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JJ Kelly

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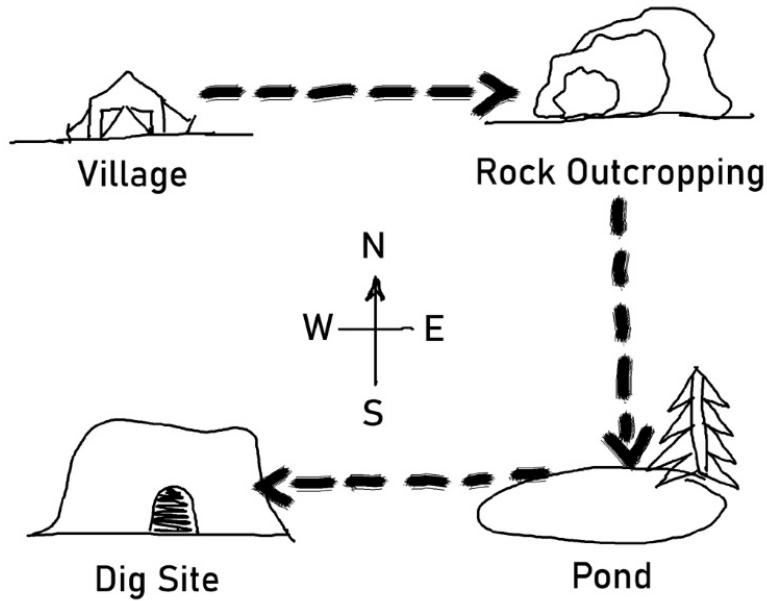
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THE RATIONAL ANIMAL

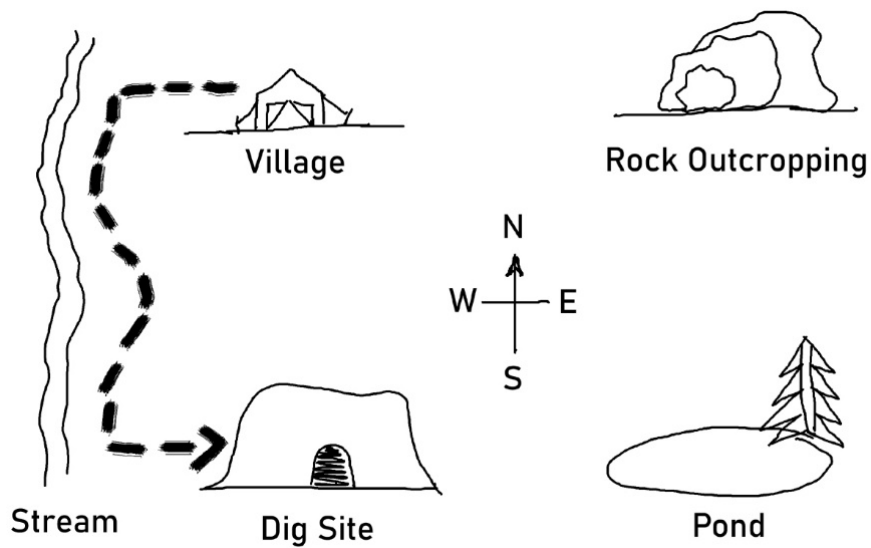


Chapter 1.2 Pathways

THE PHYSICAL BRAIN



Chief's directions to your dig site.



Follow the stream to the dig site.

Chapter 1.5 Automation

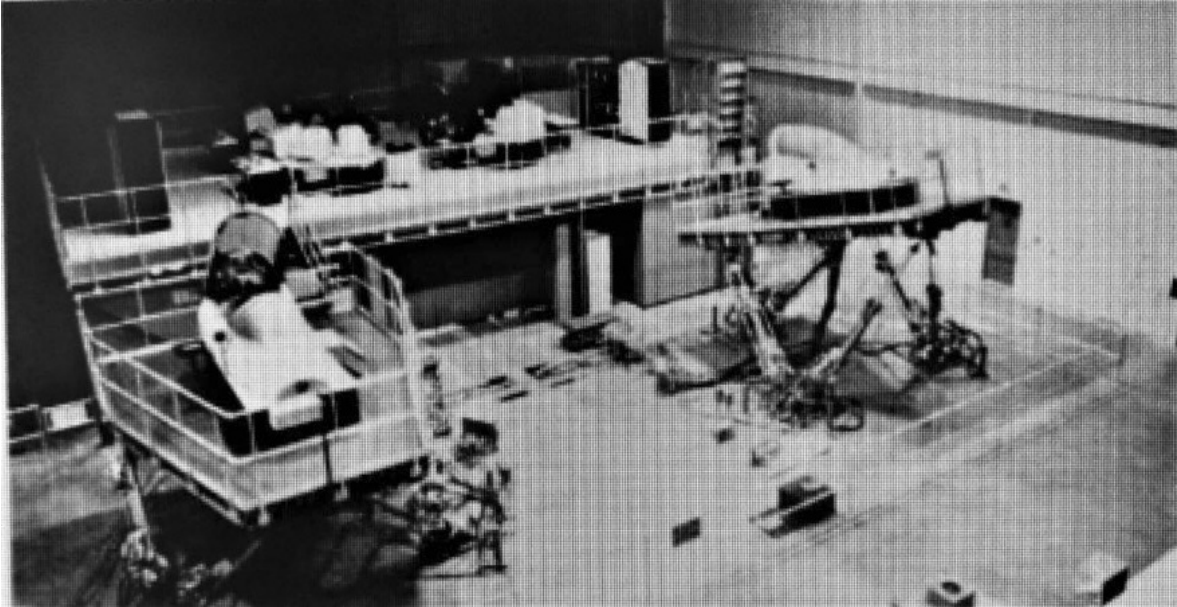
IMAGINATION

Beginning Exists in Reality	Imagination's Purpose	Ending Exists in Reality
Box, Poles, Wheel	Integrating into goal—an image of something that can be created in reality.	A physical Wheelbarrow
Horse, Antelope Horn	Integrating into a fantasy—an image of something that cannot be created in reality	A work of art depicting a Unicorn

Imagination

Chapter 1.8 The Flight Simulator Story

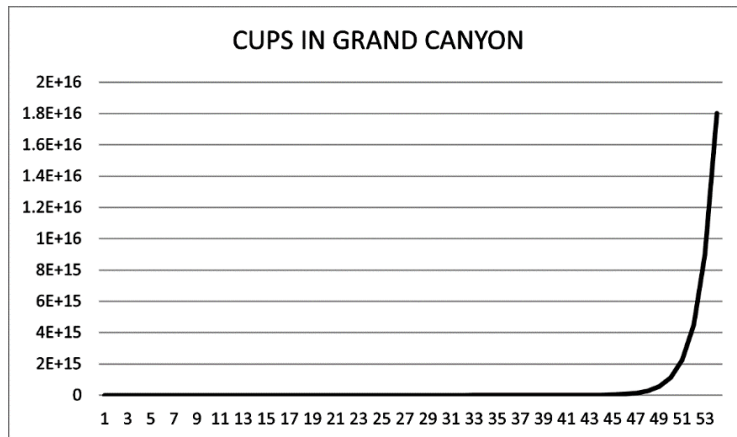
THE MISSION BRIEFING



Navy 2F101 flight simulators on hydraulic actuators providing full range of motion allowing the pilot to feel g-forces. The instructor sits at the computer console on the upper platform.

