were out sight. After the two officers had left in their vehicle, the group returned to the courts and continued the game.

The white schools were integrated the next year with a few blacks including top level athletes, but Ike and his friends did not change schools. In some instances, black parents likely did not want their children's education potentially disrupted by anything negative arising from the initial days of integration.

After graduation, Ike and a friend would go to previously whites-only restaurants and be the only blacks there. It appeared that they (in addition to wanting a meal) were occupying the ground that had been won in the earlier days of the 1960's.

While Ike and his friends did not change to previously whites-only schools, a few black kids did change to the white schools.

Danny T was one who changed schools and was the first black to play sports in the white high school system in Alabama. Danny experienced overt bigotry from spectators at his games during that season. Prior to one game, an anonymous death threat was received necessitating a significant police presence at the game.

He was an excellent athlete and played on a team of other talented players. That team won the state championship the year he played. Given the success of that team and Danny, the next year saw widespread recruiting of top athletes in black high schools by white schools.

One of those athletes was Porter M who played for a white school in the same town as Danny. Porter also was a good basketball player and, and in spite of his skills and contribution to his team, experienced overt bigotry from a few players and spectators.

Isaac S was an exceptional basketball player who eventually played for a top level university team and later in the NBA for several years until he was injured and left pro basketball. He then became an athletic director at a large university.

One of the local white high schools tried to recruit Isaac to play including having him practice with the team during the summer. In the end, however, Isaac did not transfer, staying at his black school.

It was a surprise to the white high school coaches and players that a black player would not opt to go to a white school with a top level program. Isaac's talent, however, was such that he did not need the white school to be recognized by university programs.

Biased individual behavior is related to present authority, someone's relationship to the authority and a belief that their actions are accomplishing a greater good. People frequently will do things they are not necessarily comfortable with if they believe it serves a greater good as influenced by their social identity with a group. Once a person identifies with a group, he or she will resist even credible evidence that does not support the groups goals.

People will comply with leaders who they identify with socially but tend to resist those who attempt to dictate a position to them. As a result of several sociological experiments over the past half century and real world events in history, no specific demographics (gender, ethnicity, age, religion, etc.) can be identified that are more subject to these behaviors than are others.

Thinking & Learning

Critical thinking contributes to a satisfying existence.

Principles of critical thinking include:

- Independent confirmation of information
- Substantive debate by knowledgeable proponents of all viewpoints
- No “authorities” who are infallible
- Test fairly and quantitatively more than one hypothesis
- If two hypotheses explain the data equally well, usually the simpler is correct

Create the Single Sentence

When communicating something you think is important, ask yourself: Can I articulate my position, my stance, my big idea, in one sentence?

Distilling your message into a single sentence will make your writing or speaking flow better, and make your key points easier to arrange. If you become overwhelmed with an abundance of data or competing themes, the single sentence will help you stay on track.

It will help inform the choices you make regarding what information to keep and what to set aside in your communication. Any piece of data, story, or anecdote that does not fit with your single sentence will wind up sidetracking and diluting your message.

When discussing issues avoid:

- ad hominem comments
- argument from authority
- argument from adverse consequences
- appeal to ignorance
- special pleading
- begging the question (aka assuming the answer)
- observational selection (counting the hits and ignoring the misses)
- statistics of small numbers
- misunderstanding of the nature of statistics inconsistency
- non sequitur
- post hoc, ergo propter hoc — “It happened after, so it was caused by”
- meaningless question
- false dichotomy — considering only the two extremes in a continuum of possibilities
- confusion of correlation and causation
- straw man — caricaturing a position to make it easier to attack
- suppressed evidence, or half-truths
- weasel words

An example of a failure in critical thinking and analysis is a mathematical theory, purporting to show the tipping point upon which individuals and groups “flourish” or “languish.” An exact ratio was identified: greater than 2.9 positive to 1 negative emotions result in a smoother life versus a hard life.

The theory was well credentialed. Cited in academic journals over 350 times, it was first put forth in a 2005 paper and published in the flagship peer-reviewed journal of the largest organization of psychologists in the U.S.

But an undergraduate university student was skeptical.

After researching the theory in more detail, he concluded that normally a rigorous method would be selected and used. In this case, the authors picked a model that fit their data and then ran some simulations.

Their process was indistinguishable from having made up the data. The student happened upon a line in the paper that described the equation from which the ratio was derived.

The equation was included in a 1963 paper by the American mathematician and meteorologist Edward Lorenz on nonlinear aspects of fluid mechanics, a subdiscipline of fluid dynamics—or the study of liquids and gases in motion. In a valid fluid dynamics problem, the numbers plugged into the equation must correlate to the properties of the fluid being studied.

In attempting to draw an equivalence between the physical flow of liquids and the emotional “flow” of human beings, the theory authors simply had lifted the numbers that Lorenz used in 1963 to explain his method in the abstract, numbers used merely for illustrative purposes. The tipping point ratio was meaningless.

After carefully and mathematically disproving the theory, it took many months and considerable effort to have the original theory retracted by the original journal of publication.

In spite of the flawed theory (plus initial failed actual results), the U.S. Army spent more than a hundred million dollars on a program, based on the theory, to treat PTSD of soldiers.

Another example of failure to think critically is the case of a researcher wanting to see if a leading North American journal of cultural studies...would publish an article liberally permeated with nonsense if: (a) it sounded good and (b) it flattered the editors' ideological preconceptions. The researcher submitted such a paper to a postmodern cultural studies journal that published it. Afterwards, the hoax was announced.

Learning

Albert Einstein provided valuable lessons about how to learn and think in way that resulted in extraordinary insights and new knowledge. At the age of 42, Einstein was awarded the Nobel Prize for his work in physics.

A common misconception about Einstein is that he was a poor student. The truth, however, is that Einstein was a strong math student from a very young age.

At the end of college, nevertheless, Einstein graduated the second-to-worst student in the class. This indicates that it often can be very easy to judge the genius of someone after the fact, but harder to predict in advance.

Observations from writings by and about Einstein reveals several methods or behaviors that appeared to have enabled both Einstein's revolutionary discoveries and his deep understanding of the subject matter.

1. Learning comes from solving hard problems, not attending classes.

As he claims, "I played hooky a lot and studied the masters of theoretical physics with a holy zeal at home." Einstein learned physics, not by dutifully attending classes, but by obsessively playing with the ideas and equations on his own.

2. You really know something when you can prove it yourself.

Einstein, was driven by a strong curiosity both to know how things actually work, and a belief that, "nature could be understood as a relatively simple mathematical structure." He would develop a deep understanding and intuition about physical concepts.

3. Intuition matters more than equations.

Einstein was a better intuitive physicist than he was a mathematician.

Einstein's later education in Aarau, Switzerland, was heavily influenced by the philosophy of Swiss educational reformer, Johann Heinrich Pestalozzi who claimed, "Visual understanding is the essential and only true means of teaching how to judge things correctly," adding, "the learning of numbers and language must definitely be subordinated."

4. Thinking requires a quiet space and deep focus.

Einstein was a master of deep work; he had an incredible ability to focus. His intellectually unstimulating and light work load at the Bern patent office gave him time and privacy to unravel the mysteries of relativity.

5. Understand ideas through thought experiments.

Einstein's most famous method for learning and discovering physics were his thought experiments. These thought experiments were built on his intuitive understanding of physics, which in turn was built on his experience with working through theories and problems.

6. Overturn common sense ... with more common sense.

Einstein's genius was to reconcile two commonsense principles—relativity and the constancy of the speed of light—by discarding a third (the idea of absolute measurements of space and time). This practice suggests a method for learning the many, counter-intuitive principles of math and physics—start by building off of a different commonsense premise.

7. Insights come from socialization

While solitude and focus were essential components of how Einstein learned and did physics, it was often conversations with other people that provided his breakthroughs.

Discussing ideas aloud, sharing them with others, can often put together insights that were previously unconnected.

8. Be rebellious.

Einstein was never much of a conformist. This rebelliousness likely helped him in learning physics as he pushed against the traditions and orthodoxy with which he did not agree.

9. All knowledge starts with curiosity.

"Curiosity has its own reason for existing," Einstein explained. "One cannot help but be in awe when one contemplates the mysteries of eternity, of life, of the marvelous structure of reality."

According to Einstein, "Love is a better teacher than a sense of duty." Love of learning and knowledge is, perhaps, a more important skill to cultivate than discipline. His curiosity, humility and tenacity are worth emulating.

Train Your Brain to Remember

The Forgetting Curve describes how we retain or lose information that we take in, using a one-hour lecture as the basis of the model. The curve is at its highest point (the most information retained) right after the one-hour lecture. One day after the lecture, if you've done nothing with the material, you'll have lost between 50 and 80 percent of it from your memory.

By day seven, that erodes to about 10 percent retained, and by day 30, the information is virtually gone (only 2-3 percent retained). After this, without any intervention, you'll likely need to relearn the material from scratch.

You can train your brain to reverse the curve. With just 20 minutes of work, you'll retain almost all of what you learned.

This is possible through the practice of what's called spaced intervals, where you revisit and reprocess the information but in a very specific pattern. Spend 10 minutes reviewing the material within 24 hours of having received it (that will raise the curve back up to almost 100 percent retained again). Seven days later, spend five minutes to "reactivate" the same information and raise the curve up again. By day 30, your brain needs only two to four minutes to completely "reactivate" the same information, again raising the curve back up.

Thus, a total of 20 minutes invested in review at specific intervals and a month later you have excellent retention of that interesting seminar. After that, monthly brush-ups of just a few minutes will help you keep information fresh.

https://getpocket.com/explore/item/train-your-brain-to-remember-anything-you-learn-with-this-simple-20-minute-habit?utm_source=firefox-newtab-en-us

Mental Models

The brain can be trained to think in new ways with mental models. A famous example is Richard Feynman's use of differentiating parameters under the integral sign.

What separated Feynman from his peers was not necessarily raw intelligence. It was the way he saw the problem. He had a broader set of mental models.

A mental model is an explanation of how something works. It is a concept, framework, or worldview that helps to interpret the world and understand the relationship between things.

For example, supply and demand is a mental model that helps understand the economy. Game theory is a mental model that helps understand relationships and trust. Entropy is a mental model that helps understand disorder and decay.

Mental models are the thinking tools used to understand life, make decisions, and solve problems.

Mental models are imperfect, but useful. There is no single mental model from physics or engineering, for example, that provides a comprehensive explanation of the entire universe.

The best mental models are the ideas with the most utility. Understanding these concepts will help make wiser choices and take better actions. This is why developing a broad base of mental models is critical for anyone interested in thinking clearly, rationally, and effectively.

It is important to not only learn new mental models, but to consider how they connect with one another. Creativity and innovation often arise at the intersection of ideas. By spotting the links between various mental models, unique solutions can be identified. that most people overlook.

A few dozen models exist that provide a good grasp of how the world works. Each field has a few models that form the backbone of the topic. Following is a list, developed by James Clear, of key models in major fields.

Business

Economics

- Common Knowledge
- Comparative Advantage
- Diversification
- Economies of Scale
- Efficient Market Hypothesis
- Game Theory
- Incentives (Reward and Punishment)
- Scarcity
- Supply and Demand

Psychology

- Anchoring
- Classical Conditioning (Pavlov)
- Commitment and Consistency Bias
- Hyperbolic Discounting
- Illusion of Control
- Loss Aversion
- Maslow's Hierarchy of Needs
- Mere Exposure Effect
- Operant Conditioning (Skinner)
- Reciprocity
- Status Quo Bias
- Survivorship Bias
- Tribalism

Thinking

- The Scientific Method
- Inversion
- Surfing or “Riding the Wave”
- Working Backward

Science

Biology

- Evolution by Natural Selection
- Equilibrium (Homeostasis)
- Heredity
- Signaling

Chemistry

- Activation Energy
- Atomic Theory
- Autocatalysis
- Entropy (The Second Law of Thermodynamics)
- Catalysts

Physics

Critical Mass
Relativity
Velocity

Math and Engineering

Engineering
Break Points
Leverage
Margin of Safety
Redundancy

Mathematics
Normal Distribution (Bell Curve)
Permutations and Combinations
Power Laws

https://getpocket.com/explore/item/mental-models-how-to-train-your-brain-to-think-in-new-ways?utm_source=pocket-newtab

<https://jamesclear.com/mental-models>

Reading

Reading is the primary and essential key to increasing knowledge and prosperity for an individual and in turn a community. Learning to read effectively is based on proven principles that recently have been re-confirmed by several states in the USA ... states which historically have ranked lowest in education.

Mississippi, Alabama and Louisiana have seen a turnaround in their student reading skills after implementing a series of similar literacy practices. Part of the emphasis on developing multiple generations of readers. These practices frequently are mandated by state government legislation.

These practices emphasize phonics and early screenings for struggling kids. The screenings include signs of reading deficiencies or dyslexia as early as kindergarten, informing parents if a problem is found and giving those kids extra support.

Students are held back in third grade if they cannot pass a reading test but they are given multiple chances to pass after intensive tutoring and summer literacy camps. A challenge is that an emphasis on small-group intervention is a strain on scheduling and staffing.

All three states have trained thousands of teachers in the science of reading; the most proven, research-backed methods of teaching reading. Training teachers in these practices are important since most learn nothing in college about teaching kids to read. Literacy coaches help teachers implement that training, especially in low-performing schools.

https://apnews.com/article/reading-scores-phonics-mississippi-alabama-louisiana-5bdd5d6ff719b23faa37db2fb95d5004?utm_source=pocket-newtab

While it has been practiced in some cultures for centuries, “Mindfulness” is becoming more understood and practiced generally.

An example of practicing mindfulness is the Japanese error-prevention drill that railway employees use. Conductors point at the things they need to check and then name them out loud as they do them, a dialogue with themselves to ensure nothing gets overlooked.

In a research project, when asked to perform a simple task workers typically make 2.38 mistakes per 100 actions. When using mindfulness, this number reduced to just 0.38 – an 85% drop.

Mindfulness is moment-to-moment awareness. For example, participants take time to notice this moment with a person in a place never will happen again.

Haiku poets attempt to capture a moment’s essence in just 17 syllables, using evocative images from nature to convey a Zen-like sense of sudden enlightenment. A famous haiku is:

An old pond
a frog jumps
the sound of water

Practical applications can govern virtually every aspect of daily life, all designed to help you ‘be in the now’. They help keep you conscious of where you are and what you are doing throughout the day,

“Mindfulness is an attitude that can permeate most actions. That present-moment awareness not only boosts stress resilience and well-being, but also lowers levels of anxiety and depression.

https://getpocket.com/explore/item/the-japanese-skill-copied-by-the-world?utm_source=pocket-newtab-en-us

Routines and Practices

There is an important distinction between routines and practices. The more flexible approach is a practice.

Here are a few examples of the difference:

Making cold calls between 4 and 6 p.m. every day is a routine. Making 10 cold calls by the end of every day is a practice.

Holding an all-hands Zoom call every day at 10 a.m. is a routine. Checking in with one or two employees by the end of every day to see if they need help is a practice.

Eating broccoli and a sweet potato for lunch every day is a routine. Getting four or five servings of vegetables every day is a practice.

Routines are what you do. Practices become who you are.

<https://www.inc.com/jeff-haden/google-spent-months-learning-why-habits-fail-answer-often-comes-down-to-1-powerful-word.html>

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Human Failure

Studies failure in its various forms have concluded that there are three distinct ways to fail. Understanding the difference can help us rediscover how to fail in beneficial, less costly, and maybe even fun and exciting ways.

The types of failure to avoid

The first type of failure is “basic failure.” These are the slip-ups that occur from carelessness, distraction, exhaustion, or any number of other attention-snatching scenarios. They include a typo in an office-wide memo, forgetting your mom’s birthday, or reaching for the salt instead of the sugar when baking a pie. Most basic failures end with pint-sized consequences and easy fixes.

The second type of failure is “complex failure.” These failures stem from multiple causes and can be unavoidable if those causes coalesce in ungovernable ways. For example, senior leaders at a company must make decisions despite a myriad of external and internal dynamics to account for. These dynamics’ unpredictable and ever-changing nature means some decisions are bound to fail. However, complex failure can also occur when we have the knowledge to avoid it — or at least minimize the fallout — but we ignore the reality.

Both basic and complex failures should be avoided when possible. They’ll happen anyway, of course. No one has perfect control of their life. However, we can sidestep many of these failures if we give ourselves the time, energy, and focus to act with care and forethought, especially if the task is important.

The third type of failure is “intelligent failure.” These are the failures that teach us something new or improve us in some fashion. Whereas minimizing the basic failures and trying to catch and correct all the problems that lead to complex failures, it’s a good idea to have more intelligent failures.

To call a failure intelligent, it must meet four criteria:

- Relate to an area you don’t have knowledge in.
- Be in pursuit of a goal.
- Not be a random guess but hypothesis-driven.
- Result in a failure that is as small as possible.

Failure is the reason for science’s many successes. The trial-and-error nature of science makes failure inevitable. Still, when failure is informative, it is nonetheless successful because it shapes the next experiment and teaches us what is not true.

These five essential strategies can help as well:

Start small. Engineers don’t build a skyscraper and hope an earthquake won’t knock it over. They build table-sized models and stress test the design in simulated earthquakes. Similarly, start-ups don’t spend forever building the best version of their product. They develop a minimum viable product and test it with small groups of users.

Determine the minimum viable version of your idea and try that first. This strategy will allow you to learn valuable lessons while minimizing losses.

Have a lot of ideas. When people hold one precious idea, they risk over-investing their time, money, energy, and ego. That can lead us to fear any failure, even an intelligent one. Instead, you can brainstorm many ideas and start with the one that shows the most promise. If it doesn't work, you can move on to the next one while using those lessons to inform future attempts.

Establish a feedback mechanism to gather honest opinions and constructive criticism. Identify the feedback mechanism that works best for your idea, and be open to the insights you discover.

Know when to walk away. Quitting is often considered a type of failure, but when done strategically, the results can be intelligent.

Avoid the perfectionist trap. Perfectionist ambitions tend to blind us to failure's lessons. However, the simple truth is that you will fail, so why waste time and energy seeking the unattainable? Better to seek intelligent failure and learn to value it.

It is natural to want to avoid failure. But when we avoid failure, we also avoid discovery and accomplishment. The only way to succeed in any endeavor worth trying is to be willing to experiment, to try new things, knowing full well that many of them will yield failures.

<https://bigthink.com/the-learning-curve/intelligent-failure/>

Existential Concerns

“The four major existential concerns—death, meaning in life, isolation, and freedom—play a crucial role in the inner life of every human being”

- Existence before birth or after death
- Life has no meaning but that which you give it
- You want social interaction ... but you fundamentally are alone
- You are free to be anything ... except not free

A way to increase significantly Satisfaction is losing attachment to oneself. Much of our time is spent in self-focused ways.

All of this self-focus is not necessarily good. Research indicates that excessive self-absorption is associated with clinical depression, personality disorders, and anxiety.

Several ways of being less self-absorbed include two that are dependable:

1) Pursue Mastery

Throwing oneself fully into a work of art, intellect, or athletics is not always pleasant, requires exertion, and often is not amusing. Mastery, however, is meaningful; the benefits of taking on a challenge out of one's own volition and losing oneself in an activity are significant.

Research found that people who had a feeling of continued development and saw themselves as growing and expanding were more likely to score high on assessments of life satisfaction and self-esteem than those who did not. Other research shows that when people throw themselves into an activity for the sake of the activity itself — and not for some sort of external reward, like money or fame or social media followers — they tend to report long-term well-being and fulfillment.

The specific craft need not matter. For some it may be running, for others sculpting, cooking, or playing the cello. What does matter is that one pursue long-term progress in it, and participate not for the sake of raising oneself up (i.e., an ego boost) but for the sake of transcending the very notion of “self” altogether.

2) Be Kind

As meaningful as devoting oneself to mastery may be, devoting oneself directly to helping others is perhaps even more powerful. And, the two are not mutually exclusive.

Research continues to show that one of the best ways to boost Satisfaction is to perform acts of kindness, such as volunteering, mentoring, coaching, or even just writing someone a letter of gratitude. When individuals participate in these activities, they report more positive emotions, both immediately and over time.

Those who undertook altruistic acts reported significantly greater increases in Satisfaction versus those who did not, suggesting a causal relationship, or that acts of kindness are not merely associated

with but actually create Satisfaction. Though the exact mechanism by which performing acts of kindness enhances Satisfaction is unknown, researchers speculate that doing so makes us feel more connected to community.

Additionally, doing nice things for others affords us a purpose that is beyond ourselves and the opportunity to contribute to a greater cause — both of which are associated with increased Satisfaction.

Many paths exist to generate personal wealth. Select your path(s) and follow them changing paths only as necessary.

Following is just one example of a path to increase personal wealth:

- If you earn median income in the USA of \$40,000, this plan will make you a “millionaire” in 40 years.
- Buy and hold shares of a quality S&P500 index fund with 10% of your income (\$333 per month)
- Historic average returns on the stock market (since 1870) after tax are 8% annual.
Do not withdraw any of the fund for the 40 years; do not try to “time” the market

“Luck”, usually, is the end result of smart hard work. You make your luck.

Smart hard work, however, does not guarantee that a person will get lucky. That work just puts one in a position to exploit good luck when it comes along.

The most financially “successful” people are not necessarily the most talented, just the luckiest, studies indicate. Wealth distribution follows a power law distribution, the distribution of human skills and of effort (as measured by hours worked) generally follow normal distributions. Wealth is much more concentrated than are skills or effort.

The wealthy do not bury their money. They invest in job-creating businesses and the acquisition of goods and services. Their wealth ultimately is “redistributed”.

Individuals experience lucky events that they can exploit to increase their wealth if they are talented enough. However, they also experience unlucky events that reduce their wealth.

These events occur at random. Life is not “fair” ... but it can be Satisfying in almost any circumstances if one’s focus remains on serving the self-interests of others.

<https://getpocket.com/explore/item/if-you-re-so-smart-why-aren-t-you-rich-turns-out-it-s-just-chance>

Designed

Abiotic and Biotic items naturally occur and evolve. “Designed” items are conceived of and created by humans.

Designed items include technology-based and art creations. Designs result in emerging capabilities that support Platforms and Processes which in turn influence Satisfaction.

Technologies are comprised of raw materials. The key Technologies in turn will affect significantly emerging capabilities over the next 20 years.

The societal impacts of emerging Technologies include their enablement of the wider distribution and personalization of tools, information and work. In other words, individuals continue to do more on their own. An increasing number of these capabilities are available on-demand for those that a user needs only occasionally.

In addition to this autonomy, an individual may work as part of a permanent, temporary or virtual group and use these same capabilities to become more productive for that group. These capabilities free people to be more creative and flexible in addition to being more productive.

An estimated 25% of all existing manual labor and administrative tasks can be automated. Only 15% of existing production assets have been automated and networked, so significant potential societal impact remains.

This combination of increased productivity, creativity and globalization has initiated a new economic boom around the world. Successful individuals and organizations use the initial benefits of these emerging technologies to survive and prosper in the growing economy and the uncertain global political situation.

Significant availability of a Technology is defined here as the point when it achieves more than about a quarter of global market penetration of relevant potential users (“user” refers to a person, animal, plant, machine or other entity that may use the capability being described).

This publication use primarily 5 to 20-year forecast horizons for two reasons:

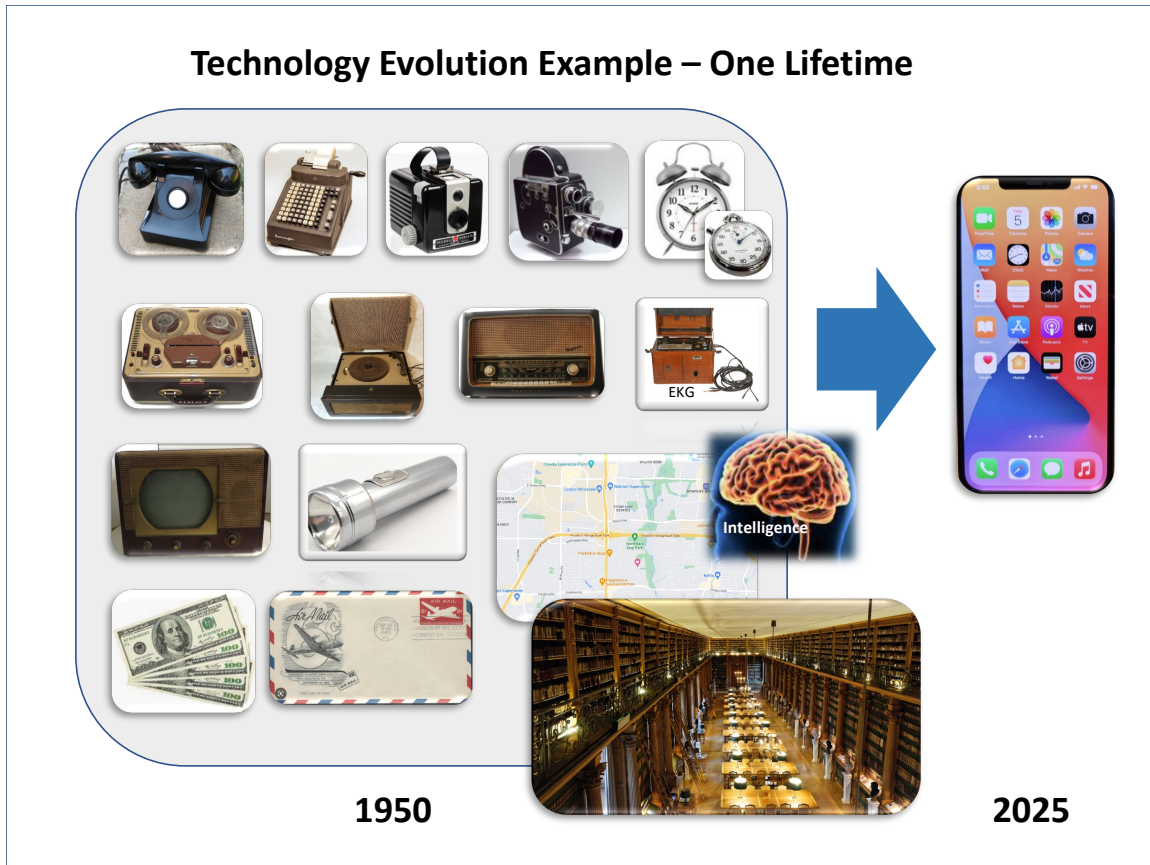
First, advances in technology that use extensive combinations of new software and new hardware tend to experience market adoption curves with peak at about 20 to 30 years after conception.

Second, software-only or hardware-only capabilities tend to experience adoption curves that peak in the 5-year range.

Cell phones are an example of the longer adoption cycle with the “smart phone” variant having a shorter adoption cycle. In 2020, 70% of the population worldwide has a cell phone with more than half being smart phones.

Adoption of the Internet web browser is another example of the shorter-term adoption curve. In comparison, the Internet itself, which included both complex hardware and software developments, evolved from conception to widespread use in the 20 to 30-year range.

Technology evolves at an accelerating pace. The following graphic indicates advancement over a lifetime.



Emerging Capabilities

The primary applications of emerging capabilities are listed below, and are compared to the previous 20 years.

-20 to 0 Years Past

- Smart phones/watches
- GPS mapping and direction
- Email/Text
- Social media
- Broadband network access – wired and wireless
- Ubiquitous video surveillance
- Virtual assistants
- Streaming on-demand AV
- On-line retail and wholesale
- Shared ride applications and services
- Drone aircraft
- Driver assist
- Industrial and limited consumer robots
- Molecular biology detail imaging (e.g. PET scans)
- DNA analysis

0 to 5 Years Future

- Augmented real time contextual user interface, biometric access and control
- Software defined networks/functions, more agile networks; virtual functions
- Carbon fiber and other composite materials
- Genetic & molecular level diagnosis
- Electric cars
- Reusable rockets

5 to 20 Years Future

- Immersive hands-off, heads-up user interface, precision search, predictive info
- Networked common devices (e.g., lighting, HVAC, security, kitchen, AV)
- Super light/strong materials: carbon nanoscale, adaptable; self-healing
- Piloted VTOLs
- Hybrid solar and wind (economically comparable with carbon sources)
- Low-code and no-code software development

20 Plus Years Future

- Super strong lightweight composite materials
- Additive production (e.g., 3D printing; biological scaffolding, nanoscale)
- Autonomous ground and VTOL vehicles
- General purpose autonomous robots
- Possible hypersonic aircraft ... but technical challenges (fuel, material, stealth, performance)
- Self-contained micro power sources that also provide energy back to the grid
- 4th generation nuclear power
- Ubiquitous wireless power
- Genetic, stem cell and microbiome monitoring, engineering and medical treatments
- Brain - machine interface
- Full sensory virtual teleportation
- Deep learning systems with rigorous automated software engineering
- Quantum and biological (mechanical, chemical, electrical) information processing
- Standardized packetization of things (information, distributed ledger, physical items,)

The following technology timeline for Platforms provides a high-level summary of technology applications history and trends.

1/4th of relevant population uses	- 200 Years	-100 Years	-20 Years	Present	+20 Years	100+ Years
Nutrition	Bread Gruel Alcoholic beverages Well & stream water	Meat Fruit Eggs Fermented Seed made mixes Filtered drinking water Small food stores	Poultry High yield cross-bred crops Chemical fertilizers Irrigation Mechanical cultivation Chem/bio water treatment Large food stores	Genetically modified crops Bottled water No till planting Irradiated purification	Robotic plant & harvest Precision agriculture Plant gene editing Home grocery delivery Nano fertilizers Nano herb and pesticides	Vertical agriculture Aquaculture In vitro manufactured foods 3D printed food Precision food preparation Robotic food Algae based Personal genetics diet From air & sea elements
Clothing	Hand woven wool, cotton Spinning wheel Hides	Sewing machines Mechanized production Buttons	Synthetic fabrics Easy fasteners	Athletic leisurewear On-line shopping	Nano anti stain & wrinkle Body scan custom fit Power embedded	3D knitted & printed Energy cloak, protect, HVAC Robot & laser production
Shelter	Iron Brick Heavy framing	Light framing Steel Glass Elevators Plumbing Electric lights	High rise Central HVAC Fluorescent lights Automatic elevators	Wood frame mid-rise multi LED lighting Automated HVAC Automated security	Voice control Converged networks	Stronger lighter materials 3D printed Robot assist Integrated control apps Ductless HVAC Gasless refrigeration
Transportation	Horse & horse drawn Sailing ships	Bicycles Automobiles Steam trains Hard surface roads	Aircraft Space vehicles Engine driven ships Diesel & electric trains	Ride share Radar control & assist	Commercial VTOLs Self driving cars Electric drive cars Carbon fiber materials	Shared personal VTOLs Hyperpersonal aircraft Satellite air traffic control Dedicated personal VTOL
Health	Blood letting Amputation	Surgery Antiseptics Anesthesia Blood typing Eugenics	Penicillin, Vaccines Animal insulin Chemotherapy Minimally invasive surgery Imaging (Xray, CT, MRI)	Functional imaging (PET) Electronic Medical Records Synthetic insulin	Brain mapping Nerve management Auto monitor/diagnose Immunotherapy Optimum electro-chemicals	3D print and artificial organs Bionic limbs Neural implants Genetic engineering On-body auto treatment
Production	Grinding mills Hand crafting	Assembly machines Production lines	Machine tools Automated production Automated tracking Lean, 6 sigma methods	Programmed robots & tools 3D CAD Shale oil & gas Air jet fast looms	Nanoscale Dynamically configurable Exoskeletons	Additive manufacturing Continuous liquid interface Materials from air & sea Molecular replication
Protection	Blade weapons Single fire guns, cannon	Semi & automatic weapons	Guided munitions Nuclear weapons	Integrated weapons control	Unmanned weapons Remote controlled DNA + AI investigations	Directed energy weapons Predictive suppression
Power Management	Wood, oil, coal heat & light Wind Animals	Electricity Steam Fossil fuel	Oil Gas Hydro Nuclear Small batteries	Smart meters	Hybrids-fossil, battery, solar High capacity batteries Advanced grid Super capacitors Laser machines	Grid scale storage Solar and Wind 4 th gen & fusion nuclear Ambient User generated
Information Management	Letters Books	Phone (multiparty) Mechanical calculators	Software languages Window type OS Office & graphical software Movies, radio, TV Internet/world wide web Browsers & Search engines Mobile phones & devices Electronic computers	Web & mobile applications Context search App Programming Interface Wireless data (WiFi & cell) Smart phones Laptops and pads Geo Positioning (GPS) Barcode tracking, RFID	5G wireless (1G access) Continuous code develop Drag/drop code develop Internet of Things Realtime big data Artificial intelligence Brain/machine control Neural-like processing	Mesh peer 2 peer Distributed ledger Brain to brain & to machine AI generated code Standardized personal info Quantum & bio compute Packet info, energy, matter Immersive virtual interface

Humans are the only creature who significantly modify their environment. These modifications are accomplished with Technology.

For various reasons (all not fully understood yet), humans have developed relatively more capable brains than other animals. Humans have more ability for abstraction, complexity, language, writing, speech, and dexterity. A related factor is accelerated cumulative culture.

Technology transforms lives by amplifying naturally occurring capabilities. The simple bicycle, for example, resulted in humans becoming the most energy efficient creature or machine to move from one location to another. Without the bicycle, humans' energy efficiency is in the middle of the pack of other creatures and machines.

Technology is combinations of matter, energy, information and power developed and used to assemble the Platforms that support Processes which help fulfill the needs and wants (Purposes) of individuals, or organizations ... organizations which in turn serve individuals or other organizations.

Technology has disrupted industries and the businesses and individuals in those industries. There are many examples of businesses and job types that no longer are market leaders, or that even exist, due in part to their insufficient response to technology-driven disruption.

A few of these are:

- Alta Vista (if you don't remember Alta Vista, "Google" it)
- Blockbuster
- Borders Books

- Phone operator
- Elevator operator
- Pool typist

Most businesses are damaged not only by a lack of technology foresight but a combination of that and operational absorption, misguided business practices, leadership discontinuity, changing business models, financial and other issues. Blockbuster is just one of many examples.

Over the course of 10 years, Blockbuster (which rented VCR tapes of movies) grew an extraordinary brand and dominant market position with more than 5000 stores. Along with mailed and kiosk and big box store rented and inexpensive purchased DVDs as well as later streaming video, however, Blockbuster was essentially out of business within 10 more years.

Blockbuster was not blind to the emerging technologies. In the late 1990's, for example, it teamed with Enron (which was starting up a global telecommunications backbone network business) and Verizon to deliver video-on-demand over high-speed networks. The venture fell apart, however, as Enron's unrelated corporate financial issues were exposed and as Blockbuster's other business issues escalated.

The lesson: technology planning and development is a key part of enterprise evolution but only a part. All aspects of an organization must be managed as a well-integrated whole.

Other businesses (and individuals) have adopted emerging technologies, transforming and succeeding over several decades. Organization must continually enhance the experiences of their customers, employees and suppliers to sustain their success, deliver the goods and services that transform lives.

These new technologies gradually work their way into our day to day life and will have enormous impacts.

Even the poorest women and men throughout the world now often have a smartphone with a data plan giving them easy access to much of the information in the world. Information transforms lives.

An important opportunity is to more fully engage many individuals of all ages and other characteristics whose potential contribution is being underutilized. Many want to contribute more but cannot readily match their capabilities with uses for them.

Designed materials quantities have become significant since the Industrial Revolution. For example, concrete in the world soon will outweigh all living matter.

Concrete accounts for around half of all human-made things. At its current rate of growth, concrete will overtake the total weight of Earth's biomass sometime around 2040. This will mean a greater weight of concrete on Earth than the combined weight of every plant, fish, animal, and person.

Time

According to physicist John Wheeler, "Time is what prevents everything happening at once." The concept of time is a human construct. Without clocks and calendars we would have a sense only of changes. Daylight changing, weather changing, human bodies changing, knowledge changing, etc.

"Space" references existence, "time" references change/events. Time is the way we reference change... and change is the outcome of energy differential.

Humans have a relationship with time because they are surrounded by clocks. But the reality of time is very different.

If there are no sentient beings to measure it then time does not exist. Humans create it in their minds, and maybe animals do too, depending on their level of cognition.

Time could be thought of as a sphere on which, for example, a human life is a small arc that appears to be linear with a beginning and an end but in fact simply is part of the non-linear sphere.

Time is not an absolute, or a force, it is just a standard system of measurement. Measurements are not inherent qualities of physical objects and energies; they purely are arbitrary, created by humans just to have standardized references for comparison to other things.

Time is the measurement of the change in real things. Time is not the real thing.

The two theories of physics, General Relativity and Quantum Mechanics, each treat time differently.

General relativity specifies time as a dimension along with space (with both subject to dilation which has been demonstrated in experiments) while quantum mechanics treats time as external to the theory. Resolution of the specifications for time may be dependent on the ultimate integration of general relativity and quantum mechanics.

Time typically is thought to flow in only one direction, from past to future. Unlike general relativity, quantum mechanics, and particle physics, thermodynamics embeds a direction of time. Its second law states that the total entropy, or disorder, in an isolated system never decreases over time.

This does not mean that the conventional notion of time is firmly grounded. Entropy, or disorder, is subjective. In other words, the distinction between past and future, the growth of entropy over time, depends on the way one has described the system, which in turn depends on how one interacts with the system.

Even the notion that the present is fleeting is questionable. Light traces a cone in four-dimensional spacetime that grows larger as it travels. No information can cross the bounds of the light cone because that would require information to travel faster than the speed of light. The past is whatever is inside the light-cone. The “present” for a photon emitted by the star Alpha Centauri A 4.35 years ago is different than the present for an earthling having that photon hitting her eye. The earthling is seeing how Alpha Centauri A appeared 4.35 years ago.

We know from general relativity that space time is curved and can be warped by matter and energy. Depending on our position and speed, time can appear to move faster or slower relative to others in a different part of space-time because of time-dilation effects. Time appears to move slower near massive objects because the object's gravitational force bends space-time.

A generally accepted firm definition of time has not been identified so far. Following are five ideas about time.

1. Time is undefined

Quantum mechanics is more consistent with our familiar notion of time. Yet quantum mechanics portrayal of time as outside the system leaves no definition of time (if time is real).

2. Time is an illusion

The physicist Julian Barbour thinks that space and time must be decoupled. The only way to define space is to consider it as the geometric relationship between observable particles, which means no reference to time. Time is not real, but merely something perceived — an illusion that comes about because the universe is constantly changing from one geometric relationship between observable particles to another.

3. Time is an entropic arrow

All of our physical laws are time-symmetric, which means that, mathematically speaking, it is equally possible for things to run backwards or forwards. The only exception is the second law of thermodynamics that says entropy, or the amount of disorder, always increases over time in isolated collections of particles and energy. The unique asymmetry of this law has led many physicists to suspect that the resolute forward flow of time we observe is linked to entropy. There is also a quantum version of this “entropic arrow of time” which views increasing entropy as the result of increasing quantum entanglement.

4. Time is real

If entropy constantly increases, then the universe at the time of the big bang must have been in a low-entropy (highly ordered) state. There is no obvious explanation for why it would have started that way. That returns to the question of why physical laws are time-symmetric. Perhaps the laws

simply are wrong. Alternative fundamental laws may have time directionality built in. And those laws might themselves change over time.

5. Time is equal to quantum space

Quantum mechanics allows a particle to exist at one location and not another. Maybe, it should also let a particle exist at one time and not another, without the need to include interactions that create or destroy it. This would change a cornerstone of physics — the conservation of mass.

Time would continue to flow as currently perceived even if the universe (space-time continuum) were contracting. If the universe were contracting towards a “big crunch” or a “big bounce”, entropy still would continue to increase, and thus our perception of time would be the same. The universe is a closed system (an enormous one), and whether it is expanding or contracting, the laws of thermodynamics still apply.

Quantum entanglement - the fact that subatomic particles can react to measurement at the same time even if they are separated by light years of spacetime - belies time and space. Time is an illusion - it does not exist. Humans created time to measure the progress of entropy.

Various manifestations of energy can be observed moving in space with various speeds that suits them in relation to all the rest and they are all interacting, observable to us through our senses and instruments, or not.

Throughout the universe, all matter and energy is diffusing and ultimately destined (after trillions of years) to spread uniformly through space. This gradual spreading of matter and energy is called thermalization.

Thermalization is not written into the underlying laws that govern the motion of the molecules. Rather, thermalization is a statistical outcome.

With thermal equilibrium, no more energy flows between molecules, and no further change occurs. Thus thermal equilibrium on a cosmic scale means the end of evolution of the universe.

How does the process begin? A fractal is a never-ending pattern. Fractals are infinitely complex patterns that are self-similar across different scales. They are created by repeating a simple process over and over in an ongoing feedback loop.

Quantum systems in various extreme starting conditions seem to fall into a fractal-like pattern, exhibiting universal scaling for a period of time before transitioning to standard thermalization. Extreme conditions existed at the beginning of the universe when the particles that now populate the cosmos originated.

These conditions would have occurred right after “cosmic inflation” — the explosive expansion of space thought by many cosmologists to have jump-started the Big Bang. Inflation would have destroyed any existing particles, leaving only the uniform energy of space itself: a perfectly smooth, dense, oscillating field of energy known as a “condensate.”

After cosmic inflation, the hypothetical oscillating, space-filling condensate would have quickly transformed into a dense field of quantum particles. Some scientists conjecture that these far-from-equilibrium particles then exhibited fractal scaling governed by universal scaling exponents as they began the thermal evolution of the universe.

The ideas about the early universe are not easily testable. But, experiments in which heavy atomic nuclei are smashed together at nearly the speed of light in the Relativistic Heavy Ion Collider in New York and in Europe's Large Hadron Collider may provide useful insights.

The way to make time accessible to mathematical concepts may be to give it some kind of dimensional property. That, however, does not mean mathematics should be confused with reality.

This document takes the position that Time simply is another term for Change.

Time is not real ... since it by definition is infinite. No matter how far you go back, there had to be something "before". Also, time varies based on relative speed and gravitation (aka, time dilation) and disappears – i.e., is zero - at the speed of light.

Time, however, as measured by "hours" and "minutes" is a useful tool for human existence.

Time as a quantity (or asset), rather than a linear measurement, is a somewhat different perspective. In this sense Time is scarce and important.

Unlike other assets, Time is a zero-sum item that cannot be expanded through innovation ... only perhaps used more efficiently. The liberty to use as one sees fit and the most valuable use of a quantity of Time are fundamental to human existence.