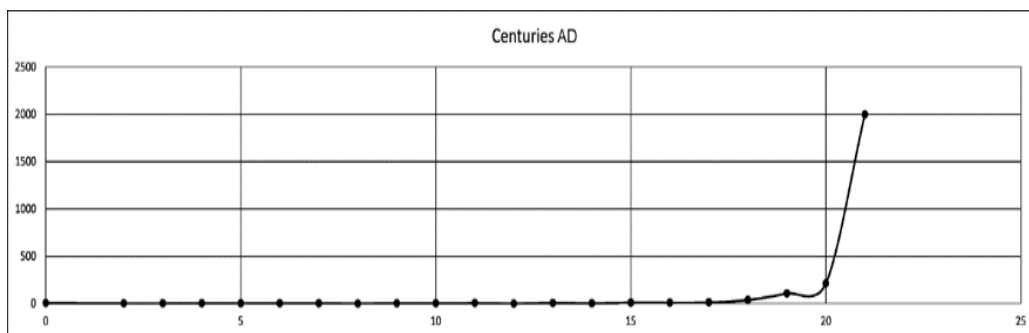
Chapter 2.1 Warning! Sharp Curve Ahead

THINGS EXPONENTIAL

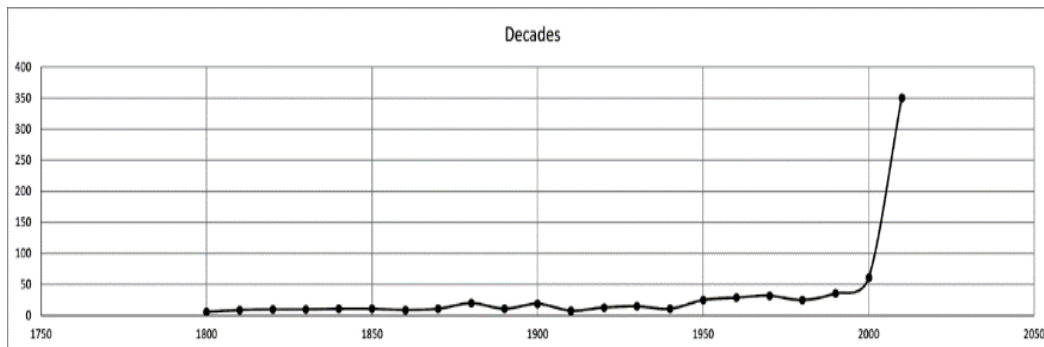


Exponential curve changes from horizontal to vertical after 50 doublings.

TECHNOLOGY GROWTH CURVE



Inventions by Centuries

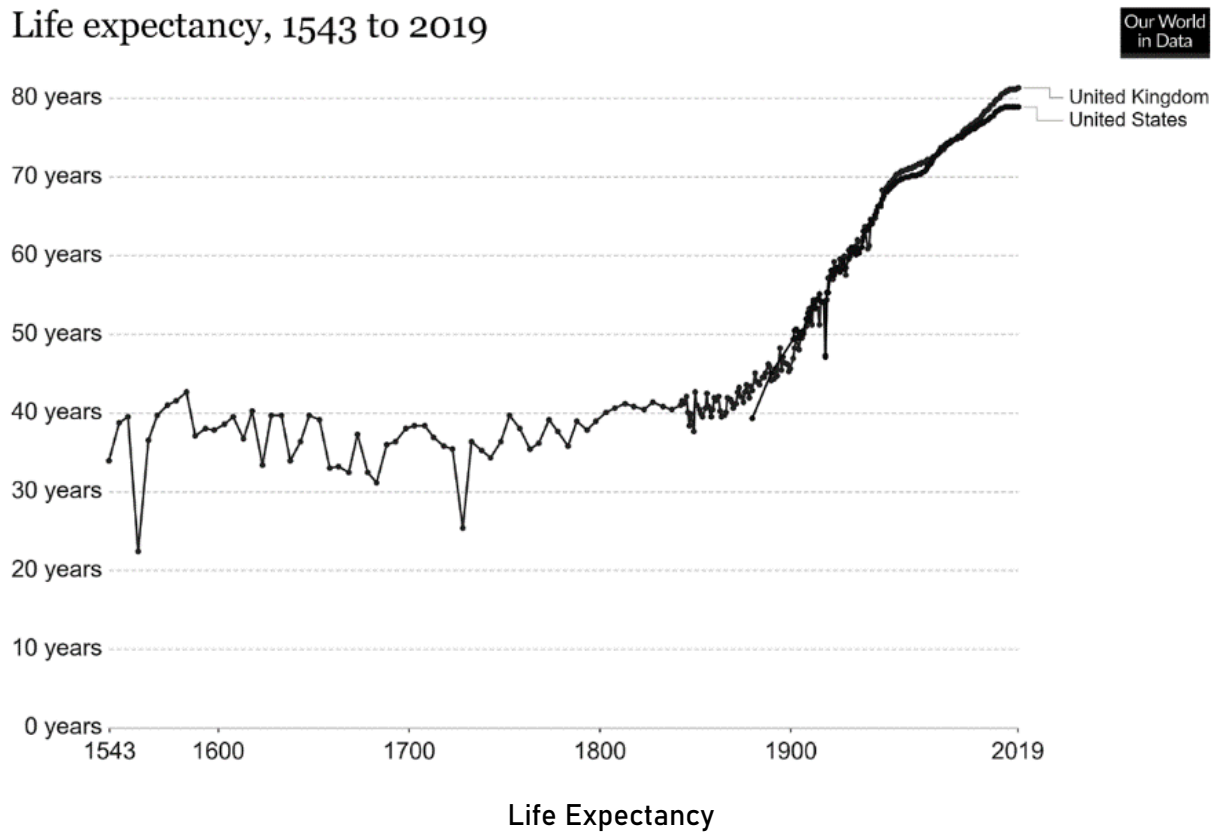


Inventions by Decades

Chapter 2.2 You Might Live Longer Than You Expect

AVERAGE LIFE EXPECTANCY

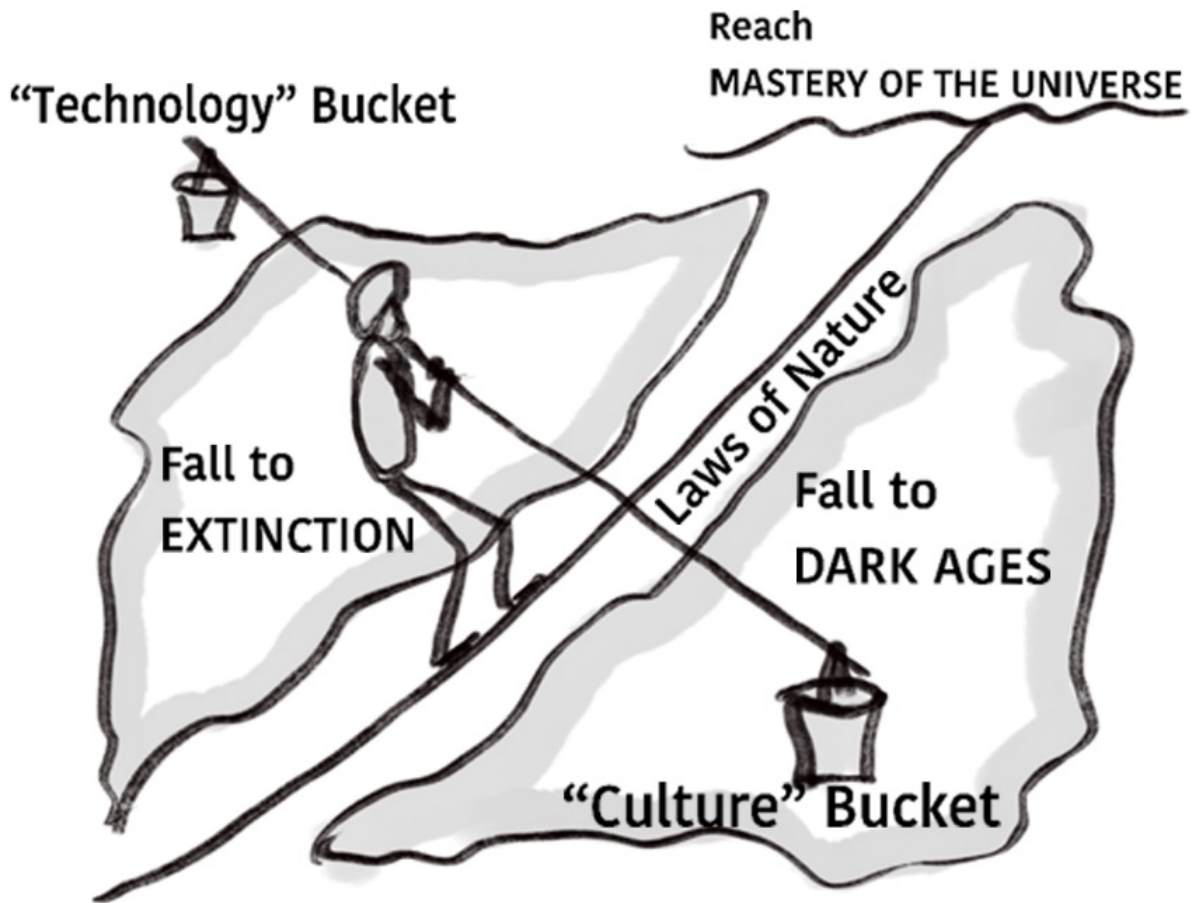
Life expectancy, 1543 to 2019



[\[https://ourworldindata.org/grapher/life-expectancy?time=1543..&country=GBR+USA\]](https://ourworldindata.org/grapher/life-expectancy?time=1543..&country=GBR+USA)

Chapter 2.3 Everything You Consider Normal Will Change

THE "TIGHTROPE"



The "Tightrope"

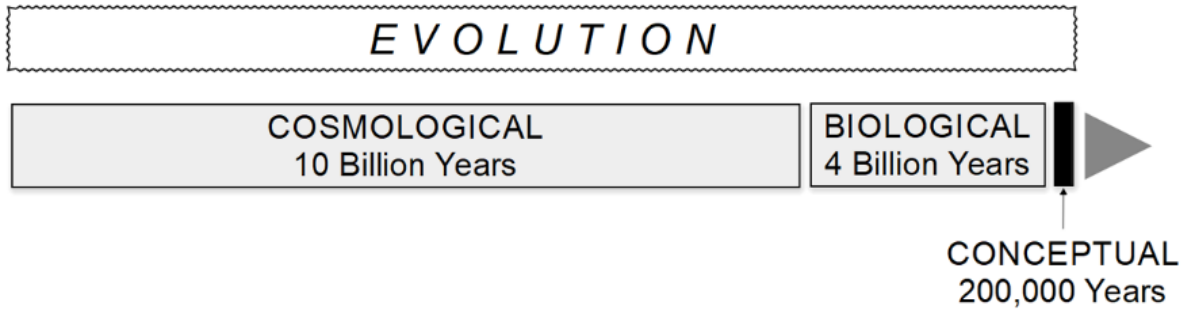
Chapter 2.4 The Great Unraveling

WHERE HAVE THE PRINCIPLES GONE?



Chapter 3.1 Evolution

THE BIG PICTURE



Evolution's Periods

Period of Evolution	Causal Process	Acts On	Increases	Until
Cosmological (10 billion years)	Laws of Physics	Inanimate matter	Complexity of matter	Earliest life forms appeared
Biological (4 billion years)	Natural Selection	Biological entities	Levels of intelligence	Conceptual level intelligence appeared
Conceptual (200,000 years+)	Technology Cycle	Conceptual-level entities (biological or technological)	Knowledge of universe, modification of matter, intelligence	Post-conceptual period or mastery of the universe

Evolution's Periods

PRIMACY OF EXISTENCE

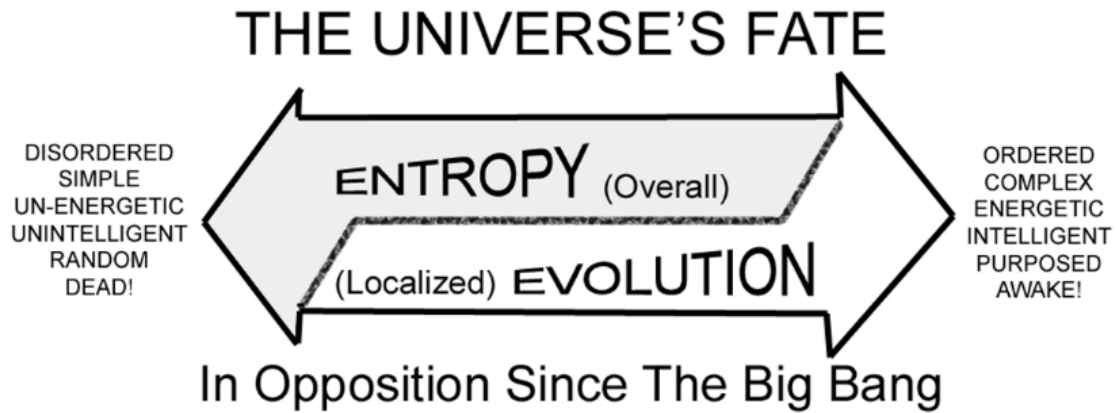
APPLIES TO:	QUESTION:	ANSWER:
Existence	<i>What is out there?</i>	<i>A "real" reality.</i>

COSMOLOGICAL EVOLUTION

When	What
In the first second	Elementary particles of matter are formed
At 10 seconds	The universe becomes a super-hot glowing fog of gas
At 3 minutes	Lithium, heavy hydrogen, and helium form from protons and neutrons
At 70,000 years	Gravitational collapse of matter begins
At 10 million years	Heavier elements and the chemistry that will later spark life begin
At 200-300 million years	First stars begin to shine
At 700 million years	Galaxies begin to form
At 9.2 billion years from Big Bang or 4.54 billion years ago	Our solar system and Earth-moon system are formed
At 4.41 billion years ago	The oceans are formed
At 4.28 billion years ago	Earliest discovered life - Fossilized microorganisms in hydrothermal vents

Cosmological Evolution Timeline

[https://en.wikipedia.org/wiki/Timeline_of_epochs_in_cosmology]