Language

A language is a structured system of communication used by humans consisting of speech (spoken language), gestures (sign language) and writing. Most languages have a writing system composed of symbols to inscribe the original sound or gesture and its meaning.

Estimates of the number of human languages in the world vary between 5,000 and 7,000. Natural languages are spoken or signed, but any language can be encoded into secondary media using auditory, visual, or tactile stimuli. In other words, human language is modality-independent. Oral, manual and tactile languages contain a phonological system that governs how symbols are used to form sequences known as words or morphemes, and a syntactic system that governs how words and morphemes are combined to form phrases and utterances.

Human language has the properties of productivity and displacement, and relies on social convention and learning. Its complex structure affords a much wider range of expressions than any known system of animal communication.

Language is thought to have originated when early hominins started gradually changing their primate communication systems, acquiring the ability to form a theory of other minds and a shared intentionality. This development is sometimes thought to have coincided with an increase in brain volume, and many linguists see the structures of language as having evolved to serve specific communicative and social functions.

Language is processed in many different locations in the human brain. Humans acquire language through social interaction in early childhood, and children generally speak fluently by approximately three years old. The use of language is deeply entrenched in human culture. Therefore, in addition to

its strictly communicative uses, language also has many social and cultural uses, such as signifying group identity, social stratification, as well as social grooming and entertainment.

Languages evolve and diversify over time. Some academics forecast that between 50% and 90% of languages spoken at the beginning of the 21st century probably will have become extinct by the year 2100.

Language plays a significant role in the creation and circulation of concepts, children raised in an environment where language is accessible will acquire language without formal instruction. Languages may even develop spontaneously in environments where people live or grow up together without a common language

Communication systems used by other animals such as bees or apes are closed systems that consist of a finite, usually very limited, number of possible ideas that can be expressed. In contrast, human language is open-ended and productive, meaning that it allows humans to produce a vast range of utterances from a finite set of elements, and to create new words and sentences. This is possible because human language is based on a dual code, in which a finite number of elements which are meaningless in themselves (e.g. sounds, letters or gestures) can be combined to form an infinite number of larger units of meaning (words and sentences).

While some animals may acquire large numbers of words and symbols, none have been able to learn as many different signs as are generally known by an average 4 year old human. Human languages differ from animal communication systems in that they employ grammatical and semantic categories, such as noun and verb, present and past, which may be used to express exceedingly complex meanings

The emergence of spoken languages is estimated at 60,000 to 100,000 years ago. Some scholars place the development of primitive language-like systems (proto-language) as early as *Homo habilis* (2.3 million years ago) while others place the development of primitive symbolic communication only with *Homo erectus* (1.8 million years ago) or *Homo heidelbergensis* (0.6 million years ago), and the development of language proper with Anatomically Modern *Homo sapiens* with the Upper Paleolithic revolution less than 100,000 years ago.

Writing systems represent language using visual symbols, which may or may not correspond to the sounds of spoken language. In order to represent the sounds of the world's languages in writing, linguists have developed the International Phonetic Alphabet, designed to represent all of the discrete sounds that are known to contribute to meaning in human languages

The direction used in a writing system is entirely arbitrary and established by convention. Some writing systems use the horizontal axis (left to right as the Latin script or right to left as the Arabic script), while others such as traditional Chinese writing use the vertical dimension (from top to bottom). A few writing systems use opposite directions for alternating lines, and others, such as the ancient Maya script, can be written in either direction and rely on graphic cues to show the reader the direction of reading.

In prehistoric cave paintings in Europe, a discovery has been made that could push the timeline of written language back by tens of thousands of years. Figures that were made by the human species between roughly 15,000 and 40,000 years ago often include non-figurative markings, such as dots and lines.

Many animals have what appear to be numbers associated with them. Previous researchers have suggested that these symbols could be some form of numerical notation, perhaps designed to count the number of animals sighted or killed by these prehistoric artists.

More recent research suggests that they form a calendar system designed to track the life cycles of animals depicted in the paintings. It seems more likely that information pertinent to predicting their migratory movements and periods of aggregation, i.e. mating and birthing when they are predictably located in some number and relatively vulnerable, would be of greatest importance for survival.

The researchers note that the paintings are never accompanied by more than 13 of these lines and dots, which could mean that they denote lunar months. A “Y” symbol, which is commonly drawn directly on or near animal depictions, could represent birthing.

A database was developed of more than 600 line and dot sequences without the Y symbol, as well as some 250 sequences with the Y. These sequences span tens of thousands of years.

After conducting a statistical analysis of the database, the researchers found that their lunar calendar seems to hold up well with the patterns. There is a remarkable degree of correlation between the numbers of lines/dots in sequences and mating and birthing behaviors. These data indicate that the purpose of this system of associating animals with calendar information was to record and convey seasonal behavioral information about specific animals in the geographical regions of concern.

Some may argue that this does not meet the exact definition of “writing”. Perhaps it is best described as a proto-writing system, an intermediary step between a simpler notation/convention and full-blown writing.

It implies, however, that a form of writing existed tens of thousands of years before the earliest Sumerian writing system. If the hypothesis from this research is accurate, it indicates that Paleolithic ancestors were cognitively advanced.

https://www.vice.com/en/article/pkg95v/a-total-amateur-may-have-just-rewritten-human-history-with-bombshell-discovery?utm_source=pocket-newtab

Speaking is the default modality for language in all cultures. The production of spoken language depends on sophisticated capacities for controlling the lips, tongue and other components of the vocal apparatus, the ability to acoustically decode speech sounds, and the neurological apparatus required for acquiring and producing language. The study of the genetic bases for human language is at an early stage: the only gene that has definitely been implicated in language production is FOXP2, which may cause a kind of congenital language disorder if affected by mutations

When described as a system of symbolic communication, language is traditionally seen as consisting of three parts: signs, meanings, and a code connecting signs with their meanings. Signs can be composed of sounds, gestures, letters, or symbols, depending on whether the language is spoken, signed, or written, and they can be combined into complex signs, such as words and phrases. When used in communication, a sign is encoded and transmitted by a sender through a channel to a receiver who decodes it.

The rules by which signs can be combined to form words and phrases are called syntax or grammar. The first grammatical descriptions of particular languages occurred in India more than 2000 years ago, after the development of the Brahmi script.

Sounds as part of a linguistic system are called phonemes. Phonemes are abstract units of sound, defined as the smallest units in a language that can serve to distinguish between the meaning of a pair of minimally different words.

Each language contrasts sounds in different ways. For example, in a language that does not distinguish between voiced and unvoiced consonants, the sounds (if they both occur) could be considered a single phoneme, and consequently, the two pronunciations would have the same meaning. Similarly, the English language does not distinguish phonemically between aspirated and non-aspirated pronunciations of consonants, as many other languages such as Korean and Hindi.

All spoken languages have phonemes of at least two different categories, vowels and consonants, that can be combined to form syllables. As well as segments such as consonants and vowels, some languages also use sound in other ways to convey meaning. Many languages, for example, use stress, pitch, duration, and tone to distinguish meaning.

At this time, English appears to be the language that is expanding most rapidly as a first and second language for people around the world. This trend seems driven more by commercial than cultural factors, but both are influences.

English, however, is taking on more and more local color in the different places where it is used. Accordingly, while the number of languages in the world is diminishing, the number of Englishes is increasing.

Technology

Technology is used to build Platforms that mostly are intended to enhance, directly or indirectly, the personal Satisfaction of individuals. These Platforms support the Processes people use to achieve their Purposes.

The following table illustrates the changes in platforms over two 70-year “lifetimes” (1880 to 2020).

USA Averages	1880	1950	2020
House (sq ft).	500	1000	2500
Avg People per Household	5	3.5	2.5
Multifamily (% of population):	20%	25%	30%
Cars per Household	0	1	2
Cars per Person	0	.25	.5
Screens per Household	0	0.1	7
Telephones per Household	0	0.5	3
Appliances	None	Refrigerator	Refrigerator, AC, Dishwasher, Clothes Washer/Dryer
Average Annual Wage (2020 \$s)	\$500 (\$11,000 in 2020 \$s)	\$3300 (\$40,000 2020 \$s)	\$55,000
Information Sources	Newspapers Books	Newspapers, Books, Radio	Newspapers, Books, Radio, TV, Internet

Despite the increase in real wages since 1880, wages in the U.S. have stagnated since the early 1970s. Between 1979 and 2020, workers’ wages grew by 17.5% while productivity grew over three times as fast at 61.8%.

Technologies are applied by combining them into Platforms that support Processes used to fulfill the Purposes of humankind. The Internet may be the most significant example of integrating Technologies and Platforms to empower individuals and society and is pictorially represented here:

Among other things, the Internet has enabled social networks in which people are strongly connected to a relatively small group of people and loosely connected to more distant people.

Research has directly linked this network situation (when adjusted for other factors) to significant societal changes.

The integration of emerging blockchain, Internet of Things (IoT) and 5G wireless applications likely will expand significantly the capabilities of the Internet. In addition there is a growing trend of blockchain being integrated with technologies such as Big Data and Artificial Intelligence.

IoT devices range from simple consumer-devices to heavy industrial machines. They interact over the internet smoothly and involve sensing, monitoring, and exchange of data, followed by efficient data storing and processing including cloud computing.

Data is thereby transmitted from the device to the IoT network where the information is managed using analytics and then directed back to the IoT equipment. The analytics capabilities of the IoT use these data to convert insights into action, impacting business processes and leading to new ways of working.

In the meantime the Internet of Things has provided many services in the fields of intelligent transportation, smart cities, medical treatment, smart agriculture and many others. These IoT-based solutions allow the automation of daily tasks and enable effective monitoring and control of the connected devices. This may result in improved efficiency and convenience in performing tasks.

Implementation challenges include high capacity requirements, assured privacy and security, scalability of heterogeneous applications, ultra-low latency, optimized use of network resources, efficient energy management and low costs. Since current mobile networks including 5G and also more general IoT systems are based on centralized models they face challenges to meet the requirements of future 5G-enabled-IoT use cases.

With the huge number of devices in IoT networks, these centralized arrangements have restricted scalability that can be costly and sluggish as well as expose a large number of vulnerable points endangering network security. Centralized systems requirement to authenticate, authorize and connect nodes in a network can be a significant bottleneck.

The networks can be easy targets for cyber-criminals to exploit the weak security protection. Privacy is an issue with the processing of data transactions across multiple devices that are owned and administered by different organizations. A lack of common standards and protocols including auditability and control over data sharing and usage must be resolved.

Blockchain can help address these challenges in a unified and decentralized way. It can ensure data provenance and authenticity, accountability, immutability, security, lower cost, and non-repudiation for each user. Blockchain offers unchanging nature, non-revocation, confirmation of provenance, integrity and protection.

The distributed ledger in a blockchain system is tamper-proof. The ledger is protected against alterations with the utilization of digital signatures. Transparency of smart contracts supports decentralization and can enable fast processing diminishing data validation time. Costs are reduced by eliminating the processing overheads (deploying expensive high-end computing infrastructure) related to IoT gateways, associated with middlemen and intermediaries.

Applications of Blockchain IoT include process automation, supply chain management, smart cities, smart homes, smart farms, asset tracking and monitoring, data analytics, data sharing and communication, smart cars, decision analytics, home automation, and smart energy grids.

The potential for 5G IoT is limited by a fragmented IoT ecosystem. Standardized infrastructures, open application programming interfaces (APIs) and collaborations among stakeholders is needed

Designed DNA is an expanding area of medical opportunity. Some strategies, such as gene therapy, have been available for a while, including the ability to genetically modify cells in order to produce a therapeutic effect—that is, to add a corrected gene into the genome in order to try to treat disease.

Traditionally, viruses have been used to deliver healthy genes into cells. The next-generation technology, gene editing, enables precise targeting of abnormal genes.

With the arrival in 2012 of a gene-editing tool called CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) gene editing now is easier, cheaper and more efficient than with older genome editing methods.

CRISPR can be used to not just cut specific locations in DNA of any organism, but also to provide a template to repair the DNA. CRISPR is accelerating the pace at which treating disease such as Sickle Cell via genetic engineering is moving.

Currently, bone marrow (stem cell) transplants are the only option for curing sickle cell, but finding healthy donor matches can be challenging. Two primary gene-editing strategies are being used in the attempt to cure sickle cell patients.

One type uses CRISPR to essentially flip a genomic switch, turning on healthy fetal hemoglobin production again, which was shut down early in life. A second gene editing strategy, gene correction, directly fixes the mutation in a faulty gene that has caused disease.

The technology also is being employed by scientists researching cancer, lymphoma, AIDS, cystic fibrosis and more, for diagnostics including SARS-CoV-2 detection, and even in agricultural efforts to engineer larger tomatoes, non-browning apples, and longer-lasting mushrooms. The ability to excise nonworking genes and replace them with normally functioning ones may help with treatment of a wide variety of diseases.

Work is underway on next-generation CRISPR technology that is more precise. “Base editors,” which correct single-letter DNA mutations without cutting the DNA double helix, have been demonstrated recently. And “prime editors” which can replace even larger DNA problems.

Issues remain, including the implications of how far a concept like gene editing might be taken, as well as cost, safety and accessibility.

Lipid nano particles increasingly will be used to transport specialized medicines into human body cells for therapeutics. They already have been used in the mRNA-based COVID-19 vaccines and will be used in future therapies that could treat Ebola, HIV and even cancer.

Science always has experienced phases of expansion and concentration. Times of unstructured exploration were followed by periods of consolidation, grounding new knowledge in fundamental concepts.

For example, little fundamental understanding exists of the inner workings of self-learning algorithms, or of the limits of their applications. These new forms of AI are very different from traditional computer codes that can be understood line by line. Instead, they operate within a black box, seemingly unknowable to humans and even to the machines themselves.

The current state of AI is nothing new in the history of science.

Knowledge sometimes flows “downstream”, from the source of an abstract idea, through the twists and turns of experimentation, to a broad delta of practical applications.

An example is Albert Einstein’s general theory of relativity. It began with the fundamental idea that the laws of physics should hold for all observers, independent of their movements. He then translated this concept into the mathematical language of curved space-time and applied it to the force of gravity and the evolution of the cosmos.

AI may be an example of knowledge flowing “upstream”. A fundamentally important idea can emerge from a long series of step-by-step improvements and experimentation.

An illustration is the discovery of the laws of thermodynamics, a cornerstone of all branches of science. These equations, describing the conservation of energy and increase of entropy, are laws of nature, obeyed by all physical phenomena.

But these universal concepts only became apparent after a long period of experimentation, starting with the construction of the first steam engines in the 18th century and the gradual improvement of their design. Out of these practical considerations, mathematical laws slowly emerged.

Another example is the history of hydrodynamics. For travel by water, humans initially did not have a fundamental understanding of fluid dynamics.

Over the millennia that followed, people built and sailed ships, engineering ever more efficient shapes based solely on empirical knowledge and experience. In the 19th century, the Navier-Stokes equations were identified that describe, mathematically, the motion of fluids.

Alchemy may have been a useful and perhaps even necessary precursor to modern chemistry. Alchemy, however, also is a good example of “science” that overpromised and underdelivered.

The current experimentation in artificial intelligence, quantum devices and genetic editing, with all their related useful applications, may lead eventually to a deeper fundamental understanding of the world.

The Gartner Group has a concept known as the “Hype Cycle” in which a new technology is understood often to have a time period in which it receives a large amount of societal visibility. Then, as the promise of the tech is not immediately realized, the interest declines significantly for a time after which visibility increases again (to a lower level than initially) as the benefit of the tech is realized and becomes more widely adopted.

An example is “video conferencing” which received significant hype starting in the 1980’s but then experienced low usage (due to the initial costly premises equipment and complicated session scheduling and conduct) and concurrent visibility. The potential benefit of video conferencing remained, however, and as easy user-controlled conferencing applications, such as Zoom and

FaceTime, became available on personal computers and smartphones (and further accelerated by the COVID-19 pandemic), video conferencing now has risen to the final “plateau of productivity” visibility designated in the Hype Cycle model.

Energy

Energy is the reason humans are the dominant species

A resting human being requires about 90 watts (joules per second) of energy. But the average human being in a developed country uses up to 100 times that amount, all the energy to get around, build and heat homes, grow food and other things used are added.

In addition ... and unlike virtually every other creature on Earth, humans do much more with energy than just power their own metabolism. Humanity's relationship with energy began hundreds of thousands of years ago, with the discovery of fire.

Anything that allows an organism to get energy more efficiently is going to have huge effects on the evolutionary trajectory of that organism.

Fire did much more than just keep humans warm, protect from predators and give a new tool for hunting. A number of anthropologists believe fire actually refashioned human biology.

The brains of modern humans are bigger than those of more ancient members of the human family. Some scientists believe control of fire helped increase human brain size.

The decisive development was cooking which transforms the energy available from food. Carbohydrates, proteins and lipids that provide our bodies with nutrition are unraveled and exposed when they are heated. That makes it is easier for human digestive enzymes to do their work effectively, extracting more calories more quickly than if humans ate their food raw.

The extra energy it reliably gave permitted evolution of the small colons and relatively large energy-hungry brains that distinguish humans from other primates. And, as human brains began to grow, it created a positive feedback loop.

As neurons are added to the mammalian brain, intelligence increases exponentially. With smarter brains, humans got better at hunting and foraging.

Humans figured out more ways to access the calories in food - by pounding it with a rock, by grinding into a powder, or even just letting it rot - or by roasting it over a fire. In doing so, humans further increased the supply of energy to their bodies. This permitted the evolution of even smarter brains, and the ensuing virtuous circle accelerated the growth of the human brain.

Over hundreds of thousands of years, the climate constantly changed, with ice sheets advancing and then retreating across the northern hemisphere. The last Ice Age ended around 12,000 years ago. Global temperatures rose rapidly and then stabilized, and humanity embarked on its next energy transformation.

The world reached unprecedented levels of technological change. Within 2,000 years, all over the world, people began domesticating crops.

Cultivating crops had been pretty much impossible during the Ice Age, but the new warmer climate, coupled with a big rise in carbon dioxide levels, was very hospitable to plant life. It took large investments of human energy in the form of labor; in return, humans reaped a far more abundant and reliable food supply.

Crop fields absorb solar energy turning the Sun's rays into packages of digestible chemical energy.

Cereal crops - domesticated grains like wheat, maize and rice act like a kind of storable energy currency. Bank it away in a silo to consume as needed during the winter months. Or take it to market to trade with others, or invest it in planting the next harvest or in fattening up animals, which could convert that energy into meat, dairy or animal labor power.

As the centuries passed, animals and plants domesticated in different locations coalesced into an agricultural packages. The crops fed animals. The animals worked the land. Their manure fed the crops. And, as a package, they provided a much more reliable and abundant food source.

More food meant more people - who could then expand into new territory, and develop new technologies that produced even more food. It was another virtuous circle, but this time powered by the solar energy captured through agriculture.

The surplus energy created meant much larger populations, could be sustained and furthermore, not everyone needed to farm. People could specialize in making tools, building houses, smelting metals, or telling other people what to do.

In farming communities, however, inequities can develop. For thousands of years, the standard of living for the vast majority people on Earth did not improve significantly, despite the bounty of agriculture.

The more affluent, leisurely lifestyles that more enjoy today would take a shift in energy provided by fossil fuels. First, coal contains the solar energy captured over millions of years by fossilized forests.

In the 20th Century, coal was succeeded by richer geological stores of photosynthetic energy - oil and natural gas. Not only were fossil fuels abundant. They also provided ever greater sources of power, liberating humans from dependence on animals.

Fossil fuels has had a significant effect on standard of living. Since the Industrial Revolution humans have grown taller and healthier, life expectancy has increased vastly, and in the developed world humans are on average 30 to 40 times economically better off.

Energy imbalances are threatening the world economy. Nations are more reliant than ever on natural gas to heat homes and power industries amid efforts to quit coal and increase the use of cleaner energy sources.

Enough gas, however, is not available to fuel continued full growth. Countries are trying to outbid one another for supplies as exporters move to keep more natural gas home. Calmer weather has reduced output from wind turbines while aging nuclear plants are being phased out or are more prone to outages—making gas even more necessary.

Some fertilizer producers have been forced to reduce output threatening to increase costs for farmers and potentially adding to global food inflation. Economies that cannot afford higher fuel costs could be seriously hurt.

Accelerating energy costs, in conjunction with squeezed supply chains and food prices, could drive significant sustained inflation. In some areas there may be insufficient gas available at any price.

Importers of liquefied natural gas are paying record prices to secure supplies. Some are buying “dirtier” fuels such as coal and heating oil to supplement their limited gas supplies. A few countries already are rationing electricity to industries as authorities divert gas to light and heat households.

Lowest flows in the rivers of several countries have reduced hydropower output and forced utilities to rely more heavily on gas. Oil and gas producing countries have huge demand from all customers that they fully cannot meet. U.S. shale drillers are reluctant to boost production based on financial and regulatory concerns.

The world is learning how much the global economy depends on natural gas.

Geothermal energy is the thermal energy in the Earth's crust which originates from the formation of the planet and from radioactive decay of materials. Temperatures at the core–mantle boundary can reach over 4000 °C (7200 °F).

The high temperature and pressure in Earth's interior cause some rock to melt and solid mantle to behave plastically. This results in parts of the mantle moving upward since it is lighter than the surrounding rock.

Geothermal energy is enough energy in the first 10 kilometers below the planet's surface to provide all humankind’s expected energy needs for millions of years.

Most high temperature geothermal heat is harvested in regions close to tectonic plate boundaries where volcanic activity rises close to the surface of the Earth. In these areas, ground and groundwater can be found with temperatures higher than the target temperature of the application. However, even cold ground contains heat, below 6 meters (20 ft), and it may be extracted with a ground source heat pump.

Recent technological advances have reduced costs significantly and thereby expanded the range and size of viable geothermal resources. In 2021, the U.S. Department of Energy estimated that geothermal energy operating costs of about \$0.05/kWh which generally is competitive with other technologies.

In 2019, 13,900 megawatts (MW) of geothermal power was available worldwide. An additional 28 gigawatts of direct geothermal heating capacity has been installed for district heating, space heating, spas, industrial processes, desalination and agricultural applications as of 2010.

The future of geothermal power depends on technology, energy prices, subsidies, plate boundary movement and interest rates. The recent practice of injecting cooled geothermal fluids back into the Earth to stimulate production has the side benefit of reducing environmental risks. Enhanced geothermal systems, however, can trigger earthquakes as part of hydraulic fracturing.

Geothermal has minimal land and freshwater requirements.

Energy and Wealth

A country’s wealth (GDP) is directly correlated with its energy usage and resources. For example, the USA has the largest GDP and uses and produces more energy than any other country.

Recently, however, the USA's energy production has decelerated and it now is a net consumer of energy. Its once vast oil and gas reserves are at risk of becoming uneconomical to produce consumable fuel.

While fracking technologically is advanced, it is less economical than historical production methods. Furthermore, even marginally economical fracked oil and gas could be depleted in a few years.

Approximately, 5% of USA energy is provided from wind, solar, and other new renewables, and those are not accelerating quickly. These inconsistently available energy sources likely will not be dominant sources of energy for a long time, if ever.

A potential but still unproven source of additional energy is "abiogenic" petroleum based on an hypothesis that most of earth's petroleum and natural gas deposits were also formed inorganically. Traditional theories about the formation of hydrocarbons on earth point to an origin from the decomposition of long-dead organisms.

In 1986, a team published a prognostic map for discovering giant oil and gas fields at the Andes in South America based on abiogenic petroleum origin theory. Discoveries have been made in places shown on the 1986 prognostic map as promising areas. The result is convincingly positive, and this is a strong contribution in support of abiogenic theory of oil origin.

https://en.wikipedia.org/wiki/Abiogenic_petroleum_origin

The USA (and other countries with a few exceptions) appear to have missed the opportunity years ago to fulfill their needs by using nuclear energy.

An exception is France which derives about 70% of its electricity from nuclear energy due to a long-standing policy based on national energy security. Government policy, reset in 2014, aimed to reduce nuclear's share of France's electricity generation to 50% by 2025; this target was delayed in 2019 to 2035.

In February 2022 France announced plans to build six new reactors and to consider building an additional eight. France is the world's largest net exporter of electricity due to its very low cost of generation.

It seems that the USA and other countries rapidly should develop and implement the new safer nuclear technologies to provide energy. This effort should include streamlining (while not compromising) government regulations to speed the deployment.

The current generation of nuclear power plants use simpler standardized designs which reduce capital costs. They are more fuel efficient and are inherently safer with passive safety features which require no active controls or operational intervention to avoid accidents.

<https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/advanced-nuclear-power-reactors.aspx>

Value Creation & Money

Value is created by humans through their production and consumption of goods and services.

Money streamlines exchange of goods and services (versus bartering). Money also provides a means to store efficiently value for later use (e.g., when not working, purchase goods and services from saved money. e

Nearly all existing money systems are based on fiat money. Fiat money does not have intrinsic value or a guarantee that it can be converted into a valuable commodity (such as gold). It has value by government mandate (fiat). A government usually makes it unlawful not to accept the currency as repayment for debts.

The money supply of a country consists of banknotes and coins and the balances in the various types of bank accounts. Bank money, which mainly is digital records, is the other part of money and is created by private banks through the recording of loans as deposits of borrowing clients.

Money is created in two ways. Cash money created by minting coins and printing banknotes. Bank money is the money created by private banks through the recording of loans as deposits of borrowing clients, with partial support indicated by the cash ratio.

Commercial bank money is created through fractional-reserve banking where banks maintain a fraction of their deposits in reserve and lend out the remainder while maintaining the capability to redeem all these deposits upon demand. Commercial bank money differs from commodity and fiat money in that it is not physical and there is some element of risk if the financial institution becomes insolvent.

Non-governmental digital currencies, known as cryptocurrencies (such as Bitcoin), are decentralized and based on distributed ledger platforms.

The stock market is not included in most monetary supply calculations but it does influence the money supply and price inflation. The velocity of money is the speed at which people are motivated to spend their money. The status of the stock market can influence peoples motivation to spend.

Tools used to control the money supply include:

- changing the interest rate at which the central bank money is loaned or borrowed
- currency purchases or sales
- increasing or decreasing government borrowing
- increasing or decreasing government spending
- adjustment of exchange rates
- increasing or decreasing bank reserve requirements
- regulation or prohibition of private currencies
- taxation or tax breaks on imports or exports

In addition, the stock market provides a low long-term risk method for creating individual wealth. Over more than a hundred years, the stock market has provide a total return of about 10% ... or roughly 7% after adjustment for inflation.

An annual investment in a standard broad stock market (e.g. S&P 500) index fund of \$10,000 US in a tax deferred 401K or Roth IRA will produce an amount in today's dollars of about \$1.5 million (\$3

million in future inflated dollars) after 40 years. Of course, variation of the annual investment amount will increase or decrease the final total investment value.

An investor must be able to accept significant fluctuation of market (and their investment) value day to day and sometimes over several years to achieve this growth in wealth. As long as a relatively free private enterprise system remains in effect, the broad stock market likely will sustain this performance over the long term. With your investment, you are helping fund the businesses that are making money for you.

It's never too late to start saving and investing. The sooner you start, however, the better.

Compound interest means the interest on an investment grows exponentially - rather than linearly - over time. What this means for a tax deferred retirement account like a 401(k) or Roth IRA is that every little bit you contribute goes a long way, especially compared to a traditional savings account.

The key is that with compound interest, how early you start saving usually outweighs how much you contribute. Even an investment left untouched for decades can keep growing.

Assume a moderate 6.5% annual investment return on retirement funds.

Scenario 1: Starting at age 35

You save \$1,500 per year from age 35 to 55

Total amount invested: \$30,000

By age 66 (31 years after starting), your investment grows to: \$186,138

Compound interest earned: \$156,138

Scenario 2: Starting at age 25

You save \$1,500 per year from age 25 to 45

Total amount invested: \$30,000

By age 66 (41 years after starting), your investment grows to: \$373,569

Compound interest earned: \$343,569

Scenario 3: Starting at age 15

You save \$1,500 per year from age 15 to 35

Total amount invested: \$30,000

By age 66 (51 years after starting), your investment grows to: \$749,029

Compound interest earned: \$719,029

These scenarios demonstrate the advantage of starting to save and invest early:

Starting at 35: Your \$30,000 investment grows about 6.2 times.

Starting at 25: Your \$30,000 investment grows about 12.5 times.

Starting at 15: Your \$30,000 investment grows about 25 times.

By starting just 10 years earlier (at 25 instead of 35), you more than double your retirement savings. Starting at 15 instead of 35 results in four times the retirement savings.

Of course, the best-case scenario is that you start saving early and never stop investing. But the scenarios above demonstrate how important time is as a factor, and how any savings at all – if left untouched for years - can go a long way.

Wisdom includes the co-existence of contradictory truths, and money is a clear example of this. We must accept its importance while also recognizing its lack of actual value.

By having an awareness of the contradiction, we can make choices that do not make us dominated by money. We can do something beautiful, choose fulfilling work, and be present with our loved ones.

Many have an unhealthy relationship with money. Here are ways to improve it.

Money issues typically are a symptom and not the actual problem. We are often conditioned to have limiting beliefs about money from a very young age. Money is not something we talk about or are taught about in school.

Here are some ways to help your relationship with money:

View money as just a tool. You can either use the hammer to build a useful shelf for your home, or you could use the hammer to break things. And just like how you have to learn how to swing a hammer, you have to learn how to use money to build the life you want.

Let go of the belief that money is complicated or confusing. All money skills are learnable, but without effort, we can fall into a complacency with money, which is the first step toward crisis. There always is something you can do to get better with it and improve your situation.

Realize that your money situation can change. Remembering that much of what feels overwhelming in life, and with finances, is temporary is a good first step to overcoming anxiety when managing your finances.

Find a budget buddy. Understanding that the emotions you are going through are very real, and most likely have been felt by people you know. Talking to your partner, a close friend, or family member about what is going on may help you let go of financial anxiety.

Don't compare yourself to others. Nobody is perfect. While making money technically involves work, it does not have to be a miserable, nonstop hustle. Part of healing our relationship to money is not only believing that we are capable of making it, but believing that pursuing money and pursuing satisfaction, balance, and peace are by no means mutually exclusive and, in fact, are mutually supportive.

Tune in to your spending emotions. Track what you spend and how it makes you feel so you can decide what is worth it to you and what is not. Shift your spending toward what brings you satisfaction — such as paying down debt, savoring a treat, investing in an experience, or helping another person.

Focus on your goals, not the dollars. When it comes to priorities, money can help you get there but should not be your primary focus. If you want to have a partner and children, for example, or you want to make a career change, those goals cannot be attained or measured by how much money you have in the bank

The Economy

An “economy” is an area of the production, distribution and trade, as well as consumption of goods and services by different agents. In general, it is defined as a social domain that emphasize the practices, discourses, and material expressions associated with the production, use, and management of scarce resources. The global economy refers to humankind’s economic systems overall.

A given economy is a set of processes that involves its culture, values, education, technological evolution, history, social organization, political structure and legal systems, as well as its geography, natural resource endowment, and ecology, as main factors. These factors give context, content, and set the conditions and parameters in which an economy functions. In other words, the economic domain is a social domain of interrelated human practices and transactions that does not stand alone.

Economic agents can be individuals, businesses, organizations, or governments. Economic transactions occur when two groups or parties agree to the value or price of the transacted good or service, commonly expressed in a certain currency. Monetary transactions, however, only account for a small part of the economic domain.

Economic activity is spurred by production which uses natural resources, labor and capital. It changes over time due to technology, and innovation (new products, services, processes, expanding markets, diversification of markets, niche markets).

A market-based economy is one where goods and services are produced and exchanged according to demand and supply between participants (economic agents) by barter or a medium of exchange with a credit or debit value accepted within the network, such as a unit of currency. A command-based economy is one where political agents directly control what is produced and how it is sold and distributed.

<https://en.wikipedia.org/wiki/Economy>

The global economy is complex and various ideas exist as to how it works. The ways that millions of people interact with one another — buying and selling, lending and borrowing, intersecting with governments and central banks and businesses and everything else around us — amount to a system so complex that no one fully comprehends it. Macroeconomics remains, to a large degree, a black box.

Debates continue about the relationship between unemployment and inflation, how deficit spending affects the economy, and more.

A conventional idea is that people’s expectations for future inflation influence the level of inflation experienced today. Mainstream policymakers believe that inflation is, in large part, self-fulfilling — that what people expect future inflation to look like has an ability to shape how much prices rise in the near term. Discussions over the inflation outlook often spend a lot of time focusing on things like what bond prices suggest inflation will be five or 10 years from now, or how people answer survey questions about what they expect.

Others argue that this is not the real mechanism through which inflation takes place. A simpler explanation is that businesses and workers arrive at prices and wages based on the conditions they have experienced in the recent past, not some abstract future forecast.

For example, when inflation has been low in the recent past, workers might not demand raises as they would in a world where inflation was high; after all, their existing paychecks go pretty much as far as they used to. You do not need some theory involving inflation expectations to get there.

On the other hand, an idea about inflation expectations supported by lots of history is that if people distrust a country's monetary system, inflation shocks can spiral upward. Economic policy credibility matters. But that is not the same as assuming that some survey or bond market measure of what will happen to inflation in the distant future is particularly meaningful for forecasting the near future.

Central bankers believed there was a tight relationship between the unemployment rate and inflation, known as the Phillips Curve. Over the course of the 2000s, though, that relationship appeared to weaken and become a less reliable guideline for how to set policy.

Similarly, interest rates and inflation fell worldwide, for reasons that scholars are still trying to understand fully. That implied a lower "neutral interest rate," or the rate that neither stimulates nor slows the economy, than was widely believed to be the case as recently as the mid-2010s.

In the realm of fiscal policy, it was thought that large government debt issuance would risk causing a spike in interest rates and crowd out private sector investment. But in the recent period, huge budget deficits have been paired with low interest rates and abundant credit for businesses.

All of this makes it a challenging time for central bankers and others who attempt to shape the economy with policy.

The main sectors of the economy are:

- Raw Materials – extraction, farming, fishing
- Finished Goods – manufacturing, utilities, construction
- Services – retail, financial, hospitality & leisure, real estate, communications, IT
- Other – education, government

While millions of enterprises worldwide operate in these sectors, each sector tends to be dominated by a few dozen very large enterprises (that come and go over decades) ... including state-owned entities in countries with command-based economies (e.g., China)

A key part of the U.S. economy is the role of the Federal Reserve. It is the central bank of the United States -- it is the bank of banks and the bank of the U.S. government.

The Fed regulates financial institutions, manages the nation's money and influences the economy. By raising and lowering interest rates, creating money and using a few other tools, the Fed attempts either to stimulate or to slow down the economy. This manipulation is intended to help maintain low inflation, high employment rates, and manufacturing output.

The Fed's original job was to organize, standardize and stabilize the monetary system in the United States. It had to set up a method that could create "liquidity" in the money supply -- in other words, make sure banks could honor withdrawals for customers. The Fed also needed to come up with a way to create an "elastic currency," meaning it had to control inflation by making sure prices did not climb too quickly, and it needed a way of increasing or decreasing the country's supply of currency in order to avoid inflation and recession.

Inflation can slow economic growth. For example, when inflation is high, things cost more and people spend less. They also do less long-term planning that involves spending money, such as building houses and investing.

Businesses are affected in the same ways. When inflation is high, it tends to fluctuate quite a bit. This uncertainty makes people wary of spending money for fear that inflation will increase even more and they will not be able to pay their bills.

High inflation also adds additional costs to long-term interest rates. These costs are to offset the risk associated with inflation. The additional costs make borrowing money less attractive.

When people do not buy things (when demand is down), then the supply of goods gets too high, production has to decrease, and unemployment increases -- in other words, recession hits.

When prices are stable (when inflation is low), consumers make more purchases, investments, etc., production output is maintained and employment remains high.

When recession hits, the Fed can lower interest rates in order to encourage people to borrow money and make purchases. This works in the short run, but it has to be handled carefully so that inflation is not impacted in the long run. The Fed has to carefully balance the short term goals of increasing output and employment with the long term goals of maintaining low inflation.

The Fed regulates financial institutions, acts as the U.S. government's bank, acts as a bank's bank, and is responsible for managing the nation's money. The Fed has two divisions: One group, the Board of Governors, is responsible for setting monetary policy and managing the nation's money; the other group, the 12 regional Reserve Banks, acts as the service division that carries out the policy and oversees financial institutions. The regional Reserve Banks represent the private sector.

In its role as money manager, the Fed has two primary goals:

1. Maintain stable prices (control inflation)
2. Ensure maximum employment and production output

It achieves these goals indirectly by raising or lowering short-term interest rates. Although these are two separate goals, the intention of each is the same - a stable economy.

Maximum employment does not necessarily mean that everyone is working. Economists have a "natural rate" of unemployment that is ultimately the goal. If the unemployment rate is pushed too low - below 5% or so - inflation rises because more money is in the economy, and that goes against the long-term Fed goal of stable prices.

Monetary policy refers to the actions the Fed takes to influence financial conditions in order to achieve its goals. The Fed's primary control is in the raising and lowering of short-term interest rates. In doing this, the Fed can indirectly influence demand, which then influences the economy.

For example, if interest rates are lowered, borrowing money to make purchases becomes less expensive, and people are more motivated to spend money because they can get a better deal on the loan. Spending money, in turn, stimulates economic growth, which is what the Fed is trying to do in that instance.

If there is too much money in the economy, however, people spend more money and demand increases at a faster rate than supply can match. Prices rise too quickly because of the shortage of

products, and inflation results. If there is too little money in the economy, people do not have excess spending money, and there is little economic growth.

The Fed watches economic indicators closely to determine in which the direction the economy is going. By forecasting increases in inflation or slow-downs in the economy, the Fed knows whether to increase or decrease the supply of money.

Influencing inflation takes a long time and has to be looked at as a long-term goal. Influencing employment and output, however, can be done more quickly and therefore is a short-term goal.

Finding the balance between the two is key. The lags in the effects that monetary policy has on the economy are significant. This is why the Fed has to make forecasts of inflation prior to it actually happening - one, two or even three years in advance. If the Fed waited until inflation were apparent, then it would be extremely difficult to catch up and get it back under control.

As a regulator for financial institutions, the Fed establishes the rules of conduct that these institutions must follow. The regional Reserve Banks then carry out the supervision and enforcement of these regulations. These regional banks monitor the activities of banks within their regions and ensure that they are operating appropriately.

The Federal Reserve also watches out for the public interest by monitoring banks that are seeking to merge with other banks or holding companies. The Fed rules on these requests according to the impact the merger will have on the local community and general public interest.

The Fed acts as a bank for banks. The Fed keeps the pipeline of transactions flowing. It processes and clears one-third of all the checks processed in the country -- that's about 20 billion checks per year.

The regional Reserve Banks provide these services to the banks within their regions. The transactions are done on a fee basis, which is part of how the Federal Reserve supports itself.

Banks are not required to use the Reserve Banks; they can choose to use a private competitor. This helps to ensure that the processing fees being charged are kept under control.

The Fed maintains the checking account of the U.S. Treasury. As the largest bank customer in the country, the U.S. government does quite a bit of business and performs a lot of financial transactions, all of which are handled by the Fed.

These transactions amount to trillions of dollars and include all of the tax deposits and withdrawals for U.S. citizens. It also includes securities such as savings bonds, Treasury bills, notes, and bonds that are bought by and for the U.S. government.

Coin and paper currency produced by the U.S. Treasury's Bureau of the Mint and Bureau of Engraving and Printing is distributed to financial institutions by the Fed as part of its role as the government's bank. The Fed also monitors the condition of currency and either sends it back into circulation or has it destroyed.

Because there are times during the year when people need more cash, currency is stored at Reserve Banks so that banks can order more paper money as they need it. These "orders" are paid for with funds from the bank's reserve account balance held with the Fed.

The job of the Fed has is to manage the nation's money and the overall economy. The Fed has to be able to affect the rate at which consumer banks and financial institutions create "checkbook" money for customers through the loans they grant and investments they offer. They do this by influencing short-term interest rates and the amount of money in circulation.

The Fed uses three tools:

1. The reserve requirement
2. The discount rate
3. Open market operations

The Reserve Requirement

In order to combat the problems of insufficient cash reserves (and the inability to pay depositors) that were faced before the creation of the Federal Reserve System, banks now have to set aside a certain amount of cash in "reserve." The reserve balance that banks must maintain is typically a percentage of their total interest-bearing and non-interest-bearing checking account deposits (currently 3% to 10%).

This percentage of required reserves directly affects how much money they can "create" in their local economies through loans and investments. It is this connection between the required reserve amount and the amount of money a bank can lend that allows the Fed to influence the economy.

If the reserve requirement is raised, then banks have less money to loan and this will have a restraining effect on the money supply. If the reserve requirement is lowered, then banks have more money to loan.

Reserve money is used to process check and electronic payments through the Federal Reserve and to meet unexpected cash outflows. These reserves can be held as "cash on hand," as a reserve balance at a regional Reserve Bank, or both.

Although the Fed has the power to do so, changing the amount of reserve cash a bank has to have can have dramatic effects on the economy; for this reason, this tool is rarely used. The Fed more often alters the supply of reserves available by buying and selling securities.

In the event that a bank's money supply drops below the required reserve amount, that bank can borrow either from another bank or from a Reserve Bank. If it borrows from another bank's excess reserves, then the loan takes place in a private financial market called the federal funds market. The federal funds market interest rate, called the funds rate, adjusts according to the supply of and demand for reserves.

The Discount Rate

If a bank chooses to borrow emergency reserve funds from a Reserve Bank, then it pays an interest rate called the "discount rate". The discount rate is the interest rate that a regional Reserve Bank charges banks and financial institutions when they borrow funds on a short-term basis. The Fed discourages banks from borrowing except for occasional, short-term emergency needs.

The discount rate often plays a larger role in the overall monetary policy than would be expected because it is a visible announcement of change in the Fed's monetary policy. Typically, higher discount rates indicate that more restrictive monetary policies are in store, while a lower rate might signal a less restrictive move.

Changes in the discount rate can affect:

- Lending rates (by making it either more or less expensive for banks to get money to lend or hold in reserve)
- Other open market interest rates in the economy (because of its "announcement effect")

Loans "create" money. When banks loan money, that money is spent on goods or services. These goods or services create income for the people providing them, which they in turn spend on other goods and services. When lots of loans are made, even more spending is done and more money is pumping through the economy.