BIOLOGICAL EVOLUTION

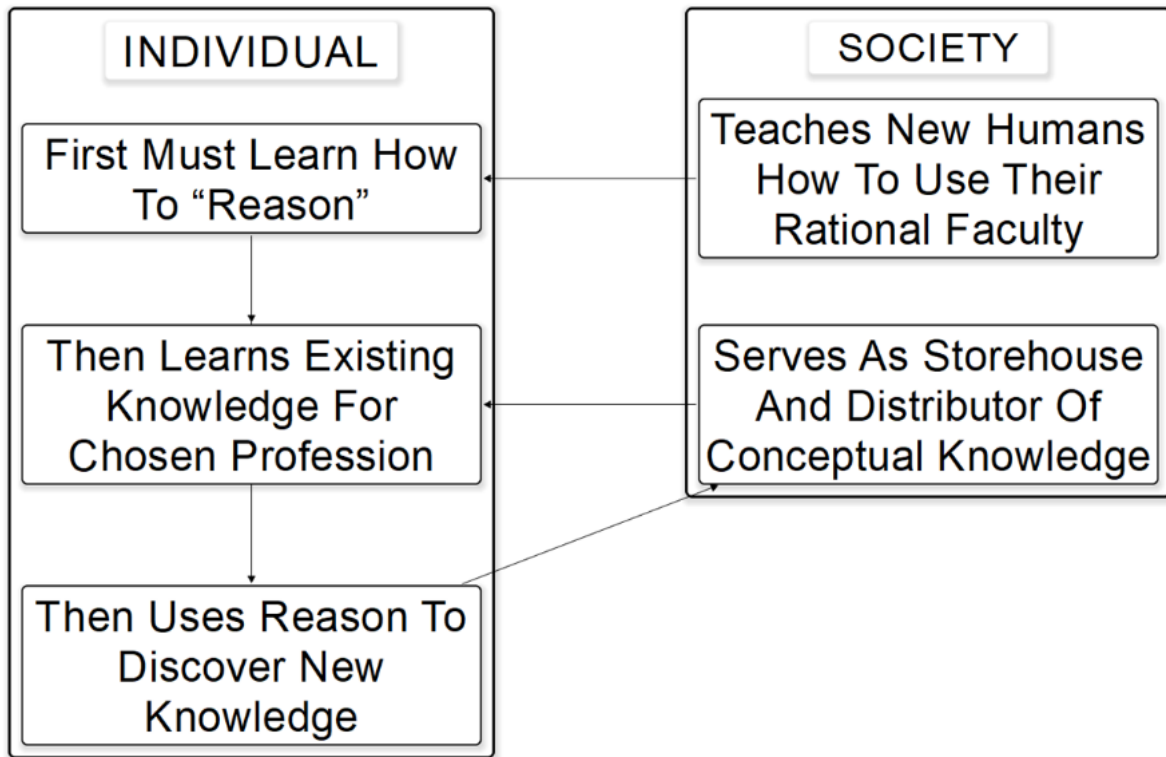
When	What
4.0 billion years ago	Matter assembled into the first self-replicating molecules in life forms in the oceans
3.8 billion years ago	“Primitive life forms”—cells (archaea) and bacteria
3.5 billion years ago	Swimming cells and bacteria
3.0 billion years ago	Photosynthetic bacteria—they create oxygen in the Earth’s atmosphere
2.8 billion years ago	Microbial life appears on land
1.8 billion years ago	Cells with organelles serving different functions, (eukaryotes) “complex” life forms
1.2 billion years ago	Sexual reproduction in single cell organisms appears and speeds up evolution
1.0 billion years ago	Plants appear on land. They further increase oxygen and carbon dioxide in the atmosphere
600 million years ago	Increasing oxygen develops the ozone layer that protects emerging land life from ultraviolet radiation

580 million years ago	Larger, multi-cellular animals of the modern phyla appear
530 million years ago	Earliest footprints on land
485 million years ago	Vertebrate fishes with true bones appear
360 million years ago	Carboniferous period begins. Earth resembles its present state. Insects on land, sharks in the ocean, seed-bearing plants and forests, four-limbed tetrapods on land
320 million years ago	Precursors to mammals separate from reptiles
60 million years ago	Earliest true primates
6.5 million years ago	Earliest larger primates (hominins)
2.5 million years ago	Stone tools use begins by hominins
2.0 million years ago	First of the homo genus (Homo Habilis)
350,000 years ago	Neandertals and Denisovans branch from the human lineage and interbreed with humans later
250,000 years ago	Anatomically modern humans appear
50,000 years ago	Behaviorally modern humans appear

Biological Evolution Timeline

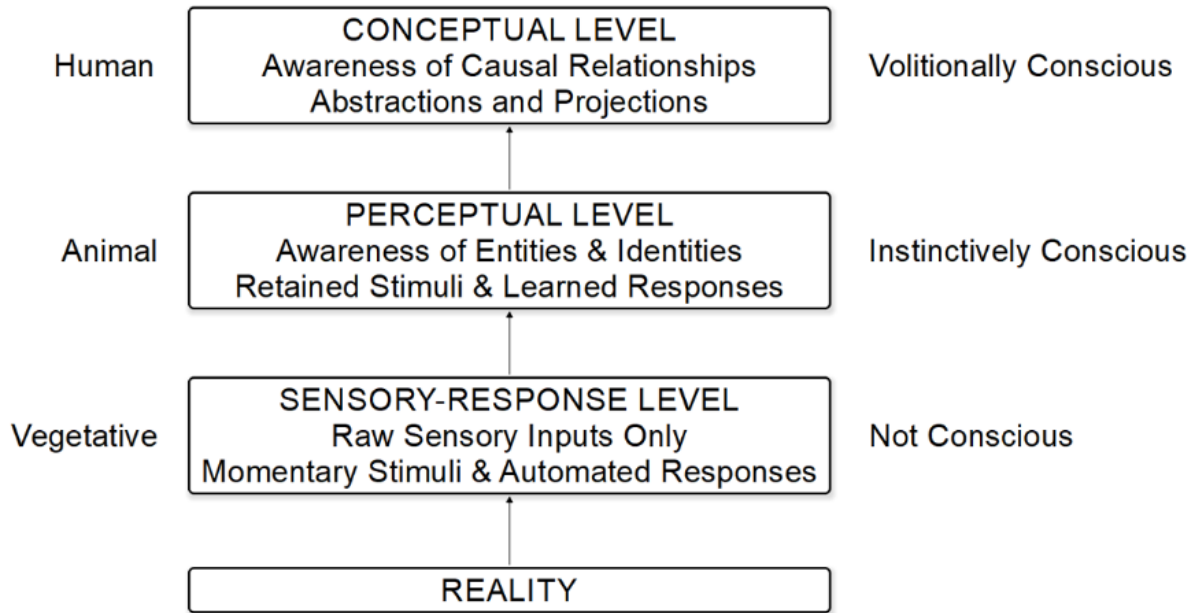
[https://en.wikipedia.org/wiki/Timeline_of_the_evolutionary_history_of_life]

CONCEPTUAL EVOLUTION



Conceptual Evolution's Roles

LEVELS OF CONSCIOUSNESS



Levels of Consciousness

Conceptual Consciousness Level

APPLIES TO:	QUESTION:	ANSWER:
Knowledge	<i>How do I know it?</i>	<i>I can trust my senses and my mind to grasp reality.</i>

VALUES AND VIRTUES

APPLIES TO:	QUESTION:	ANSWER:
A Person	<i>What should I do?</i>	<i>I must use my mind to identify and achieve my own happiness.</i>

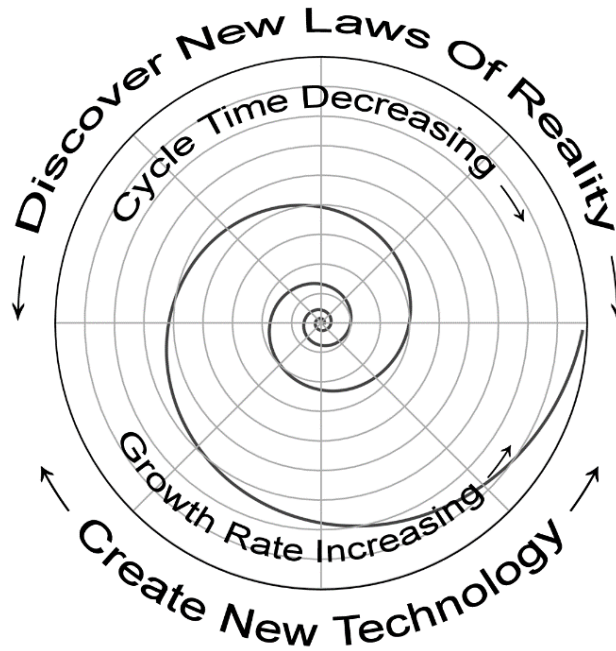
ART



Art: *"This is what life means to me."*

APPLIES TO:	QUESTION:	ANSWER:
Art	<i>What is the image of my Worldview?</i>	<i>Art that shows a real world and rational people.</i>

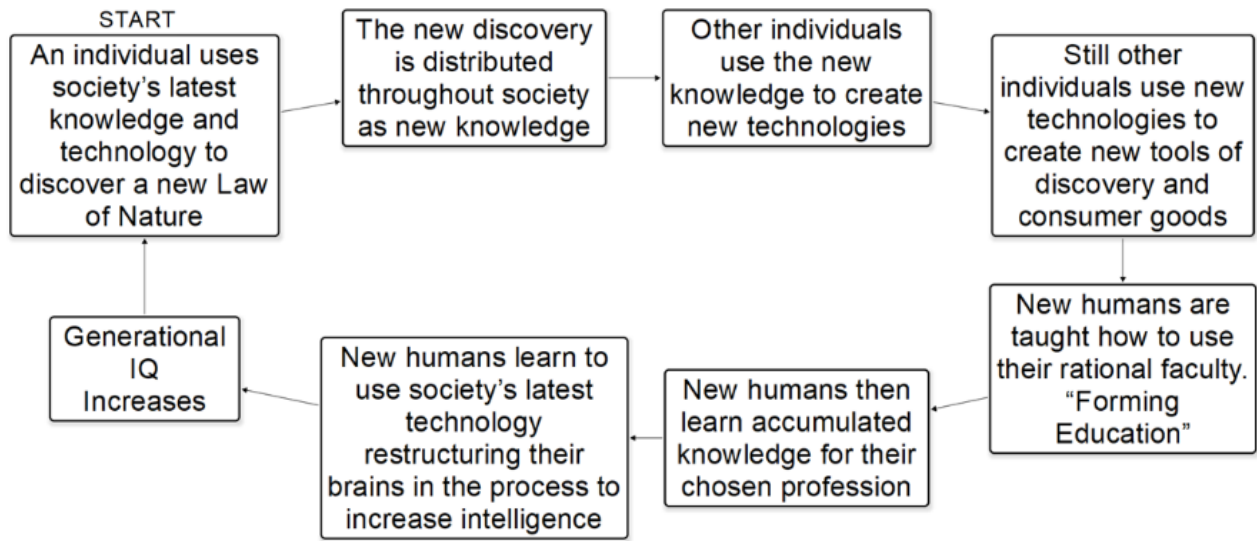
TECHNOLOGY CYCLE



Technology Cycle:

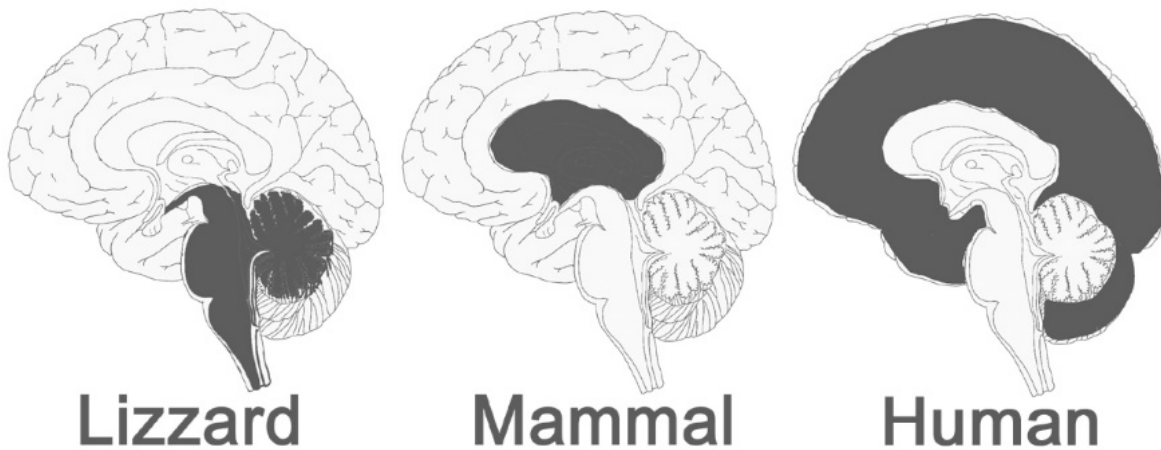
Knowledge increases and cycle times decrease at an exponential rate.

COGNITIVE FLUIDITY



Technology Cycle and Cognitive Fluidity

POST-CONCEPTUAL EVOLUTION



Triune Brain

Chapter 3.2 The Law of Intellopy

THE LAW OF INTELLOPY



Intelligent Matter—"Living" and "Purposed"

ULTIMATE OUTCOME



Will Mankind Awaken the Universe?

Chapter 3.3 Technology

Engineers

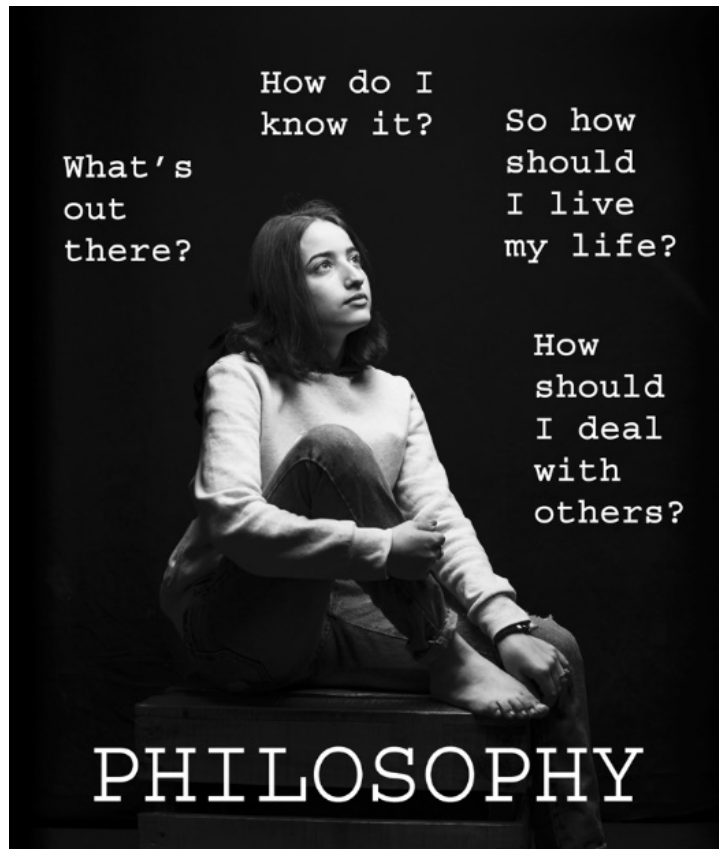
Differences	Scientist	Engineer
Essential role:	Inquiry	Design
Asks the question:	How can we discover new knowledge?	How can we deliver new products?
Physical things:	Study then describe	Describe then build
Information flows:	From matter into their minds	From their minds into matter
The unknown:	Focuses on the unknowns	Avoids or offsets the unknowns
Produces:	New knowledge that enables engineering	New tools that enable science

Summary Of Differences Between Science and Engineering.