When the Fed sees that too much money is going through the economy and prices are rising too quickly (inflation), it attempts to put the brakes on by selling securities. This reduces the amount of reserves available to banks, causing interest rates to rise, and banks will not make as many loans because it costs more for consumers to borrow. Ultimately, the economy slows down and inflation slows down with it.

The most effective tool the Fed has, and the one it uses most often, is the buying and selling of government securities in its open market operations. Government securities include treasury bonds, notes, and bills. The Fed buys securities when it wants to increase the flow of money and credit, and sells securities when it wants to reduce the flow.

The Fed purchases securities from a bank (or securities dealer) and pays for the securities by adding a credit to the bank's reserve (or to the dealer's account) for the amount purchased. The bank has to keep a percentage of these new funds in reserve, but can lend the excess money to another bank in the federal funds market.

This increases the amount of money in the banking system and lowers the federal funds rate. This ultimately stimulates the economy by increasing business and consumer spending because banks have more money to lend and interest rates are lowered.

When the Fed wants to decrease the money supply, it sells securities. That transaction deducts the purchase amount from the bank's reserve (or the dealer's account). This reduces the amount of money the bank has to lend in the federal funds market and increases the federal funds rate. This move ultimately slows the economy down by decreasing the amount of money banks have to loan, which increases interest rates and typically reduces consumer and business spending.

These decisions are made by the Federal Open Market Committee (FOMC), which consists of the seven members of the Board of Governors, the president of the Federal Reserve Bank of New York, and four rotating members from the other eleven Reserve Banks. This committee has eight meetings per year to discuss and direct the monetary policy. Additional emergency meetings are called when needed. The FOMC specifies either a quantity of reserves to be purchased or sold or a specific change in the federal funds rate. (The federal funds rate is the interest rate at which banks lend reserves to other banks.)

The Federal Reserve System was established in 1913 when Congress passed the Federal Reserve Act. Although the Fed is independent of the government, it is ultimately accountable to Congress because Congress can amend the Federal Reserve Act at any time. Its actions, however, do not require any kind of approval from the government.

The Fed is uniquely structured to eliminate government control but still remains accountable to both the government and the public. The Board represents the interests on the government side, and the regional Reserve Banks (whose boards of directors consist of local citizens) represent the interests of the private side. In order to operate independently of the government, the Fed finances its own operations.

The Board of Governors

The Fed has a seven-member Board of Governors and 12 regional Reserve Banks. The U.S. president appoints (and the Senate confirms) the seven Governors, whose 14-year terms are staggered to prevent a single president from being able to appoint too many governors. The chairman of the Federal Reserve, who serves a four-year term, is also appointed by the president.

District Directors

Each of the 12 Reserve Banks has nine directors on its board. The directors are responsible for the overall operations of their banks and report to the Board of Governors. The directors are divided into three groups that represent a cross-section of ideas and interests for the region. These groups are called Class A, Class B and Class C. Class A represents commercial banks that are members of the Federal Reserve System. These member banks elect both the Class A and Class B directors. Class B and C directors do not come from the banking industry. They represent the economic interests of the local district, including agriculture, manufacturing, labor, consumers and nonprofits, and are elected by the Board of Governors. This allows both the private sector and the government/public sector to have representation.

Regional Reserve Banks

Each regional Reserve Bank president is appointed to a five-year term by the bank's Board of Directors, but the Board of Governors gets the final say-so in the appointment.

FOMC

The Federal Open Market Committee (FOMC) consists of the seven members of the Board of Governors, the president of the Federal Reserve Bank of New York, who acts as vice chairman, and four members from the other eleven Reserve Banks that rotate at the end of each year.

Member Banks

Any national bank that is chartered by the federal government is automatically a member of the Federal Reserve System. State banks have to meet specific standards that the Board of Governors sets in order to become members.

Member banks are required to buy stock in their regional Reserve Banks. This stock does not give the bank any kind of voting privileges and cannot be sold or used as collateral for loans. What the banks do get is a six percent dividend on the stock and the ability to vote for the Class A and Class B directors of the Reserve Bank.

In order to develop the nation's monetary policy, the FOMC looks at many economic indicators. This gives the FOMC a feel for what the economy is doing and what direction it may be taking.

It also looks to The Beige Book, which is a report that summarizes comments received from businesses and other contacts outside of the Federal Reserve. This, in addition to economic indicators, forms the basis for the FOMC's monetary policy.

The Federal Reserve chairman accesses data about the economy every half hour or so when things in the economy are calm, and every 15 minutes when things are not. This is simply to make sure nothing is happening in the economy that the chairman does not know about.

The chairman can also tap into a network of business contacts that provide insight into a wide range of businesses, revealing who is buying what and in what amounts. By staying on top of where the economy is right now and where it is going, the Fed can project future changes and act accordingly.

The economic indicators examined by the Fed are:

Consumer Price Index (CPI) - This indicates the change in price for a fixed set of merchandise and services intended to represent what a typical consumer might purchase over a given period. It is compiled monthly by the U.S. Department of Labor's Bureau of Labor Statistics. By keeping track of the rate of change in the CPI, the Fed can get a measure of inflation.

Real Gross Domestic Product (GDP) - The GDP is the total of all of the goods produced in the United States, regardless of who owns them or the nationality of the producers. The measurement is produced quarterly and accurately represents national output, meaning it uses real terms so inflation does not distort the numbers. It is used as an indicator of the performance and growth of the economy.

Housing Starts - Because housing is very sensitive to interest rates, this indicator tells the FOMC how financial changes are affecting consumers. Housing starts are an estimate of the number of housing units that started construction in a given period. The report is produced monthly.

Nonfarm Payroll Employment - This measurement includes the total number of payroll jobs that are not in the farming business. It is produced each month by the U.S. Department of Labor's Bureau of Labor Statistics and also includes information about the total number of hours worked and hourly wages earned by workers. It is helpful to the FOMC as an economic indicator because it indicates the pace (or changes in the pace) of economic growth. The average hourly earnings number also shows trends in supply and demand.

S&P Stock Index - The Standard & Poor Index shows the FOMC the changes in price in a very wide variety of stock. S&P compiles the index daily. The value of watching this index as an indicator of the economy is that it often indicates the confidence consumers and businesses have in the economy. If the market is rising, then investments and spending will rise; if the market is low or falling, then investments and spending will also slow down.

Industrial Production/Capacity Utilization - This measures industrial output both by product and by industry. It is compiled by the Board of Governors each month and is useful because it tells the FOMC about the current growth of the Gross Domestic Product. By understanding the level of capacity utilization, the FOMC can understand how well resources are being utilized. All of this can indicate future changes in the rate of inflation.

Retail Sales - This is a total of all merchandise sold by retail merchants in the United States. The numbers are presented in dollar amounts, and are adjusted for seasonality but not for inflation. The U.S. Department of Commerce produces this report each month. This measurement tells the FOMC how much consumers are buying. This is called the personal consumption expenditure and indicates future growth or lags in the economy.

Business Sales and Inventories - This is a measurement of the total sales and inventories for the manufacturing, wholesale, and retail sectors. This report is compiled monthly by the U.S.

Department of Commerce and can be a good indicator of growth or slow downs in the economy because it shows the level of inventory and whether it is moving or not. Inventory that isn't moving indicates a future slow down; inventory that is moving may indicate an increase in future production. Light-Weight Vehicle Sales - Because changes in car sales can account for a large portion of the change in the GDP from quarter to quarter, this measurement has to be taken into account. The report is compiled by Ward's Automotive Reports and the American Automobile Manufacturer's Association, and seasonally adjusted numbers are generated by the U.S. Department of Commerce and the Bureau of Economic Affairs.

Yield on 10-year Treasury Bond - This is simply the current market rate for U.S. Treasury bonds that will be maturing in 10 years. This is good as an indicator because mortgage rates tend to follow it. Changes in mortgage rates, in turn, indicate future changes in the housing industry.

M2 - Because there is often a link between the supply of money and the growth of the GDP, this measurement is yet another indicator that the FOMC looks to when making decisions about monetary policy. The report is produced by the Board of Governors weekly and monthly.

Money Supply Measures

The Fed categorizes money based on its liquidity. It is divided into three categories:

- M1 - The actual cash money supply, spending money, checking accounts and currency
- M2 - A larger category that includes M1, small savings accounts and time deposits at banks, and money market mutual funds
- M3 - Larger and less liquid, including corporate CDs, etc.

Economic Indicators: Leading, Coincident, Lagging

Economic indicators are categorized as leading, coincident, or lagging. Leading indicators anticipate the direction in which the economy is going. Coincident indicators tell the Fed about the economy's current status. Lagging indicators help the Fed determine how long a downturn or upturn in the economy will last because these indicators are affected months after an upturn or downturn has begun.

By studying the indicators as they fall into these categories, the Fed can determine the phase of the business cycle that the economy is in at the time. The four phases of the business cycle are:

Expansion or recovery

Peak

Contraction or recession

Trough

The categories of "leading," "coincident," and "lagging" indicate the turning points of the economy relative to the business cycle. As the economy moves from one phase to the next, these indicators change.

For more detailed information about how economic indicators work, check out Economic Indicators on the Fed 101 Web site.

How does the Fed support itself?

In order to remain independent of the U.S. government, the Federal Reserve totally supports itself. It generates its income for the most part from interest. This interest comes from many sources, including:

Government securities that it acquires through open market operations

Foreign currency investments

Bank/depository institution loans that the Fed makes using the discount rate

The Fed is also paid fees for services it provides such as funds transfers (Fedwire), check processing, and automated clearinghouse (ACH) operations. (ACH options are electronic alternatives to the paper-based check system. Examples include automatic payroll deposits and electronic bill paying.)

Any money the Fed has left over after it pays all of its expenses are sent to the U.S. Treasury. Since the Federal Reserve System began in 1914, about 95 percent of the Reserve Banks' net earnings have ended up being paid into the Treasury.

Information about the income and expenses of the Federal Reserve Board can be found in the Board of Governor's Annual Report.

Checks and Balances

The structure of the Federal Reserve was carefully laid out to incorporate a strong system of checks and balances. Its decentralized status and broad range of participants eliminates the chances of any one group having too much control.

Each of the Fed's tools is under the authority of a different group within the system. For example, the Board of Governors has the authority to change bank reserve requirements; the boards of directors for the individual Reserve Banks can initiate changes to the discount rate (which then has to be approved by the Board of Governors); and the open market operations (the most important tool) is controlled by the FOMC, which represents both groups.

These checks and balances, along with the overall structure of the Federal Reserve, are intended to limit partisan interests and ensure that the Fed's decisions represent the broad interests and needs of the entire United States.

<https://money.howstuffworks.com/fed1.htm>

Supply Chain

A supply chain transforms raw materials and components into finished products and services that are delivered ultimately to end users. It is made up of a complex network of organizations and activities, such as raw materials suppliers, manufacturers, distributors, retailers and the customer. Human existence is dependent on an extensive and extended global supply chain that both supports livelihoods and provides goods and services.

The COVID-19 pandemic has demonstrated the robustness of this complex supply chain but also its fragility on the margins with some products and services being in short supply and at higher costs and prices. Other events such as severe weather and a ship blocking the Suez Canal also add impacts on the supply chain.

The supply chain utilizes equipment and systems but those must be developed, installed, operated and maintained by humans. COVID-19 related health and other personal impacts (fear, illness, death, child daycare, etc.) as well as government and corporate policies (mandates, etc.) have limited availability of labor at key links of the supply chain.

Emerging technologies may help reinforce the supply chain. For example, shortages of truck drivers and dock workers inhibit the full flow of goods. Future autonomous ship unloading robots and trucks may help limit these issues with the supply chain.

Supply chain management is the orchestration between these networks comprising procurement, management and storage of raw materials and manufacturing, as well as the moving, delivery, and storing of finished goods. It includes after-market services to create maximum efficiency, lower cost and net value.

It is the oversight of materials, information and finances as they move in a process from materials supplier to manufacturer to distributor to retailer and then to the consumer. The three main flows of the supply chain are the product flow, the information flow and the finances flow.

These occur across three main stages: strategy, planning and operation. SCM involves coordinating and integrating these flows both within and among companies.

Supply chain management (SCM) is a crucial process because an optimized supply chain results in lower costs and a more efficient production cycle. Companies seek to improve their supply chains so they can reduce their costs and remain competitive.

Traditional supply chains follow a linear progression. The output of one step is typically the input of the next step.

For instance, suppliers must send raw materials to the manufacturer before the products can be made. If there is a problem at any step, the entire linear chain is disrupted.

Current supply chains, however, are more complex than linear models. They are sophisticated supply networks that are more flexible and efficient.

This helps meet customer expectations for a wide selection of customized products and fast deliveries that meet individuals' specific needs.

The key steps in a supply chain include:

- Planning the inventory and manufacturing processes to ensure balanced supply and demand
- Manufacturing or sourcing materials needed to create the final product
- Assembling parts and testing the product
- Packaging the product for shipment or holding in inventory until a later date
- Transporting and delivering the finished product to the distributor, retailer, or consumer
- Providing customer service support for returned items

There are several common supply chain business models. The models have two main focuses: responsiveness and efficiency.

Each model strives for some combination of both but approaches those goals differently. In addition, models tend to favor one over the other.

Organizations can evaluate the value proposition of each in relation to their goals and constraints, and choose which suits them best. The models often overlap and should be designed by the supply chain manager to fit the unique supply chain.

The model types are:

- Continuous flow model - for mature industries with a degree of stability
- Agile model – for industries with unpredictable demand and products that are made to order
- Fast chain model - for products with a short lifecycle, such as fashion items
- Flexible model - for industries with a level of stability and a few predictable demand peaks.
- Custom configured model – for products requiring customizing
- Efficient chain model - for highly competitive markets in which pricing plays a large part

SCM provides centralized control for the planning, design, manufacturing, inventory, and distribution phases required to produce and sell a company's products.

A goal of SCM is to improve efficiency by coordinating the efforts of the various entities in the supply chain. This can result in a company achieving a competitive advantage over its rivals and enhancing the quality of the products it produces, both of which can lead to increased sales and revenue.

SCM best practices are seen in successful supply chains. They:

Continuous improvement

Aim for increased velocity

Encourage collaboration among the individual businesses in the supply chain

Seek new technologies that improve their processes

Have metrics in place that allow employees to measure the success or failure of each step

Logistics is one link in the supply chain. Logistics deals with the planning and control of the movement and storage of goods and services from their point of origin to their final destination. Successful logistics management ensures that there is no delay in delivery at any point in the chain and that products and services are delivered in good condition. This, in turn, helps keep costs down.

Efficient supply chain systems deliver each piece of the product where it is needed, when it is needed. This means controlling the flow of manufacturing costs.

The flow of manufacturing costs is most relevant to businesses that produce products requiring many different parts from many vendors. If some supplies arrive too early, they must be stored at the business' expense. If some arrive late, the machines stand idle while they wait.

Visibility is a top priority. Managers want to focus on adding technology such as sensors that give them a better view of their orders throughout the process. Also, a transition to digitization continues with that digital transformation combined with increased automation which will accelerate over the next few years.

The fundamental steps of a supply chain in order are as follows:

- Sourcing raw materials
- Refining those materials into basic parts
- Combining those basic parts to create a product
- Order fulfillment/Sales
- Product delivery
- Customer support and return services

The amount of time it takes any one of these processes from start to completion is known as lead time. Supply chains are managed by supply chain managers, who monitor lead time and coordinate the processes in each step to maximize customer satisfaction.

Modern supply chains are complex and present several common challenges. These are:

- Transparency that enables stakeholders to understand the status of the supply chain
- Gauging supply, demand or capabilities to avoid overstocked inventory
- Meeting and managing customer expectations while providing a valuable product
- Avoiding lost or delayed goods that delay the process and can impact customers negatively
- Establish resiliency to sudden changes preparing for the unexpected with the ability to pivot

Supply chain managers need to adapt to the growing speed and scale of the global marketplace. Best practices for doing this include:

- Use lean SCM and logistics techniques increasing flexibility and minimizes inventory waste
- Increase inventory velocity so supply does not outweigh demand
- Collaboration with other businesses in their supply chain to optimize the entire chain
- Shorten cycles to meet customer expectations
- Use supply chain technology to integrate their supply chains and collaborate more effectively
- Implement useful metrics
- Machine learning, artificial intelligence and automation

Supply chains contrasted against value chains contribute to the end product in different ways. Supply chains aim to meet customer demands. Value chains seek to add value to a product on top of its inherent value.

The purpose of the value chain is to give the company a competitive advantage in the industry. Supply chain management and value chain management are two slightly different perspectives on the same basic process and work in tandem to meet two slightly different definitions of "demand."

<https://www.accenture.com/us-en/insights/supply-chain-operations/supply-chain-management-operations-index>

<https://www.investopedia.com/terms/s/supplychain.asp>

The global supply chain can be categorized as follows.

Raw Materials

- Extraction
- Farming/Fishing

Finished Goods

- Manufacture
- Utilities
- Construct

Service

- Retail
- Finance
- Hospitality/Leisure
- Real Estate
- Communications
- Information Tech & Services
- R&D
- Education
- Public
- Other

Major private and state-owned Supply Chain entities are listed here:

Raw Materials			Finished Goods			Service					[government]			
Extraction	Farm/Fish	Manufact	Utilities	Construct	Retail	Finance	Hosp/Leig.	Real Est	Comm	IT	Other	Education	Public	R&D
Glencore BHP Rio Tinto Jiangxi Vele SA Shenhua Yanzhou Anglo Am	Catholic Riehart Mudanjiang Austral Ag Jumbuck Ford Emmerson Malone Reed Turner Kroonke	Toyota Apple Samsung Daimler GM Hon Hai Honda Cardinal Hit GE BMW Nissan China Rail Boeing Dongfeng Siemens Nestle Huawei Bosch Hyundai Hitachi Enel Eni IBM Dell	NextEra Duke Vistra Southern Bendrola Dominion Enel Narell UK Amer Elec Exelon	CHINA STATE CHINA RAIL CHINA COMM VINCI POWER CHINA ACS ACTIVIDADES BOUYGUES SHANGHAI CNST CHINA METAL HOCHTIEF CHINA ENERGY BECHTEL STRABAG SE OJAYASHI SKANSKA AB FLUOR CORP KAJIMA CORP HYUNDAI EIFFAGE TECHNIPFMC FERROVIAL TASEI CORP LARSEN	Walmart Amazon Costco Schwarz Home Dep Kroger Walgreen Edeka JD.com Alibaba CVS Lowe's Ahold Aeon Tesco Alibabcons Edeka Rena Sainsbury Best Buy Publix Centres Worths AUS IKEA	Bank Of China JPMorgan Japan Post China Cnst Bok Bank of Amer Ag Bank China Credit Agricole Wells Fargo Bok of China	Marriott Jim Jiang Hilton IHG Wyndam Accor Huazhu Choice OYO BTH	Keller Brookfield CBRE Jobs Cushman Amer Tys Simon Realogy Welltower Prologis Boston Equity AvolonBay Vonardo Anschutz Re/Max	ATT Verizon China Mob Comcast NTT DT Softbank China Tel T-Mobile Am Mobil Vodafone Orange	Microsoft IBM Oracle Arcnture HP SAP Tata Capgemini		Public schools Private schls	Govments Universities Companies	
Aramco PetroChina China Pet Mowei Exxon Total BP PLC Chevron Marathon Valero Phillips	Nichiro Nissul Thai Union Mowei Mitsubishi Total Dongwon Chamber Skretting BASF Panasonic Beijing Auto FAW Group ArcelorMitt Mitsubishi	Sempra Naturgy Tosngas Almos ENN NISource GAIL Tokyo Gas UGI Osaka					Starbucks Compass McDonalds Darden Yum RBI							
		P&G Norinco Pepco Intel Dow DuPont Unilever United Tech Aviat China Baowei ChemChina Hoffmann Renault Arheuser-LG Elect POSCO Shandong Wololao Pfizer Hewlett- Bayer Sinopharm Nippon SH					MGM Caesars							

Food Security

Food security is the measure of the availability of food and individuals' ability to access it. Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. 3 billion or more people are estimated to be unable to afford even the cheapest healthy diet

Slowdowns and downturns since the 2008-9 financial crisis have degraded social conditions and pests and diseases have spread, making undernourishment more prevalent. High import and export dependence ratios are meanwhile making many countries more vulnerable to external shocks. In many low-income economies, debt has grown to levels far exceeding GDP, eroding growth prospects. Protracted violence and mass displacement has significantly increased the number of displaced people grew by 70 percent.

About a third of people are believed to live in food-insecure households. The pillars of food security are availability, access, utilization, and stability.

Food availability relates to the supply of food through production, distribution, and exchange. Per capita world food supplies are more than adequate to provide food security to all, and thus food accessibility is a greater barrier to achieving food security.

Food production is determined by a variety of factors including land ownership and use; soil management; crop selection, breeding, and management; livestock breeding and management; and harvesting. Crop production can be affected by changes in rainfall and temperatures. Distribution involves the storage, processing, transport, packaging, and marketing of food.

80 to 90 percent of all families in rural Africa rely upon producing their own food.

Utilization refers to the metabolism of food by individuals. Food safety affects food utilization. The health of individuals controls how the food is metabolized.

For example, intestinal parasites can take nutrients from the body and decrease food utilization. Sanitation can also decrease the occurrence and spread of diseases that can affect food utilization.

Stability refers to the ability to obtain food over time. Stability can be affected by natural disasters, conflicts, loss of employment or productivity.

Food insecurity with young children can cause stunting. Once stunting has occurred, improved nutritional intake after the age of about two years is unable to reverse the damage.

Stunted individuals suffer a higher rate of disease and illness and defects in cognitive development. Worldwide, the prevalence of stunting is about one fifth of all children. Food insecurity also is strongly associated with a higher risk of depression, anxiety, and sleep disorders.

Water deficits exist in scores of countries (including northern China, the US, and India) due to widespread over-pumping using powerful diesel and electric pumps.

Land degradation and desertification includes deforestation, overgrazing, over exploitation of vegetation for use. Approximately 40 percent of the world's agricultural land is seriously degraded.

Agricultural diseases (such as wheat stem rust), and genetic diversity affect food security. Wild plants and modern varieties are crossed through means of modern plant breeding in order to transfer the resistance genes from the wild plants to the modern varieties.

Mass starvation has been used as a political and wartime weapon of war rewarding supporters while denying food supplies to opposition.

Maintaining buffers to ensure food stability requires a certain amount of food to be lost or wasted. At the same time, ensuring food safety involves discarding unsafe food, which then is counted as lost or wasted. Higher-quality diets tend to include more highly perishable foods.

Increase in population in the future (but a steady decline in the population growth rate) means agricultural output has increased, however, the ratio of crops produced to energy input has decreased over time.

Agricultural insurance includes two types: claim-based insurances and index-based insurances. Index insurance eliminates the loss verification step, thereby mitigating a significant transaction cost. A second advantage of index-based insurance is that, because it pays an indemnity based on the reading of an index rather than individual losses, it eliminates much of the fraud, moral hazard and adverse selection, which are common in classical claim-based insurance. Basis risk is a major disadvantage of index-based insurance. It is the situation where an individual experiences a loss without receiving payment or vice versa.

Developing technology is helping enhance food security. One example is robot weeder which can reduce pesticide use. Laser-equipped robots zap weeds as they go. Each one can destroy 100,000 weeds an hour.

These devices reduce soil disturbance, which can contribute to erosion, and enable farmers to heavily reduce or even eradicate the use of herbicides. This avoids contamination of ground and surface water, not affect wildlife and non-target plants, and decrease cancer risk.

Even with robots that do use herbicides, their ability to precisely target weeds can reduce the use about 90% compared with conventional blanket spraying. Robots also are designed to perform tasks such as seeding, harvesting and environmental monitoring.

Ten of the US's 20 largest vegetable growers now use robot weeders. Removing pests, such as aphids, thrips and lygus bugs, is a next step reduce the use of fungicides and pesticides.

Robots also can shorten food supply chains. Robot-run greenhouses can use hydroponics – growing plants without soil – to produce food closer to large population centers.

Bad Science

Eugenics is a group of theories and applications to improve certain groups of the human population by improving their genetics through various techniques. This purported improvement of a particular group often was at the expense of other groups considered to be inferior.

Modern eugenics began in the early 20th century when it became popular in most developed countries with the espoused purpose of improving their populations. Governmental and other societal programs promoted reproduction of individuals determined as fit to reproduce along with marriage prohibitions and forced sterilization of people designated as unfit for reproduction (people with mental or physical disabilities, low IQ test results, criminals, and members of certain minority groups). Eugenics were used by the Nazis as justification for their genocidal atrocities.

Eugenics had broad support among the political, scientific and academic communities (although a few individuals were outspoken opponents). Even popular culture accepted eugenics as evidenced for example by the 1917 movie "The Black Stork" which grossly misrepresented reproduction related genetics to support a non-scientific opinion of reproduction.

Genetics related policies are susceptible to abuse by whichever group (or even all groups) is in political power at the time. In addition to being a violation of reasonable human self-determination, eugenic policies can result in loss of genetic diversity, and the practicality of eliminating genetic traits is very limited.

As the abuses became apparent, eugenics lost support over the second half of the 20th century. Subsequent reproductive assistance and direct gene editing techniques, however, have created concerns about genetic related abuses once again.

Very little regulation of human genetic modification exists in any country (except for bans on human cloning in several dozen countries). As genetic modification techniques advance, we all should stay aware of the situation and determine the reasonable use of those techniques.

Individual self-determination should be the main principle with state mandated limitations minimized to avoid political abuse. Some regulation, however, is needed to help avoid misuse by individuals and by the state.

The Soviet scientist Trofim Lysenko published work on vernalization (a form of plant memory) in the late 1920s. The Soviet government, looking for an agricultural panacea, inundated him with money and prestige.

As Lysenko gained power, he made unsupported claims that vernalization could transform all kinds of plants and boost the production of Soviet lands.

However, Lysenko could not breed new varieties of grains that inherited memories of seasons. He promised to but could not prevent famine in 1946 and 1947. When geneticists challenged him, Lysenko denounced them leading to the imprisonment and death for hundreds of scientists.

A generation of Russian geneticists gave up their work, left the country, or were punished. Without them, Lysenko never would see that plants could form memories of seasons but could not transmit the memories across generations.

Artificial sweeteners

Artificial Sweeteners

Artificial sweeteners have proven actually not to be better than regular sugar. Your taste buds may think that aspartame or saccharin is like the sugar you crave, but your brain may not.

Research indicates that consuming artificial sweeteners actually trains your insulin response to store more fat, not less. When you eat real sugar, your taste buds send an alert to your pancreas to produce insulin. The insulin then helps break down the sugars, which either provide immediate energy or go into fat cells for storage.

If your body interprets something as sweet that is not real sugar, however, it may end up producing that same insulin response. Artificial sweeteners do not trigger reward circuits the same way, so a person does not get the satisfaction of ingesting sugar.

In addition, constantly triggering your insulin response leads it to malfunction. Eventually your pancreas starts producing too much insulin in response to all food, increasing weight gain. People who drink diet beverages tend to gain weight.

Sugars activate our reward circuits—they give us a hit of feel-good neurochemicals that prompt us to continue craving them. The more sugar you eat, the more you want it.

Since artificial sweeteners do not satisfy the brain the way real sugar does, the eater does not sate the craving. The person will probably end up eating more calories overall.

Alcohol

Sources generally agree that, when it comes to assessing the cumulative health effects of occasional or light drinking—whatever benefits or harms may exist are modest. It is entirely possible that light or moderate alcohol consumption has no meaningful health impact for many people.

Even if alcohol increases cancer or other health risks, at low or moderate levels (somewhere between 0 and 1-2 drinks per day) it may simultaneously reduce cardiovascular risk. And, in the U.S. where heart disease is the biggest killer, that could seem a worthwhile trade-off.

Proposed mechanisms for alcohol's cardiovascular health boost include that it might increase the amount of the body's "good" HDL-cholesterol, inhibit clotting, or help moderate blood sugar levels—though it's hard to disentangle the effects of alcohol itself from the other compounds present in beverages like red wine. Some also suggest that the social aspect of alcohol may mean those who engage in moderate drinking have richer social lives and are less lonely.

For now, the state of the research leaves experts unconvinced one way or the other on the potential benefits of alcohol. There is no consensus of scientists on the cardiovascular effects.

https://www.popsci.com/science/is-alcohol-good-for-you/?utm_source=firefox-newtab-en-us

Lost Technology

Sometimes technology is lost. Sometimes it is rediscovered.

“In most cases, we don’t know what causes asthma, and we don’t know how to cure it”

- Centers for Disease Control and Prevention (CDC)

Every day in the U.S. 44,000 people have an asthma attack. There are more than 3,300 deaths due to asthma each year and asthma is indicated as “contributing factor” for nearly 7,000 other deaths.

In the 1950’s Dr. Elmer D. Gay treated thousands of asthma sufferers with a solution that included arsenic. For over 2,400 years, arsenic has been used as a therapeutic agent. Arsenic and its derivatives have been found to be useful in treating diseases including forms of cancer.

In 1967, Harvard University researchers Drs. John Nader and Mark Novitch reported the results of a controlled trial of Gay’s solution in patients whose asthma was intractable to treatment with either bronchodilators alone or bronchodilators plus corticosteroids. The Harvard researchers their research paper, An evaluation of Gay’s solution in the treatment of asthma - John G. Nader, M.D., and A. Mark Novitch, M.D., Boston, Mass., December, 1967, that “Gay’s solution is effective in the treatment of severe asthma and that this effectiveness is dependent on the presence of arsenic in the mixture. Because of the high incidence of side effects, we recommend that it be tried only in refractory cases and that they be followed carefully.”

The arsenic based solution used Dr. Gay’s treatment ceased to be used in the 1970’s. The understanding of arsenic’s biological mechanism for inhibiting asthma has become better understood in recent years.

Perhaps arsenics use for asthma treatment again is an example of a technology should be used once again. In 2001, the FDA approved the use of arsenic for treatment of leukemia.

3D Living ... Free Space Technologies are Freeing Us

It began with wireless communications. 2-way radio, cellular, Wi-Fi and other forms untethered us from wires for telecommunications. We can be anywhere in space that sufficient radio energy for a link is able to reach us.

Batteries and other portable power sources provide freedom to operate electrical devices in unconstrained space. Aircraft provide a certain amount of freedom to be transported in three dimensional space.

This 3D free space trend will continue with several emerging technology-based platforms. Small vertical takeoff and landing vehicles VTOLs (aka “flying cars”) sometimes are derided as the technology fantasy that never arrives. The difference this time is that precision guidance and collision avoidance systems, compact quiet powerful electric motors and strong lightweight composite materials are available and will permit VTOLs to operate in essentially unconstrained airspace.

Small VTOLs use of 3-dimensional space along with higher speeds will enhance radically transportation. The main barriers now are societal. In addition to convenience, however, the potential for dramatic reduction of the more than one million annual global traffic deaths will help overcome this inertia.

Energy packet networks will store and forward quantized energy units to and from devices via wireless transmission. The storage of energy (e.g., in batteries in discrete units) is replenished by a flow from external sources including ambient energy harvesting.

Immersive augmented and virtual reality 3D user interfaces with information systems will provide a more useful and enjoyable experience than the existing 2D flat screen displays.

This all leads to an environment in which information, energy and matter (physical items) are transported as standardized units (packets) in full three-dimension unconstrained free space.

Augmented Reality

One of the key developments in human experience is Augmented Reality (AR). AR is an interactive experience where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, manipulation, pressure and temperature, and olfactory. The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations, which are perceived as natural parts of an environment.

With AR technologies the information about the surrounding real world of the user becomes interactive and manipulated. AR includes registration and tracking between the superimposed perceptions, sensations, information, data, and images and some portion of the real world.

The inclusion of heads up display (HUD) technology enhances the AR experience. A HUD is a transparent display that presents data without requiring users to look away from their usual viewpoints.

Applications of AR span commercial industries such as education, communications, medicine, and entertainment. For example, AR is used by customers to preview how products might look at home.

Augmented reality (AR) differs from virtual reality (VR) in the sense that in AR part of the surrounding environment is actually 'real' and just adding layers of virtual objects to the real environment. On the other hand, in VR the surrounding environment is completely virtual.

Hardware components for AR are: a processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements, which often include a camera and microelectromechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid state compass, making them suitable AR platforms. Various technologies are used in augmented reality rendering, including optical projection systems, monitors, handheld devices, and display systems, which are worn on the human body.

Contact lens-like AR devices can include a built-in camera on the lens itself. The design is intended to control its interface by blinking an eye.

A virtual retinal display (VRD) a display is scanned directly onto the retina of a viewer's eye. This results in bright images with high resolution and high contrast. The viewer sees what appears to be a conventional display floating in space. Geotagged locations can appear on a stylized map for the user to interact with.

Similar to the VRD, a computer-controlled laser light source has infinite depth of focus and causes the eye itself to, in effect, function as both a camera and a display by way of exact alignment with the eye and resynthesis (in laser light) of rays of light entering the eye.

Spatial augmented reality (SAR) augments real-world objects and scenes, without the use of special displays such as monitors, head-mounted displays or hand-held devices. SAR makes use of digital projectors to display graphical information onto physical objects. The key difference in SAR is that the display is separated from the users of the system. Since the displays are not associated with each user, SAR scales naturally up to groups of users, allowing for collocated collaboration between users.

Mobile networked AR often relies on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is sometimes utilized. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there are many real-time multimedia transport protocols, support is required from network infrastructure as well.

Include devices and techniques include speech recognition systems that translate a user's spoken words into computer instructions, and gesture recognition systems that interpret a user's body movements by visual detection or from sensors embedded in a peripheral device such as a wand, stylus, pointer, glove or other body wear.

Wearable devices are in development that provide instantaneous information about what you are thinking directly to an information system. The system analyzes the sensed visual and other data to synthesize and position augmentations.

Augmented Reality Markup Language (ARML) is a data standard developed within the Open Geospatial Consortium (OGC), which consists of Extensible Markup Language (XML) grammar to describe the location and appearance of virtual objects in the scene, as well as ECMAScript bindings to allow dynamic access to properties of virtual objects. To enable rapid development of augmented reality applications, some software development kits (SDKs) have emerged.

AR can augment the effectiveness of navigation devices. For example, information is displayed on an automobile's windshield indicating destination directions and meter, weather, terrain, road conditions and traffic information as well as alerts to potential hazards.

Issues that must be managed with AR are overload of information, overreliance, privacy and intellectual property. The Code of Ethics on Human Augmentation, which was originally introduced by Steve Mann in 2004 and further refined with Ray Kurzweil and Marvin Minsky in 2013, was ultimately ratified at the Virtual Reality Toronto conference.

Artificial Intelligence

So-called Artificial Intelligence (AI) is the “intelligence” of machines and software, as opposed to the intelligence of human beings or animals. AI often refers to machine learning using neural networks.

Elon Musk has stated that he thinks artificial intelligence may well eventually eliminate the need for humans to work. "In a benign scenario, probably none of us will have a job," Musk said. "There will be universal high income — and not universal basic income — universal high income. There'll be no shortage of goods or services."

In his opinion, there is an 80% chance that AI advances will result in such a situation where humans will not need a job and will have all they need. "The question will really be one of meaning, of how — if a computer can do, and the robots can do everything better than you ... does your life have meaning?"

"I think we are seeing the most disruptive force in history here," Musk said of AI.

<https://www.foxbusiness.com/technology/elon-musk-expects-ai-replace-all-human-jobs-universal-high-income>

Bank tellers, cashiers, postal workers, and the jobs of administrative assistants are among those forecast to decline by 2030 due to the impacts of AI.

Jobs in decline

Clerical and secretarial workers, including cashiers, ticket clerks, administrative assistants, and executive secretaries are expected to see the largest decline in absolute numbers. The fastest-declining roles are also expected to include postal service clerks, bank tellers, and data entry workers.

Jobs predicted to grow

Frontline job roles are predicted to see the largest growth in terms of absolute volume, including: farmworkers, delivery drivers, construction workers, salespeople, and food-processing workers. Care economy jobs, such as nurses, social workers, counselors, and personal care aides are also expected to grow significantly over the next five years, alongside teachers.

Technology-related roles are the fastest-growing jobs in terms of percentage, and include: big data specialists, fintech engineers, AI and machine learning specialists, and software and application developers.

The top in-demand skills and areas of growth are in technology within AI, big data, and cybersecurity, and 41% of employers intend to downsize as AI automates existing tasks.

But human skills like critical and creative thinking, including resilience, flexibility, and agility remain highly sought after. In fact, analytical thinking is the most sought-after core skill among employers, with 7 out of 10 companies calling it essential.

On average, workers can expect 39% of their existing skill sets will be transformed or become outdated in the next 5 years. However, many workers likely already are "upskilling" or getting additional training.

https://www.fastcompany.com/91256947/jobs-most-at-risk-fastest-growing-declining-by-2030-ai-wef-world-economic-forum?utm_source=firefox-newtab-en-us

Others, however, think Artificial Intelligence (AI) probably is not coming for your job anytime soon.

We live in an age specialization. This is a trend that has been evolving for centuries.

AI has begun to alter, even reverse, this evolution. While society is moving toward ever more specialization, AI is moving in the opposite direction and attempting to replicate humans' greatest evolutionary advantage - adaptability.

Long-term artificial general intelligence (AGI) could lead to a shift away from specialization. AGI that would, theoretically, have abilities beyond that of humans and could either propel us into a life of leisurely pursuits or turn us into a super AI server servant class.

Some predictions are that AI will replace 85 million jobs by 2025. More than a third of businesses have already been replacing workers with AI.

While Musk believes most jobs will eventually be replaced by AI, Open AI CEO Sam Altman takes a more moderate view that all repetitive human work not requiring a "deep emotional connection" between people will be done better, cheaper, faster by AI.

For example, how much of a lawyer's work could be subject to replacement by some form of AI. In reviewing discovery documents, the inherent set of document review tasks seems to be tailor-made for AI.

How good is AI at analyzing the merits of a case or determining the usefulness of a specific document and how it fits into a plausible legal argument? For now, some argue, we are not even close. Lawyering can be greatly aided by AI but at present is not about to be fully replaced by AI.

https://www.fastcompany.com/91130124/heres-why-ai-probably-isnt-coming-for-your-job-anytime-soon?utm_source=pocket-newtab-en-us

"Soft computing" is a set of techniques, including genetic algorithms, fuzzy logic and neural networks, that are tolerant of imprecision, uncertainty, partial truth and approximation. Most successful AI programs in the 21st century are examples of soft computing with neural networks.

Two of the most important fields in AI development are "machine learning" and its sub-field, "deep learning." What's the difference between machine learning and deep learning?

Machine learning (or ML) is a broad category of artificial intelligence that refers to the process by which software programs are "taught" how to make predictions or "decisions."

ML provides for machines to make "predictions or decisions based on data. The more information that is fed into the system, the more it's able to give accurate predictions.

Unlike general programming where a machine is engineered to complete a very specific task, machine learning involves training an algorithm to identify patterns in data by itself.

Unlike some other forms of machine learning, Deep Learning (DL) seeks to allow algorithms to do much of their work. DL is fueled by mathematical models known as artificial neural networks (ANNs). These networks seek to emulate the processes that naturally occur within the human brain—things like decision-making and pattern identification.

One of the biggest differences between deep learning and other forms of machine learning is the level of "supervision" that a machine is provided. Supervision is a process whereby a human helps

the machine recognize patterns in labeled, structured data, and thereby improve its ability to carry out predictive analysis.

Machine learning relies on huge amounts of “training data.” Such data is often compiled by humans via data labeling, a training dataset is built, which can then be fed into the AI algorithm and used to teach it to identify patterns.

For instance, if a company was training an algorithm to recognize a specific brand of car in photos, it would feed the algorithm huge tranches of photos of that car model that had been manually labeled by human staff. A “testing dataset” is also created to measure the accuracy of the machine’s predictive powers, once it has been trained.

With DL, a machine engages in a process called “unsupervised learning.” Unsupervised learning involves a machine using its neural network to identify patterns in what is called unstructured or “raw” data—which is data that hasn’t yet been labeled or organized into a database.

ANNs are made up of what are called “nodes.” One ANN can have “thousands or even millions” of nodes. These nodes can be a little bit complicated but the shorthand explanation is that they—like the nodes in the human brain—relay and process information.

“Deep” learning networks involve multiple layers of nodes. Information moves through the network and interacts with its various environs, which contributes to the machine’s decision-making process when subjected to a prompt.

Another key concept in ANNs is the “weight,” which one commentator compares to the synapses in a human brain. Weights, which are just numerical values, are distributed throughout an AI’s neural network and help determine the ultimate outcome of that AI system’s final output. Weights are informational inputs that help calibrate a neural network so that it can make decisions.

To each of its incoming connections, a node will assign a number known as a “weight.” When the network is active, the node receives a different data item — a different number — over each of its connections and multiplies it by the associated weight. It then adds the resulting products together, yielding a single number. If that number is below a threshold value, the node passes no data to the next layer. If the number exceeds the threshold value, the node “fires,” which in today’s neural nets generally means sending the number — the sum of the weighted inputs — along all its outgoing connections.

In short: neural networks are structured to help an algorithm come to its own conclusions about data that has been fed to it. Based on its programming, the algorithm can identify helpful connections in large amounts of data, helping humans to draw their own conclusions based on its analysis.

<https://qz.com/meta-facebook-instagram-ai-video-feed-reels-1851315404> s

AI applications include advanced web search engines (e.g., Google Search), recommendation systems (used by YouTube, Amazon, and Netflix), understanding human speech (such as Siri and Alexa), self-driving cars (several examples), generative or creative tools (ChatGPT and AI art), and competing at the highest level in strategic games (such as chess and Go).

The general problem of simulating (or creating) intelligence has been broken down into sub-problems. These consist of particular traits or capabilities that researchers expect an intelligent system

to display. The traits described below have received the most attention and cover the scope of AI research.

Reasoning, problem-solving

Many of these algorithms are insufficient for solving large reasoning problems because they experience a "combinatorial explosion": they became exponentially slower as the problems grew larger. Even humans rarely use the step-by-step deduction that early AI research modeled. They solve most of their problems using fast, intuitive judgments. Accurate and efficient reasoning is an unsolved problem.