Free Market and Government

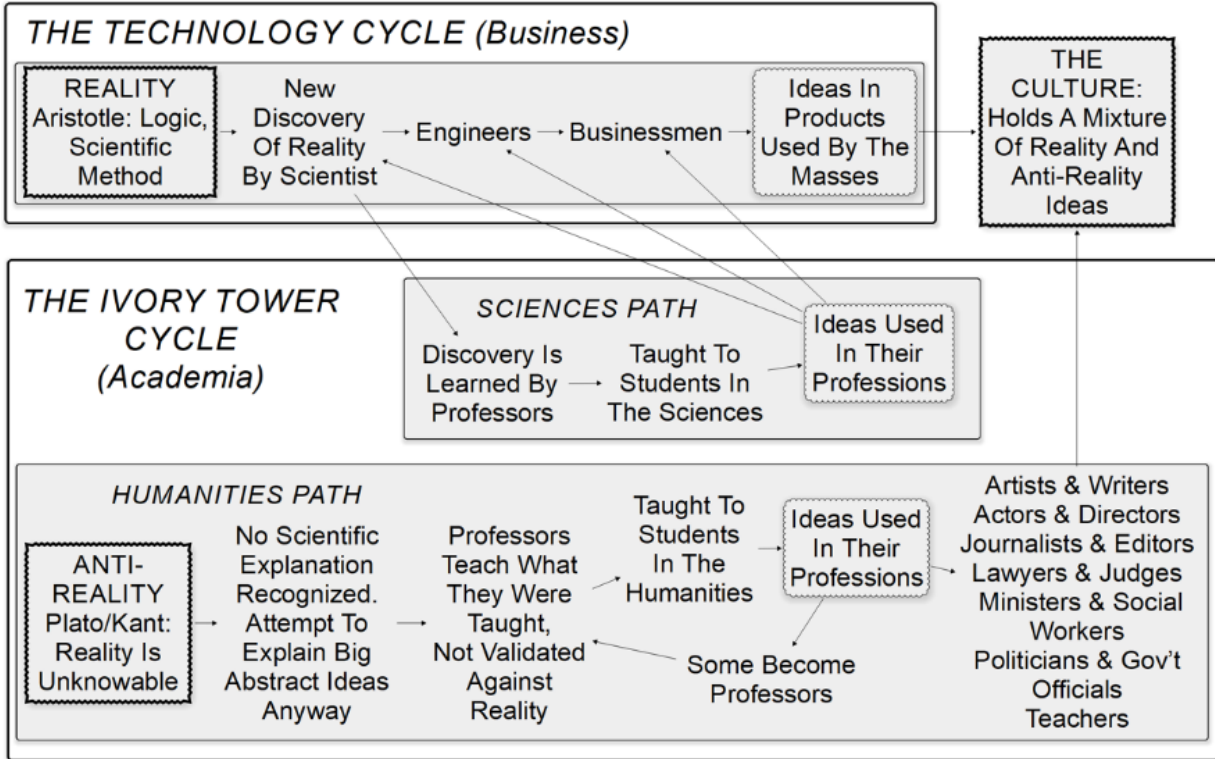
APPLIES TO:	QUESTION:	ANSWER:
Society	<i>What about dealing with others?</i>	<i>Everyone must be free to think, act, and trade with each other without force, coercion, or sacrifice.</i>

PHILOSOPHY



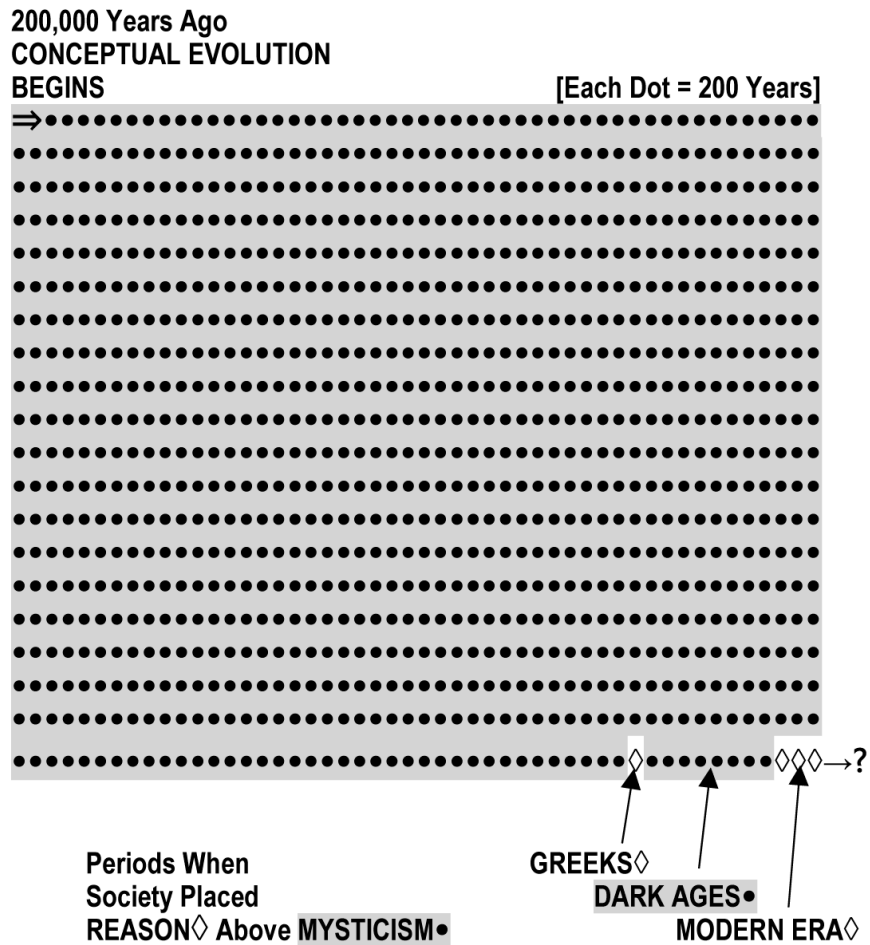
Chapter 3.4 Society

The Humanities Pathway:



Conceptual Evolution's Processes

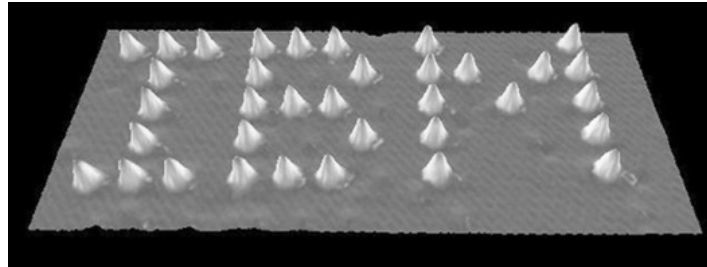
THINKING MODE



Human society is just beginning to learn to replace ancient mysticism with reason.
Will our second experiment succeed, or will it fail, causing a New Dark Ages?