Knowledge representation (KR)

An ontology represents knowledge as a set of concepts within a domain and the relationships between those concepts. Knowledge representation and knowledge engineering allow AI programs to answer questions intelligently and make deductions about real-world facts. The most general ontologies are called upper ontologies, which attempt to provide a foundation for all other knowledge and act as mediators between domain ontologies that cover specific knowledge about a particular domain (field of interest or area of concern).

Knowledge bases need to represent things such as: objects, properties, categories and relations between objects; situations, events, states and time; causes and effects; knowledge about knowledge (what we know about what other people know); default reasoning (things that humans assume are true until they are told differently and will remain true even when other facts are changing); and many other aspects and domains of knowledge.

Among the most difficult problems in KR are: the breadth of commonsense knowledge (the set of atomic facts that the average person knows) is enormous; the difficulty of knowledge acquisition and the sub-symbolic form of most commonsense knowledge (much of what people know is not represented as "facts" or "statements" that they could express verbally).

Planning and decision making

Automated planning and automated decision making are part of AI.

Learning

Machine learning is the study of programs that can improve their performance on a given task automatically. It has been a part of AI from the beginning.

There are several kinds of machine learning. Unsupervised learning analyzes a stream of data and finds patterns and makes predictions without any other guidance. Supervised learning requires a human to label the input data first, and comes in two main varieties: classification (where the program must learn to predict what category the input belongs in) and regression (where the program must deduce a numeric function based on numeric input).

In reinforcement learning the agent is rewarded for good responses and penalized for bad ones. The agent learns to choose responses that are classified as "good". Transfer learning is when the knowledge gained from one problem is applied to a new problem. Deep learning uses artificial neural networks for all of these types of learning.

Natural language processing

Natural language processing (NLP) enables programs to read, write and communicate in human languages such as English. Specific problems include speech recognition, speech synthesis, machine translation, information extraction, information retrieval and question answering.

Modern deep learning techniques for NLP include word embedding (how often one word appears near another), transformers (which finds patterns in text), and others. In 2019, generative pre-trained transformer (or "GPT") language models began to generate coherent text, and by 2023 these models were able to get human-level scores on the bar exam, SAT, GRE, and many other real-world applications.

Perception

Feature detection helps AI compose informative abstract structures out of raw data. Machine perception is the ability to use input from sensors (such as cameras, microphones, wireless signals, active lidar, sonar, radar, and tactile sensors) to deduce aspects of the world. Computer vision is the ability to analyze visual input. The field includes speech recognition, image classification, facial recognition, object recognition, and robotic perception.

Robotics

Robotics uses AI

Social intelligence

Affective computing is an interdisciplinary umbrella that comprises systems that recognize, interpret, process or simulate human feeling, emotion and mood. For example, some virtual assistants are programmed to speak conversationally or even to banter humorously; it makes them appear more sensitive to the emotional dynamics of human interaction, or to otherwise facilitate human-computer interaction. However, this tends to give naïve users an unrealistic conception of how intelligent existing computer agents actually are. Moderate successes related to affective computing include textual sentiment analysis and, more recently, multimodal sentiment analysis, wherein AI classifies the affects displayed by a videotaped subject.

General intelligence

A machine with artificial general intelligence should be able to solve a wide variety of problems with breadth and versatility similar to human intelligence.

Personal superintelligence

One AI concept is to provide everyone their own personal superintelligence. This differs from current industry focus on automating work

Personal superintelligence for everyone, will further enable creative and leisurely pursuits.

AI keeps accelerating with AI systems improving themselves. What we should direct superintelligence towards?

The intention of personal superintelligence is to help you achieve your goals, create what you want to see in the world and grow to become the person that you aspire to be.

This vision is different from others in the industry which would direct AI at automating all of the valuable work. Putting the power of superintelligence in people's hands directs it towards what they value in their own lives."

Some of this will be about improving productivity, but a lot of it will be more personal in nature.

200 years ago, about 90% of people were focused on farming for survival, while today fewer than 2% of the population produce the food that feeds the world.

Advances in technology have freed much of humanity to focus less on subsistence, and more on the pursuits that we choose. That at each step along the way, most people have decided to use their newfound productivity to spend more time on creativity, culture, and just enjoying life – and superintelligence may accelerate this trend even more.

If past trends continue, there will be less time spent on productivity software and more time on creating and connecting, and personal devices such as AI-enabled smart glasses, will become the "main computing devices."

<https://www.foxbusiness.com/markets/zuckerberg-wants-give-everyone-own-personal-superintelligence-through-metas-new-vision>

Tools

Logic

Logic is used for highly formalized knowledge representation and problem-solving.

Search and optimization

AI can solve many problems by intelligently searching through many possible solutions. There are two very different kinds of search used in AI: state space search and local search.

State space search

State space search searches through a tree of possible states to try to find a goal state. For example, Planning algorithms search through trees of goals and subgoals, attempting to find a path to a target goal, a process called means-ends analysis.

Simple exhaustive searches are rarely sufficient for most real-world problems: the search space (the number of places to search) quickly grows to astronomical numbers. The result is a search that is too slow or never completes. "Heuristics" or "rules of thumb" can help to prioritize choices that are more likely to reach a goal.

Adversarial search is used for game-playing programs, such as chess or go. It searches through a tree of possible moves and counter-moves, looking for a winning position.

Local search

Local search uses mathematical optimization to find a numeric solution to a problem. It begins with some form of a guess and then refines the guess incrementally until no more refinements can be made. These algorithms can be visualized as blind hill climbing: we begin the search at a random point on the landscape, and then, by jumps or steps, we keep moving our guess uphill, until we reach the top. This process is called stochastic gradient descent.

Evolutionary computation uses a form of optimization search. For example, they may begin with a population of organisms (the guesses) and then allow them to mutate and recombine, selecting only the fittest to survive each generation (refining the guesses).

Distributed search processes can coordinate via swarm intelligence algorithms. Two popular swarm algorithms used in search are particle swarm optimization (inspired by bird flocking) and ant colony optimization (inspired by ant trails).

Neural networks and statistical classifiers (discussed below), also use a form of local search, where the "landscape" to be searched is formed by learning.

Probabilistic methods for uncertain reasoning

Many problems in AI (including in reasoning, planning, learning, perception, and robotics) require the agent to operate with incomplete or uncertain information. AI researchers have devised a number of tools to solve these problems using methods from probability theory and economics.

Probabilistic algorithms can also be used for filtering, prediction, smoothing and finding explanations for streams of data, helping perception systems to analyze processes that occur over time (e.g., hidden Markov models or Kalman filters).

Precise mathematical tools have been developed that analyze how an agent can make choices and plan, using decision theory, decision analysis, and information value theory. These tools include models such as Markov decision processes, dynamic decision networks, game theory and mechanism design.

Classifiers and statistical learning methods

The simplest AI applications can be divided into two types: classifiers (e.g. "if shiny then diamond"), on one hand, and controllers (e.g. "if diamond then pick up"), on the other hand. Classifiers are functions that use pattern matching to determine the closest match. They can be fine-tuned based on chosen examples using supervised learning. Each pattern (also called an "observation") is labeled with a certain predefined class. All the observations combined with their class labels are known as a data set. When a new observation is received, that observation is classified based on previous experience.

There many kinds of classifiers in use. The decision tree is the simplest and most widely used symbolic machine learning algorithm. K-nearest neighbor algorithm was the most widely used analogical AI until the mid-1990s, and Kernel methods such as the support vector machine (SVM) displaced k-nearest neighbor in the 1990s. The naive Bayes classifier is reportedly the "most widely used learner" at Google, due in part to its scalability. Neural networks are also used as classifiers.

Artificial neural networks

A neural network is an interconnected group of nodes, akin to the vast network of neurons in the human brain. Artificial neural networks were inspired by the design of the human brain: a simple "neuron" N accepts input from other neurons, each of which, when activated (or "fired"), casts a weighted "vote" for or against whether neuron N should itself activate. In practice, the "neurons" are a list of numbers, the weights are matrixes, and learning is performed by linear algebra operations on the matrixes and vectors. Neural networks perform a type of mathematical optimization -- they perform stochastic gradient descent on a multi-dimensional topology that is created by training the network.

Neural networks learn to model complex relationships between inputs and outputs and find patterns in data. In theory, a neural network can learn any function.

The most common training technique is the backpropagation algorithm. In feedforward neural networks the signal passes in only one direction. Recurrent neural networks feed the output signal back into the input, which allows short-term memories of previous input events.

Perceptrons use only a single layer of neurons, deep learning uses multiple layers. Convolutional neural networks strengthen the connection between neurons that are "close" to each other -- this especially important in image processing, where a local set of neurons must identify an "edge" before the network can identify an object.

Deep learning

Deep learning uses several layers of neurons between the network's inputs and outputs. The multiple layers can progressively extract higher-level features from the raw input. For example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to a human such as digits or letters or faces. Deep learning has drastically improved the performance of programs in many important subfields of artificial intelligence, including computer vision, speech recognition, image classification and others.

Specialized hardware and software

In late 2010s, graphics processing units (GPUs) that were increasingly designed with AI-specific enhancements and used with specialized TensorFlow software, had replaced previously used central processing unit (CPUs) as the dominant means for large-scale (commercial and academic) machine learning models' training.

Historically, specialized languages, such as Lisp, Prolog, and others, had been used.

Applications

In the late 2010s and early 2020s, machine learning applications found their use in search engines (such as Google Search), targeting online advertisements, recommendation systems (offered by Netflix, YouTube or Amazon), driving internet traffic, targeted advertising (AdSense, Facebook), virtual assistants (such as Siri or Alexa), autonomous vehicles (including drones, ADAS and self-driving cars), automatic language translation (Microsoft Translator, Google Translate), facial recognition (Apple's Face ID or Microsoft's DeepFace), image labeling (used by Facebook, Apple's iPhoto and TikTok), spam filtering and chatbots (such as ChatGPT).

In the early 2020s, generative AI gained widespread prominence. ChatGPT, based on GPT-3, and other large language models, were tried by 14% of Americans adults.

In 2023, the increasing realism and ease-of-use of AI-based text-to-image generators such as Midjourney, DALL-E, and Stable Diffusion sparked a trend of viral AI-generated photos.

There are also thousands of successful AI applications used to solve problems for specific industries or institutions. A few examples are energy storage, deepfakes, medical diagnosis, military logistics, foreign policy, or supply chain management.

In the 2010s, experimental applications were developed, such as DeepMind's model that could learn many diverse Atari games on its own and AlphaFold 2 (2020), which demonstrated the ability to approximate, in hours rather than months, the 3D structure of a protein. Other applications predict the result of judicial decisions, create art (such as poetry or painting) and prove mathematical theorems.

In 2019, AI was the most prolific emerging technology in terms of the number of patent applications and granted patents, the Internet of things was estimated to be the largest in terms of market size. It was followed, again in market size, by big data technologies, robotics, AI, 3D printing and the fifth generation of mobile services (5G). The ratio of scientific papers to inventions has significantly

decreased from 8:1 in 2010 to 3:1 in 2016, which is attributed to be indicative of a shift from theoretical research to the use of AI technologies in commercial products and services.

Twenty application fields were identified in 2016 and included, in order of magnitude: telecommunications (15 percent), transportation (15 percent), life and medical sciences (12 percent), and personal devices, computing and human–computer interaction (11 percent). Other sectors included banking, entertainment, security, industry and manufacturing, agriculture, and networks (including social networks, smart cities and the Internet of things). IBM has the largest portfolio of AI patents with 8,290 patent applications, followed by Microsoft with 5,930 patent applications.

Deep learning began to dominate industry benchmarks in 2012 and was adopted throughout the field.

In a 2017 survey, one in five companies reported they had incorporated "AI" in some offerings or processes".

Adapting for AI's reasoning era

AI is graduating from recognition to reasoning—and organizations must follow suit by scaling their computing power with purpose-built AI infrastructure.

The large language models (LLMs) first publicly released in 2022 were impressive but limited. Today's advanced reasoning models can navigate ambiguity and backtrack when necessary, carefully working through problems with a methodical approach.

Reasoning models are qualitatively different than earlier LLMs. They essentially create an internal representation of a decision tree based on the training data they've been exposed to, and explore which solution might be the best.

This adaptive approach to problem-solving isn't without trade-offs. Earlier LLMs delivered outputs in milliseconds based on statistical pattern-matching and probabilistic analysis. This was—and still is—efficient for many applications, but it doesn't allow the AI sufficient time to thoroughly evaluate multiple solution paths.

In newer models, extended computation time during inference—seconds, minutes, or even longer. Making these assessments successfully could result in groundbreaking scientific discoveries at previously unthinkable speed and scale.

To tap into this enormous potential, organizations will need to ensure they have the right infrastructure and computational resources to support the advancing technology.

In health care, reasoning AI systems could analyze patient data, medical literature, and treatment protocols to support diagnostic or treatment decisions. In scientific research, reasoning models could formulate hypotheses, design experimental protocols, and interpret complex results—potentially accelerating discoveries across fields from materials science to pharmaceuticals.

In financial analysis, reasoning AI could help evaluate investment opportunities or market expansion strategies, as well as develop risk profiles or economic forecasts. Reasoning capabilities are also a milestone in the proliferation of agentic AI systems.

Armed with these insights, their own experience, and emotional intelligence, human doctors, researchers, and financial analysts could make more informed decisions, faster.

Safeguards and governance frameworks will need to be ironclad, particularly in high-stakes contexts like health care or autonomous vehicles.

To operate optimally, reasoning models require significantly more computational resources for inference. This creates distinct scaling challenges. Specifically, because the inference durations of reasoning models can vary widely—from just a few seconds to many minutes—load balancing across these diverse tasks can be challenging.

Overcoming these hurdles requires tight collaboration between infrastructure providers and hardware manufacturers, such as Microsoft's collaboration with NVIDIA, which brings its accelerated computing platform to Microsoft products, including Azure AI.

Enterprises really have to think about the entire system as a whole, including multiple data centers. These considerations extend into reliability challenges at all scales: from memory errors at the silicon level, to transmission errors within and across servers, thermal anomalies, and even data center-level issues like power fluctuations—all of which require sophisticated monitoring and rapid response systems.

Required is holistic system architecture designed to handle fluctuating AI demands. Every three months, there is a new foundation model. The hardware is also evolving very fast.

Without robust, accessible infrastructure, the benefits of reasoning models will remain relegated to companies with massive computing resources.

https://www.technologyreview.com/2025/04/16/1115033/adapting-for-ais-reasoning-era/?utm_source=firefox-newtab-en-us

Philosophy

Many feel that AI must be defined in terms of "acting" and not "thinking". Artificial intelligence is not, by definition, simulation of human intelligence. One definition stipulates the ability of systems to synthesize information as the manifestation of intelligence, similar to the way it is defined in biological intelligence. Some sources, especially in the business world, use the term "artificial intelligence" to mean "machine learning with neural networks".

Symbolic AI and its limits

Moravec's paradox is the discovery that high-level "intelligent" tasks were easy for AI, but low level "instinctive" tasks were extremely difficult. Philosopher Hubert Dreyfus had argued since the 1960s that human expertise depends on unconscious instinct rather than conscious symbol manipulation, and on having a "feel" for the situation, rather than explicit symbolic knowledge

Neat vs. scruffy

"Neats" hope that intelligent behavior is described using simple, elegant principles (such as logic, optimization, or neural networks). "Scruffies" expect that it necessarily requires solving a large number of unrelated problems. Modern AI has elements of both.

Soft vs. hard computing

Finding a provably correct or optimal solution is intractable for many important problems. Soft computing is a set of techniques, including genetic algorithms, fuzzy logic and neural networks, that are tolerant of imprecision, uncertainty, partial truth and approximation. Most successful AI programs in the 21st century are examples of soft computing with neural networks.

Narrow vs. general AI

The goals of artificial general intelligence can be to solve as many specific problems as possible (narrow AI) in hopes these solutions will lead indirectly to the field's long-term goals. General intelligence is difficult to define and difficult to measure, and modern AI has had more verifiable successes by focusing on specific problems with specific solutions.

Machine consciousness, sentience and mind

The philosophy of mind does not know whether a machine can have a mind, consciousness and mental states, in the same sense that human beings do. This issue considers the internal experiences of the machine, rather than its external behavior. Mainstream AI research considers this issue irrelevant because it does not affect the goals of the field: to build machines that can solve problems using intelligence.

Computationalism and functionalism

Computationalism is the position in the philosophy of mind that the human mind is an information processing system and that thinking is a form of computing. Computationalism argues that the relationship between mind and body is similar or identical to the relationship between software and hardware and thus may be a solution to the mind-body problem.

The appropriately programmed computer with the right inputs and outputs would thereby have a mind in exactly the same sense human beings have minds. Some counter this assertion with even if a machine perfectly simulates human behavior, there is still no reason to suppose it also has a mind.

Superintelligence

A superintelligence is a hypothetical agent that would possess intelligence far surpassing that of the brightest and most gifted human mind.

If research into artificial general intelligence produced sufficiently intelligent software, it might be able to reprogram and improve itself. The improved software would be even better at improving itself, leading to recursive self-improvement. Its intelligence would increase exponentially in an intelligence explosion and could dramatically surpass humans.

Some have predicted that humans and machines will merge in the future being more capable and powerful than either. This idea is called transhumanism the next stage in evolution.

Risks

Technological unemployment

In the past, technology has tended to increase rather than reduce total employment, but AI is uncharted territory. It could be a net benefit if productivity gains are redistributed.[

Unlike previous waves of automation, many middle-class jobs may be eliminated by artificial intelligence. AI could do to white-collar jobs what previous automation did to blue-collar ones.

Weaponized AI

AI provides a number of tools that are particularly useful for authoritarian governments: smart spyware, face recognition and voice recognition allow widespread surveillance; such surveillance allows machine learning to classify potential enemies of the state and can prevent them from hiding; recommendation systems can precisely target propaganda and misinformation for maximum effect; deepfakes aid in producing misinformation.

Terrorists, criminals and rogue states may use other forms of weaponized AI such as advanced digital warfare and lethal autonomous weapons. Dozens of countries are reported to be researching battlefield robots. Machine-learning AI is also able to design tens of thousands of toxic molecules in a matter of hours.

Algorithmic bias

AI programs can become biased after learning from real-world data. It may not be introduced by the system designers but learned by the program, and thus the programmers may not be aware that the bias exists.

Bias can be inadvertently introduced by the way training data is selected and by the way a model is deployed. It can also emerge from correlations: AI is used to classify individuals into groups and then make predictions assuming that the individual will resemble other members of the group. In some cases, this assumption may be unfair.

Existential risk

It has been argued AI could become so powerful that humanity may irreversibly lose control of it. For almost any goals that a sufficiently intelligent AI may have, it is instrumentally incentivized to protect itself from being shut down and to acquire more resources to better achieve these goals.

Sentience or emotions are then not required for an advanced AI to be dangerous. In order to be safe for humanity, a superintelligence would have to be genuinely aligned with humanity's morality and values.

Copyright

In order to leverage as large a dataset as is feasible, generative AI is often trained on unlicensed copyrighted works, including in domains such as images or computer code; the output is then used under a rationale of "fair use". Experts disagree about how well, and under what circumstances, this

rationale will hold up in courts of law; relevant factors may include the purpose and character of the use of the copyrighted work and the effect upon the potential market for the copyrighted work.

Ethical machines

Machines with intelligence have the potential to use their intelligence to make ethical decisions. The field of machine ethics provides machines with ethical principles and procedures for resolving ethical dilemmas.

Regulation

The regulation of artificial intelligence is the development of public sector policies and laws for promoting and regulating artificial intelligence (AI); it is therefore related to the broader regulation of algorithms. The regulatory and policy landscape for AI is an emerging issue in jurisdictions globally.

The annual number of AI-related laws passed in the 127 survey countries jumped from one passed in 2016 to 37 passed in 2022. Between 2016 and 2020, more than 30 countries adopted dedicated strategies for AI. Most EU member states had released national AI strategies, as had Canada, China, India, Japan, Mauritius, the Russian Federation, Saudi Arabia, United Arab Emirates, US and Vietnam.

The Global Partnership on Artificial Intelligence was launched in June 2020, stating a need for AI to be developed in accordance with human rights and democratic values, to ensure public confidence and trust in the technology. In 2023, OpenAI leaders published recommendations for the governance of superintelligence, which they believe may happen in less than 10 years.

https://en.wikipedia.org/wiki/Artificial_intelligence

In a trial of healthcare related capability, the popular AI application ChatGPT provided incorrect or incomplete information when asked about drugs, and in some cases invented references to support its answers, two evaluative studies found.

Questions sent to a drug information service for pharmacists were later posed to ChatGPT, which provided no response, an inaccurate response, or an incomplete response to 74% of them. Moreover, in instances where the artificial intelligence (AI) chatbot did provide a response with references, it did so each time citing references that were fabricated,

ChatGPT AI is an evolving technology and cannot be relied on right now as the definitive source of information.

In a second study, ChatGPT missed at least half of established side effects for 26 of 30 FDA-approved drugs. It was mostly inaccurate, and pharmacists always have to be accurate.

ChatGPT uses a generic Large Language Model (LLM) that is not optimized to assess or evaluate healthcare relevant information. It is not trained specifically on that kind of data. Study limitations included a lack of validated tools to measure the accuracy of ChatGPT and using versions of ChatGPT that may not be the most current.

In addition, accuracy of AI tools being used in medicine are irrelevant if regulatory bodies like the FDA do not create a framework or standards for their quality.

https://www.medpagetoday.com/meetingcoverage/ashp/107716?xid=nl_mpt_DHE_2023-12-06&eun=g1629893d0r&utm_source=Sailthru&utm_medium=email&utm_campaign=Daily%20Headlines%20Evening%202023-12-06&utm_term=NL_Daily_DHE_dual-gmail-definition

Quanta Magazine’s computer science coverage in 2023 included progress on new approaches to artificial intelligence, a fundamental advance on a seminal quantum computing algorithm, and emergent behavior in large language models.

Vector-Driven AI

As powerful as AI has become, the artificial neural networks that underpin most modern systems share two flaws: They require tremendous resources to train and operate, and it’s too easy for them to become inscrutable black boxes. Researchers have developed a new approach called hyperdimensional computing which is more versatile, making its computations far more efficient while also giving researchers greater insight into the model’s reasoning.

Improving the Quantum Standard

For decades, Shor’s algorithm has been the paragon of the power of quantum computers. This set of instructions allows a machine that can exploit the quirks of quantum physics to break large numbers into their prime factors much faster than a regular, classical computer - potentially compromising much of the Internet’s security systems. In August, a computer scientist developed an even faster variation of Shor’s algorithm, the first significant improvement since its invention.

The Powers of Large Language Models

Get enough stuff together, and you might be surprised by what can happen. This year, scientists found so-called “emergent behaviors,” in large language models — AI programs trained on enormous collections of text to produce humanlike writing. After these models reach a certain size, they can suddenly do unexpected things that smaller models cannot, such as solving certain math problems.

AI and the Economy

Some experts argue that AI eventually will be powerful enough to drive per capita economic growth rates as high as 30% a year (compared to about 2% annual in the USA currently). Three general arguments are offered for why such a dramatic explosion in economic growth might be possible.

The first argument is historic. The trajectory of the world economy back to 10,000 BCE is superexponential. Exponential growth means the economy grows by a steady, compounding rate every year. Superexponential growth means that the growth rate is increasing over time.

The second argument relies on population growth enabling economic growth to speed up. More people are available to find new ideas, and the next new idea is discovered more quickly. That feedback loop leads not just to economic growth but to accelerating economic growth.

Robots could be built in a much shorter time than the decades it takes to birth, raise, and educate a human worker, and at less expense. The fast-growing population of robots would be able to come up with, and implement, enough economically useful ideas to get the economy going faster and faster.

The third argument for transformative growth is based on the size of the economy being dependent on the amount of labor, the amount of capital, and a measure of productivity. Capital specifically

means tools and property that can be used to make stuff. Automating research, for instance, could lead to technology improving rapidly, with massive economic consequences.

Reasons exist to doubt a growth explosion. Effects of information technology on growth to date have been famously meager. In the US, the advent of personal computers coincided with a marked decline in productivity growth, not an increase.

Economic growth as a whole is still bottlenecked by labor-intensive sectors (e.g., healthcare) where productivity growth is harder to achieve. AI, however, can help in making even these labor intensive sectors much more efficient and effective.”

<https://www.vox.com/future-perfect/24108787/ai-economic-growth-explosive-automation>

AI systems are becoming so complicated it's hard to keep track of how they operate.

With conventional software, someone with inside knowledge can usually deduce how it is operating. With the current breed of artificial intelligence there is no such understanding, even among the people building it.

AI relies heavily on machine learning, in which software identifies patterns in data on its own, without being given any predetermined rules as to how to organize or classify the information. These patterns can be inscrutable to humans.

The most advanced systems use neural networks. They simulate layers of neurons, which transform information as it passes from layer to layer. As in human brains, these networks strengthen and weaken neural connections as they learn, but it's hard to see why certain connections are affected. As a result, researchers often talk about AI as 'black boxes', the inner workings of which are a mystery.

The field of explainable AI (XAI) is expanding its inventory of tools to help reverse-engineer AI systems. It's had some success, but XAI is still very much a work in progress.

The problem is especially acute for large language models (LLMs), the machine-learning programs that power chatbots such as ChatGPT. These AIs have proved to be particularly inexplicable, in part because of their size. LLMs can have hundreds of billions of 'parameters', the variables that the AI uses internally to make decisions.

These inscrutable models are now taking on important tasks. People are using LLMs to seek medical advice, write computer code, summarize the news, draft academic papers and much more. Yet it is well known that such models can generate misinformation, perpetuate social stereotypes and leak private information.

XAI tools are being devised to explain the workings of LLMs, so that they can create safer, more efficient and more accurate AI. Understanding the behaviour of LLMs could even help us to grasp what goes on inside our own heads.

Some XAI tools interrogate AI workings by simply asking the models to explain themselves. This approach resembles those used in human psychology. Such "conversation" can illuminate sophisticated behaviors that emerge from simple underlying calculations.

Interrogated AI is examined for the activation of their ‘neurons’ similar to performing a neuroimaging scan for humans. Methods, also, are required to fix incorrect or outdated facts without retraining the whole model.

By mapping when each neuron is activated, the behavior of neurons can be described by a collection of virtual neurons that each lit up in response to just one concept. In effect, embedded in the multitasking neurons are thousands of virtual neurons with more singular roles, each handling one type of task.

Some argue that AI companies should at least be trying to provide explanations for their models — and that regulations should be in place to enforce that. The European Union’s AI Act, for example, requires explanation of ‘high-risk AI systems’ such as those deployed for remote biometric identification, law enforcement or access to education, employment or public services.

Some companies, such as OpenAI — the firm behind ChatGPT — maintain secrecy around their largest models. OpenAI told Nature it does so for safety reasons, presumably to help prevent bad actors from using details about how the model works to their advantage.

Companies including OpenAI and Anthropic are notable contributors to the field of XAI. In 2023, for example, OpenAI released a study that used GPT-4, one of its most recent AI models, to try to explain the responses of an earlier model, GPT-2, at the neuron level.

doi: <https://doi.org/10.1038/d41586-024-01314-y>
https://www.nature.com/articles/d41586-024-01314-y?utm_source=pocket-newtab-en-us

By determining how concepts are stored inside an AI model, developers can modify how the model interprets those concepts to guide its behavior. Understanding how a model represents features that make it biased, misleading, or dangerous will help developers guide AI toward better behavior.

Computer science, particularly on the software side, has historically involved more “engineering” than “science.” Until about a decade ago, humans created software by writing lines of code. If a human-built program behaves weirdly, one can theoretically go into the code, line by line, and find out what’s wrong.

But in machine learning, systems have many billions of connections — the equivalent of many millions of lines of code — created by a training process, instead of being created by people.

AI assistants like OpenAI’s ChatGPT 3.5 and Anthropic’s Claude 3.5 are powered by large language models (LLMs), which developers train to understand and generate speech from a vast amount of text scraped from the internet. These models are more like plants or lab-grown tissue than software.

Humans build scaffolding, add data, and kick off the training process. After that, the model grows and evolves on its own.

After millions of iterations of training the model to predict words to complete sentences and answer questions, it begins to respond with complex, often very human-sounding answers. LLMs and other AI systems were not designed so humans could easily understand their inner mechanisms — they were designed to work. Few anticipated how quickly they would advance.

Computer scientists established a new field of research: AI interpretability, or the study of the algorithms that power AI. The field is still in its infancy.

AI researchers can look to those in biology and neuroscience who have been trying to understand the human brain. The human brain likely has over 100 times as many synaptic connections as GPT-4 has parameters, or adjustable variables (like knobs) that calibrate the model's behavior.

As increasingly large, obfuscated AI systems develop in medicine, education, and the legal system, the need exist to determine how they work — not just how to train them.

100 million people use ChatGPT every week, and neither they nor its developers know precisely how it comes up with responses. Learning more about how the systems actually works could empower us to build better.

As AI systems get smarter, it will get easier for them to deceive us. The more capable a system is, the more capable it is of just telling you what you want to hear.

AI interpretability is intended help protect us from misinformation and from more existential AI risks

The ease with which researchers have broken through the safety controls built into widely used AI systems is concerning. A major goal of interpretability research is to make AI safer by making it easier to trace errors back to their root cause. The goal is to give the model an arbitrary input, look at its output, and determine why something happened.

Most advanced AI assistants are powered by transformer models (the “T” in “GPT”). Transformers turn typed prompts, like “Explain large language models for me,” into numbers.

The prompt is processed by several pattern detectors working in parallel, each learning to recognize important elements of the text, like how words relate to each other, or what parts of the sentence are more relevant. All of these results merge into a single output and get passed along to another processing layer...and another, and another.

To teach the model to give reasonable answers to text prompts, developers give it lots of example prompts and their correct responses. After each attempt, the model tweaks its processing layers to make its next answer a tiny bit less wrong. After practicing on most of the written internet, a trained LLM can write code, answer tricky questions, and give advice.

LLMs fall under the broad umbrella of neural networks: loosely brain-inspired structures made up of layers of simple processing blocks. These layers are really just giant matrices of numbers, where each number is called a “neuron”. Inputs set off a constellation of neurons, which somehow translates into an output down the line.

This scientific challenge is as much a philosophical question as a technical one. Different research groups use different approaches, and new methods are introduced continually.

Many AI researchers use a neuroscience-inspired technique called neural decoding or probing — training a simple algorithm to tell whether a model is representing something or not, given a snapshot of its currently active neurons. By reverse-engineering the algorithms AI models learn during their training, researchers hope to figure out what every neuron, every tiny part, of a model is doing.

Real and digital neurons fire in response to a confusing combination of inputs. One can't study AI one neuron at a time — the activity of a single neuron doesn't tell you much about how the model works, as a whole. When it comes to brains, biological or digital, the activity of a bunch of neurons is greater than the sum of its parts.

If we can identify at least some things a model knows about, those representations can be tweaked to intentionally guide its behavior. Understanding the potential dangers of AI is termed “red teaming,” or trying to trick a model into doing something bad, to help determine how “safe” is a given model.

Whether they do it like us, or in their own way, LLMs are thinking. Human cognition is just another computational process in a family of computational processes.

https://www.vox.com/future-perfect/362759/ai-interpretability-openai-claude-gemini-neuroscience?utm_source=pocket-newtab-en-us

Modern warfare is being reshaped by AI.

For example, “Mixed Reality Command and Control” goggles allow the war fighter to see the battlefield, available air assets, enemy targets and supply routes in 3D.

Software companies including Govini and Palantir are behind the production and modernization of today's most high-tech weapon systems. Fear that AI could lead to killer robots and take humans out of the so-called "kill chain" has led to anxiety and threats of regulation that worries system innovators.

Such technology could help shorten (or deter) wars, possibly leading to different outcomes. make critical decisions in real time.

It's about speed. What was able to be done in days or weeks is now done in minutes.

As drone swarms have become more prominent in modern warfare, knowing exactly what weapons are in stockpiles would be critical. “Maverick” is an AI-generated target effector. I provides a list of targets, the priority with which to action those targets and the effect best used in order to take action on the targets.

Govini’s “Ark” software can map all potential supply chain issues, from forecasting demand to finding hidden dependence on adversary nations.

AI can find a nefarious cargo ship hiding in busy sea lanes and show the route of a certain ship flagged.

AI-enabled software is making even older weapons more lethal, accurate and efficient.

Humans still are the key decision-makers. AI will help them do it faster, to do it more efficiently and to do it at a scale where they are going to be able to make the best decisions.

<https://www.foxnews.com/politics/how-artificial-intelligence-reshaping-modern-warfare>

AI is helping new crops five-times faster. Using current and past data, such as from satellite imagery and temperature and rainfall readings, and combining that with future projections, AI systems aim to give farmers the most accurate possible, locally-tailored weather forecasts, from one hour to six months ahead. It then advises on exactly when to plant and harvest particular crops, and predicts their yields.

AI helps seed companies to see how specific test seeds have performed in a particular region or locality. This can help seed companies figure out the optimal locations for growing seeds.

AI is helping speed up work called phenotyping. This is the visual studying of new crop varieties based on observations of their characteristics, such as how many flowers, pods or leaves that a plant has.

The phenotyping work traditionally relied on the human eye. But humans are not doing this consistently, with the high levels of precision necessary, to make subtle, yet important, plant selections.

Taking photos of crops through an app on a smartphone the AI then quickly analyses, records, and reports what it sees. Computers can count every flower or pod, from every plant, every day without getting tired. This is important as the number of flowers in bean plants correlate to the number of pods which directly influence yields.

Data can be complicated, but AI can be used to make sense of that complicated data and pick up patterns, show where resources are needed and show recommendations. Plant breeders estimate that with the better data from AI they may be able to shorten the breeding cycle to only a few years.

AI is used to help study a crop's genetics. The process starts with genomic data about crops, for example, the sequences of various varieties. For example, with different tomatoes, there are some small differences in genomes that give them different traits, for example different flavors and pesticide-resilient profiles.

Developers have been able to create a broccoli that matures in a greenhouse in 37 days rather than the standard 45 to 60 days. Broccoli produced on that timescale can get additional growth cycles. Plant geneticists also working to make rice resistant to frost, and potatoes more tolerant to drought.

AI can identify the genetic basis of complex traits and, via sequencing and predictive analysis, quickly and inexpensively assess and model new plant varieties. They are creating new varieties for diverse crops that are developed five-times faster and for a fraction of the cost compared to traditional breeding.

https://www.bbc.com/news/articles/c9xxjx7e2gjo?utm_source=pocket-newtab-en-us

OpenAI's secret project 'Strawberry' could power AI with superhuman-level intelligence capable of delivering advanced reasoning capabilities. AI could plan ahead enough to navigate the internet autonomously and reliably to perform what OpenAI terms "deep research" enabling AI models to see and understand the world more like humans do.

AI capable of answering tricky science and math questions is out of reach of today's commercially-available models. Specialized way of processing an AI model after it has been pre-trained on very large datasets could change this.

Reasoning is key to AI achieving human or super-human-level intelligence. While large language models can already summarize dense texts and compose elegant prose far more quickly than any human, the technology often falls short on common sense problems whose solutions seem intuitive to people, like recognizing logical fallacies. When a model encounters these kinds of problems, it often "hallucinates" bogus information.

Reasoning, in the context of AI, involves the formation of a model that enables AI to plan ahead, reflect how the physical world functions, and work through challenging multi-step problems reliably. Improving reasoning in AI models is seen as the key to unlocking the ability for the models to do everything from making major scientific discoveries to planning and building new software applications.

Other companies like Google, Meta and Microsoft are likewise experimenting with different techniques to improve reasoning in AI models, as are most academic labs that perform AI research. Researchers differ, however, on whether large language models (LLMs) are capable of incorporating ideas and long-term planning into how they do prediction.

The post-training phase of developing a model involves methods like “fine-tuning,” a process used on nearly all language models today that comes in many flavors, such as having humans give feedback to the model based on its responses and feeding it examples of good and bad answers. Strawberry has similarities to a method developed at Stanford in 2022 called “Self-Taught Reasoner” or “STaR”, one of the sources with knowledge of the matter said. STaR enables AI models to “bootstrap” themselves into higher intelligence levels via iteratively creating their own training data, and in theory could be used to get language models to transcend human-level intelligence.

Among the capabilities OpenAI is aiming Strawberry at is performing long-horizon tasks (LHT) referring to complex tasks that require a model to plan ahead and perform a series of actions over an extended period of time. AI models use these capabilities to conduct research by browsing the web autonomously with the assistance of a “CUA,” or a computer-using agent, that can take actions based on its findings.

OpenAI also plans to test its capabilities on doing the work of software and machine learning engineers.

https://www.fastcompany.com/91156102/how-openais-secret-project-strawberry-could-power-ai-super-human-level-intelligence?utm_source=pocket-newtab-en-us

Evaluation of AI applications

Evaluation is an essential component of the generative AI lifecycle to build confidence and trust in AI-centric applications. If not designed carefully, these applications can produce outputs that are fabricated and ungrounded in context, irrelevant or incoherent, resulting in poor customer experiences, or worse, perpetuate societal stereotypes, promote misinformation, expose organizations to malicious attacks, or a wide range of other negative impacts.

Evaluators are helpful tools that assess the frequency and severity of content risks or undesirable behavior in AI responses. Performing iterative, systematic evaluations with the right evaluators can help teams measure and address potential response quality, safety, or security concerns throughout the AI development lifecycle, from initial model selection through post-production monitoring.

Base model selection

The first stage of the AI lifecycle involves selecting an appropriate base model. It's essential to identify which model best suits your specific use case. Compare different models by testing their outputs against a set of criteria relevant to your application.

Pre-production evaluation

After selecting a base model, the next step is to develop an AI application. Following development, pre-production evaluation begins. Before deploying the application in a production environment, rigorous testing is essential to ensure the model is truly ready for real-world use.

Post-production monitoring

After deployment, the AI application enters the post-production evaluation phase, also known as online evaluation or monitoring. At this stage, the model is embedded within a real-world product and responds to actual user queries. Monitoring ensures that the model continues to behave as expected and adapts to any changes in user behavior or content.

Establishing a reliable and repeatable process for managing generative AI applications across their lifecycle is essential. Evaluation plays a vital role at each stage, from base model selection, through pre-production testing, to ongoing post-production monitoring. By systematically measuring and addressing risks and refining AI systems at every step, teams can build generative AI solutions that aren't only powerful but also trustworthy and safe for real-world use.

<https://learn.microsoft.com/en-us/azure/ai-studio/concepts/evaluation-approach-gen-ai>

The Big AI Question

Just as modern Humans displaced their pre-Human ancestors, will Intelligent Machines (IMs) eventually displace Humans?

Could AI and robotics (possibly including electrical, mechanical, chemical and biologic elements) evolve capabilities sufficient to displace Humans as the next dominant beings on Earth?

Air, Sea & Sun - Future Resources

The air and the sea contain essential materials. Sea water contains 46 minerals and air has seven natural elements as its major constituents. These minerals and elements, obtained today from other sources such as mining, are used in many applications.

In addition to the potential for most fresh water from sea water, the minerals and elements include among others: salt, potassium chloride, sulfate, Magnesium, hydrocarbons such as methane and others. Salt has thousands of applications. Other components currently are used to produce fertilizers, industrial chemicals, metal alloys, fuels, plastics, lubricants, sealants and batteries.

Technology powered by the sun will extract these materials to use for fabrication. Today, electrolysis, biological processing, filtering with adsorbent materials are used to extract constituents from water and air.

Solar energy – as it becomes economical in the next few years - will be used widely to power extraction and fabrication of devices, food, and other materials. In addition, excess radio frequency energy will be harvested directly from air and converted to electricity for powering electronic devices.

Concentrated solar power (CSP) uses arrays of revolving mirrors called heliostats, light is reflected into a massive receiver. CSP uses rock depositories underground to store heat for days. The heat from the receiver generates hydrogen that can be transported to other areas.

Using cameras, AI, and machine learning, CSP systems are becoming much more efficient. Thanks to recent advancements in technology, the cost to construct CSP also is dropping. CSP will help solar energy be cleaner and cheaper.

So far, these processes have been found to have no significant impact on the Earth's ecosystem.

Technology Forecast

Technology is one of the six major influences on Existence. It also affects and is affected by the other major influences:

- Market
- Economic
- Political
- Social
- Legal
- Technology

Individuals and organizations can consider how they are affected by each of these major influences including Technology. The organization applies Technologies and the Platforms they enable to the Processes which deliver the goods and services. These goods and services, in turn, help fulfill the Purposes of the end users (individuals or other organizations)

Technology often is thought of in terms of “Platforms”, those devices and systems used in Products and used in support of the Processes that deliver the Products. Innovation, however, must be applied to the planning, development and management of all the areas of an organization listed above for it to remain successful.

Technology results from scientific methodology and discovery. The aim of science is to prove a proposition wrong (not right) from which we deduce a discovery is valid. Research must be validated through challenges, independently, repeatedly, for it to have useful purpose in informing our actions.

The integration of various emerging technologies result in benefits. For example, researchers are using VTOL “drones” coupled with artificial intelligence to identify and eliminate land mines significantly limiting risk to humans with the current laborious approach to removing land mines.

The Internet is the epitome of integrating various emerging technological capabilities to powerfully support human Purposes, mainly because it gives almost everyone near instant access to most of the world’s knowledge. These capabilities include:

• Electric Grid	• Telecommunications Networking
• Batteries	• Browsers
• Electronics	• Hypertext Markup Language
• High Level Software Languages	• Search
• Operating Systems	• End User Devices

Just as the Internet has become pervasive over the past 20 years (after 30 years of conception, research and development prior to the general public use of the Internet), the emerging technologies described herein eventually will permeate our existence as well.

Exceptions to the typical development cycles exist. The World War II race by Germany, Japan and the U.S. to build a nuclear weapon is an example.

The threat to its existence was the motivation for the U.S. to complete very complex micro and macro research, engineering and production in 7 years (1938 to 1945) from the confirmation of fission in uranium by Otto Hahn, Lise Meitner and Fritz Strassmann to the availability of the first weapon. Many of the leading scientists and engineers of the 20th century with diverse nationalities (including some forced out of Germany) collaborated to accomplish this extraordinary achievement.

This document does not predict specific technology or product winners, and it avoids using technical jargon. It instead focuses on the evolution of functional capabilities for these technologies and products, the likely timing of their availability, and how you can use them to build your success.

100-year and even more distant views are useful in helping to determine the interim 20-year forecasts.

Many of the applications anticipated 100 years from now actually exist currently to some degree, but most are too costly and/or not fully capable at this time. Societal inertia (more so than technological or economic limitations) will delay their general availability for years.

In the even more distant future, a possible scenario includes the following:

- Stable population at about 10 billion worldwide ... or possibly decreasing
- Humans have solar powered personal energy fields that provide individual physical protection, cloaking, and heating/cooling.
- Nutrients will be converted from air and sea water (using a very small on-body portable device) and directly infused into the person.
- An on-body device will provide for an immersive virtual environment augmented with artificial intelligence, computation and direct brain-to-brain and brain-to-machine communication and control (including transfer of specific images not just words) using multi-hop mesh peer-to-peer networks.
- Transport of people and physical items may be via a personal portable VTOL and hyper speed long haul vehicles. Virtual full-sensory mixed reality “teleportation” will permit a person in one location to experience other locations and people as if the person was in the remote locations. Molecular level decomposition and re-composition of at least inanimate objects at the distant locations may be possible (using extraordinary advancements in processing, bandwidth and power).
- Manufacturing of the devices will occur via additive production devices that extract elements from air and water to provide materials for the production.
- Business will consist mainly of producers and suppliers of materials, devices and information. Producers use additive manufacturing, robots and deep learning systems.
- Autonomous robots perform most manual labor e.g., landscaping, building, materials handling, health care.
- Devices of all sizes have embedded neural type control using micro components that include integrated processing and storage and mesh peer-to-peer networking.

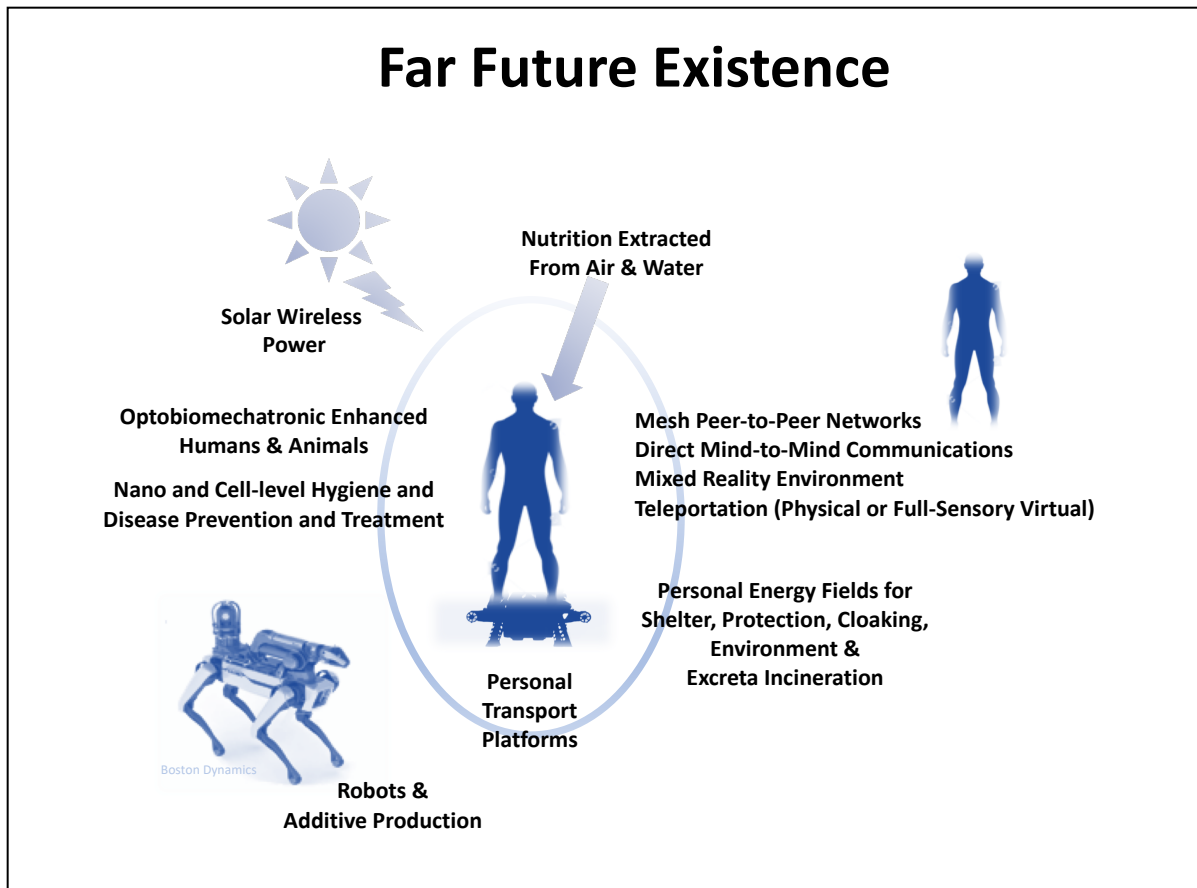
In this scenario, the following no longer would exist for the most part:

- Shared use infrastructure (roads, rail, airports, utilities – electric, gas, water sewer)
- Land vehicles
- Clothing
- Farms
- Physical schools
- Houses owned by the residents
- Physical retail establishments
- Mining and drilling

This future world is one in which most work is completed by robots and deep learning systems results in human purpose that emphasizes:

- Family
- Social
- Entertainment
- Recreation
- Inquiry
- Philanthropy
- Oversight of the otherwise autonomous design and production of devices and services

Matter, energy and information are managed and controlled with distributed ledger type systems for speed, security, and transparency.



Will individuals “work”? They may oversee the design and building of new systems by existing systems or the results of highly automated systems production, or create highly original art that even very advanced machine systems cannot create. Will individuals own, and offer in exchange for other value, specialized robots much as technicians and craftsman today have specialized tools they use in providing their products and services?

In any event, humans will evolve and adapt to this future world as we have always. Whatever the future, we can hope and expect that humankind will continue its uneven but steady progress toward more liberty and justice, better health and increased prosperity and self-determination for every individual.

To determine how best to apply Technologies, the benefits that they offer must be understood. These benefits are considered within the framework described in the Overview which links Technologies to the Purposes of individuals.

- Purposes of an individual's existence (such as taking care of family) are enabled by
- Processes (e.g., health care) which in turn are supported by
- Platforms (e.g., MRI machines; antibiotics; vaccines) that are composed of Technologies

Technologies are used in combinations to create Platforms for particular applications that amplify the natural capabilities of people and transform lives.

Technology advances with new discoveries in physics, chemistry and biology. For example, elementary particles are subatomic particles (quarks, leptons, bosons) with perhaps no substructure, and thus not composed of other particles.

As more is learned about elementary particles new applications of their properties likely will provide radically new and currently unimagined capabilities. Similar to the progression of atomic structure from theory to discovery to application (for electronics, power, biologics, etc.), subatomic elementary particles will evolve in their applications.

Emerging Technologies will be used to enhance the experiences of customers, employees and suppliers by those organizations that will be successful over the next 20 years.

The Technologies are forecasted for when the capabilities are used by about one quarter of relevant potential users (the typical so-called "tipping point" for wide spread use of a technology) in developed countries in the past and in the next 20 years. You likely will be affected in 20 years by decisions you make today, despite how distant that time frame may seem at this point.

Concepts are ideas that describe natural phenomena and begin as hypotheses, transition to theories as they become more accepted in the scientific community, and then are designated as scientific laws if is proven true via observation and experimentation. Current major scientific hypotheses and theories that have not reached the stage of early practical applications implementation include: Consciousness, Elementary Particles, Dark Matter, Dark Energy, Fusion Energy, String Theory and others.

Key scientific concepts that are confirmed and being applied and otherwise incrementally advanced include for example: Heliocentrism, Oxygen Combustion, Germ Theory, Gravitation, Electromagnetism, Atomic Theory, Special and General Relativity, Information Theory, Game Theory, Big Bang, DNA, Quantum Mechanics, Elementary Particles, and Fusion Energy.

Other concepts over time have been proven incorrect: Geo-centrism, Humors, Caloric Fluid, Eugenics, etc.

Current major concepts that are proposed but not yet fully developed and confirmed include:

- Origin(s) of Water and of Life on Earth ... of the Universe
- Consciousness
- Dark Matter and Energy
- Wave function collapse mechanism in quantum mechanics
- Integration of General Relativity and quantum mechanics
- Additional Elementary Particles
- Limits of human intellect

Applications of Technologies in Platforms are preceded by a Concept of the application by the developer that then was developed into the Platform. Conceptualization is the necessary first step in the innovation process.

As an example of Concept development, understanding consciousness is one of the challenges facing humans. Pursuit of this understanding likely will provide insights that benefit the development of new technology-enabled capabilities.

Controlling aspects of Consciousness, including with technology-based methods, is what much of research and development is about.

In addition, developers are designing computers that will imitate human emotions. Robot technology for service applications include domestic robots, medical robots, business robots and others. These robots work with people and benefit from emotional affinity with humans.

This type of emotional processing sometimes is called “affective computing”. Affective computing (also referred to as artificial emotional intelligence, or emotional AI) is the study and development of systems and devices that can recognize, interpret, process, and simulate human affects. Machines interpret the emotional state of humans and adapt their behavior, giving an appropriate response to those emotions.

Nascent biological computing (computing composed of biological components) uses molecules such as DNA and proteins to perform computational calculations involving data storage, retrieval and processing. This biocomputing utilizes the science of nanobiotechnology which provides the ability to engineer biomolecular systems to result in the functionality of a computer.

The application of affective computing and biocomputing will result in life-like devices with novel and useful applications.

Several important general advancements are emerging in each of the five Technology areas as outlined in the following

Designs

Designs continue to evolve and enable the creation of new Platforms using Technologies. Innovative arrangements of Technologies and Platforms are enhanced by computer-based systems including the application of machine learning.

Innovative evolving designs include those for:

- Aesthetic
- Functional
- Economic
- Organizational

Among many other items, significant design innovations will occur for:

- Autonomous vehicles and supporting infrastructure
- Neural-like circuits, processors and networks (electronic, optical, biochemical)
- Immersive user interfaces
- Intuitive software and information applications
- Additive production of buildings and devices
- Materials
- Manufactured food

For example, VTOLs fundamentally are not so different than existing aircraft but benefit from design enhancements such as ducted fans (that are more efficient than standard propellers), autonomous controls, and composite materials.

Materials

Materials are transitioning from homogeneous metals, plastics and others with static properties to super light and strong composite materials that dynamically adapt to their environment and are self-healing. They are used in additive custom manufacturing (3D printing of parts and buildings) and for replacement of biologic material. Chemical and physical designs enable easy recycling of plastics, metals and other materials.

Today we have smart machines; tomorrow we will have smart materials. These will include “4D” materials that add time and activators (moisture, sunlight, etc.) to dynamically program “printed” shapes. In addition, self-assembling materials are being developed.

Emerging basic materials include:

- Translucent metals & woods
- Metal foams
- Nanomaterials
- Aerogels
- Metamaterials (engineered properties not found in natural materials)
- Super alloys
- Synthetic silk
- Petroleum-based to more biology-based materials
- Waste conversion by high temperature and energy pulses to graphene and other materials

An example of a promising new material is metallic hydrogen. It is created by pressurizing a hydrogen sample to more pounds per square inch than exists at the center of the Earth.

Metallic hydrogen could potentially enable rockets to get into orbit in a single stage, even allowing humans to explore the outer planets. It also has been predicted to be a possibly room-temperature superconductor.

There are no other known room-temperature superconductors in existence, meaning the applications are immense - particularly for the electric grid, which suffers for energy lost through heat dissipation. It also could facilitate magnetic levitation for futuristic high-speed trains; substantially improve performance of electric cars; and revolutionize the way energy is produced and stored.

Biologics

Biologics include direct genetic and cellular manipulation, and precision targeted delivery of therapies, as well as artificial biological organ growth and engineered macro natural solutions.

The following are used in biologic applications:

- CRISPR gene editing tool
- Monoclonal antibodies
- Nanobodies and related objects
- Soluble receptors
- Recombinant DNA
- Fusion proteins
- Immuno-therapeutics
- Synthetic vaccines.

Power

Power sources use hybrid (battery/solar/fossil fuel) configurations to optimize design, become more autonomous and more portable, and to provide surplus power back to the shared power grid. Wireless electricity is available and solar and wind are economically comparable with fossil fuels.

In emerging liquid metal batteries, electrode and electrolyte layers are heated until they are liquid and self-segregate due to density and immiscibility. Such batteries may have longer lifetimes than conventional batteries, as the electrodes go through a cycle of creation and destruction during the charge–discharge cycle, which makes them immune to the degradation that afflicts conventional battery electrodes.

Ionic liquids have been shown to have promise for use in rechargeable batteries. The electrolyte is pure molten salt with no added solvent, which is accomplished by using a salt having a room temperature liquid phase. This causes a highly viscous solution, and is typically made with structurally large salts with malleable lattice structures.

Advancements are occurring in the following areas

- Fossil (e.g., improved methods of fracking)
- Solar
- Wind
- Hydro – ocean wave
- Nuclear fission 4th Generation
- Nuclear fusion
- Geothermal
- Thermoelectrochemical
- Thermoelectric polymers
- Betavoltaics – radiation sources
- Wideband piezoelectric
- Ambient energy conversion
- Wireless – long range induction
- Optical rectenna

Information Processing

Information Processing includes designs that support highly parallel neural-like processing; higher level languages (with graphical drag & drop) and machine learning.

These capabilities will continue to expand

- 1 to 10 Gbps-plus wireless access
- Deep learning algorithms
- Immersive AR and VR
- Quantum processing
- Neural-like processing and networks
- Biological processing – mechanical, chemical, electrical

The emerging technologies will be utilized in significant applications that will include capabilities provided in emerging Platforms.

More than one fourth of relevant populations in developed countries will use the following capabilities over the next 20 to 100 years.

Nutrition

Robotic plant & harvest: autonomous machines with GPS and machine learning for optimization
Precision agriculture: dynamic response to small area condition variability for planting and harvesting
Plant gene editing: accelerate plant domestication and improve quality, productivity, stress resistance
Nano fertilizer, herbicides, pesticides: improved controlled, conditional and synchronized release
Vertical agriculture: crops grown in layers using artificially controlled environment techniques
Aquaculture: controlled farming of water creatures and plants in closed or open water environments
Water from air & sea: efficient atmospheric water generation and desalination
Invitro manufactured foods: starting with cells that then are cultured to proliferate and grow
3D printed: using consumable and digestible compounds to create edible products
Robotic dish preparation: autonomous machine learning devices prepare food and clean up

Clothing

Nanomaterials: provide excellent mechanical strength, repellency, and antibacterial properties
Seamless: fewer sewing and finishing costs, just-in-time production, quicker samples
Body scan custom fit: optical measurements for accuracy equivalent to human tailor
3D knitted & printed: customized articles utilize cloth like materials for style, comfort and durability
Energy cloak & protect: covering made of energy, plasma, or particles and active camouflage

Shelter

Voice control: of security, lighting, HVAC, music, robots, appliances, water
Stronger lighter materials including nanomaterials with embedded electronics
3D printed: additive manufacturing method to fabricate buildings or construction components.
Robot assist: semi and fully autonomous machines that handle household chores
Ductless HVAC: small self-contained space heating and cooling units that do not require ducting
Gasless refrigeration: for example, using magnetocaloric effect to change temperatures of materials

Transportation

Personal VTOLs: small quiet vertical take-off and landing vehicles for personal and shared use
Self-driving cars: autonomous vehicles that require no human intervention
Electric drive cars: more economical and higher performance than internal combustion engines
Carbon fiber materials: high strength, chemical resistance, temperature tolerance, light weight
Supersonic commercial and possibly hypersonic (above Mach 5) military aircraft
Simpler optics replace radar for proximity control
Satellite air traffic control: navigation system transitions from ground-based to primarily satellite

Health

Brain mapping: enhanced imaging links behavior to brain regions for therapy and other applications
 Nerve management: techniques to manage pain while retaining basic function
 Auto monitor/diagnose: nonintrusive permanent on-body sensors and processors identify issues
 Immunotherapy: broad scale treatment of disease by amplifying or suppressing the immune system
 Optimum balance of electro-chemicals (neurotransmitters, hormones, etc.)
 Artificial bio-organ growth: using stem cells and other catalysts plus sometimes scaffolds
 3D printed organs: using “bio ink” material to successively build layers of the organs
 Bionic limbs: use mechanics, electronics, optics, and biologics to produce artificial limbs.
 Neural implants: connect directly to a brain to circumventing dysfunctional areas and control devices
 Genetic engineering: treat disorders by replacing defective genes with functioning ones
 Cure for colds, flu, other virus-based disease: Antivirals from sequencing of human rhinovirus strains
 Encapsulation of injected therapeutic cells to protect them
 Micro robots work inside body to analyze, modify and deliver therapies
 Chemical plus light energy cellular level treatments
 Wireless skin sensors
 Sensitive artificial skin
 Hyperbaric therapies for dementia conditions
 Blood biopsies will assist with detection, diagnosis, prognosis and guide treatment.

Production

Nanoscale: for items that are very small, stronger, lighter, more durable, more reactive, conductive
 Dynamically configurable: quickly adjust to sudden market or other changes
 Additive: addition under computer control, of minuscule material layers to create items
 Materials from air & sea: by extracting and combining chemical elements
 Process automation and factory automation (e.g., Industry 4.0 initiative)

Protection

Unmanned weapons: remote controlled and autonomous air and surface devices
 Directed energy weapons: engages targets with laser, microwaves, particle beams, other sources
 Less lethal weapons: chemicals, electrical, acoustic, and microwaves to incapacitate without killing
 Materials that block extreme toxins such as VX nerve agent
 Improved identification of and response to elusive causation of crime (vs. just unreliable correlation).

Power

Solar: will be more economical than fossil fuel, hydro and nuclear sources
 Hybrids: fossil, battery, solar: to optimize energy sources across the entire operating range of engine
 High capacity batteries: inorganic and organic materials and liquid metals; charge in seconds, last days
 Advanced grid: renewables, microgrids, energy storage, two-way flows, scale storage
 Super capacitors: charged and discharged unlimited number of times, unlike electrochemical batteries
 Laser and plasma cutting machines: for industrial and electronics manufacturing
 4th gen & fusion nuclear: sustainable closed fuel cycle for the reactor improved safety and waste
 Mini-nuclear plants one tenth size of existing; and produce desalinated water in coastal areas.
 These min plants use standardized prefabricated components making their approval and construction faster and easier and safer.
 Ambient: motion and energy generated by a source is captured and used for another application
 User generated: solar, batteries and small generators provide off-grid energy

Information Management

Wireless access: 3 terra bits per second (Tbps) compressed to 10 Gbps for supporting immersion VR
 5G will not replace fixed wired or Ethernet but rather complement them

Expanded broadcast, multicast and integrated ecosystems applications with 5G

Continuous software development: automated build, test and deployment of new code

Internet of Things: network of many edge sensor and control devices that exchange data

Realtime big data: analyzing large amounts of data as it is generated or used

Artificial intelligence: machine learning from external data to adaptively complete tasks

Brain/machine control: two-way direct communication between a brain and an external device

Mesh peer 2 peer: user devices directly connect to each other over many hops using other devices

Distributed ledger: digital database independently replicated in nodes of a peer-to-peer network

Hyperledger framework: for enterprise grade distributed ledger and blockchain deployments

Brain to brain: permits people to share information through thought only using electrical brain waves

AI translates brain activity into human language communication

Drag/drop software coding and applications development with drill down and relational data

AI generated code: based on learning from previous code and the intent for the new application

Intuitive data analysis using point/click/move of graphical objects

Standard personal info: digital data retained by an individual with portions provided as required

Quantum computing: using quantum-mechanics to enable data “bits” with more than binary values

Optical chips and circuits form very fast neural networks

Packet info, energy, matter: standard packaging, free-space routing of information and physical items

Broad integrated applications (e.g., home and neighborhood controls and security)

Cloud networks (public and private)

Big data management

Zero click purchasing and acquisition

Voice synthesized directly from the brain

Software Design (SDN) and Network Function Virtualization (NFV) designs

End-to-end Wi-Fi and Wired Ethernet 802.11ax (10 Gbps)

AI “reads” faces for emotions, intent, etc.

Large information sets integrated, analyzed and applied in near real-time

Increased analog processing in hybrid analog/digital systems

Neural-like processing architectures

Engineered biological processing including at the cellular level

Increased use of analog processing hybrid analog /digital devices

Neural like architectures

Compilers and High-Level Languages for analog computers

Engineered biological processing including at the cellular level

Low-code and no-code development

Continuous production code delivery using integrated automated development and operations steps

Modular code sets for development speed and flexible integration

Platforms include **semi-autonomous edge devices** that communicate and interoperate with centralized devices which use and are managed by advanced software algorithms.

As an example, a customer orders a product through a distributed ledger contract online. The request is sent to the internal network of a factory, and production lines communicate offers. Robotic agents representing different lines compete on material availability, run time, and historical performance metrics.

After production is complete, warehousing, delivery, and logistics agents provide offers for the next stage of the order. Finally, after the order has been completed, all of the participating autonomous agents accumulate data on the work performed, analyze their own performance, and make forecasts about the future state of demand.

The raw material procurement agent might decide that the demand for its products has increased, and purchase more raw materials. The logistics agent might learn that delivery through drones is more profitable than through land transport.

The advantages of robotization will be so great that most production and service work and much professional work eventually will be performed by robotic agents. As a result, the economy based on robots will account for most of the total economy. The shift to robots could come rapidly.

An example of significant recent advancements in brain-machine control is a prosthetic hand attached to the bone and controlled by electrodes implanted in nerves and muscle. It can operate much more precisely than conventional prosthetic hands.

Use of the prosthesis was improved by integrating tactile sensory feedback that users control how hard to grab or squeeze an object. With time, patients have learned to manage smaller changes in the intensity of sensations.

The advanced prosthetic has a direct connection to a person's nerves, muscles, and skeleton. It is mind-controlled and delivers sensations that are perceived by the user as arising from the missing hand.

It is self-contained so patients do not need to carry additional equipment or batteries. It is safe and stable; the technology has been used without interruption by patients during their everyday activities and is not restricted to confined or controlled environments.

The sensation of touch, is possible through stimulation of the nerves that were connected to the biological hand before the amputation. Force sensors located in the thumb of the prosthesis measure contact and pressure applied to an object while grasping.

This information is transmitted to the patients' nerves leading to their brains. Patients can feel when they are touching an object, its characteristics, and how hard they are pressing it.

Recent research has demonstrated a brain implant that transmits full words from neural signals. No spelling out of letters is needed for a person to use the first-of-a-kind neuroprosthesis.

Previously with a device that relied on head motions to control a keyboard, a person could produce about five words a minute, one character at a time. The typical rate when someone is speaking fluidly can be up to 200 words a minute.

A processor connected to an array of electrodes implanted in a brain receives the messages and translates them into words displayed on a screen. With a suite of at least 50 words, a person could transmit up to 1,000 complete sentences.

Earlier generations of neuroprostheses have relied on communications from the brain to the arm or hand muscles to activate letters on a keyboard. Messages are relayed around the unresponsive muscles to a processor that translates them into single-letter keystrokes.

As with using head movements, word production is slow and tedious and often produces just a few words a minute. Now researchers have decoded the origin of brain signals controlling speech and created the new neuroprosthesis that facilitates the production of whole words, yielding a faster word-per-minute rate. The researchers are sorting out how the brain controls speech-related muscles, pinpointing the messages and movements associated with each vowel and consonant in the English alphabet.

In sessions with a subject, researchers would present a target word or sentence on a screen. When the subject engaged his brain to send the related speech signals, the processor picked them up through the implanted electrodes and transmitted their message to a computer.

The computer side of the device decoded the subject's messages correctly 75 percent of the time (logging more than 90 percent accuracy occasionally) - and it produced a median rate of about 15 words per minute. Achieving better performance and accurate message decoding likely will require combining the high accuracy of devices that signal through an upper limb and this technique of whole word signals.

Researchers also are using a larger vocabulary to train the machine that decodes the brain's output. The vocabulary has already expanded beyond the 50 words described in the research reported.

Semiconductor electronics affect most areas of Technology. Given that

- semiconductor improvements are slowing (reflecting the end of Moore's Law),
- peak power per unit of chip area is decreasing (due to the end of Dennard scaling),
- power budget per chip is not increasing (due to electro-migration and mechanical and thermal limits)
- chip designers have already used multi-core (which is limited by Amdahl's Law)

Researchers at the Georgia Institute of Technology recently have found a new semiconductor that is a good candidate for making computers faster and smaller than ever. It works by combining graphene with silicon carbide.

<https://www.youtube.com/watch?v=oXBtPmVrES4>

Another path left for major improvements in performance-cost-energy is domain-specific architectures. These designs perform only a few specialized tasks but perform them extremely well.

New techniques such as innovative analog, quantum and bio-mechanical/chemical/electric processing may help continue the trend of more processing per unit of space and energy.

Designs that incorporate more analog components will improve speed and power requirements for specific applications such as in medicine, biotech, drug design, cybersecurity, and search. Digital technology leaves most of the information capacity of components (e.g., transistors) unused. Analog design uses most of that information capacity. Fully analog VLSI chips can include processing, storage communications, sensors, activators, and manipulators.

Collaborative automated software development includes built-in quality control tools. Visualization capabilities provide a direct link between process requirements and tools that generate code. Improved methodologies include separating critical code from non-critical code, which greatly reduces debugging tasks and making the critical code more reliable and secure.

The initial releases of new software have zero defects due to improvements that bring the design and development of software to the same level of rigor as other technology engineering disciplines. Software modules that are re-usable and have open and standardized interoperable interfaces provide for fast, easy-to-deploy and complex operation among the processes of different organizations.

These new software processes and tools will help avoid the destructive software failures such as those for the Boeing 737 MAX planes and its Starliner spacecraft, for the navy ship control system that resulted in the collision of guided-missile destroyer John S. McCain and the Iowa primary caucus application. They also will help thwart the ransomware and other malicious hacking of commercial and government platforms that can result in significant economics damage and safety issues.

For example, 1 in 10 of the USA's 50,000 water and wastewater plants have critical cybersecurity vulnerability. More than 80 percent of the major vulnerabilities are software flaws, including a widespread problem of employees not updating software.

With existing traditional methodologies, software invariably has bugs and security vulnerabilities. As platforms continue to become software intensive and interconnected, enhancements to software design and development will help limit these problems.

Developers have integrated development environments (IDEs) that help them produce high-quality code and get platforms to market faster. These IDEs enable pinpointing hard-to-find bugs, resolving memory leaks, and maximizing system performance including problems such as inter-task corruptions, missed real-time requirements, and external hardware events. The IDEs step, run, and debug forwards and backwards through code to find the root cause of a problem.

IDE capabilities include run-time error checking and status of kernel objects, tasks, and resources. They provide complete postmortem application debugging that includes traversing the stack, browsing objects, viewing memory and registers, a timeline of system events, and a probe and debugger solution for multicore processing.

These tools include optimizing compilers to generate the fastest and smallest code, eliminate unnecessary code and variables, inline across modules, better analyze inter-procedural aliases,

eliminate performance bottlenecks in code, and find memory leaks at compile time. A profile of processor time consumed by each task, function, source line, and assembly language instruction helps design a faster, more streamlined application.

To assist in optimizing processor performance and cost, compiler optimizations are tuned to get the most out of different chips. This helps save money with a lower-cost processor to meet the same real-time requirements, release a new product without having to produce a new hardware platform to run it on, require less power and cooling and lengthen battery life, and reduce memory costs.

The IDEs help produce clean code that is less likely to contain errors and is easier to test, understand, and modify contributing to fewer bugs and greater reliability. The IDEs streamline build and update of applications.

As software becomes more complex and challenging, it no longer is limited by technology, but rather by imagination. Expert effective developers utilize several key practices.

- 1) Involve the users in the design process
- 2) Design abstractions through which complex structures can be understood
- 3) Focus on the essence first, and delay expending effort designing on the periphery
- 4) Simulate continually how the design supports a variety of scenarios.
- 5) Look around examine the designs of other software to “see how they did it.”
- 6) Reshape the problem space looking for alternative ways of understanding the problem
- 7) See errors as opportunity often revealing insights about the problem or the solution
- 8) Think about what they are not designing to avoid over- and under-designing.

Medical software is an example of software challenges. Electronic medical records (EMRs) generally are unproductive for clinician end users.

Many of the top-ranking hospitals use EMRs from one of two primary vendors. These systems have not had significant upgrades for several years.

Many find the interfaces to be very inelegant. They slow down users drastically and consumes much of users' time.

Speed is not just a feature, it is the feature.

What is needed is not "training" but rather design thinking and approaching the problem from first principles. Disruptive "upgrades" which actually upgrade nothing result in lost productivity estimates of like 60-70 percent.

EMR creators should take the approach: measure how long every action takes and speed it up. Simplify the interface. Store data more efficiently. And data from different systems must be designed to facilitate transfer of patient records among systems.

Some providers have found that the “benefits” of increased payments for electronic data submission, such as Physician Quality Reporting System (PQRS), were so minimal that it just did not make sense

to buy an expensive EMR system and pay quarterly support fees, especially when primary care reimbursements are so low.

The EMR systems have resulted in a move away from traditional methods of medical analysis and decision making for a recently and quickly “developed” method that is ever more focused on cost without tracking clinical outcome or results. From the Subjective, Objective, Assessment and Plan (SOAP) note to the History and Physical Examination (H&P) to the consultation have decreased in favor of the billing focused EMR. Nor does the EMR allow for that occasional "creative" order needed to address a particular situation that an IT person would not have considered.

Users complain that EMRs are more designed for use by insurance for post care audits. They have to spend time justifying every little thing done especially on repeat visits instead of making notes that will actually help the patient, the Doc and anyone else who is involved in the care.

The Health Information Technology for Economic and Clinical Health (HITECH) Act has contributed to the issues. Teams of doctors and other medical professionals in different practice environments were not consulted.

Instead, the clinical staff are required to use dysfunctional EMRs that do not communicate with each other, to the detriment of patient care and the medical professionals. The EMR systems were force upon the healthcare system by government and business.

Software companies know very well that the decision makers are not the physicians and other clinicians. Rather, it is occupants of the C-Suite who are focused more on cost than useability.

Medical record (EMR) is in part a billing scheme to support the United States healthcare system which is almost twice as expensive as any other developed nation with the poorest longevity.

Relative Value Units (RVU) are the specific types of units that are assigned to Medicare to determine the cost of the provided service. No other country uses the Relative Value Unit (RVU) billing scheme and the major purpose of the EMR is to justify fee-for-service RVU-based billing.

Government mandates artificially raised the cost of entry into the market so high that many potential startups are priced out of the market. This limits innovation.

The dominant EMR suppliers are successful because they were in the right place at the right time when a piece of legislation provided an artificial selection pressure on a nascent industry, rather than because they have a good product. This accidental favor for a company with an inferior product stifled innovation at a time when EMRs were still poorly conceived and developed, locking in a stagnant, poorly-designed product.

The brain and the computer both contain basic units—neurons and transistors, respectively—that form complex circuits for processing information transmitted by electrical signals. The architectures of the brain and the computer similar, with regions for input, output, central processing, and memory.

The computer is good at particular tasks whereas the brain is better at others.

The computer has significant advantages over the brain in the speed of basic operations. Standard computers can perform elementary arithmetic operations, such as addition, at a speed of 10 billion

operations per second. The brain can perform about a thousand basic operations per second, or 10 million times slower than the computer.

The computer also has advantages over the brain in the precision of basic operations. The brain, at best, has precision which is millions times less than a computer.

The brain, however, is neither slow nor imprecise. Moreover, it (and the rest of the body) can accomplish very complex near real-time tasks with power consumption about ten times less than a personal computer.

The computer and the brain process information in different ways. Computer tasks are performed mainly in serial steps. The brain uses serial plus massively parallel processing, exploiting the large number of neurons and of connections for each neuron.

This massively parallel processing is possible because each neuron receives inputs from and sends output to many other neurons ... about 1,000 on average for both input and output. In comparison, each transistor has three nodes for input and output.

Information from a single neuron can be sent to many parallel downstream pathways. At the same time, many neurons that process the same information can pool their inputs to the same downstream neuron. This property increases the precision of information processing.

The computer and the brain also have similarities and differences in their signaling modes. The transistor employs digital signaling, which uses discrete values (0s and 1s) to represent information.

The spike in neuronal axons is also a digital signal since the neuron either fires or does not fire a spike at a given moment and all spikes are approximately the same size and shape. As with digital communications signals, this property helps provide reliable long-distance spike propagation.

Neurons also utilize analog signaling, with continuously varying values representing information. Some neurons are non-spiking, and their output is transmitted by such varying electrical signals that can transmit more information than spikes.

Another property of the brain, is that the connection strengths between neurons can be modified in response to activity and experience which is believed by neuroscientists to be the basis for learning and memory. Repetition enables the neuronal circuits to become better configured for the tasks being performed, resulting in improved speed and precision.

Engineers have studied the brain to improve computer design. The principles of parallel processing and modification of connection strength have both been designed into modern computers.

Increased parallelism, such as the use of multiple processor cores in a single computer, is an example. As another example, “deep learning” in machine learning and artificial intelligence, has provided rapid advances in object and speech recognition.

Deep learning employs multiple layers to represent abstract features and the weights of connections between different layers are adjusted through learning rather than designed by engineers. These recent advances have expanded the array of tasks a computer is capable of performing.

Nevertheless, the brain still has superior flexibility, and learning capability compared to a state-of-the-art computer.

Analog neuromorphic 3D VLSI with nonvolatile memory, organic electrochemical transistors (that can learn plus autonomously form new connections) and similar advances will continue the general performance improvements described by Moore's law.

Neuromorphic technology is an essential enabler for cognitive computing. It is an architecture of memories which react to input patterns and can be compared to the brain because of its low power requirements, scalability, and instantaneous internal communications.

A neuromorphic chip is a fully parallel silicon neural network. It is a chain of identical elements (i.e., neurons) which can store and process information simultaneously. The elements are addressed in parallel and have their own "genetic" material to learn and recall patterns without running a single line of code and without reporting to any supervising unit.

Another result of the parallel architecture of the neuromorphic chip is its constant learning and recognition time regardless of the number of connected neurons, as well as the ability to expand the size of the neural network by cascading chips.

Neuromorphics are useful for domain-specific designs. Since semiconductors improvements are slowing (reflecting the end of Moore's Law), the peak power per mm of chip area is decreasing (due to the end of Dennard scaling), and the power budget per chip is not increasing (due to electro-migration and mechanical and thermal limits), and chip designers have already used multi-core (which is limited by Amdahl's Law), a path left for major improvements in performance-cost-energy is domain-specific architectures. They do only a few specialized tasks but do them extremely well.

Several companies have developed neuromorphic-enabled devices and systems, based on a variety of circuit designs, that support new applications including those that part of the emerging Internet of Things.

"Big data" includes data sets from many sources such as social media, search engines, electronic device applications, ecommerce and others. Data from these sources will more and more be integrated, interpreted and applied through intermediate and end point platforms including in real time.

Ongoing development of related technology will lead increasingly to tools that are more integrated with human neuron-level function.

In addition, machines will incorporate capabilities of human emotions, for various applications, using the electrochemical and other physical characteristics of neurotransmitters. This so-called "affective processing", among other things, will provide a more natural human interaction between machines and humans.

Mini Nuclear Power Plants

With all nuclear power plants, the heat created by nuclear fission is converted into electricity. A nuclear reactor core is very hot, but if it gets too hot it will cause a meltdown irradiating the environment, killing people and resulting in billions of dollars of damage.

A new generation of reactors aims to eliminate these problems. These reactors are smaller and more efficient than current nuclear power plants, and they will be meltdown-proof.

Millions of submillimeter-size grains of uranium are individually wrapped in protective shells. It is called triso fuel.

Trisotristructural isotropic - fuel is made from low enriched uranium, and it is surrounded by three alternating layers of graphite and silicon carbide ceramic. Each particle is smaller than a poppy seed, but its layered shell can protect the uranium inside from melting under even the most extreme conditions that could occur in a reactor providing an accident-proof reactor.

This enables small reactor designs that would not previously have been possible. A large containment vessel that costs hundreds of millions of dollars for a reactor and space around the vessel no longer are needed because the fuel provides its own containment. A reactor could fit in a cargo container and still has all the safety features of a traditional commercial reactor.

One smaller, safer, cheaper reactor molten design for a salt micro-nuclear reactor (MSR) design has a chamber that measures four by seven feet (1.2 x 2.1 meters) and fits in the bed of a 40-foot truck. It has no risk of a meltdown and can produce enough energy to power 1,000 homes. The reactor's output should be around 10MWe.

MSRs dissolve fissile material into a molten salt that also acts as the reactor's primary coolant. Treating the fuel and primary coolant as one, and not relying on keeping water coolant flowing and below boiling point, is one safety advantage, among others, for MSRs.

In a typical MSR, the primary fuel salt, with its high melting point of 1022°F (550°C), moves through the reactor and transfers its heat to non-radioactive secondary coolant salt, which can pass on its heat to other things, such as traditional steam-turbine-driven electricity generators. Safe and stable, the core reaction does not produce carbon emissions, and it generates valuable elements accessible for reprocessing after the reaction is complete.

The technology works has not been shown to work on a large scale and could deliver electricity at a cost as low as \$20/MWh. Efficiency gain from thorium as an energy source is a factor 10 over other comparative technologies.

In addition to its efficiency other benefits including safety, ability to scale and not least to convert spent nuclear fuel into energy while reducing its storage time down to 300 years from 100,000 years.

Waste generated by an MSR reactor would allow companies to extract Molybdenum-99, an expensive element used in medical imaging; Cobalt-60; gold; platinum; neodymium; and other elements that could be sold for other applications.

The salt can be made fully clean again and reused. The salt indefinitely can be recycled.

Fluoride salts are very corrosive to metals and other materials used to build reactors. This problem can be solved by removing water and oxygen from the salt, massively reducing the corrosion issue.

The MSR design does not require salt to flow through the reactor, which means it eliminates components such as pumps and valves, as well as solving operational problems, like having to tightly control flow and temperature. The reactor is also designed to cool itself down using nothing but conduction which makes it a truly passively safe reactor.

MSRs are being developed for assembly line manufacture. The design would provide 100MW output thorium energy reactors in 40-foot containers, which could be fabricated on an assembly line at a rate of one per day for deployment almost anywhere.

Applications for the assembly line MSRs include ammonia fertilizer production and as a fuel for large shipping. In addition, other uses for the molten salt technologies exist including as an enveloping material for hot nuclear fusion reactors.

https://www.theregister.com/2022/10/05/micro_molten_salt_reactor/
<https://www.enlit.world/nuclear/how-thorium-energy-can-change-the-future-of-nuclear-power/>

Poland has authorized the construction of 24 small nuclear reactors at six sites across the country. The Japanese who shut down their nuclear power plants after the Fukushima accident in 2011 are using them again, and are planning to build new ones.

In California environmentalists have stopped complaining about nuclear power and are now fighting to get nuclear plants back online. In Sweden, nuclear power is being reconsidered. Germans are rethinking their decision to phase out nuclear power.

Nuclear power has the reputation of being expensive and slow. Small modular reactors are built in a factory and shipped to location making them more economical and available sooner..

Several of these small reactors can connect several of them together. This has the potential to make the construction even cheaper and faster.

The reactors in Poland all will be built by GE Hitachi, a collaboration between U.S.-based General Electric and Hitachi, a Japanese company. The reactor type is called BWRX-300.

These small reactors take 2 to 3 years to construct, and can deliver up to 300 Megawatts of power, which will power approximately 240 thousand homes. The small reactors run on enriched uranium and use a passive cooling technique with enhanced safety features. In case of a loss of power, they can operate for up to seven days without the need for intervention.

The government of Ontario in Canada authorized the construction of a small modular reactor of the same type, and in the summer upgraded their plan to four in total. The costs are expected to be significantly lower both per energy capacity and electricity produced than for conventional, large, reactors.

https://www.youtube.com/watch?v=5_FU5yFpzJk

The trends and applications of Existence indicate a future in the next 20 years that include the following emerging technology-based capabilities:

Autonomous Networked Devices and Systems

- Self-driving ground and small vertical take-off & landing (VTOL) vehicles
- Robots for commercial and residential use
- Exoskeletons and other intelligent augmentation tools
- Personal portable health monitoring & treatment

Additive Custom Manufacturing

- Rapid flexible custom production & construction
- Remote on-site fabrication of items
- Artificial organ growth for humans and animals

Real-time Precision Optimum Information, Control, and Services

- Anticipatory and predictive
- Customized individual biological and mechanical diagnoses and treatments
- Precise fast on-line search results
- Swarm intelligence for fast optimum resolution of issues

Immersive Hands-off, Heads-up Virtual User Interface

- Augmented real-time information assistance for professionals and others
- Non-intrusive video display, audio, voice and free-space hand control
- Full sensory collaborative virtual teleportation

Hybrid Flexible Power

- Integrated battery/solar/fossil fuel motors
- Wireless mobile electrical charging
- Open grid – users also provide excess generated energy to the grid
- 4th generation nuclear – smaller, safer and cleaner

Dynamic Communications Networks

- Software configured
- Virtualized functions
- Peer-to-peer multi-hop mesh
- Ultra-wideband wireless access

Standardized Packetization of Things (information, energy, physical items)

- Open global logistics including nesting containers and real-time tracking
- Distributed ledger for fast secure standardized transactions.
- Quantized energy units for selling and trading
- Containerized software that's plug and play and self-configuring
- Next generation information packetization



The emerging capabilities will result in changes to existence such as those described in the following.

Autonomous Networked Devices

Robotic and remote-control capabilities help humans and animals avoid working in inhospitable environments. These capabilities also provide for the knowledge and physical skills of an expert to be used in a situation where the expert is not present physically such as remote surgery, unmanned combat aircraft, etc. The capabilities include widespread use of machines that are remotely controlled by others or that operate autonomously with enough precision to perform complex tasks.

Autonomous devices are aware of their environment, their state, and incoming data and have the capability to learn and make decisions on their own. Teams of robots (macro, micro and nano-sized) will operate in concert to accomplish tasks requiring multiple robots.

EXAMPLE: A doctor in one location performs surgery at a remote location using a robotic machine that he controls remotely. The machine is augmented with expert and deep learning-based information and controls.