Chapter 4.3 Nanotechnology

THE NANOTECH AGE



GRASPING WHAT NANO MEANS

Metric prefix	Symbol	Name	Number	Powers of Ten
Exa	E	Quintillion	1,000,000,000,000,000,000	10^{18}
Peta	P	Quadrillion	1,000,000,000,000,000	10^{15}
Tera	T	Trillion	1,000,000,000,000	10^{12}
Giga	G	Billion	1,000,000,000	10^9
mega	M	Million	1,000,000	10^6
kilo	K	Thousand	1,000	10^3
unity	--	One	1	10^0
milli	m	Thousandth	1/1,000	10^{-3}
micro	μ	Millionth	1/1,000,000	10^{-6}
nano	n	Billionth	1/1,000,000,000	10^{-9}
pico	p	Trillionth	1/1,000,000,000,000	10^{-12}
femto	f	quadrillionth	1/1,000,000,000,000,000	10^{-15}
atto	a	quintillionth	1/1,000,000,000,000,000,000	10^{-18}

Metric Numbering System

Chapter 4.5 5G Network

DRIVERS OF 5G DEPLOYMENT

Cell Class	Coverage Area	Power	No. of Users	Application	Cost
Macrocells	35 kilometers	10 watts	Up to 1,200–1,500	Outdoors	high
Microcells	2.5 kilometers	2–5 watts	200	Outdoors	medium
Picocells	100–250 meters (indoor)	250 milliwatts	32–64	Indoors	low
Femtocells	10–50 meters	100 milliwatts	8–16	Indoors	low

Classes of 5G Cell Sites

Different-sized cells can be combined to create a heterogeneous network (HetNet), a radio access network (RAN) that comprises traditional large macrocells with many smaller cells, ranging from femtocells to microcells.

[Singh, A. (2019)]

Chapter 4.9 Nuclear Fusion

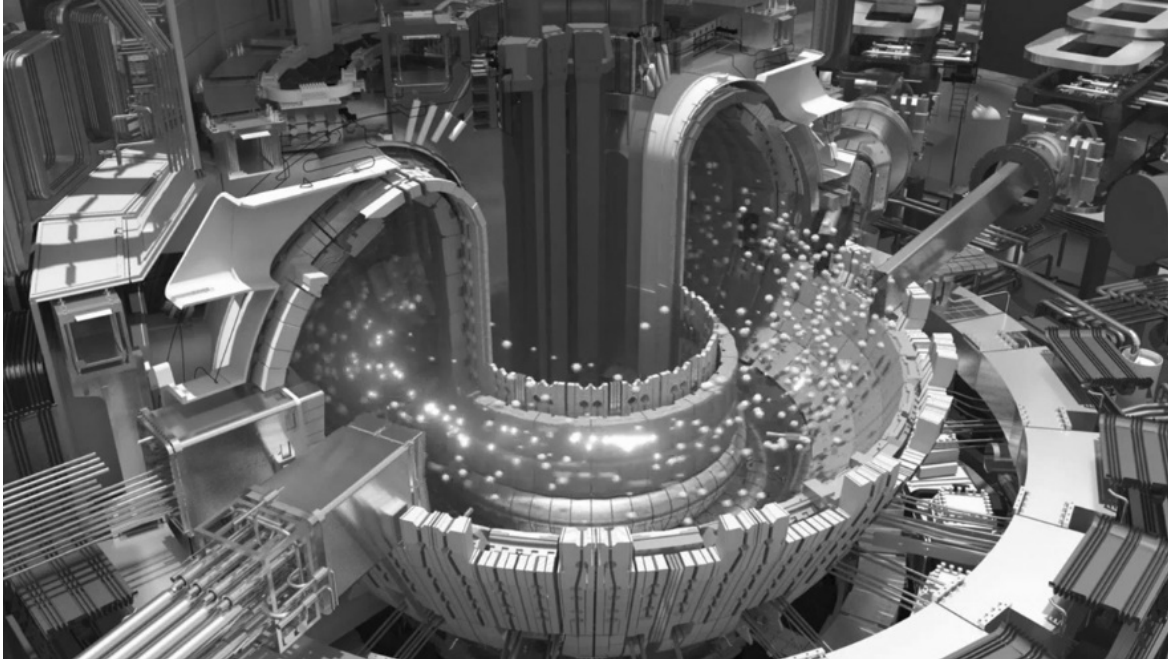
ENERGY OPTIONS

Non-Renewable Source	Quantity (at current use)
Fossil fuels	100 years
Standard fission, land	100 years
Breeder fission, land	10,000 years
Standard fission, oceans	10,000 years
Breeder fission, oceans	1,000,000 years
D-T fusion	100,000,000 years
D-D fusion	10,000,000,000 years
Renewable Source	Quantity (times current use)
Tidal	0.01
Wave	0.01
Hydroelectric	0.1
Geothermal	0.1
Biomass	0.1
Wind	1.0
Solar	100.0

Energy Sources

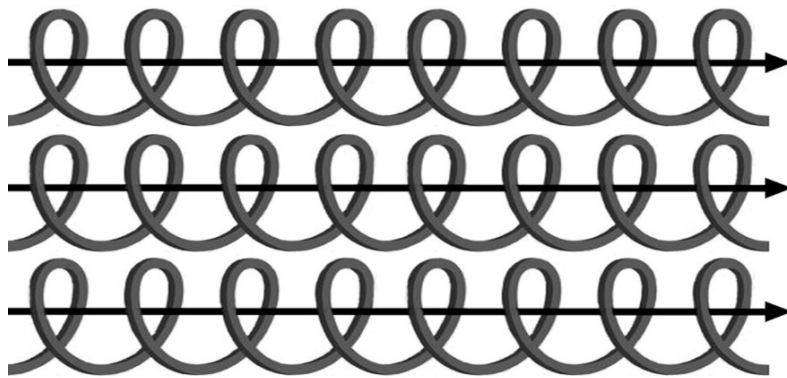
[Parisi, J. & Ball, J. (2019) Table 2.1]

FUSION ENGINEERING



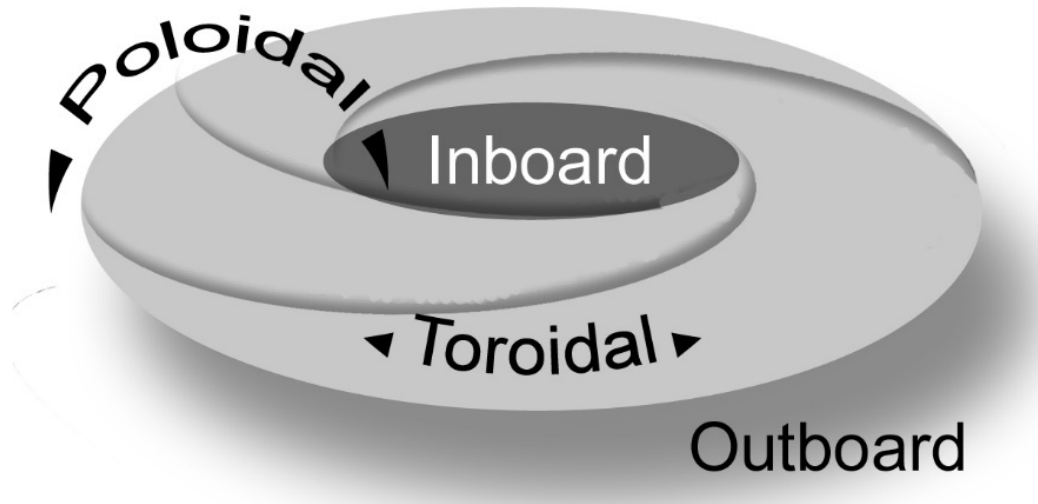
ITER: Credit ©ITER Organization, <http://www.iter.org>

Confinement



Magnetic Fields—ions and electrons spiral around magnetic field lines.