Optobiomechatronic devices integrate optical, biological, mechanical, electronic and machine deep learning capabilities to provide physical and mental leverage for humans and animals, helping them to better think, work and play. These devices are manipulated by (and in some cases directly attached to the organs of) humans or animals to enhance their performance. In addition, micro machines include

biologic components (such as muscle tissue to move the machine) directly grown on man-made components to form a hybrid device.

EXAMPLE: An “exoskeleton” device is used by a laborer to help her lift very heavy objects (that she would not be able to lift on her own) while maintaining more mobility and precision than she would have with a standard forklift vehicle.

EXAMPLE: Bionic Human Limbs

In 2018, researchers at the Center for Bionics and Pain Research (CBPR) in Sweden used a unique combination of surgery and AI to connect a woman’s skeleton, muscles, and nerves to a bionic hand, and it changed her life, reducing her pain and giving her more control over her prosthetic.

The fact that she has been able to use her prosthesis comfortably and effectively in daily activities for years is a promising testament to the potential life-changing capabilities of this novel technology for individuals facing limb loss. The key to her success lies in how the researchers connected the bionic hand to her residual limb (the part of the arm left after the amputation) on multiple levels.

First, she underwent a procedure, known as “osseointegration,” during which titanium rods were implanted in the radius and ulna bones of her arm. These rods now protrude from the end of the residual limb, and she uses them to attach and detach her bionic hand.

Osseointegration eliminates the need for a socket, the cup-like device that typically connects a prosthetic to the residual limb. Sockets can cause sweating, skin irritation, and other issues, and because they press on nerves, they can also increase the pain.

Surgeons also removed jumbles of nerve cells called “neuromas” from the ends of the three main nerves in her residual limb. These structures often form after an amputation and have been linked to stump pain and phantom limb pain.

Using electrodes and muscle grafts taken from her leg, the researchers connected the nerves and muscles in her residual limb to the titanium rods. This allows for bi-directional communication between the bionic hand and her residual limb: the muscles and nerves in her arm can send signals to it, and it can send signals back to them.

With conventional socket-attached bionic hands, electrodes stuck to the surface of the residual limb detect and translate muscle movements into commands for the prosthetic. Those electrodes can be affected by sweat, friction from clothes, and other external factors, leading to inconsistent readings and unreliable control of the bionic device.

After the surgery, she used computer simulations to train AI algorithms to translate the signals in her arm when she tried to move her amputated hand into commands for the bionic hand. She also learned how to interpret electric pulses that are sent from sensors in the forefinger and thumb of her bionic hand back to her arm. Based on these signals, she can determine how much force is required to effectively grip an object between the digits.

On two tests used to gauge the functionality of a prosthetic (the ACMC and the SNAP), she scored higher with the new integrated system than the socket and surface electrode system she was using before, even though it was attached to the same actual bionic hand she was using previously:

She also used a more advanced bionic hand — Prensilia’s “Mia Hand” — which has multiple degrees of freedom, unlike her previous “MyoHand”.

Based on her experience with both bionic hands over about two years, she completed questionnaires assessing her quality of life, perception of her disability, and pain levels before and after the intervention, and all improved. On a scale of 0 to 10, the average intensity of her phantom limb pain went from a 5 to a 3, while the pain in her residual limb dropped from a 6 to a 0.

“For me, this research has meant a lot, as it has given me a better life... [I have] better control over my prosthesis, but above all, my pain has decreased,” she said. “Today, I need much less medication.”

Even though her highly integrated bionic hand is a huge upgrade, it still is not nearly as functional as the hand she lost in the farming accident. That’s because the human hand is one of the most complex structures in nature — roboticists still have not managed to perfectly replicate it, and they do not integrate their mechanical hands with a human brain and nervous system, like bionics developers do.

Still, her experience shows that changing how bionics are integrated with the human body can have a huge impact on their functionality and greatly improve the lives of the people using them. Making such approaches accessible to anyone who wants them will be the next hurdle — a bionic hand can cost tens of thousands of dollars, and the surgeries and training likely would add significantly to the overall cost.

By combining osseointegration with reconstructive surgery, implanted electrodes, and AI, human function can be restored in an unprecedented way. The below-elbow amputation level has particular challenges, and the level of functionality achieved marks an important milestone for the field of advanced extremity reconstructions as a whole.

<https://www.freethink.com/hard-tech/bionic-hand-phantom-limb>

Micro and nanoscale electromechanical devices are very small devices that may, in some cases, exploit quantum phenomena (“quantum phenomena” include atomic mechanical states such as spin directions of electrons or polarization orientations of a photon. These states may be used to produce, for example, very small, very fast computers). Nano machines also can be used to automatically assemble other nano devices.

Quantum-related technology can be considered in four areas:

1. Computing: for special purpose applications. Can it scale (from 50 to 1 million qubits)?
2. Internet: good for cryptography, but cannot break every non quantum crypto
3. Simulation: direct (vs. math conversion). e.g., simulate black holes using super fluids.
4. Metrology: improves measurements with less damage to measured items

EXAMPLE: Nano-materials are attached to cancer cells, marking them. After the cancer has been covered by these particles, the cancer can be burned away without harming healthy cells.

Devices incorporate more advanced materials. A combination of two or more materials that have significantly different properties is a composite material. These different materials work together to provide unique properties (e.g., strength combined with lightness and flexibility). The properties of some composite materials will dynamically and automatically alter as changes occur in their environment (e.g., mechanical stresses, enemy radar scans).

EXAMPLE: Carbon fiber composite materials are used to enable commercial suborbital space flight.

Robots as well as personal communications and computing devices are migrating from separate specialized devices to more integrated universal general-purpose devices.

Devices have information and control capabilities coupled with wireless mobile communications. They are pocketed, worn or otherwise carried by users. In addition, they operate stand alone or embedded in other devices. When they are turned on, the devices network (transparent to the user) and interoperate with other devices using automatic self-configuration.

These very small devices provide processing, storage, sensing, wireless networking and user interface capabilities so that living things and machines can exchange information and interoperate with each other. They self-configure automatically with the nearest wireless mesh network when they power on. (A “mesh” network is non-hierarchical and has a dynamic topology. It provides a device linkage to the network via another nearby device that is already connected to the network).

Systems and devices use software and hardware to automatically learn from their environment, design additional capabilities or other devices, as well as self-detect and repair failures (or without losing functionality until the user can take actions to permanently fix the failure).

Edge devices that use AI plus neural processing architectures (versus traditional Von Neuman designs) will provide for fast efficient sensors and controllers that do not need to communicate with a remote source of data and processing to execute their functions.

EXAMPLE: A sensor/controller on a machine tool measures parts being produced and adjusts of the tool to maintain specified tolerances for the parts without communicating with a remote device.

Vehicles in the future will have autonomous ground and air capabilities including self-driving cars and small vertical take-off and landing (VTOL) aircraft for personal human transportation and for package delivery. The use of small commercial VTOLs may be one the most significant changes to our daily lives during the next 20 years. These VTOLs technologically and economically will be viable in that period. The challenges (and they are significant) for the widespread use of VTOLs are operational.

VTOLs will be enabled by strong and light materials; advanced battery, electric motor and propeller design; autonomous control systems; GPS; collision avoidance systems and ride scheduling applications. Large (e.g., Boeing, Airbus, Bell Helicopter, Uber, Porsche, etc.) and small companies already are producing concept vehicles and working prototypes.

Battery performance is a challenge but improvements continue. And costs are improving as well; Tesla battery cost have declined ten-fold in 10 years.

Several challenges must be overcome for small VTOLs to be practical. The confidence of users must be established. Many have an inherent fear of flying. When compared to the 1.5 million annual deaths worldwide from car accidents, however, VTOL travel likely will be much safer. Shared rides will be a significant use of small VTOLs so personal security with fellow passengers is important.

Government regulation of air traffic must quickly change to accommodate the presence of autonomous VTOLs. Even with quieter electric motors and propellers, noise from VTOLs will be difficult to manage especially in residential neighborhoods. Noise levels of about 50 to 60 decibels or less for the typical listener may be required along with time-of-day restrictions.

In addition, landing areas in residential neighborhoods (considering trees, sharing streets with cars, etc.) are a significant challenge. Residential neighborhoods have been designed for cars, not small VTOLs.

If the noise and landing area issues cannot be overcome, small VTOLs will be relegated to more public common areas making them less useful and prevalent (more like public buses or trains) than if the VTOLs can pick up passengers at their residences, businesses and other end point locations.

What's next for semiconductors? The vacuum tube was invented in 1904. The semiconductor transistor (which displaced the vacuum tube) was invented in 1947, 43 years later. It now has been 60 years since the invention of the existing, semiconductor, technology.

During the past 60 years, the manufacturing of solid-state semiconductor devices and design of systems using the devices has experienced extraordinary advancements which likely will continue indefinitely. The basic doped and ion-implanted semiconductor technology, however, fundamentally has not changed during that period.

The smallest sizes of semiconductor nodes now are less than 20 nm with the possibility of going to 5 nm and perhaps to 1 nm using carbon nanotubes. At those sizes, uncontrollable quantum effects occur (atoms have diameters of 0.1 to 0.5 nm) that make integrated circuits beyond those sizes not possible.

Since any substitute material also will be limited by the size of the atoms comprising it, smaller size chips likely will not be possible after the next 10 years or so.

Future advancements in electronics performance will come more from improvements in the following rather than reduction in node sizes:

- Additional semi-conductor materials such as germanium, gallium arsenide, gallium nitride, molybdenum disulfide, titanium dioxide and carbon nano materials
- Memristors - a simpler and smaller alternative to the transistor, with the capability of altering its resistance and storing multiple memory states chips for new kinds of non-Von Neumann computers
- Vacuum electronic devices for power critical systems such as radar
- Highly distributed more parallel and autonomous devices that incorporate artificial intelligence algorithms
- Groups of specialized energy-efficient chips instead of individual, general-purpose processors
- Quantum computing for specific applications (e.g., optimization, simulations). Likely more centralized due to temperature and mechanical requirements.
- Extreme ultraviolet lithography for manufacturing
- New algorithms for highly parallel processing devices, quantum computing and other. architectures.
- Improved control of quantum computers (e.g., new Intel chip to control quantum computers)

Quantum machines are widely expected to revolutionize computing. But progress has been slow. While engineers labor to build rudimentary quantum computers, theoretical computer scientists have confronted a more fundamental obstacle; they have been unable to prove that classical computers will never be able to perform the tasks for which quantum computers are designed.

In the realm of communication (rather than computation), however, the benefits of a quantum approach have been demonstrated. Computer scientists proved that quantum communication beats classical ways of sending messages for certain tasks. Combining quantum computing and communication could provide a significant advantage.

Other yet undefined technologies and designs likely will develop as well to continue the improvements in the performance of electronic devices.

Practical quantum computers have not yet built that are well suited for everyday use and normal conditions (for example, many quantum computers operate at very low temperatures).

Classical computers process information using combinations of “bits”, their smallest units of data. These bits have values of either 0 or 1.

Quantum computers, on the other hand, use quantum bits, or qubits. Unlike classical bits, qubits don't just represent 0 or 1. Thanks to a property called quantum superposition, qubits can be in multiple states simultaneously. This means a qubit can be 0, 1, or both at the same time. This is what gives quantum computers the ability to process massive amounts of data and information simultaneously.

Quantum computers are able to explore every possible solution to a problem all at once, instead of once at a time. It would allow you to navigate your way through a maze by simultaneously trying all possible paths at the same time to find the right one. Quantum computers are therefore incredibly fast at finding optimal solutions, such as identifying the shortest path, the quickest way.

An example is the extremely complex problem of rescheduling airline flights after a delay or an unexpected incident. This happens with regularity in the real world, but the solutions applied may not be the best or optimal ones.

In order to work out the optimal responses, standard computers would need to consider, one by one, all possible combinations of moving, rerouting, delaying, cancelling or grouping, flights. On the other hand, a quantum computer would be able to try all these possibilities at once and let the best configuration organically emerge.

Qubits also have a physical property known as entanglement. When qubits are entangled, the state of one qubit can depend on the state of another, no matter how far apart they are. Entanglement allows quantum computers to solve certain problems exponentially faster than traditional computers can.

Quantum computers likely will not completely replace classical computers in the foreseeable future. Quantum computers are incredibly powerful for solving specific problems – such as simulating the interactions between different molecules, finding the best solution from many options or dealing with encryption and decryption. However, they are not suited to every type of task.

Classical computers are extremely predictable, robust and less prone to errors than quantum machines. For everyday computing needs such as word processing or browsing the internet, classical computers will continue to play a dominant role.

There are at least two reasons for that. The first one is practical. Building a quantum computer that can run reliable calculations is extremely difficult. The quantum world is incredibly volatile, and qubits are easily disturbed by things in their environment, such as interference from electromagnetic radiation, which makes them prone to errors.

The second reason lies in the inherent uncertainty in dealing with qubits. Because qubits are in superposition (are neither a 0 or 1) they are not as predictable as the bits used in classical computing. Physicists therefore describe qubits and their calculations in terms of probabilities. This means that the same problem, using the same quantum algorithm, run multiple times on the same quantum computer might return a different solution each time.

To address this uncertainty, quantum algorithms are typically run multiple times. The results are then analyzed statistically to determine the most likely solution. This approach allows researchers to extract meaningful information from the inherently probabilistic quantum computations.

In addition to big, established companies like IBM and Google, new ones are joining, such as IQM, Pasqal and startups such as Alice and Bob. They are all working on making quantum computers more reliable, scalable and accessible.

Companies increasingly the prioritizing ways to correct the errors that quantum computers are prone to. This shift is crucial for developing large-scale, fault-tolerant quantum computers, as these techniques are essential for improving their usability.

Google's latest quantum chip, Willow, recently demonstrated remarkable progress in this area. The more qubits Google used in Willow, the more it reduced the errors. This achievement marks a significant step towards building commercially relevant quantum computers

The probabilistic nature of these machines represents a fundamental difference between quantum and classical computing. It is what makes them fragile and hard to develop and scale.

At the same time, it is what makes them a very powerful tool to solve optimization problems, exploring multiple solutions at the same time, faster and more efficiently than can classical computers.

https://theconversation.com/were-getting-closer-to-having-practical-quantum-computers-heres-what-they-will-be-used-for-246274?utm_source=firefox-newtab-en-us

Neuromorphic technology is an essential enabler for cognitive computing. It is an architecture of memories which react to input patterns and can be compared to the brain because of its low power requirements, scalability, and instantaneous internal communications.

A neuromorphic chip is a fully parallel silicon neural network. It is a chain of identical elements (i.e., neurons) which can store and process information simultaneously. They are addressed in parallel and have their own “genetic” material to learn and recall patterns without running a single line of code and without reporting to any supervising unit.

Quantum computing design may include silicon spin qubits since they may be more producible and scalable.

Challenges for all quantum computing are simulators, algorithms, software, interconnects, and materials engineering. A quantum computer with a few thousand qubits would have world-changing impact and could be available in 10 or so years.

The goal in devising an algorithm for a quantum computer is to manage a pattern of constructive and destructive interference so that for each wrong answer the contributions to its amplitude cancel each other out, whereas for the right answer the contributions reinforce each other. If that happens, then the right answer is identified with a significant probability.

Conjectured quantum computer advantages versus traditional computing have repeatedly disappeared when classical algorithms were found with similar performance.

Universal robots (ubots) are designed to be all-purpose devices. The ubot can complete a wide variety of tasks both autonomously or under human voice control and remote electronic commands from a human or another device.

Ubots may or may not have humanoid physical characteristics (other appliances are not human-like).

Additive Production & Services

This category of emerging Technologies includes

- 3D printing
- Continuous liquid interface production
- Artificial, induced organ growth
- Cellular food production

Images are directly converted into the formulation of holographic images and of solid objects. Easy, economical formulation of product models, machine parts, custom clothing and many other objects is enabled.

Enhanced imaging and formulation also provide for the remote creation of objects.

EXAMPLE: items such as unique food recipes can be used to create a dish at a remote location with the proper remote formulation equipment and ingredients.

Additive production promises to radically change the way we live and the economic models of Business. Additive Manufacturing includes processes in which liquid, powder or other material are layered using computer control to create an object. A key element of Additive Manufacturing is 3D printing. It is used both for rapid prototyping and for full scale production of manufactured items.

In conventional machining, material is removed from a base object to form the final object. In additive production, an object is built from a computer data file usually by adding material layer by layer.

There are several processes for additive production including material jetting, powder bed fusion, binder jetting, directed energy deposition, sheet lamination, material extrusion, and vat photopolymerization. Combinations of additive production deposition, growth scaffolds and

other elements will be coupled with deep learning (AI) algorithms and large data sets to assemble very powerful additive production systems.

Additive production is being applied to mechanical parts, food, clothing, and biological organs. Additive production who is applied to prototyping and building of tools that themselves are used in more traditional materials removal or molding manufacturing applications.

Hybrid applications of additive production include producing an initial object with and then finishing it to final specifications with removal machining.

Biological application of additive production build organs with successive layering of living cells in various media such a gels or on scaffolds that support the tissue until it is fully developed.

Additive production likely will result in significant economic, legal and social impacts. One concern is that this wave of technologies, more so than previous technology waves, will result in cost reduction through replacement of labor.

Safety standards, intellectual property considerations will be affected as additive production becomes more pervasive. Shipping services may be reconfigured as production becomes more distributed, local and custom. As the ability to generate custom physical objects easily and on-demand, work and personal life may be even more intertwined than they are today.

Precision Optimum Information, Control, and Procedures

Emerging information content, control, and communications have the following characteristics; they are:

- real time
- context based
- predictive
- universal search capable (text, image, audio, matter)
- available always everywhere, on all Platforms
- easy to use

These capabilities give users the precise information they want when and where they want it. The capabilities take advantage of advances in:

- natural language processing
- personal profiling
- queuing analysis and control algorithms
- unified communications
- business process information management

This optimum information is in the context of the user's immediate situation (location, environment, demographics, time/date, emotional state, etc.) and in the format required (audio, text, graphics, streaming video or a combination of these). It includes integrated automated personal and business processes, unified communications with several sources, and supporting information systems that automatically communicate with each other to exchange information necessary for completing a task.

These processes interoperate automatically and seamlessly among individuals and organizations. Information is provided consistent with the user's previously designated preferences as well as the characteristics of the existing environment.

The processes include global real-time communications with others. These services have consistent features and functionality that are always available anywhere. They are always on and active.

Hardware and software innovations make possible the near-instant availability of any desired information and entertainment. These innovations include faster expanded search capabilities and devices that process large amounts of information in parallel rather than in a serial bit-by-bit manner. A challenge for the so-called Internet of Things (IoT) is that many of the edge devices will generate such low traffic (and revenue) streams that creative pricing models will be needed to make IoT traffic financially attractive.

A key trend in optimum information is massive data capture and near real-time analysis of the data. For example, researchers are collecting large amounts of information on human brain function from tens of thousands of individuals. Enhanced imaging, and advanced materials and computing are combined to achieve this capability. The results of analyzing this information are available to doctors as they are performing brain surgery.

Another example of massive data analysis is the use of the enormous amount of information contained in Internet search engines. This information not only is being used for search, but to train intelligent machines in the contextual understanding of text.

Machine deep learning algorithms ... also known as artificial intelligence (AI) ... will analyze large data sets and compare to an individual's characteristics to provide very early diagnosis of cancer and other diseases.

Search will include the use of machine vision plus mega data sources plus AI to provide for identifying the characteristics of any physical matter.

AI will assess, types of intelligence for a person and tailor individual education. And help enhance b intelligence in the education process. AI algorithms designs will minimize bias and pigeon holing.

Quantum computing and artificial intelligence are both transformational technologies and artificial intelligence likely will require quantum computing to achieve significant progress. Although artificial intelligence produces functional applications with classical computers, it is limited by the computational capabilities of classical computers. Quantum computing can provide a computation boost to artificial intelligence, enabling it to tackle more complex problems and Artificial General Intelligence (AGI).

Quantum AI is the use of quantum computing for the computation of machine learning algorithms. Thanks to the computational advantages of quantum computing, quantum AI can help achieve results that are not possible to achieve with classical computers.

Quantum mechanics is a universal model based on different principles than those observed in daily life. A quantum model of data is needed to process data with quantum computing. Hybrid quantum-classical models are also necessary for quantum computing for error correction and the correct functioning of the quantum computer.

Quantum data can be considered as data packets contained in qubits for computerization. However, observing and storing quantum data is challenging because of the features that make it valuable which are superposition and entanglement. In addition, quantum data is noisy, it is necessary to apply a machine learning in the stage of analyzing and interpreting these data correctly.

It is highly possible to obtain meaningless data when only using quantum processors to generate quantum data. For this reason, a hybrid model emerges when it is powered by fast data processing mechanisms such as CPU and GPU, which are frequently used in the classical computer.

An algorithm is a sequence of steps that leads to the solution of a problem. In order to execute these steps on a device, one must use specific instruction sets that the device is designed to do so.

Quantum computing introduces different instruction sets that are based on a completely different idea of execution when compared with classical computing. The aim of quantum algorithms is to use quantum effects like superposition and entanglement to get the solution faster.

Although AI has made rapid progress over the past decade, it has not yet overcome technological limitations. With the unique features of quantum computing, obstacles to achieving AGI (Artificial General Intelligence) can be eliminated.

Quantum computing can be used for the rapid training of machine learning models and to create optimized algorithms. An optimized and stable AI provided by quantum computing can complete years of analysis in a short time and lead to advances in technology.

Neuromorphic cognitive models, adaptive machine learning, or reasoning under uncertainty are some fundamental challenges of today's AI. Quantum AI is one of the most likely solutions for next-generation AI.

Quantum AI is an immature technology. To become a more mature technology, the following are needed:

- Less error-prone and more powerful quantum computing systems
- Widely adopted open-source modeling and training frameworks
- Substantial and skilled developer ecosystem
- Compelling AI applications for which quantum computing outperforms classical computing

<https://research.aimultiple.com/quantum-ai/>

Large scale precision 3D biological imagery will be economical.

Analysis and manipulation of DNA, proteins, stem cells and other techniques to predict, diagnose and treat diseases and to manipulate other characteristics continue to be developed. Combined with nanotechnology, composite materials, high-resolution imaging, and other technologies, diagnosis and treatment are very precise and minimize damaging side effects.

Imaging will include hyper spectral cameras that can see things invisible to the human eye and identify the composition of materials. It also will include x-ray computed tomography for seeing inside solid objects (e.g., streamlining airport security screening).

In industry, genetically modified bacteria are used to clean up toxic residues from manufacturing and other processes.

A recent popular advancement in AI application is ChatGPT. It is an interactive chatbot powered by machine learning. The technology has absorbed much of the Internet content and patterns in language that it can recreate.

Give it a prompt, and ChatGPT can do an array of things: write a story in a particular style, answer a question, explain a concept, compose an email, write a college essay — and it generate coherent, seemingly human-written text in seconds. An AI system called GPT-3, a predecessor to ChatGPT that was less user-friendly and largely inaccessible to the general public. OpenAI, the company behind GPT-3 and other AI tools, released ChatGPT to the public for free.

The text ChatGPT generates is pretty formulaic and not always accurate. But it is a significant step in AI generated text.

It does raise concerns. How many jobs will this kill? Will this empower nefarious actors and further corrupt our public discourse? How will this disrupt our education system? What is the point of learning to write essays at school when AI — which is expected to get exponentially better in the near future — can do that?

The essay, in particular the undergraduate essay, has been the center of the way children are taught how to research, think, and write. That tradition could be disrupted.

Software, however, also is being developed that helps identify whether something has been written by a machine. Software, called GitHub Co-Pilot, is powered by GPT-3 and has been used to create this AI-generated text identification capability.

This identification application is called GPTZero. It uses ChatGPT functionality, checking whether there's zero involvement or a lot of involvement of the AI system in creating a given text.

People can know when something is written by a human or written by a machine according to the developer. He is not trying to stop AI but, rather, build safeguards.

https://www.npr.org/sections/money/2023/01/17/1149206188/this-22-year-old-is-trying-to-save-us-from-chatgpt-before-it-changes-writing-for?utm_source=pocket-newtab

EXAMPLE: The genetic anomalies causing Parkinson's disease are corrected using alteration of a patient's stem cells. Patients can thus avoid the debilitating effects of the disease as well as the complex medications, brain surgeries and implants that only treat Parkinson's symptoms rather than cure the disease.

AI-based systems will need a hardware architecture that balances the high-performance processing capabilities with adequately performing memory resources.

Challenges for Information will be minimizing the centralization of and energy used by block chain systems, the regulation (by industry and government) of crypto currency, and the interoperability of disparate block chain systems. Another challenge will be increasingly realistic fake AI-based multimedia that is almost impossible to identify as fake.

Advances in information processing will support ever improving operational designs of physical such as the so-called XBOW design of more effective deep-sea vessels and the design of quiet supersonic aircraft.

The use of precision information in biology includes the development of designed antibodies.

Current antibody drugs have increasingly fewer adverse effects due to their high specificity. As a result, therapeutic antibodies have become the predominant class of new drugs developed in recent years. Antibodies have become the best-selling drugs in the pharmaceutical market.

Humans are susceptible to infection by existing and future pathogenic organisms. The immune system continuously evolves its capability to eliminate infectious organisms.

The immune response uses antibodies that are immunoglobulin proteins produced and secreted by plasma cells present in bone marrow. Certain antibodies can be designed, produced and unfused in humans to protect against and to cure diseases.

Some designed antibody treatments provide both act as protection against and therapy for a disease negating the need for a protection-only vaccine.

No cures exist for viral infections. Anti-viral treatment medications often provide only a small benefit as they are minimally effective in stopping further virus production in the body

Mammals generally have similar immune systems. Molecules from humans are recognized as foreign by other species, e.g. mice.

Blood serum from an immunized animal can bind to and kill human tissues, such as cancer cells, in vitro. The serum, however, cannot be used for therapy in humans because it is foreign provokes an adverse response that can be severe.

Monoclonal antibodies are laboratory-produced molecules engineered to serve as substitute antibodies. These monoclonal antibodies are made by identical immune cells that are all clones of a unique parent cell.

Monoclonal antibodies can bind to the part of an a toxin or other foreign substance (known as an antigen) that is recognized by the antibody. An antigen is a molecule or molecular structure, which in particular may be present at the outside of a toxin or other foreign substance (a pathogen), that can be bound to by an antigen-specific antibody. Polyclonal antibodies bind to multiple parts of an antigen and are usually made by several different antibody secreting immune cell lineages. These engineered antibodies are a tool in biochemistry and medicine. When used as medications, non-proprietary drug names end in “mab” (monoclonal antibodies).

Fully biologic methods takes years to produce viable therapeutics. The process of harvesting, isolating, determining sequence, and finally humanizing animal antibodies is time consuming.

In silico designs (computer modeling and simulation) utilize bioinformatics and computation to save years in the development process. In addition, antibodies can be designed against antigens too toxic to inject into a living creature.

In silico designs are not without flaws. The designed antibodies produced only are as good as the algorithm that produces them.

Pharmaceutical companies develop and produce antibody cocktail products that treat certain diseases such as HIV, Ebola and COVID-19. A cocktail of several antibodies help retain effectiveness even if virus mutations render a single antibody therapy less effective over time. These companies screen billions of antibodies in their human antibody libraries to identify antibody candidates for a specific disease.

Designed antibodies currently are used to treat:

- Inflammation (arthritis, colitis, Crohn's, spondylitis, asthma, transplant rejection)
- Cancer (leukemia, lymphoma, squamous cell, colorectal, breast with HER2/neu)
- Viral (hepatitis C)
- Other (Respiratory Syncytial Virus in children, coagulation in coronary angioplasty)

Dozens of additional designed antibody therapeutics are in clinical trials and will become available over the next few years.

Ultimately, personalized health care will include real-time monitoring of cellular level conditions and immediate in vivo or otherwise rapid response to those specific conditions. Among other things, this capability supports the important “catch it early” principle of effective medicine.

For example, COVID-19 is a complex and dynamic disease resulting from a variety of individual responses to the virus including immune system over-reaction which can cause organ damage and death. The disease can transition very quickly from viral to immunological distress.

The ability to monitor the condition of cellular level conditions helps determine when the transition occurs in order to appropriately modify treatment and modulate immune suppression in a balanced manner.

Precision information has application in public safety and law enforcement. For example, less than one percent of the population is involved in groups connected to half of homicides and shootings. A far smaller number within those groups are directly involved in committing that violence.

Public safety actions can be directed at this tiny subset of the population. Deterrence strategies focus resources on the people at highest risk of being involved in violence. These type of strategies offer a more effective, and less damaging, approach to preventing violence than surveilling a vast number across entire areas of a city for unknown perpetrators.

Waves

A gap (400 to 789 terahertz) exists on the electromagnetic spectrum where engineers cannot tread. The spectrum covers everything from radio waves and microwaves, to the light that reaches our eyes, to X-rays and gamma rays.

Humans have mastered the art of sending and receiving almost all of them. No one, however, has succeeded in building a consumer device that can transmit waves in the terahertz gap.

Existing silicon chips are not fast enough to make terahertz waves. Light-producing technologies like lasers do not work with terahertz waves either. In addition, terahertz waves do not propagate well in the Earth's atmosphere.

There are, however, potential applications for which some researchers are slowly making progress. They might open up new technologies such as a much faster successor to Wi-Fi, a smarter detection system for skin cancer, explosives detection and avoiding potentially harmful ionizing radiation like X-rays. Some existing telescopes currently already these wavelengths.

Although terahertz applications research has been ongoing for decades, it still is in early stages, but progress continues.

https://www.popsci.com/science/terahertz-waves-future-technologies/?utm_source=pocket-newtab

Immersive User Interface

These user interfaces are three dimensional, use virtual and enhanced vision, and are controlled by natural speech commands or by moving your arms, hands, fingers, or eyes. Limited controls using simple thoughts are available.

These interfaces provide an immersive 3D visual, audio, touch, taste and smell experience while not unduly interfering with the user's awareness of his immediate physical environment. The interfaces will also sense physical and emotional states and adapt their interactions consistent with those states. Contact lenses will provide virtual display, night vision and some bio monitoring and processing.

EXAMPLE: "Virtual teleportation" is achieved by an immersive full-sensory experience in a remote environment (including with other people) in which the user feels he actually is at that physical location and with those people.

Hybrid Flexible Power

An expanded array of power sources is becoming available. These sources are tailored to the specific situation of the power user (i.e., economics, geography, environmental conditions, etc.). These power sources include hybrid applications of traditional sources (e.g., the combination of internal combustion motors and electric motors).

Secondary power is derived from ambient energy sources (such as vibrational energy from a carbon fuel engine).

Power sources are embedded in the materials of the device that is being powered such as dye sensitive solar cells in thin flexible sheets.

EXAMPLE: Natural gas is used to power fuel cells for individual buildings that generate more efficient power for the building than existing power sources.

Dynamic Communications Networks

Mobile devices and content, server virtualization, and advent of cloud services are among the trends driving emerging networking design. Both public and private cloud services are growing rapidly and customers want the agility to access applications, infrastructure, and other resources on demand and à la carte.

"Big data" sets require massive parallel processing on thousands of servers, which need connections to each other. The rise of mega datasets drives a constant demand for additional network capacity.

Software-defined networking (SDN) is a design concept that is dynamic, adaptable, and cost-effective. It is suitable for emerging information applications. SDN architectures decouple network control and routing functions, enabling network control to become independent of the underlying infrastructure, network services and applications.

Network function virtualization (NFV) provides flexibility for the physical location of the virtualized functions. There are benefits in using SDN concepts to implement and manage an NFV architecture.

Edge access to network routing and other processing elements will be via 5G and 5G+ wireless with typical available median bandwidths of 1 Gbps (which will support high quality full motion 3D video) increasing to 20 Gbps. This edge wireless access will be connected via long haul optical fiber that will support multi-Pbps per fiber (1 Petabit = 1000 Terabits) over distances of several thousand kilometers.

Eventually, dynamic mesh peer to peer networks will exist eliminating, at least to some extent, third party network services providers.

Low Earth orbit satellites for broadband internet access are being developed which are planned to offer speeds similar to land line services for currently underserved rural and other remote areas. SpaceX Starlink is in early stages of deployment and other companies such as Kuiper and OneWeb are developing services as well.

Human to human communication relies on the use of

- physical phenomena (e.g., air and soundwaves, eyesight, publications, electronic and photonic telecommunications)
- symbology (e.g., letters, numbers, graphics)
- shared logic (e.g., languages, mathematics, concepts)

These items act as conduits of information between human brains, however, they require layers of translation that inherently are somewhat inefficient and inaccurate.

For example, instead of taking a photograph of a specific dog and sending it electronically to the device of a recipient for viewing, the observing individual instantly could transmit the image of the dog to the brain of the recipient.

More direct connectivity between human brains could make communication more efficient and precise. It could enable people to work across language barriers. Moreover, it could provide help for those with impaired ability to communicate.

In addition, basic experimentation on animals has demonstrated that multiple networked brains outperformed individual brains for simple tasks. The capabilities of networked human brains could be a faster, more efficient and effective way of working together.

Brain-to-brain interfaces also work across species. In experiments, a human controlled a rat's movements via brain implants in the rat.

Issues that likely will evolve from brain-to-brain communication include privacy, missing the nuances of existing speech, the effect on individual personality, and other considerations. Gains from directly linking brains must be balanced with other important factors.

Information transfer using noninvasive approaches could be accomplished with techniques such as functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS) that uses magnetic fields to stimulate nerve cells in the brain. More invasive and possibly more efficient brain interfaces are being developed by Elon Musk (thousands of ultrathin robotically implanted electrodes), Defense Advanced Research Projects Agency (neural interface engaging one million nerve cells simultaneously) and others.

Non-invasive sensors and other electronics that measure and analyze a brain's electrical impulses and blood flow at the speed of thought. Some developers believe these types of devices will be available at consumer pricing in about ten years.

The technology needed to make implants work is difficult to perfect—among other things, the human body tends to muddy the devices' signals over time, or to reject them outright—and the surgery may not be widely accepted.

Non-invasive devices must minimize electromagnetic interference and penetrate the human skull, which is well-evolved to prevent penetration. It is unlikely a helmet will achieve the level of information an implant can.

An example of a non-invasive technique is measuring changes in blood oxygenation levels. As parts of the brain activate and neurons fire, blood rushes in to provide oxygen. The blood also carries proteins in the form of hemoglobin, which absorbs infrared light differently when transporting oxygen. This technique takes advantage of this phenomenon by firing laser pulses and measuring how long the pulse takes to come back.

Another non-invasive technique measures electromagnetic activity. As neurons fire and alter their electrical potential, ions flow in and out of the cells. This process produces a weak magnetic field, that changes its behavior in milliseconds, making it difficult to measure and detect.

These invasive and non-invasive devices not only will provide information and control for individuals but also will help create a better understanding of the human brain.

Packetization of Things (Information, Energy, Objects)

Free-space small-packet routing of information and physical items has proven to be most effective.

Examples:

- Modern wireless packetized (i.e., IP packets) telecommunications access to networks
- Personal cars (i.e., “small packets”) – including shared rides – instead of buses and trains
- Energy packet networks that support easy routing of energy from sources to users

This inherent understanding of free space packetization benefits for example drives the ongoing desire for personal VTOL air vehicles despite the operational challenges with deploying such vehicles. The fundamental impetus for small VTOLs is to transform “last mile” and long-haul physical transport from the existing two-dimensional and conduit-confined environment of roads, rail and sea and air traffic routes to a three-dimensional essentially unconstrained free space environment. This impetus is similar to the on-going freeing of telecommunications local access from a wired to a wireless environment.

Standardized personal information applications (SPIAs) contain a person's or device's key demographic, financial, medical and other information. Other systems are authorized to extract the elements of SPIA data they may need for access to and usage of services.

EXAMPLE: of the more “autonomous, packetized” future is the Zoox vehicle under development. Zoox robot vehicle delivers on-demand autonomous vehicular transportation to the masses.

A Zoox vehicle does not have manual controls. The intention is to provide a safer, more efficient and reliable form of vehicular transportation.



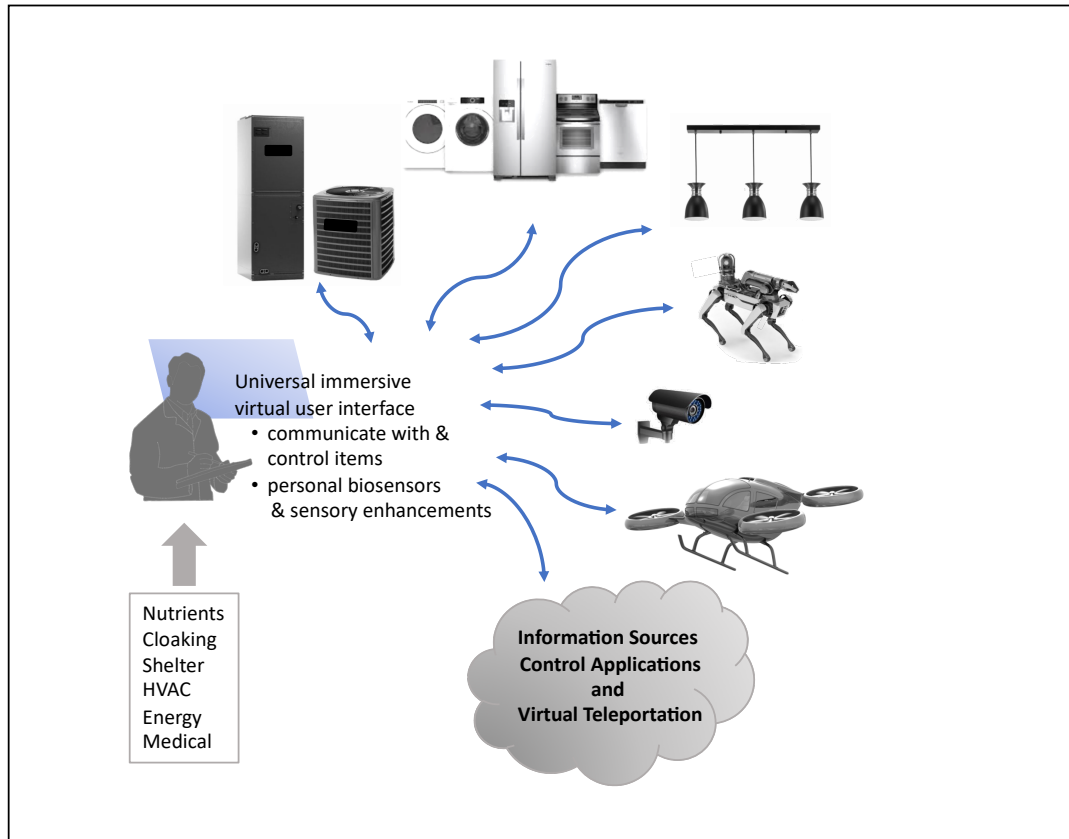
EXAMPLE: an individual applies for life insurance simply by authorizing access for the insurance carrier to her SPIA for extracting only her personal demographic and health information necessary to complete the carrier’s application (that is designed to work with SPIAs). Time is saved by both the insured and the insurer and errors are avoided in completing and processing the application.

The so-called “Physical Internet” concept embodies packetization of physical goods. It envisions manipulating standardized containers and information to encapsulate physical goods.

Packetization of energy includes the concept of unified energy providers and consumers through the energy packet network (EPN) paradigm, which represents both the flow of work that requires energy, and the flow of energy itself, in terms of discrete units. An initial model of the EPN has been developed that determines the equilibrium state of a system including energy storage units, energy transmission networks, energy consumers, and energy sources. The model shows how the sources and usages of energy can be optimized and includes reserve energy for possible future needs.

Universal Immersive Virtual User Interface

This graphic depicts the Universal immersive virtual user interface to control & communicate with most Platforms in the emerging future.



Global Mind: Knowledge Capture, Synthesis, Utilization

The Internet coupled with potential for related tools to quickly capture, synthesize and utilize in an integrated manner information from the web along with the knowledge and ideas of people who will support a specific analysis (i.e., "crowdsourcing"). Rapid and comprehensive integration and analysis of such information offers the opportunity to quickly and effectively address issues, solutions and other items.

Crowdsourcing tools are available but website scanning tools that do more than simply performance analytics and content organization, indexing and extraction are not available. In addition, tools that consolidate and process scraped website with crowdsourced information and are not yet available to the general public.

For example, a rapid global knowledge synthesis capability could have been used to quickly coalesce previous and ongoing research and clinical experience during the COVID-19 pandemic to best understand prevention, diagnosis, prognosis, treatment and recovery options. Such a capability, if objectively applied and used, potentially could have helped saved many lives and limited much suffering.

An example of global mind using a set of existing components includes:

Data Infrastructure: Amazon Web Services – on demand cloud computing platforms
<https://aws.amazon.com/>

Crowdsource: Amazon Mechanical Turk - crowdsourcing marketplace
<https://www.mturk.com>

Web scrape : Dexi.io - extracts and transforms data from any web source with intelligent mining.
<https://www.dexi.io>

Synthesis: Realtime Data Synthesis and Analysis (REDASA) - curate and filter large amounts of complex information in a short amount of time.
<https://www.imperial.ac.uk/news/238051/new-data-synthesis-tool-rapidly-sort/>

Since these components are not a single integrated system, a significant level of human effort still would be required to complete synthesis and interpretation of the collected information.

Organizations & Governments

Jericho is claimed to be the oldest city in the world, and it is the city with the oldest known protective wall. Archaeologists have unearthed the remains of more than 20 successive settlements in Jericho, the first of which dates back 11,000 years (to 9000 BCE). Copious springs in and around the city have attracted human habitation for thousands of years. As the world warmed up, a new culture based on agriculture and sedentary dwelling emerged.

Communities such as Jericho have been the mechanism for supporting humans and their organizations and for the governments that administer them.

Organizations

- Priorities: 1. Members; 2. Customers; 3. Other Stakeholders
- Good leaders: competence, humility, integrity; not over-confident, charismatic, or narcissistic.
- It is an honor to serve any organization you are privileged to lead.
- Leaders - hire good people, collaboratively plan, remove impediments, team freedom to work
- Have a compelling vision and a comprehensive plan.
- Leaders hold themselves and teams accountable for deciding, “What business are we in?”
- Positive leadership conveys always a way to success
- Leaders are responsible for articulating and demonstrating a set of behaviors
- Leaders reinforce the processes used to meet goals
- Members commit to the enterprise and each other ... they work for more than themselves
- Members either adopt your culture, or they leave
- Everyone is included, part of the team, respected, and participates
- When people feel accountable, included and supported it is more satisfying
- A safe environment is necessary for an honest dialogue, especially when things go wrong
- What is the deep customer need you are uniquely positioned to satisfy?
- Example: Henry Ford understood the desire for freedom of mobility is enduring and universal
- Great companies grow value by satisfying customers better than competitors
- Facilitate connections between the organization and the outside world
- A frequent review of strategy and implementation plans is essential
- Plans are coherent end-to-end “story” and include ...
- Possibilities, Prospects, Providers, Products, Processes, Platforms, Performance, Projects
- Messages address recipients’ interests in the format: Interrupt + Engage + Educate + Offer
- As new information emerges, incorporate it right into the plan
- Look at every element of cash flow, the income statement and the balance sheet
- Manage your time and your energy. Build and use your energy wisely.
- Integrate your personal and work demands into one calendar to attain balance

Organization Plan Framework

Organization Plan Business, Government, Home, etc.

Plan Overview

Principles

Prospects

Places

Providers

Products

Pricing

Promotion

Processes & Platforms

Partners

Public Policy

People

Performance

Programs & Projects

A business or other organization can be described in terms of its:

- Possibilities – for value creation to benefit customers, investors, employees
- Plans – summary of key actions to pursue the selected Possibilities
- Products – that include the goods and services offered
- Prospects – to whom Products are offered
- Purchasers – who already have acquired Products
- Processes – that used to source, market, deliver and support Products
- Platforms – combinations of technologies that support Products and Processes
- Partners – external individuals or other organizations that work with an organization
- People – who work with the organization
- Providers – that supply or who are partners or competitors
- Places – where Products, Processes and Platforms are provided
- Public Policy – created by government and other organizations
- Performance – of an organization from a feature, functional and financial perspective

Organization Segments

The following provides information about how the emerging Technologies will affect each of the major organization Segments and the existence of Organizations. Also included are present and previous capabilities as a reference and context for the future capabilities. Past, present and future time periods are shown when the capabilities are used by more than a quarter of the relevant population in developed countries

One of the essentials for a successful organization is its leadership. Organizations such as Microsoft, Tesla, Apple, Google, and Amazon grew very fast and sustained their success. Why? The common factor seems to be visionary hands-on founder leaders.

In addition, however, research indicates that the best leaders exhibit competence, humility, and integrity. Less effective leaders exhibit over-confidence, charisma, narcissism; many people, however, are attracted to these traits and thus organizations often find themselves with less effective leaders.

A balance of vision, commitment and the other traits of a good leader can enhance significantly the performance of an organization.

In addition, the demand to serve current, profitable customers in the short-to-medium term seems to be the focus of most companies. The needs of these customers make it easy not to invest in other initiatives, and so, these firms are at risk of being blindsided.

Organizations are misled by the practices—such as listening to their customers, or designing next-generation products for existing users—that made them successful. Firms performed well by adhering to the needs of key players, but that eventually leads to myopia and decline.

Following are forecasts for each Organization Segment.

Professional & Other Services for Consumers & Organizations (incl. education, government)

20 Years Ago

- Phone help desks, reservations
- Direct measurement test instruments
- Paper-based information

Present

- On-line directories, services descriptions, advisory information
- Web-based reserve, order, pay
- Microprocessor based test instruments
- On-line self-appointments/reservations
- Mobile device payment
- Mobile field service system: integrates back office, client info, field rep mobile devices
- “Expert System” on-line advice
- 1st-level services self-administered; 2d level remote artificial expert; 3rd level- human

5 Years Future

- Automated remote testing of products

20 Years Future

- Self-healing products with reporting to providers
- Open banking: cross banking IT systems
- Distributed ledger transactions

Manufacturing

20 Years Ago

- Manual machine tools
- Automated production lines
- Computerized materials tracking
- Early computer aided design (CAD)

Present

- Programmed robots & machine tools
- Bar coded, automated material tracking & reporting
- Wireless controlled worker devices
- 3D CAD

5 Years Future

- Dynamic production configurations
- RFID tracked materials
- On-line, 3D, virtual, interactive, collaborative planning
- Additive manufacturing: e.g., industrial 3D printing
- Industrial control systems: fully digitized processes, devices improve quality, lower costs
- Customer-driven design: integration of preference information, development processes

20 Years Future

- Optobiomechatronic tools
- Nano scale production tools and parts
- Integrated production & quality systems
- Components fabricated on site
- Next generation industrial robots: dynamically configurable, self-learning, adapting

Construction

20 Years Ago

- Manual power tools
- Main-frame computer project planning tools
- 2D computer aided design (CAD)
- Remote surveillance

Present

- Computerized project management
- 3D CAD
- Mobile on-site information technology
- Bar coded materials

5 Years Future

- Lighting systems detect human presence
- RFID tracked materials and tools
- Unified communications for project members
- Digital documentation
- Mobile field service software to support project managers
- Building information modeling (BIM)
- 3D modeling videos

20 Years Future

- Intelligent, networked sensors for work sites and buildings
- Adaptable building materials
- Exoskeletons for laborers
- Integrated, automated project management systems
- Integrated CAD/business intel management (BIM) systems
- Open BIM: e.g., for designs, permits
- Data analytics for BIM, sensors
- Mobile apps for tracking projects and materials
- Wearables to monitor safety, bio status
- Augmented and virtual reality design
- Thermal imaging
- Autonomous equipment
- Modular components
- 3-D printing of materials

Mining & Drilling

20 Years Ago

- Manual tools & vehicles
- Computerized assay & modeling
- Oil, gas from underground pools

Present

- Software modeling for mine design
- Satellite imaging, GPS analysis
- Oil, gas extraction - shale, sands

5 Years Future

- Cryonic treatment of machine parts for durability
- Remote control trucks & equip for safety
- Robotic assay labs
- Wireless self-learning oil drill logging system

20 Years Future

- Self-learning systems analysis to maximize material recovery
- Autonomous extraction and transport equipment
- More efficient digital control systems and sensor-fed data
- Undersea mining and related specialized ecology management

Transportation

20 Years Ago

- Internal combustion engines – fuel injected
- Jumbo commercial passenger jets
- Heavy rail & bus

Present

- Regional jets
- Light rail & bus
- Glass cockpit, electronic controls
- Semi-autonomous robotic controls
- Wireless toll tags
- Reusable space launch vehicles

5 Years Future

- Standard + hybrid gas/electric & networked vehicles
- Safety: 360 video + auto distance control
- Shared use of private truck fleet capacity

20 Years Future

- Electric engines
- Suborbital personal travel
- Sensors in transport vehicles, containers continuously capture, share, act real-time
- Monitor during transport the quality of goods being shipped

Power

20 Years Ago

- Fossil fuels
- Hydro
- Nuclear

Present

- Wind
- Smart metering

5 Years Future

- Power use optimization systems
- More reliable power grid management systems

20 Years Future

- 4th generation nuclear plants
- Solar
- Geothermal?
- Tidal?
- Grids of combined AC and DC electricity?
- High-capacity battery storage
- Consumer-to-grid
- Advanced grid management
- Predictive trouble identification

Defense & Security

20 Years Ago

- Precision-guided weapons
- Satellite & terrestrial video surveillance
- Manual surveillance
- Analog imaging

Present

- Drone surveillance & attack
- Stealth aircraft
- Short range missile defense

5 Years Future

- Pervasive hi-resolution surveillance & track
- Networked multimedia for tactical units
- Remote controlled equipment
- Long range missile defense

20 Years Future

- Autonomous surveillance & response
- Augmented reality battlefield
- Laser weapons
- Unmanned robotic stealth vehicles
- Electrical, optical for stealth
- Simple brain machine interface for information & control

Information Content Computing Networking

20 Years Ago

- Off-the-shelf general-purpose computers
- Custom, application-specific embedded platforms
- Wired “circuit” analog narrowband telecom
- Over-the-air analog broadcast
- Mainframe, mini computers
- CRT displays
- Analog TV, VCR, radio, tape, phones , CDs
- Digital “circuit switched” phone backbone network

Present

- Unified search
- Broadband packet digital data & telecom
- Shared servers, storage
- Software defined networks
- Individual personal digital devices.
- Wireless spread spectrum digital phones
- Optical fiber access
- Direct to end user satellite communication
- High definition TVs
- Integrated multimedia (voice, video, data)
- On-demand media

5 Years Future

- More targeted search
- Content - based network routing
- Open platforms, information, collaboration
- Personal on-line presence
- Hyper speed wireless
- Cloud based process and platforms as a service
- Key programming languages: JavaScript; Python; R; Lisp; Prolog; C++; C#
- Data explosion: 2020, 50 ZB to 2025, 150+ ZB

20 Years Future

- Plug & play software modules
- Contextual, predictive use of distributed content
- Wearable/embedded process/control/net devices
- Self-configuring wireless mesh networks
- Virtual, 3D, enhanced vision displays and controls
- Real-time image processing of dynamic patterns
- Standard Personal Profile & ID
- Distributed ledger transactions

Bioscience, Health & Medical

20 Years Ago

- Manual paper medical information & records
- 2D static imaging (X-rays)
- External & ingested macro - level treatments
- Minimally invasive internal exams & surgeries
- Non-targeted drug delivery

Present

- Equipment based on general purpose computing
- 3D dynamic imaging – MRIs, CAT, PET scans, etc.
- Implanted biological treatment & dispensing

5 Years Future

- Networked & radio ID based information
- Biochip based equipment
- Whole body imaging
- Continuous body monitoring
- Targeted drug delivery in body
- Networked experts to guide procedures
- Electronic personal medical information & records
- Improved radiological technologies
- Personalized cancer vaccines and immunotherapy
- Synthetic biology, synthetic genomics
- Tissue engineering
- Viruses transport treatments to locations of diseases

20 Years Future

- Personalized genomics & preemptive treatments
- Implanted autonomous & remote-controlled devices
- Robotic surgery
- Early detection algorithms
- Behavior-specific brain map
- Integrated decentralized med applications, physical facilities
- Self-learning systems analyze, prescribe, dispense medicines
- Digital behavior monitor, control
- Augmented reality for medical staff information exchange
- Drones deliver and return test kits; pre-ambulance arrival early care
- Molecular level real-time image
- Transplants of most organs
- Treatments with nanobots
- Organ regeneration with manipulation of cells and large morphology
- Artificial wombs for birth outside a woman
- Anti-aging drugs: anti-inflammatory; halt cognitive and functional decline
- AI discovered compound/drugs from enormous sets of combinations

Agriculture, Forestry, and Fishing

20 Years Ago

- Conventional hybrid crops, chemical fertilizers
- Animal deployed sensors

Present

- GPS & context-based planting
- No-till planters
- Genetically engineered plants
- Irradiated purification
- Underwater imaging systems for fishing
- Laser mapping of terrain
- On-line pest identification
- GPS-based equipment control

5 Years Future

- Digital analytics; geographic information databases
- Wireless field monitoring
- Precision farming: nutrients, moisture, crops
- Real-time food bacteria sensors
- Drone, satellite and underwater digital survey
- Thermal imaging (infrared) cameras
- Endocrinology tools
- Habitat mapping camera systems

20 Years Future

- Deep image assisted planting
- Robotic harvesting machines
- Precision robot application displaces broadcast chemical applications
- Biotech bugs control harmful pests
- Self-cloning plants that produce stable seeds
- Food from aquaculture farms (seaweed, algae)
- Engineered natural solutions
- Nanotech fertilizers
- Cultured meat, plants
- Plant, animal genomics
- Phyto and microbial remediation for pollution

Retail & Wholesale Trade

20 Years Ago

- Electronic cash registers
- Dial-up credit card verification
- Phone ordering of retail goods and services
- Computerized accounting
- Automated conveyor belts
- Bar coded items

Present

- Networked point of sale, inventory and shipping
- Web-based ordering and shipment tracking
- Just in time supply
- Radio Frequency Identification (RFID)
- Customer pre-visit store inventory check
- Global supply synchronization
- Full integration of catalog & in-store
- Electronic inventory and pricing
- Mobile device payments
- Mobile customer self-checkout
- Store pickup at curb

5 Years Future

- Dynamic pricing
- Wireless self-identification of items offered for sale
- Networked items for inventory management
- Customer information available to store clerk
- Social media ecommerce
- Convergence of all digital data for an enterprise
- Automated re-supply
- 3D sensing; e.g. facial recognition for security, personal profile matching
- Proximity beacons: transmit relevant targeted information to nearby mobile devices

20 Years Future

- Robots for administrative work in stores (e.g. stocking shelves)
- Robotic warehouse stocking, pick & pack
- Autonomous delivery vehicles
- Virtual reality: e.g., for visualizing products in use
- Augmented reality + localization: to provide proactive information about nearby items
- Wearable devices: e.g., “smart rings” for human hands
- Distributed ledger transactions: e.g., for financial transactions, contracts, digital currency
- Supply chains managed by self-learning systems
- “Physical Web” applications: e.g., global logistics to shipping package and product level
- Automated personal agent: monitors and acts on behalf of an individual’s environment

Organization Operation

Business, government and other organizations (all of which are composed of individuals) exist to serve the Purposes of living things and, ultimately, individual humans. Some organizations, of course, serve other organizations.

An organization should have a comprehensive evergreen plan understood by all its people. This plan includes:

Introduction

1. Plan
2. Principles
3. Prospects
4. Places
5. Providers
6. Products
7. Pricing
8. Promotion
9. Processes & Platforms
10. Partners
11. Public Policy
12. People
13. Performance
14. Portfolio, Programs & Projects

Essentials for the existence of a successful organization include the following items.

Mutual Trust is the Core Principle

Can each person trust others and be trusted to serve the interests of others and to continually improve their own individual capabilities and those of the organization. The organization leadership communicates a clear plan supported by the members of the organization and enables them to execute that plan.

Mutual Trust never is 100%, but the greater the Mutual Trust the more productive, easier, successful and satisfying will be the experience for members of the organization.

Successful organizations adhere to the following principles and policies

- Good leaders: competence, humility, integrity; not over-confident, charismatic, narcissistic.
- It is an honor to serve any organization you are privileged to lead.
- Leaders - hire good people, collaboratively plan, remove impediments, give team freedom
- Have a compelling vision and a comprehensive plan.
- Leaders hold themselves and teams accountable for deciding, "What business are we in?"
- What is the deep customer need you are uniquely positioned to satisfy?
- Great companies grow value continually by satisfying customers better than competitors.
- Positive leadership conveys always a way to success.
- Facilitate connections between the organization and the outside world.
- Everyone is included, part of the team, respected, and participates.
- When people feel accountable, included and supported it is more rewarding and fun.
- A safe environment is necessary for an honest dialogue, especially when things go wrong.
- A brief focused weekly business plan review of strategy and implementation is essential .
- As new information emerges, incorporate it right into the plan.
- Look at every element of the income statement and the balance sheet.
- Leaders are responsible for articulating and demonstrating a set of behaviors.
- Leaders reinforce the processes used to meet goals.
- People commit to the enterprise and each other. They work for more than themselves.
- People either adopt the culture ... or they leave.
- Manage personal time and energy. Build and use energy wisely.
- Integrate personal and work demands into one calendar to attain balance.

A Comprehensive Plan and Powerful Message

As you plan for success, understand your possibilities ... think bigger. Then focus on your top priorities; pursue other opportunities after you have the top priorities well established.

Plan every aspect of your organization and ensure all aspects are fully integrated. These aspects include: prospective customers, places you offer products, product characteristics, organization processes and the platforms and partners that support them, and a portfolio of well-managed projects that convert your plan to the results you expect.

Amazon is the example of success. Why? Because Jeff Bezos always focused on delighting customers. Amazon uses disciplined planning via its so-called “internal press releases” and “six pagers” to ensure it is delivering the things customers want and in a way which carefully builds every part of that delivery.

Separate yourself from your competition and eliminate them as a choice in your prospective customers’ minds. Messages and other marketing activities based on proven principles greatly increase their probability of success as well as your ability to improve them in a systematic way as your organization evolves.

Principles, Processes, Platforms and People that Accelerate Your Growth

Superior employee and customer experiences multiply your success ... fast. Don’t be blindsided by surprise disruptions to your business. You disrupt ... with exceptional product features and customer, employee, partner and supplier experiences.

Define and implement lean agile processes that deliver these experiences. Eliminate wasted time and resources.

Evaluate and select the best people and platforms to support your processes. Identify the qualities you want for your team members.

Experienced Partners Who Takes Responsibility for Your Success

Work with partners that have people who have delivered exceptional growth. Choose partners committed to your success who roll up their sleeves to deliver it.

Establish and maintain a team of high-performance partners in whom you have confidence (advisors, suppliers, alliances, professional services, etc.). Don’t compromise.

1. Plan

Use this section to provide a concise summary of your entire plan. This summary includes a very brief high-level description of each of the major elements of your planning as outlined in the table of contents.

This section tells your high level “story” and provides an easy and quick understanding of your plans by your staff, investors and others who may need to know it.

The summary should be only a page or two. Briefly hit the high points of your plan.

Start with a one sentence description of your plan. What's the organization idea, what problem does it solve and how does it fit into the marketplace?

Provide a one to two-page overview of your plans for each of the following:

- Prospects & Places
- Providers
- Products & Pricing
- Promotion
- Processes, Platforms & Partners
- People
- Performance
- Projects

In addition, provide a brief description of your significant risks and plans to mitigate them

2. Principles

Describe the two to three key principles by which you run your organization. This description provides clarity for everyone in your organization about these principles with which you operate.

Example Principles:

- a) Trust, in every way, is the essential principle. The greater the mutual trust, the more worthwhile the relationship.

Can you trust me and can I trust you to:

- Understand that individual self-interest is best served by serving the self-interest of others (as they define their self-interest) and then act on that understanding
- Continuously improve individual professional and interpersonal competency

- b) Success is dependent 80% on good relationships and 20% on the best tools and techniques

Second level principles that could flow from these overarching example principles are;

- The purpose of our organization is to exceed a sufficient return on investment
- Eliminate distractions from anything not related to this purpose
- Clearly state the benefit of our organization for humankind so that the team has higher purpose
- Share the plans for and the performance of our organization with the entire team
- Actively manage an optimized portfolio of programs and projects that execute our plans.

- Our employees are #1 (if they are satisfied they take care of your customers, suppliers, partners)
- Every team member ultimately is responsible for his/her own Satisfaction
- Continually, enhance each team member's knowledge and skills for their benefit
- Provide each team member as much financial ownership in our organization as possible
- Define clear high-level responsibilities for each team member
- Allow and enable each member to deliver on his/her responsibilities
- Self-organizing inter-discipline teams as necessary for quick and effective results
- Hire slow; fire fast ... it is best for everyone
- Know our exit plan (and adjust it as necessary as time passes)

Ultimately, your principles should create the best opportunity to accomplish your goals.

3. Prospects

Your ability to clearly define and identify the very best customer for your product determines your success. You want to be intensely focused on finding and satisfying clients.

The more clarity you have about your ideal customer, the more successful will be your organization. Identify the types of organization segments and prospects within those segments who have applications for which your products can be used.

Define your unique selling proposition and communicate it in every prospect contact. What are the most important qualities that your ideal customer would have? Focus all marketing and other efforts on this particular type of prospect.

Customers should be thought of as your best prospects. Treat them well as you would someone to whom you are trying to sell. Generally, keeping an existing customer is much better for you than replacing a lost customer.

Identify how the market is divided for the products that you are providing. The following parameters help identify different customer groups, either consumer or commercial:

- Geography : region, population
- Demographics : industry, seasonality, age, gender, income, family size, family lifecycle,
- Psychographics : values , lifestyle, personality, interests, habits,
- Behavior: usage, loyalty, readiness to purchase, attitude towards product, buying cycle
- Benefits : social status, health, emotions

Are your potential target segments attractive based on market size, growth potential, profitability, and risks?

Determine who are the influencers and decision makers (e.g., engineers, purchasing managers, CFO's, CEOs) for your Products with Prospects in your organization segments. Then identify those specific individuals and their contact information for your target Prospects. Maintain that information in your marketing database.

Determine the mix of smaller and larger prospects that you want to target. Smaller prospects often have shorter sales cycles and the influencers and decisions makers are easier to identify than with larger prospects. Larger prospects, however, can mean larger sales opportunities.

Channel partners can be valuable for marketing, distributing and supporting your products. Large channel partners (sometimes called master agents) serve smaller distributors. Working with master agents can give you access to a large number of distributors without having to deal individually with each of the small distributors.

Channel partners must be marketed to and supported similar to end user prospects but in a somewhat different manner. Working with channel partners should not be an afterthought but a well-planned and supported effort.

To learn more about their characteristics, survey current and potential customers. Twenty or so live phone interviews with influencers and decision makers will provide you a wealth of knowledge.

A person who is knowledgeable about and experienced with your organization should conduct the survey calls. You can say that you are doing a survey for a company to help improve their product (all true) and would appreciate the thoughts and ideas of the interviewee.

Schedule the calls at the interviewee's convenience and limit the calls to 10 minutes (although often the person will talk well beyond the 10-minute limit). Most people like to talk about their needs and how better those needs could be met.

Be relaxed, friendly, make the call about what the person would like to see in a product such as yours to make it more valuable to them (features, support, pricing, terms, etc.). Ask them what they like about the product and what they would like to see improved. Then listen; prompt them with brief open-ended questions if needed to keep the conversation going. Have a few questions ready before you place the call.

Record the conversation and/or take detailed notes. After the calls, review all the comments and document the key findings with proposed actions based on the findings.

Look for and follow organization prospects on social media. But do not try to sell to them on their social media links. Instead, try to develop relationships with potential customers. Retweet or comment on their posts or mention them in your own social media posts.

Research successful competitor brands. The simplest way to identify your prospective customers is to do research on your successful competitor brands. Look for niche opportunities that your competitors are not serving.

Research industry blogs and forums. Potential customers sometimes comment on blog posts and forums and provide insights into their needs.

Other sources of prospects include published lists that are either free or can be purchased such as chamber of commerce members, industry organization members, regional organization publications, and commercial lead list providers (Radius, InfoUSA, Salesgenie, DNB, Experian, etc.). The information from some commercial lead list providers are quite inaccurate, so factor that into your planning for purchased lists.

Depending on your situation, maintain a list of your prospects in a spreadsheet, in a CRM system or in large integrated database fed by multiple sources of internal and external information and analyzed by algorithms including deep learning based. Ensure that your database is updated and used and that the individual is clear who has overall responsibility for maintaining the data.

Information is provided in the Promotion section (section 8) about how to identify and market to your target Prospects.

4. Places

Based on the requirements to market, deliver and support your products, determine the locations where you want to offer your products. You may find it best to phase in additional locations over time as you expand your presence.

Considerations that may affect your geographical focus include:

- Concentration of Prospects
- Presence of other Providers (i.e., potential competition)
- Practical locations for your organization
- Locations of key channel partners
- Locations of suppliers
- Transportation
- Media
- Taxation
- Regulatory requirements
- Personal preferences

Understand the value you can obtain by selecting lesser known regions that have vitality and resources you need, and additional operational benefits that are not apparent. Consider locations where there is less competition for everything from office and other space to professional resources to cost of living and operations.

Within those regions select the types of retail and wholesale distribution affiliates you will use in addition to your internal distribution capabilities.

Media markets are regions where the population receives similar television, radio station programming and targeted web advertising. They include other types of media as well such as newspapers and geographically targeted Internet content.

The media markets can encompass one or more metropolitan areas, as well as rural regions with few significant population concentrations. Very large metropolitan areas often are subdivided into multiple segments. Markets may overlap so that people near the boundary of one media market may be able to receive content from other nearby markets.

Radio markets typically are somewhat smaller than television markets due primarily to technical characteristics and regulations. These markets are used in audience measurements, which are compiled by, for example, Nielsen Media Research in the U.S..

5. Providers

Providers include your competitors. Maintain your competitive information in a single repository.

Determine your unique advantages compared to other Providers and exploit those advantages to create a dominant position in a market niche. A niche is defined by a unique combination of Prospects, Places, Products, Pricing, Promotion and Processes.

The Provider with the dominant position has proportionately more success than those with non-dominant positions.

Identify the strengths and weaknesses of your key competitors. Describe the capabilities of their products, support and other relevant aspects of their business.

Primary competitors are your direct competitors, which means they are targeting the same audience or have a similar product or both

Secondary competitors offer a premium or discount version of your product, or sell something similar but to a completely different set of Prospects.

Tertiary competitors include organizations that are indirectly related to yours. These could be related products and may be beneficial to partner with.

Your prospects and customers can help you discover competitors and learn about their plans. Ask them periodically to stay current.

The description of each key competitor's capabilities should include:

- Organization strategy
- Marketing message
- Product features and customer benefits
- Pricing structure and levels
- Customer support
- Customer experience (end to end)
- Other processes
- Locations
- Organization and staffing
- Financial position
- Product costs and margins

Then compare each key competitor to your strengths and weaknesses. Describe how your strengths can be of more relative value for a customer. These advantages will be part of the basis for your marketing.

For research, consider:

- Web search
- Amazon
- LinkedIn
- Facebook

- Review sites
- Professional organizations
- Hoovers
- CrunchBase
- Glassdoor

Periodically review and update your competitive analysis and your resulting actions.

6. Products

Describe your Products in terms of the customer problems that they solve and other benefits the products offer. Identify how the Product features and other capabilities directly contribute to those solutions and benefits.

Include a description of how your products are used by an end user. Indicate why your products are easy to use and how their ease of use is superior to the use of other Providers' Products.

Products are defined by their features, user controls, user training, user documentation, support and pricing.

Outline plans for managing each product throughout its life, including product extensions or improvements. The product life cycle includes the introduction, growth, maturity and decline stages Have an exit strategy for its product in case the product performance does not meet expectations.

Establish plans and processes to make rapid product improvements as feedback is received after product is introduced.

Conduct both qualitative and quantitative marketing research for new products. Focus groups are an example of qualitative information. Focus groups provide for companies to ask their consumers about their likes and dislike of a product in small groups. A focus group allows the company to tweak the product concept before testing it through broader surveys (e.g., by phone) ... more quantitative research the results of which are more predictable across the general population.

7. Pricing

Establish your Pricing strategy. Are you priced versus your competitors at a premium, the same or as a discount to the typical industry price level?

Determine your pricing structure and levels including any discounts. Include non-recurring and recurring charges. Does your pricing strategy and include aspects such as "anchor" pricing (seed desired price with a larger number), "charm" pricing (ending in "9"), "Freemiums" (free alternatives or free trials), straightforward simple Pricing (may match a message to customers of your offerings being simple)?

Describe how your pricing structure and levels compare to those of other Providers with which you compete. Indicate the advantages of your pricing structure.

Will you provide financing for customers?

Define any Pricing experimentation you plan to conduct. Following is one example of a Pricing experiment:

- 3 different plans/packages; intention is to sell the middle one.
- The first plan is a decoy. It's similar to the middle plan, but offers less value while costing almost as much.
- Second plan, the one you want to sell, offers good value for money. The price ends with 9. Shows it has been reduced from a previously higher price .
- Third plan is to serve as a contrast to the middle one, it is a high figure as an anchor. It is much more expensive than the middle plan. You don't actually intend to sell it, but make sure you can actually deliver on it if someone purchases it.

8. Promotion

Effectively marketing your organization likely is your biggest challenge.

The average person in the U.S. is bombarded with more than 5000 marketing messages per day. For your organization message to break through that clutter, you must consistently apply principles of effective marketing and sales to the following:

- a) Marketing Message
- b) Collateral
- c) Web & Social Media Marketing
- d) Advertising
- e) Direct Sales
- f) Channel Partners
- g) Events
- h) Affinity
- i) Referral

A. Marketing Message

Purpose

- Master Message documentation (with variations for targeted segments/channels)
- Using document content, source the messaging content for customer touch points (sales scripts, product sheets, web site, blogs, etc.)
- Document is not unchanging; it incorporates feedback from market/customers and evolves

Your message is essential

- It defines the organization inside and outside and describes your purpose
- It takes effort, feedback and time to create it well using key principles

The goal of your message is to help you:

Separate yourself from your competition ... and then eliminate them as a choice in your prospective customers' minds

Example – Internet Search Engines

	Market Share	
	<u>1998</u>	<u>2013</u>
Alta Vista	#1	Defunct
Google	Unborn	#1

Google now has a dominant 85% market share

Effective marketing is based on proven principles that have been developed over time.

Following these principles and methods does not guarantee success but significantly increases the probability of success ... and provides a framework to adjust, going forward, the message to your specific target audience in a controlled manner.

Most marketing is based on puffery, platitudes and price cutting and leaves the prospects frustrated and unable to make an informed purchase decision. They instead decide solely based on price or recommendations from others.

Good marketing educates the prospects and leads them to an informed decision.

The marketer that helps inform the customer typically is viewed by the prospect as more valuable than other providers. Other providers could inform, but don't.

The prospect is led to the conclusion that he/she should acquire products or services from you.

Develop the message until you and your team would rate it at least an 8 out of 10 in effectiveness.

Remember that for any claim, the prospect probably is thinking: "prove it".

These principles help you break through the marketing message clutter and have your message heard. At the top level, the principles are: **1. Have Something Good to Say, 2. Say it Well, 3. Say It Often**

1) Have something good to say

Your Products, Processes and Platforms have the functionality and capacity to separate your organization from your competition and eliminate them as a choice in the minds of your prospects. Don't waste your resources on marketing until these things are in place.

2) Say it well

Using the following framework

- e) Interrupt (with something familiar and/or problematic. Clever if possible, but clever is not easy to do well and is not essential)
- f) Engage (with the promise of info to follow that is valuable to the prospect)

- g) Educate (deliver the information that truly is valuable to the prospect ... including real evidence to support your claims)
- h) Offer (low risk next step in the buying process ... example: free publication in exchange for prospects contact information for opt-in follow-up marketing from you.)

Ensure the message responds to the key interest (aka “hot buttons”) of the buying decision makers.

You have about one second to Interrupt and then another second to Engage a prospect. If you deliver in a useful way valuable information promised in the Engage claim, a real prospect likely will spend as much time as needed to absorb the Educate and Offer elements of your message.

Stating your message as a single sentence can help identify the “interrupt” , make your writing flow better, and make your “engage” and “education” key points easier to arrange.

The human brain craves meaning before details. Paint the big picture that is clear, concise, and engaging. The “main thing” should cater to the needs of your audience.

Keep it short. Make it easy to say and easy to remember.

A couple of examples are:

- The original Apple iPod “1,000 songs in your pocket.”
- “Google organizes the world’s information and makes it universally accessible”

3) Say it often

The average prospects must see a message 8 to 15 times before they become fully aware of it.

Only 1% to 2% are ready to buy when they do become aware ... so, continue communicating your message and valuable information until they are ready to buy and then at that time think of you as their best choice.

Frequently communicate valuable information to each prospect until they are ready to buy. Then they will remember you and consider you as their best choice.

Use message plus comprehensive disciplined marketing and sales tactics to separate from competitors

An important phenomenon to consider is the “dilution effect”. For humans, receiving too much information interferes with their ability to process it. Stick to the strongest points of a message; delivery of the message is as important as its content.

9. Processes, Platforms & Partners

Outline your plans for the following Processes and the Platforms you use and Partners you work with to help operate your Processes.

Enterprise Management

- Strategic and Operational Planning
- Organization, Human Resources, Compensation, Incentives
- Accounting, Financial, Insurance, Tax, Banking
- Legal, Regulatory, Intellectual Property
- Reporting: Operational, Financial, Management Dashboard
- Portfolio, Programs and Projects Management
 - Consolidated list (Portfolio) of Programs and Projects tracked against development stages
 - Clear leads, team members and responsibilities for each Program and Project

Marketing & Product Management

- Maintain a prospect and customer database
- Evaluate results of customer and prospect surveys to identify opportunities for improvement of customer experience.
- Maintain marketing and sales tools as needed:
 - Marketing message at 3 levels of detail ... including hard “evidence” to support claims
 - 10 to 30 second verbal message
 - Curated valuable information
 - Case studies
 - Product information sheets
 - Web site/SEO/SEM
 - Social media: LinkedIn; Facebook; YouTube; Instagram; etc.
 - Email marketing (with information valuable to prospects)
 - Maintain personal contact with key prospects (offer new valuable information)
 - Industry events
 - Partners
- Maintain information on competitive pricing
- Prospect data
- Leads to sales
- Direct Mail
- Email marketing
- Digital marketing: Web. SEO. SEM.
- Online orders
- Direct Sales
- Inside sales (inbound; outbound)
- Channel Partners
- Customer Relationship Management (CRM)

Design & Development

- For specific product design and development
- Any specific standards and other requirements that should be observed.
For example, The American National Standards Institute (ANSI) is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so that American products can be used worldwide.

Procurement & Production

- Importing logistics
- Owned or contracted production
- Sources of materials and parts
- Regulatory considerations (e.g., Importing; U.S. Occupational Safety and Health Administration)

Ordering & Fulfillment

- Order processing
- Shipment
- Installation
- Testing
- On-site user training
- User acceptance
- Channel: retailers, wholesalers, distributors, brokers
- Financing logistics: internal, letters of credit, factoring, consignment, open accounts, etc.

Assurance

- Proactive monitoring and repair
- Customer support

Billing & Collection

- Consistent with pricing and other terms and conditions
- In-house or 3rd party provided

Product Utilization

- User documentation
- Continuous improvement

Infrastructure Management

- Systems
- Facilities
- Vehicles

IT platforms can have significant impact on customer and employee experience and performance which translates into organization growth. The optimum balance of manual, mechanized (Platform) and outsourced (Partners) Processes is one key to a successful enterprise.

Mid-market companies tend to be IT resource limited compared to large organizations and so have different IT-related requirements to consider (e.g., mids cannot afford custom coding for unique applications). Unfortunately, even the best existing commercial off the shelf options for mid-market IT platforms have deficiencies.

Allocate sufficient time and resources to optimizing your plans for and selection of IT platforms.

Many Providers in the U.S. utilize Agile and Lean methods in their organizations to improve their performance and competitiveness. In general, your Processes are more effective when they are both Agile and Lean.

Agile

Agile management is an approach under which requirements and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customer(s)/end users(s). It includes adaptive planning, evolutionary development, early delivery, and continual improvement, and it encourages rapid and flexible response to change.

Emphasize the following:

- Individuals and interactions over processes and tools
- Working products over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

Tools and processes are important, but it is more important to have competent people working together effectively.

Good documentation is useful in helping people to understand how the product is built and how to use it, but the main point of development is to create the product, not documentation.

A contract is important but is no substitute for working closely with customers to discover what they need.

A project plan is important, but it must not be too rigid to accommodate changes in technology or the environment, stakeholders' priorities, and people's understanding of the problem and its solution.

Agile methods focus on:

- Customer Satisfaction by early and continuous demonstration of progress
- Welcome changing requirements, even in late development
- Close, daily cooperation between organization people and developers
- Projects are built around motivated individuals, who are trusted
- Face-to-face conversation is the best form of communication
- Working product is the primary measure of progress
- Sustainable development, able to maintain a constant pace
- Continuous attention to technical excellence and good design
- Simplicity—the art of maximizing the amount of work not done—is essential
- Best requirements and designs emerge from self-organizing teams
- Regularly, the team reflects on how to become more effective, and adjusts accordingly

Break product development work into small increments that minimize the amount of up-front planning and design. Iterations, or sprints, are short time frames that typically last from one to four weeks. Each iteration involves a cross-functional team working in all functions: planning, analysis, design, production, unit testing, and acceptance testing. At the end of the iteration a working product is demonstrated to stakeholders. This minimizes overall risk and allows the product to adapt to changes quickly.

Project information is readily available to the development team. In a brief session, team members report to each other what they did the previous day toward their team's iteration goal, what they intend to do today toward the goal, and any roadblocks or impediments they can see.

Lean

Lean operation is a systematic method for material, time and financial waste minimization within a Process without sacrificing productivity. Lean also considers waste created through overburden and waste created through unevenness in workloads. Working from the perspective of the client who consumes a product or service, "value" is any action or process that a customer would be willing to pay for.

Lean implementation emphasizes the importance of optimizing work flow through strategic operational procedures while minimizing waste and being adaptable. Lean aims to enhance productivity by simplifying the operational structure enough to understand, perform and manage the work environment.

Lean operation makes obvious what adds value, by reducing everything else (which is not adding value). Its focus is on reduction of waste to improve overall customer value.

Improving the "flow" or smoothness of work is key, thereby steadily eliminating unevenness through the system and not upon 'waste reduction' per se. Two pillar concepts: are Just-in-time (JIT) or "flow", and "autonomation" (smart automation).

All work is highly specified as to content, sequence, timing, and outcome.

The pathway for every product and service is simple and direct. Every customer-supplier connection is direct, and there is an unambiguous yes or no way to send requests and receive responses.

While you often hear about “digital transformation”, the real issue is **experience transformation**. As we move toward more deep learning and AI systems which are key to experience-enhancing platforms and the processes they support, the existing digital computing architectures cannot keep up (too slow, large, power hungry, etc.). Future architectures will be hybrid analog and digital with neural network and neuromorphic chip designs utilizing analog electronic components for optimizing performance.

Technology platforms are just tools that are part of the overall experience transformation for your customers, employees, partners, and suppliers.

Your competitors already are transforming.

Focus on customer, employee and partner experience transformation.

Process transformation is the act of radically changing the series of actions in an organization process consistent with the strategic objectives and tactical demands of the business, delivering a significant, measured increase in customer value. It examines the steps in an effort to remove duplicate or unnecessary steps and automate some actions.

No idea is off the table except by company policy, law or financial reality. This transformation is invasive and disruptive.

Defining metrics that can effectively measure performance before, during, and after the process transformation is important. An experienced process consultant can help you successfully manage these challenges and accelerate the benefits of the enhanced processes.

Organization process transformation steps include:

- Determine the goals of the transformation
- Establish baseline metrics
- Obtain input from all stakeholders
- Diagram the ideal workflow including human and system activities
- Test the new process
- Go live and monitor ... phase in slowly if needed

Issues with organization process transformation include:

- Incremental ideas overcome the disruptive ideas
- Lack of strong sponsorship throughout the entire lifecycle
- Ineffective change management practices
- Integration of processes and of platforms
- Failing to achieve key goals of the transformation

Automating work processes can help increase revenue and lower costs.

About 60 percent of customers open welcome emails versus 15 percent that receive offers for promotions (when they're not shopping). After a sale, use automation software to send a welcome email to new customers. This is done using triggers and rules and you can even personalize these emails based on customer information.

For example, you can have unique welcome emails for each landing page. These auto emails let customers know they are valued. Word the text to include a thank you, introduction to your organization and suggestions about products and services.

If customers or clients make a second purchase, use automation software to send a thank you gift. It can include a discount off their next purchase. This improves brand equity and decreases churning or negative sentiment. For birthdays, send an automated email wish which can make customers feel valued. Your automation software can automatically add customer names and you can include a discount or special promo code.

Having loyal and happy customers is important to organization growth. 90 percent of customers will leave if they are unhappy. Organizations should enable interactions across multiple channels (voice, email, text). CRM software integrates with artificial intelligence (AI). It can help you to improve customer interactions. Customers can ask basic questions and AI can offer suggestions or refer customers to videos and FAQ pages. Customers can always select a live help feature to reach human agents.

A good way to effectively reach out to customers is with support that is responsive. Customers do not like when agents do not know who they are and cannot readily help them. And, increasing customer engagement is important when nurturing leads. Use your CRM to instantly retrieve customer data. With pop-ups, agents can view customer details without having to put customers on hold and find their files.

Another innovative technology is advanced call routing. Use this feature if your organization has voice over internet provider (VoIP) phones. Ask your phone provider about advanced calling features. These can include voice-to-email and designated call forwarding. Simplify how agents receive calls and increase productivity. Take calls on the go or set up free video conferences for remote workers. With VoIP, most calls are low cost and the service works with CRM and other software integrations.

More organizations are using machine learning to help with advanced fraud detection. The software scans millions of financial transactions to find common patterns that can reduce fraud.

There are various types of software which alert you to suspicious transactions. And, it makes recommendations for steps to take to avoid illegal transactions. It can streamline how you handle customer resolutions to get money to customers faster and avoid fraud.

Various types of AI features help with organization intelligence and customer interactions. Customer intelligence looks at Big Data or all the information that comes in based on your customers. It can look at sales, social media interactions and all customer correspondence.

Smart response technology in chatbots helps with making recommendations for future interactions. You can also use the predictions and recommendations to upsell products and services. Benchmark customer data to see how other organizations are performing to help you with your own. As you improve customer Satisfaction scores, this helps improve your brand.

Robotic process automation (RPA) software is a way to help you improve the products and services you offer customers. You install it on your computer and the RPA completes repeatable tasks. It can transfer files from one software to the next or automatically print attachments in emails. You can also use it to make suggestions to customers in the knowledge base or self-serve area of your site.

Automating routine features and incorporating AI are a few ways to use emerging technologies in your processes. With machine learning, you can better interpret customer data for effective decision making. Call

routing features save you time and reduce communication costs. Use these innovations to help your organization grow and scale.

Continuous improvement of processes ensures they always perform in the most effective way possible. Improvement methods analyze processes to eliminate bottlenecks, delays, and waste.

10. Public Policy

Legal matters should have the advice and counsel of a lawyer.

To have an organization in the U.S., you register in one or more of the 50 states. Your state of registration should consider registration requirements, established commercial law, taxation, physical locations of your business, and personal preferences.

If you have intellectual property, it should be protected.

You will need to understand (with qualified assistance) and comply with laws and regulations (such as in the U.S. for example the Uniform Commercial Code – UCC; Contracts for the International Sale of Goods - CISG; antitrust; property) administered by agencies including:

- Federal Trade Commission (FTC)
- Food and Drug Administration (FDA)
- Customs and Border Patrol (CBP)

Consider each of the following that apply as you plan for doing business:.

- Entity Selection, Formation and Operation
- Taxation
- Regulation of Foreign Companies
- Sales Representatives and Agents
- Labor & Employment Law
- Immigration Law
- Contracts
- Organization Acquisitions
- Joint Ventures
- Customs, Duty and Tariffs
- Protection of Intellectual Property
- Antitrust
- Owning and Leasing Facilities
- Parties to the Convention on Contracts
- International Sale of Goods
- Advertising Laws and Regulation

11. People

Decide if you want to initiate operations with permanent employees, contractors, representatives, consultants, professional services firms, etc. Understand your legal obligations for each type of team member.

Determine your compensation plan including any incentives (commissions, bonuses, equity, stock options, etc.). Engage recruiters and/or on-line employment resources as early as possible to begin assembling a group of good candidates for your team.

Workers typically are responsible and hard-working; in return, they want to feel they are a full member of your team. Outline your actions to keep them informed and recognize them for their contributions to your enterprise.

Leaders should be good coaches and teachers. Be part of their team members' support systems to help them improve their life experiences, rather than just their employee experiences. Understand the context of each team member.

Wise leaders know that, sometimes, the best management is little or no management at all.

Understand that there are times to give orders, dominate the conversation and express strong opinions. And there are times to be less assertive, ask what others think, listen and watch in silence, and get out of the way.

Tommy Lasorda, the successful Los Angeles Dodgers manager, captured this delicate balance well when he said, "I believe that managing is like holding a dove in your hand. If you hold it too tightly, you kill it. But if you hold it too loosely, you lose it."

When bosses get this balance wrong, team performance and creativity suffer, and employee effort and commitment wanes. Get it right, and everybody wins.

Research shows that being ignored by one's boss is more alienating than being treated poorly. The impact of absentee leadership on job satisfaction outlasts the impact of both constructive and overtly destructive forms of leadership.

Constructive leadership immediately improves job satisfaction, but the effects dwindle quickly. Destructive leadership immediately degrades job satisfaction, but the effects dissipate after about six months.

In contrast, the impact of absentee leadership takes longer to appear, but it degrades subordinates' job satisfaction for at least two years. It also is related to a number of other negative outcomes for employees, like role ambiguity, health complaints, and increased bullying from team members. Absentee leadership creates employee stress, which can lead to poor employee health outcomes and talent drain, which then impact an organization's bottom line.

When interviewing candidates for work opportunities, structured interviews offer the best method of selection. Structured interviewing asks every candidate the same questions, and scores them the same way. That approach provides variability in the questions and control for answers that predict success.

Structured interview questions fall into two broad categories: behavioral and situational.

Behavioral questions ask the candidate to "tell about a time when" a certain event occurred, or a certain task or project was required, or a problem or opportunity surfaced and they had to design an approach. These questions work because a candidate's past experience in approaching similar problems is predictive of their ability to succeed in a similar role.

Situational questions are more hypothetical: "Imagine that the following event occurred. How would you handle it?" The candidate's answer will give a glimpse into their ability to think quickly and react appropriately, as well as an indication of their approach to problem-solving.

Create a list of five behavioral questions and five situational questions. Have a list each specific open job.

Research indicates that no more than four interviews are enough to make a successful hiring decision with more than an 80% confidence, with a diminishing return on interviewer feedback thereafter.

An effective sales team is vital for success.

Following are general criteria for hiring and nurturing your high-performance sales team.

- Hire slow, fire fast: Most sales candidates look like aces on their resumes; after all, selling is what they do. Look for people who are experienced but coachable, listen well, work hard, can demonstrate their selling ability, have a track record you can verify, and have some product knowledge.

People buy from people they like and trust (trust in the broadest sense). Would you buy something from your candidate?

Most important: do what is necessary (e.g., references, copies of signed contracts) for you to absolutely confirm that the candidate can and has closed sales.

Not all sales hires work out. If you know, you know ... do it now. It won't get better. And it helps the morale of other team members.

- Provide tools to succeed: CRM, lead lists, administrative support (so they can sell, not do paperwork), continuous training, a very few crystal clear KPIs with daily, weekly and monthly reporting that the entire team sees.
- Compensate effectively 4-month sales ramp up, a base salary with commission, incentives and bonuses to give the top "20%" the motivation to sell even more.
- Over communicate: fix issues fast, create urgency and competition. Sales people are your front-line radar ... talk with them early and often.

Research demonstrates that people with a high degree of narcissism get promoted faster in many organizations. Dangers exist with narcissistic leaders.

They tend to instill an individualistic culture throughout the organization, which reduces collaboration and integrity. They often make rash and risky decisions that can weaken a company's long-term resilience, and they are more likely to engage in managerial fraud.

Reasons exist for why narcissists might get ahead more quickly than their colleagues. Without the humility that would prevent others self-promoting, narcissists may be especially good at self-promotion and ensuring that their contributions are recognized – even if not deserved. Because of their inflated view of themselves, narcissists may also present more ambitious plans for the future, which could impress bosses until they eventually reach the top jobs.

A narcissist's constant vying for attention, however, could alienate the people around them. Narcissists' rapid promotion could mean they lack the necessary experience to carry out their responsibilities.

One research project found that someone with a high degree of narcissism was around 29% faster in their career progression to the position of CEO, compared to the average candidate of similar qualifications. This was the true for family and non-family businesses.

The effects of narcissism on someone's career trajectory may depend on someone's gender. Thanks to implicit or explicit sexism, recruiters may generally be more forgiving of ambition in men than in women. The small number of female CEOs in one research sample, however, meant that they were unable to come to any firm conclusions.

Practical steps that an organization could take to minimize narcissists' impact on the workplace include the following actions.

Smarter recruitment – to identify someone with problematic tendencies. A diverse hiring panel and to note how the candidate responds to people of different status within the organization. Narcissists are good at 'managing up', but tend to treat people they perceive as lower status differently.

Organizations can curb narcissists' tendencies by overtly rewarding ethical behavior, creating a system that will naturally appeal to narcissists' sense of competition. If the system rewards prosocial behavior and does not tolerate antisocial behavior, such as bullying or malicious gossip, then narcissists will use the strategies they see to be effective to climb the ladder.

A co-worker can use their understanding of narcissists' personalities to limit their effects on the co-worker's career. Narcissists tend to respond badly to direct challenges to their authority, for instance. So if one needs to question their actions or to suggest a new strategy, try to frame it in a way that might appeal to their ego.

Co-workers also can try to make sure that their own talents are clearly visible to other members of management – otherwise, there is the risk that narcissists simply will piggyback off others' achievements to further their own career.

Employee development is essential for the success of an organization. Gallup research found that 52% of exiting employees stressed that their organization could have done something to prevent them from leaving their job.

The research discovered needs leaders can meet to improve employee engagement, including:

- Prioritizing employee development
- Facilitating a sense of purpose
- Caring about employees
- Considering employee opinions
- Focusing on employee strengths

A leader can ask questions to improve engagement.

1. How would you like to grow within this organization?

Career development is the most critical of the elements. “What role would love to do (whether it exists or not), and what can I do as your manager to encourage your development in this company?”

2. Do you feel a sense of purpose in your job?

What’s purposeful to employees about their job and connects with their own values.

3. What do you need from me to do your best work?

The most effective leaders respect and care about their employees by knowing them as individuals, acknowledging their achievements, having performance conversations and reviews. Build a work environment where employees feel safe experimenting with new ideas, sharing information, exploring development opportunities, and supporting each other.

Ask, “What is your biggest frustration, and what action can I take to help you deal with it? What have you been trying to tell me that I’ve not been hearing? How would you like to be recognized?”

4. What are we currently not doing as a company that you feel we should do?

Let workers know that their opinions count by promoting open dialogue and providing honest feedback on employees’ opinions and suggestions, supporting good ideas and addressing unfeasible ones.

5. Do you have the opportunity to do what you do best every day?

To determine whether your employees are focusing on their strengths, ask, “What is the best part of your job? Which of your talents are you not using in your current role? What part of your job would you eliminate if you could?”

Get New Employees Up to Speed Fast

This information has are proven to be effective if you lead organizations. And if you are a new employee, use these actions to the extent possible, even if your employer is not explicitly providing them.

Five simple onboarding tips:

1. Match the new hire with a peer buddy
2. Help the new hire build a social network
3. Schedule a monthly check-in for the new hire's first six months
4. Encourage open dialogue
5. Meet your new hires on their first day

A new employee as an investment. Spend time ensuring that investment starts generating a return as quickly as possible.

Explaining the roles and responsibilities of the job is important, but what matters more is explaining why the job matters.

Here are 4 steps to accomplish that:

1. Describe how the employee's job creates value.

No matter what business you're in, one or two things truly drive results. Quality. Or service. Or being the low-cost provider. Or creating a genuine sense of community. Plenty of other aspects are important, but for every business, one or two are absolutely make-or-break.

Then connect that to the employee. Explain how they will create value. Explain how their job helps your business create a measurable competitive advantage. Draw a clear connection between the employee's efforts and your company's main purpose.

2. Identify the employee's internal and external customers.

Understanding the needs of every constituent helps define not just the job, but also the way it should be done -- and, again, why it matters.

Explain how the employee will create value for the business while serving all of their internal and external customers. Achieving that balance often is tricky; help them figure it out.

This will help the employee begin to build a social network.

3. Set short-term goals, and set the stage for feedback.

The employee can start building a sense of momentum. They early on can tangibly see how their job creates value, and how their job affects external and internal customers.

Start giving constructive feedback right away -- early feedback is vital.

4. Explain why you hired them.

Take the time to tell new employees why they were hired. Not just to fill a role but because of what they can do: the specific skills, experience, attitude, and work ethic that person brings to your team. Describe how excited you are to see what a difference their skills and attributes will make. Research shows early praise can make a significant difference in an employee's long-term success.

With these actions, the dots are explicitly connected between the individual, his or her job, and how that job creates value ... and between internal and external customers.

https://www.inc.com/jeff-haden/google-spent-years-researching-best-way-to-get-new-employees-up-to-speed-faster-secret-a-simple-15-minute-conversation.html?utm_source=pocket-newtab-en-us

Six Types of Attitudes Toward Work

Research indicates that people can be described by whether they see work as a job versus as a career and see work as calling that is central to their identity. Understanding employees perspectives can help in providing them the work environment that benefits them and the enterprise.

A recent report from Bain identifies six archetypes that help better understand how individuals find a sense of purpose at work. Most individuals likely are a mix of these types, but with the traits of one type most dominant. Understanding these can help in placing the right people for the right roles and then help in retaining them. A mixture of types may help make improve the performance of many teams.

1. Operators

Operators find meaning and self-worth primarily outside of their jobs. When it comes down to it, they see work as a means to an end. They are not particularly motivated by status or autonomy, and generally do not seek to stand out in their workplace.

They tend to prefer stability and predictability. Thus, they have less interest in investing to change their future compared with other archetypes. At the same time, operators are one of the more team-minded archetypes, and often see many of their colleagues as friends.

Strengths: team players. Weaknesses: not proactive, easily disengaged.

2. Givers

Givers find meaning in work that directly improves the lives of others. They are the archetype least motivated by money. They often gravitate toward caring professions such as medicine or teaching, but can also thrive in other lines of work where they can directly interact with and help others.

Their empathetic nature typically translates into a strong team spirit and deep personal relationships at work. At the same time, their more cautious nature means they tend to be forward planners, who are relatively hesitant to jump on new opportunities as they arise.

Strengths: selfless, help build trust within an organization. Weaknesses: sometimes impractical or naive.

3. Artisans

Artisans seek out work that fascinates or inspires them. They are motivated by the pursuit of mastery.

They enjoy being valued for their expertise, although they are less concerned with status in the broader sense. Artisans typically desire a high degree of autonomy to practice their craft and place the least importance on camaraderie of all the archetypes. While many find a higher purpose in work, this is more about passion than altruism.

Strengths: well positioned to solve the most complex challenges. Weaknesses: can be aloof and lose sight of bigger objectives.

4. Explorers

A free-spirited type, Explorers value freedom and experiences. They tend to live in the present and seek out careers that provide a high degree of variety and excitement.

Explorers place a higher-than-average importance on autonomy. They are also more willing than others to trade security for flexibility. They typically do not rely on their job for a sense of identity, often exploring multiple occupations during their lifetime. Explorers tend to adopt a pragmatic approach to professional development, obtaining only the level of expertise needed.

Strengths: will enthusiastically throw themselves at whatever task is required of them. Weaknesses: can be directionless or lack conviction.

5. Strivers

Strivers have a strong desire to make something of themselves. They are motivated by professional success, and value status and compensation. They are forward planners who can be relatively risk averse, as they opt for well-trodden paths to success.

Strivers are willing to tolerate less variety so long as it is in service of their longer-term goals. They tend to define success in relative terms, and thus can be more competitive and transactional in their relationships than most other archetypes.

Strengths: disciplined and transparent. Weaknesses: their competitiveness can degrade trust and camaraderie within teams.

6. Pioneers

This entrepreneurial type is more likely to be founding companies than plugging away in the trenches. Pioneers are on a mission to change the world. They form strong views on the way things should be and seek out the control necessary to achieve that vision. They are the most risk-tolerant and future-oriented of all the archetypes.

Pioneers identify profoundly with their work. Their vision matters more than anything, and they are willing to make great personal sacrifices accordingly. Their work relationships tend to be more transactional in nature. Their vision is often at least partly altruistic, but it is distinctly their own.

Strengths: infectious energy that can bring about lasting change. Weaknesses: can be uncompromising and imperious.

https://www.inc.com/jessica-stillman/hiring-employee-archetypes-bain-report.html?utm_source=pocket-newtab

Engaged Team Members

Engaged employees don't say "they." Engaged employees say "we."

When employees say "they," when referring to their own organization, this is an indication that they do not see themselves as valued members of the organization's team.

Employee engagement is "an emotional state where employees feel passionate, energetic, and committed to their work.

"They" employees put in just enough effort to get by. "We" employees go the extra mile to ensure that their companies' various initiatives are resounding successes. "They" employees complain about the problems in the workplace. "We" employees come up with solutions to those problems, helping their organization to be more profitable. "They" employees give mediocre service that leaves customers unimpressed. "We" employees give remarkable service that converts casual consumers into raving fans of the brand.

An engagement problem could also be directly costing you financially. Some research indicates that, compared to their engaged peers, disengaged employees exhibit 37% higher absenteeism, are 18% less productive, and are 15% less profitable. When translated into dollars, the cost of having a disengaged employee on your payroll can be up to 34% of that employee's annual salary.

If the disengagement problem is localized to one individual, this may be a sign that the individual is not a good fit for your organization (or vice versa). But, if there is a company-wide engagement problem, chances are that your organization needs an employee engagement effort.

Perks alone cannot drive employee engagement. Three things motivate employees are autonomy, mastery, and purpose.

Autonomy refers to employees' desire to direct, or have a say, in their professional lives. Mastery refers to the desire to get continually better at something that matters, while Purpose refers to the desire to do something larger than themselves.

For quantifiable data on the level of engagement in an organization, conduct an employee engagement or eNPS (employee Net Promotor Score) survey - or both. A qualified research team can be hired for these surveys, or a template provided by companies like Typeform, SurveyMonkey, or Qualtrics - some of which are free - can be used.

https://www.fastcompany.com/91165648/employee-engagement-team-building?utm_source=pocket-newtab-en-us

4-day workweek

A recent study suggests the four-day workweek model benefits businesses and employees alike. The participating organizations agreed to complete 100% of the usual workload in 80% of the time worked, shortening the workweek to 32 hours -- with no reduction of pay.

More efficiency, happier employees and lower turnover rates are among the positive results. One year after 61 companies opted to participate in a four-day week pilot study, 89% of the companies continued to keep the structure in place.

51% of the companies have decided to implement the four-day work week permanently and 89% have decided to continue the structure through the year. 100% reported that the four-day week had a "positive" or "very positive" impact on their organization.

82% of surveyed companies reported positive impacts on staff well-being. 50% saw positive effects on reducing staff turnover and 32% said the policy had noticeably improved their recruitment.

The benefits of the four-day workweek were felt both in and out of the office. "Improvements in physical and mental health, work-life balance and general life satisfaction, as well as reductions in burnout have all been maintained.

A recent poll found that 58% of the public expects the four-day workweek to be the standard way of working by 2030.

The four-day workweek has become a key demand in some trade union negotiations in countries such as the United States, Germany and Italy. Spain, Iceland and South Africa are among the nations that have implemented a trial of the four-day workweek for select companies and workers.

Belgium imposed a law that requires employers to offer full-time workers the right to request a four-day workweek. Lawmakers in Massachusetts introduced a bill that would provide employers with a tax credit if they shift at least 15 workers to four days a week without cutting their pay.

The four-day workweek has faced difficulty spreading from white-collar professions to low-wage ones.

Source: ABC News

12. Performance

Plan and establish reporting of performance for your operations including:

- Financial
- Marketing and Sales effectiveness
- Operations metrics (supply, production, fulfillment, support, quality)
- Customer, employee, supplier, partner Satisfaction (e.g. Net Promoter Scores)

Decide if you will use accrual accounting or cash accounting and establish records consistent with that.

- Income Statement
- Balance Sheet
- Cash Flow Statement

Accrual basis accounting is based on generally accepted accounting principles. The other option is cash basis accounting. The U.S. Internal Revenue Service allows individuals and small companies to use cash basis accounting.

In many countries outside the U.S., international Financial Reporting Standards (IFRS) are required are required for many domestic public companies.

Performance of on-line applications (web sites, social media, etc.) are monitored with analytics tools. Customer Satisfaction and employee Satisfaction are monitored with brief surveys that include key relevant measures (such as “Net Promoter Scores” which measure willingness to recommend your organization or product to someone else)

For enterprises, 10 financial key performance measures that managers and investor can use. These metrics enable comparisons across time and with other enterprises.

Revenue Split
Gross Margin
Net Profit Margin
Lifetime Value
Cost of Customer Acquisition
Days Sales Outstanding
Days Payable Outstanding
Cash Burn Rate
Current Ratio
Gross Revenue Churn

Revenue Split

This split is between recurring and non-recurring (e.g., “subscription”) revenue. Recurring revenue often is more valuable than non-recurring revenue due to its predictability and lack of ongoing acquisition costs.

Gross Margin (GM)

$GM = \text{Revenue} - \text{Cost Of Goods Sold} / \text{Revenue}$. GM indicates how much revenue is kept after paying for the production of a product or service. The higher the GM, the more efficient is production (better processes, cheaper supply, etc.).

Net Profit Margin (NPM)

$NPM = \text{Net Income} / \text{Revenue}$. This indicates revenue left after all costs and expenses have been paid. The higher the NPM, the more profitable the enterprise.

Lifetime Value (LTV)

$LTV = \text{Revenue Since Inception} / \# \text{ of Customers}$. LTV measures how much each customer contributes to the business. LTV is driven by (1) profitability per transaction and (2) number of transactions per customer.

Cost of Customer Acquisition (CAC)

$CAC = \text{Marketing Costs} + \text{Sales Costs} / \# \text{ of Customers Acquired}$. Usually compared against LTV to determine if how much it costs to acquire a customer is worth the value expected from said customer. Ideally, an $LTV/CAC > 3$ is good.

Days Sales Outstanding (DSO)

$DSO = \text{Account Receivables} / \text{Sales} \times 365 \text{ days}$. DSO measures how quickly your customer pays their bills. If DSO is meaningfully higher than credit terms (days), there may be a collections issue.

Days Payable Outstanding (DPO)

$DPO = \text{Account Payables} / \text{COGS} \times 365 \text{ days}$. Measures how quickly the enterprise pays its bills. Increases could signal cashflow constraints within the enterprise. Ideally, $DSO < DPO$, meaning the enterprise is getting paid before paying its suppliers.

Cash Burn Rate (CBR)

$CBR = \text{Company cash} / \text{Monthly expenses}$. CBR measures how quickly cash reserves are being depleted or replenished. Especially important in the early stages of a business or when there is a significant disruption in the market (e.g. COVID, recession, etc.).

Current Ratio (CR)

$CR = \text{Current assets} / \text{Current liabilities}$. Measures the ability to meet short-term obligations (e.g. pay suppliers). If the CR is less than 1, it could be a sign that the enterprise is in financial difficulty.

Gross Revenue Churn (GRC)

$GRC = \text{Revenue Lost for the period} / \text{Total Revenue at the start of period}$. Measures percentage of revenue lost during a period. Significant increases are early warning signals of problems (e.g. customer distress, increasing competition etc.).

13. Portfolio, Programs, Projects

- Establish the activities that deliver your strategy and plans Portfolio – the optimizes collections Programs and Projects in priority
- Programs – major on-going efforts that support your enterprise (e.g., Channel Partners)
- Projects – activities with specific deliverables, budgets and schedules

Assign an individual to lead your Portfolio planning as well as each Program and Project within the Portfolio. Have frequent reviews of each and deliberately adjust them as needed.

Actions

Systematically and routinely identify and apply opportunities using the following four-step process.

- Step 1 Periodically schedule an in-depth review of all the key emerging items
- Step 2 Think creatively and expansively about the possibilities for applying capabilities
- Step 3 Identify and establish a few research and development projects
- Step 4 For longer term capabilities, find information to monitor progress

Even with a systematic approach, the development of advantage is challenging and requires on-going planning and actions. Schedule “Step 1” now.

To successfully accomplish this evaluation and application, complete the following 4-step process:

Step 1: Periodically (e.g. every 3 to 6 months) schedule an in-depth review of all the key emerging opportunities and capabilities likely to affect your area of interest, including their availability and economics.

Consulting with publications and other expertise can help you with this effort.

Encourage this thinking as a continuous activity, not just at the scheduled reviews.

Include a small group of those responsible for your organization processes. In addition, include other key subject matter experts who can add significant value to the discussion.

Step 2: Think creatively and expansively about the possibilities for applying the emerging capabilities to enhance your success.

Examine each of the new capabilities listed for you. Also, examine the capabilities for the organization segments of your key suppliers and your major customers.

Identify the emerging technologies that will affect each of these segments and how you can apply them. Determine ways you can become more valuable to your existing and prospective customers as well as have your suppliers become more valuable to you.

Finally, think about potential opportunities to expand beyond your existing sphere of interest.

Your most significant opportunities likely will come from creative combinations of emerging capabilities.

For example, combining advanced statistical information processing systems with the data provided by embedded devices will result in these networks of devices providing more useful information and operating more reliably.

Consider the emerging capabilities with respect to each of the Processes in your business. Review each of these processes and determine ways to improve them; then identify capabilities that can help better implement these improvements.

As part of these review and evaluation, identify opportunities for improvement that cut across several of the Processes and the Capabilities that can support these integrated improvements.

Step 3: Identify and establish a few research and development projects (at the level of effort you can afford) that pursue the most promising applications of technology. Manage these projects aggressively and adjust them as needed.

Include in these projects tests of the functionality and the marketability of new technology applications so that you can manage the associated risks. In addition, research the experience of others and join with others to help minimize the costs of development and testing.

For each Platform you are considering, ensure that the following characteristics are evaluated and understood:

- Organization requirements
- Features and functionality
- User Interface
- Capacity
- Power requirements
- Interference (electrical and physical)
- Interoperability
- Extensibility (add new features later)
- Expandability (easily scale)
- Backward compatibility
- Standardization (of interfaces, etc.)
- Installation
- Migration (from existing to new)
- Economics

Step 4: For longer term technology capabilities, identify sources of information that you can monitor regarding progress related to those capabilities. As time passes, you can determine if and when you should start a more intensive evaluation and development program.

EXAMPLE

This example (for the Manufacturing business segment) provides an understanding of the general process to anticipate new capabilities that will affect your business and processes and is. We consider expectations for the near-term (0-5 years) and for the longer term (up to 20 years).

As a starting point, you decide to evaluate your Production and Fulfillment processes. Reviewing the capabilities outlook for Manufacturing you find that in a few years radio frequency identification (RFID) tracked materials and dynamically configurable production lines will be common-place. In 20 years, advanced robots, optobiomechatronic remote control tools, nanotech parts and production methods, and advanced integrated machine tools will be available.

Your customers are mainly in the Retail & Wholesale segment. They will need capabilities in five years that make locating, evaluating and acquiring products and services much easier for their customers.

In addition, they will have more integrated supply chain information both internally and with their suppliers and customers. In 20 years, this segment will have more automated support and more remote shopping in a virtual store environment, as well as advanced robotic materials handling in stores and warehouses.

Some of the organizations supplying your Manufacturing business are providers of mined raw materials. In five years, the Mining industry will be using remote controlled machinery and robotic assay and quality control platforms. In 20 years, Mining enterprises will use advanced computing platforms to maximize the efficiency of material recovery from mines.

As a manufacturer, develop RFID capabilities compatible with your customers' needs. In addition, consider configuring your production lines to provide for quick re-setup in order to respond to the time and feature requirements of you customers. More advanced robotics may be a part of this production line flexibility.

In addition, ensure that you are continually improving the linkage of your market planning and supply chain related information systems to those of your customers (and suppliers) so that you will be as efficient and responsive as possible.

With respect to your Mining segment suppliers, you may find it useful to link your quality management information systems directly to the automated quality management.

Identify and establish the development projects you need to accomplish these goals.

Regarding the longer term (20-year) technology capabilities, establish research efforts internally and with expert partners for:

- more advanced robots
- optobiomechatronic remote controlled tools
- nanotech parts and production methods
- advanced integrated machine tools
- more automated shopping in a virtual store environment
- advanced robotic materials handling in stores and warehouses

These example research programs will help you identify opportunities.

In summary, this example is an abbreviated illustration of the planning and development process for emerging capabilities. Continually use this process to ensure that you are leading the application of emerging capabilities rather than reacting to your competitors' use of them.

Where emerging capabilities are concerned, don't let things happen to you ... make them happen. On the other hand, don't get caught up in "technological euphoria" (i.e., spending resources on over-hyped capabilities without understanding clearly how they will build your success). Be aggressive, however, in determining your use of emerging capabilities to accelerate your success.

Alan Mulally is a successful corporate leader with set of useful principles and practices for effective leaders.

Ford Motor company was losing billions of dollars when Alan Mulally became CEO in 2006. The automaker was facing bankruptcy.

By the time he left Ford in 2014, Mulally was credited with one of the most remarkable corporate recoveries. Ford became profitable again, its stock price increased, and employees had a new confidence. Ford took no government "bailout" funds.

In the early 1990's Mulally headed the B777 program for Boeing in Everett Washington. He applied the same practices in the B777 program that he described in a 2013 interview with McKinsey & Company about his success with Ford. He later became CEO of Boeing Commercial Aircraft.

After leaving Ford in 2014, he joined the Board of Directors of Google (now Alphabet).

Aviation Week & Space Technology named him as person of the year for 2006. He was included in the 2009 *Time* 100 list. In 2011, Mulally was named Person of the Year by the *Financial Times*. He was also named the 2011 CEO of the Year by *Chief Executive* magazine.

Steve Ballmer, CEO of Microsoft said of Mulally: "He understands the fundamentals of business success as well as any business leader I know."

Mullaly seems to have those traits that recent research has found produce the best leaders. This research indicates that the best leaders exhibit competence, humility, and integrity.

Less effective leaders exhibit over-confidence, charisma, narcissism. Many, however, initially are attracted to these latter traits, and thus organizations often find themselves with less effective leaders.

Following are leadership principles and practices (described previously) that Mulally advocates and exhibits:

- It is an honor to serve any organization you are privileged to lead.
- Have a compelling vision and a comprehensive plan.
- Leaders hold themselves and their teams accountable for deciding, "What business are we in?"
- What is the deep customer need you are uniquely positioned to satisfy?
- Example: Henry Ford understood the desire for freedom of mobility is enduring and universal.
- Great companies grow value 10 percent a year by satisfying customers better than competitors.
- Positive leadership conveys there always is a way to success.
- Facilitate connections between the organization and the outside world.
- Everyone is included, part of the team, respected, and participates.
- When people feel accountable, included and supported it is more rewarding and fun.
- A safe environment is necessary for an honest dialogue, especially when things go wrong.
- A weekly Business Plan Review of strategy and implementation is essential.
- As new information emerges, incorporate it right into the plan.
- Look at every element of the income statement and the balance sheet.
- Leaders are responsible for articulating and demonstrating a set of behaviors.
- Leaders reinforce the processes used to meet goals.
- People commit to the enterprise and each other. They work for more than themselves.
- People either adopt your culture, or they leave.
- Manage your time and your energy. Build and use your energy wisely.
- Integrate personal and work demands into one calendar to attain balance.

Future Work

Humans may soon live on average to be 100 or more, which likely means more years on the job. That means work may have to be redesigned.

In the U.S., the average retirement age is 62, according to Gallup polling, 40 or so years of work. That may extend to 60 years as life spans increase. 60 years of work seems long as work is for many people today inflexible, all-consuming, and not matched the needs of living.

Redesign could start with midlife. People work increasingly harder through the years having children and often taking care of older relatives especially for women, who bear a disproportionate caregiving burden.

Allowing workers to scale their hours up or down throughout their careers, based on their needs outside of paid work, may help. This approach could introduce some inefficiencies: businesses would still have to pay the fixed costs of employing workers, such as investing in training, but then get less out of that investment if those workers work fewer hours. Plus, if workers pause their jobs entirely, they could fall behind on the latest technology and practices in their industry during a long leave.

The current model, however, has its own inefficiencies—when people are overstretched, they probably are not doing their best work. Research has indicated that reducing workloads has led workers to be more creative at work doing the job that they wanted as a parent or elder caregiver and also doing well in their job.

Working more flexibly would allow people to spend more time on other interests and friends, which could help ward off burnout. In addition, it would better balance overutilization in midlife and underutilization after 65 which will become more pronounced as people live longer and stay healthier for longer as well.

Older workers often want to work less and more flexibly, but find they have two options—continue to work full-time or else retire completely. A path to retirement would allow workers to scale back their hours before leaving the workforce entirely. It might include periods when people could temporarily come out of retirement to assist with a project or mentor younger workers.

This approach could make a 60-year career feel manageable. But there are issues with redesigning work in this way.

When dual-earner households became prevalent, that translated into people buying more rather than working less. As people live longer, they may not be able to opt out from working more, whether because of culture, their employment options, or both.

Until the late 19th century, people typically worked until they were no longer physically able to, and then hoped that their family could take care of them. Workers in 1880 were likely to work, on average, up until fewer than two years before they died.

People's incomes rose as productivity increased and, in the 1930s, the U.S. government started distributing Social Security payments to support people in old age. People stopped working because they could afford to.

Similarly radical shifts in work likely are ahead.

Government

Governments should include decision-makers who advance on the basis of their productivity, and not on the basis of their willingness to “spread the wealth around.”

The foundation of democracy – the form of government where each citizen has an equal say in the decisions that affect their lives – is compromise, an outcome where no one gets exactly what they want, but everyone gets something.

In most representative democracies, roughly half of people support having (on a spectrum of size) larger government and half support smaller government. This division creates tension ... and reluctant compromise.

The most successful government organizations will incorporate the following

- No “inalienable” rights exist ... only those rights you are willing fight for if necessary to retain.
- Nothing has done more for the health, wealth and wisdom of humans than private free enterprise.
- Private enterprise and charity are 3 or more times more effective than government programs.
- Government ensures equal protection of laws for every individual.
- Government provides primarily national security, equal justice and law enforcement.
- All government spending limited to less than 10% of GDP.
- Simple fair tax for each individual person (since equal protection)... no other revenue allowed.
- No government involvement in personal relationships (e.g., marriage); standard contracts only.
- Spiritual beliefs are personal ... no government involvement beyond physical protection.

Government programs more cost ineffective than private programs

Research demonstrates that public income redistribution agencies are estimated to absorb about two-thirds of each dollar budgeted to them in overhead costs, and in some cases as much as three-quarters of each dollar. Using government data, on average, 70 cents of each dollar budgeted for government assistance goes not to the poor, but to the members of the welfare bureaucracy and others serving the poor.

In contrast, administrative and other operating costs in private charities absorb, on average, only one-third or less of each dollar donated, leaving the other two-thirds (or more) to be delivered to recipients. Charity Navigator (www.charitynavigator.org), one of several private sector organizations that rate charities by various criteria and supply that information to the public on their web sites, found that 70% of charities they rated spent at least 75% of their budgets on the programs and services they exist to provide, and 90% spent at least 65%. The median administrative expense among all charities was only 10.3%.

In fact, the average cost of private charity generally is almost certainly lower than the one-quarter to one-third estimated by Charity Navigator and other private sector charity rating services, for at least two reasons. First, many are either run by or affiliated with religious organizations, where much of the labor is donated, further reducing overhead costs.

Charity Navigator does not include religious charities in its research, focusing instead only on tax exempt organizations required to file informational tax returns. Perhaps more important, an unmeasured but certainly very large fraction of private charitable aid is administered directly to recipients by kin without any

institutional intermediation at all. This widespread private family charity (and similar gifts) is the case in which dollar-for-dollar charitable income transfers can occur.

This all means that the costs of public programs are 6 to 7 times the costs of private programs. Furthermore, public programs often are not as customer service oriented as private programs adding a societal cost to the financial cost deficiencies.

https://cdn.mises.org/21_2_1.pdf

Optimum governing size

Studies have documented a negative empirical relationship between government size and economic growth rates. Over the period spanning the first decade of the 21st century, after controlling for factors such as population size, per capita GDP, net debt to GDP, the institutional factors of governance and economic freedom and regional variations, there is a hump-shaped relationship between the government expenditure to GDP ratio and the growth rate of per capita GDP.

Put simply, as government grows beyond a certain size, it can actually begin to hinder economic growth, thereby lowering living standards for average citizens. As well, there seems to be an association between smaller governments and greater efficiency in public service provision and often better performance outcomes.

The Government Should Do More to Solve Problems. This is the attitude held by 59% of Americans aged 18 to 29, while a similar majority (58%) of those 65 and older people think the role of the government should shrink.

Small government argue that it is a better bet as it concentrates on a few, but important attributes of the society. The very fact that it does not work with a wide range of sectors means it can concentrate on the important sectors and govern them with utmost efficiency.

Those in favor of big government argue that it is government regulation, which keeps a tab on the capitalist market. The extensive legal infrastructure required for free-market capitalism can only be provided by a big government.

A comparison of public sector size and outcome indicators such as economic growth, life expectancy, infant mortality, crime rates, and educational attainment finds the relationships are complex. While there is a positive association between government spending and favorable societal outcomes, much of the relationship is for lower amounts of spending with a leveling off of improvements as spending rises above a threshold level. This contribution illustrates that a larger public sector is not necessarily always associated with more positive health, social and education outcomes.

Taken together, the evidence suggests there are important implications for economic growth and social outcomes associated with the size of government. There is an optimal size for the government sector when it comes to the effect on economic growth.

The Fraser Institute is an independent non-partisan research and educational organization based in Canada that has researched dozens of countries. Fraser found that annual per capita GDP growth is maximized at 3.1 percent at a government expenditure to GDP ratio of 25 percent; beyond this ratio, economic growth rates decline.

This is the optimal size for the public sector related to the effect on economic growth. It also is significant for other social considerations. For example, in the case of life expectancy at birth, an increase in the government expenditure to GDP ratio from 20 to 30 percent is associated with a gain of three years. However, growth from 30 to 50 percent yields only another year, which suggests diminishing returns in the health benefits associated with increased public sector size and spending.

Federal, state and local government spending now exceeds 40% of USA GDP. In the USA, life expectancy has declined (for the first time) by 2 years between 2019 and 2022.

Analysis of data for over 180 countries indicates that the maximum annual real per capita GDP growth rate of 3 percent corresponded to a government expenditure-to-GDP ratio of 26 percent. Beyond this relative size of government, the rate of economic growth declined. Economic growth and new job creation begin to slow when total government spending is larger than about 25 percent of the economy

Increases in output per worker over time reflect increases in the amount of complementary inputs such as natural resources, labor, and capital, as well as more productive use of all inputs. Economic growth and improvements in the standard of living hinge on increasing output per input and ultimately output per capita.

As one economist noted: “Productivity isn’t everything, but in the long run it is almost everything. A country’s ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker”

Government is a key factor affecting productivity and growth ... with government tax and expenditure policies affecting saving, capital formation, and labor supply, as well as innovation and technological change. Government provides institutions such a rule of law and property rights that facilitate productivity and economic growth along with economic freedom, trust, low levels of corruption, and functioning bureaucracies. Spending financed by an expansion of government borrowing and ultimately public debt, raises future inflation and higher taxes.

International evidence that has documented slower growth rates with larger public sectors over the course of the last 150 years. While good government promotes growth, poor government or excessively large government can reduce productivity and thereby harm economic growth.

Large government can harm productivity growth in a variety of ways including by taxing and reducing the return to entrepreneurship and innovation, by discouraging capital investment and creating disincentives to work, by excessive regulation that increases costs of economic transacting, and by fueling inflation or otherwise distorting the price mechanism. Unlike the private sector, government spending decisions are not made in response to market incentives based on the highest productive return to investment. More government spending frequently leads to worse social and economic outcomes.

The manner in which government affects economic growth is complex, as government activities can also affect economic production positively, in part by providing societal benefits such as public goods and the rule of law, as well as by public investments in physical and social capital. However, when examined more carefully, this relationship is not linear but has been documented as “hump” shaped.

As the state first develops and grows, its infrastructure and institutional spending complements private sector growth, contributing to a positive relationship between public sector size and growth. However, as spending

risers, along with taxes required to finance the spending, there are adverse productivity effects on the economy and a slowing of growth rates.

A study using a cross-section of 103 countries, found that a government size of about 19 percent of GDP, measured as the tax-to-GDP ratio expressed as a percentage, maximized economic growth rates. Another study using data for over 180 countries, identified that the maximum annual real per capita GDP growth rate of 3 percent corresponded to a government expenditure-to-GDP ratio of 26 percent. Beyond this relative size of government, the rate of economic growth declined.

Times of crisis seem to generate demands for government spending which, once in place, are difficult to dislodge after the crisis passes. The rate of growth of public expenditures was driven by taxpayer perception of tolerable levels of taxation, and that this tolerance is greater during times of national or social crisis. Thus, the public sector has grown in a step-like fashion of abrupt jumps and long plateaus driven by crises such as war.

Economic growth and new job creation begins to slow when total government spending is larger than about 25 percent of the economy. Total government spending in the United States is about 40 percent of GDP.

Governments are created to protect people and property. A government too small to establish the rule of law and protect people and their property from both foreign and domestic enemies is less than optimal.

Government, however, can easily become too large, which would diminish the liberties of the people and discourage them from engaging in productive activity. After two centuries of experimentation and the unnecessary loss of hundreds of millions of human lives, most of mankind now understands that pure socialism leads to tyranny and economic stagnation.

How much government is necessary and desirable, and when does it become a drag on both liberty and economic well-being? Most studies measure the size of government as a share of GDP (realizing it is an imperfect measure because it does not measure counterproductive regulation, restrictions on liberty and other factors, but is a reasonable approximation). Free markets and uncontrolled prices do a better job in allocating resources (labor and productive investment) than politicians, who tend to resort to deciding what they believe is best for other people and, often, rewarding their friends.

The studies of the optimum size of government made by reputable scholars in recent decades have indicated that total government spending (federal plus state plus local) should be at least 17 percent, but no larger than about 30 percent of GDP. Their conclusion is that there is a 95 percent probability that the optimal size of government is less than 25 percent of GDP.

Empirical evidence shows that reducing taxes, regulations, and government spending down to at least 25 percent of GDP would do the most to spur economic growth and create more jobs over the long run.

<https://www.cato.org/commentary/optimum-government>

<https://www.fraserinstitute.org/sites/default/files/government-size-and-economic-growth-4day-week-essay.pdf>

https://www.researchgate.net/publication/299514847_What_is_the_Optimum_Size_of_Government_a_Suggestion

<https://www.timescolonist.com/opinion/livio-di-matteo-size-of-government-matters-to-the-economy-4640012>

Plan

Historical experience has demonstrated that the following are most effective

- Government provide only physical security and equal protection legal system.
- All residents pay equal amount of annual tax ... no other sources of revenue.
- Private free enterprise businesses and charities provide all goods and services.
- Independent private consumer-supported watchdog and legal support groups.

Following are the priorities of effective government with spending limited to 25% or less of GDP.

For “Limited” government

1. National Defense, Domestic Law Enforcement, Judicial System
2. Common Infrastructures (Roads, etc.)

For “Limited + Expansive” government

3. Public Education.
4. Health
5. Social Security
6. Welfare (food, housing, health, etc.)
7. Other (Space Exploration, Research Funding, FDA, EPA, SEC, FTC, etc)

Bifurcated government

People in the USA are equally divided between those who want (to varying degrees) extensive government and those who want limited government. Instead of combatting each other, there may be the possibility that each side can have what they want.

Each side must agree on common principles that include the following and that maintain consistency with the U.S. Constitution (amended as needed):

Liberty and Justice for All

Equal protection of the laws

Each individual opts-in to either

- a) Extensive government (“common” taxes plus additional taxes to support government health, education, income security, etc.)
- b) Limited government (pay only “common” taxes ... e.g., national defense, equal protection)

Only a taxes on individual residents are levied. No other taxes or fees (business, sales, licenses, etc.) are allowed.

Each individual will have their selection recorded. An individual may decide to change his/her opt-in choice at any time (along with the respective tax liability) .

Due to their personal political philosophy, many wealthy “progressives” will opt-in to the Extensive Government ... so that option will not be deprived of tax revenue.

The “common” items provided by the Federal, state and local governments include:

National security

Federal judicial system

Road infrastructure

All else is provided by private enterprise (for those opted-in to Limited Government) ... or by government for those (for those opted-in to Extensive Government).

ALTERNATIVE

The Federal government provides only national defense and ensure equal protection of (a very few) Federal laws ... and equal protection of laws within states.

Taxes necessary to support only these two items will be provided by each state proportional to its population. All else will be provided by each state based on its respective governing philosophy

Each state will determine its own governing limits, and people can migrate to states that best adhere to their personal philosophy of governing. Each state determines its agreements with other states.

Each state determines

- Safety
- Healthcare
- Welfare
- Education
- Infrastructure
- Commerce
- other

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**Transform Your Existence
Just Start ... Now**

In Memoriam

No need to be sorry. We come here
knowing nothing, wanting nothing,
expecting nothing, snatched out of the
womb and thrust into a great expanse of
time and circumstance in which nothing is
real and reality itself a longing we die with.
We meet obstacles, we pass landmarks, we
slip into series after series of situations
good and bad, like perennial actors
endlessly reacting to the flow of life in
countless different plays, day-long
comedies and all night dramas. Nothing
completely remains the same, from
moment to moment our lives skidder along
paths, twisting, bending, winding
around an inconceivable course of
fate, a virtual circus of unrelated
experiences, meeting life with life, one
minute here, gone the next, we ride the
merry-go-round that surrounds our very
being.

William Roberts