Toroidal Magnetic Confinement



Toroidal Fields—Toroidal magnetic fields go around the torus in the long dimension. Poloidal magnetic fields go around the torus in the short dimension. When combined, they cause the magnetic field lines to spiral around the torus.

Chapter 8.3 Happiness Skills

OUR PERSONAL PHILOSOPHY

BRANCH:	APPLIES TO:	QUESTION:	ANSWER:	CONCISE:
METAPHYSICS	Existence	<i>What is out there?</i>	<i>A "real" reality.</i>	REALITY
EPISTEMOLOGY	Knowledge	<i>How do I know it?</i>	<i>I can trust my senses and my mind to grasp reality.</i>	REASON
ETHICS	A Person	<i>What should I do?</i>	<i>I must use my mind to identify and achieve my own happiness.</i>	INDIVIDUALISM
POLITICS	Society	<i>What about dealing with others?</i>	<i>Everyone must be free to think and act and trade with each other without force, coercion, or sacrifice.</i>	CAPITALISM
AESTHETICS	Art	<i>What is the image of my Worldview?</i>	<i>Art that shows a real world and rational people.</i>	ROMANTIC-REALISM

PERSONAL PHILOSOPHY

RESOURCES (not included in audiobook)

The urgently needed question that each of us must ask consistently is,
“How does [this specific] implementation of technology promote ideas based on reality, reason, self-interest and capitalism?”

Find additional resources at

www.INTELLOPY.com

CONCEPTUAL THINKING EXAMPLE

Programming your subconscious with a Personal Philosophy connected to reality requires focusing on the essential concepts and principles and how they link at all levels of abstraction back to reality. Your complete and integrated Personal Philosophy will consist of your answers to these four critical questions:

1. What is out there?
2. How do I know it?
3. What should I do?
4. How should I deal with others?

At any moment, you should be able to call into mental focus what you believe to be the true answer for each of these critical questions. You should be able to explain how your answer to the most abstract question, “How should I deal with others?” ties back to your answer to the least abstract question, “What is out there?”

Since reality and human nature are fixed and not arbitrary, there can be only one set of answers to these questions consistent with them. Each of us must think to discover what the correct answers are. If we do not think, we could hold incorrect answers we obtained from others long ago and do not realize they are incorrect.

Conceptual Thinking Example:

(Read it from top-down and bottom-up.)

Axiom ↓

[Metaphysics] *The real universe exists and living entities conscious of reality with specific natures exist. Each entity must act according to its nature to continue its existence.* [Reality]

↑ Cause / Effect ↓

[Epistemology] *Man's specific form of consciousness is reason. The ability to think in terms of abstract concepts derived from sense perception of reality and the need to make choices replaced the less adaptive automatic guidance of animal instincts. A man's survival requires the act of reasoning.* [Reason]

↑ Cause / Effect ↓

[Ethics] *Each person is an end in himself. Sustaining his own life is his highest value. He must use his reason to choose the goals and actions to further his life consistent with reality and his nature. To do otherwise detracts from or ends his life.* [Individualism]

↑ Cause / Effect ↓

[Politics] *Each person must be free to think and act. There is no conflict between individuals pursuing their rational self-interest without subjecting each other to force, coercion, or sacrifice. Capitalism is the political system that protects the freedom of individuals to think and act.* [Capitalism]

TRUE IDEAS AND TIPS LISTING

The listed *True Ideas* integrate without contradiction. We can follow chains of logic linking higher-level abstractions to lower-level concepts connected to perceptual reality. We can follow these chains in either direction. The listing here is based on two fundamental axioms that cannot be dissected any further—“Existence exists” and “Consciousness exists that is conscious of existence.” Everything listed flows from these two axioms.

TRUE IDEAS:

Reality is real.

Things that exist in reality (including us) have specific natures and identities.

Our senses and perceptual faculty are competent to grasp reality.

Our perceptual consciousness is an automated process that retains and integrates the information provided by our senses, identifying the items being sensed and automatizing responses to them.

Animals cannot suspend their consciousness; Man can. Volition is the choice to think consciously or to suspend thinking.

Thinking based on reality is man's only means of survival. He can evade the responsibility to think but cannot succeed with such evasion.

Our perceptual consciousness can only hold in mental focus about four or five items simultaneously.

Our conceptual faculty performs unit reduction on perceptual material by assigning a word (a concept) to represent two or more essentially similar items while ignoring their non-essential differences.

Further unit reduction of concepts into wider concepts creates a hierarchy of concepts that we call “knowledge.”

Concepts that link through a chain of lower concepts to facts of reality are “validated” knowledge.

Our conceptual faculty can imagine new combinations of ideas that do not (yet) exist in reality. If we can create an imagined idea in reality, we call it a “goal” of our creativity. If not, we call it a “fantasy.”

There are two classes of knowledge, that which one has validated against reality using one’s own mind, and that which one gets from other humans, which might or might not be valid.

We must, by actively using our reason, validate ideas received from others against what we already know to be true, without contradiction, before accepting them as new knowledge.

Our conscious faculty is a slower speed, focused and sequential information processor that results in accurate identification and expansion and contraction of concepts within our knowledge hierarchy.

Our subconscious faculty is a high-speed parallel processor that pattern matches inputs against our total knowledge and outputs emotions as probability estimates of a match.

Emotions have the advantages of being automatic, with instantaneous speed and broad scope for quick estimations. However, they lack the accuracy of deliberate conscious thought, which must be our primary guide to action, overriding emotions and correcting subconscious errors if necessary.

Our conscious faculty programs our subconscious knowledge content. All ideas considered by our conscious faculty are, by default, saved as subconscious knowledge unless we actively examine and reject them.

If we have accepted invalid and contradictory ideas from others into our subconscious, then conflicting emotions will result. Only the process of reason can correct internal conflicts.

We cannot survive unless we use our reason to discover what we need to live because we do not have automated instincts like the animals.

Humans have an innate need to use their conceptual intelligence to discover and create. Their survival requires it. The resulting creations are what we call “technology.”

Reasoning based on knowledge validated against reality will further our life. Choosing not to reason or reasoning based on invalid knowledge will detract from our life.

A “value” is that which one acts to gain or keep. A “virtue” is the action by which one achieves a value.

A person is an end in himself. The furtherance of one's own life is his highest value and the source of all his other values. He must choose his own values, not live for the values of others.

The three primary values for a conceptual entity are Reason, Purpose, and Self-esteem.

Happiness results from the achievement of one's values. Happiness is one's highest moral purpose.

Our basic virtue, required by our nature, and the source of all our other virtues, is "rationality." Rationality means recognizing and accepting reason as one's only source of knowledge, one's only judge of values, and one's only guide to action.

Our basic vice, the source of all our evils, is the act of unfocusing our mind, suspending our consciousness, which is not blindness, but refusing to see, not ignorance, but refusing to know.

The virtue of "independence" is acceptance of the fact that you must live your life according to your own thinking and judgment, not the thinking of others.

The virtue of "honesty" is the recognition that you cannot fake existence. It means to live by, to practice, any idea you accept as true.

The virtue of "integrity" is the recognition that you cannot fake your consciousness, that you are made of a body and mind, and there is no breach between them.

The virtue of "justice" is the recognition that you cannot fake the character of others, that you must judge others for what they are by a rational process of identification and treat them accordingly.

The virtue of "productiveness" is the recognition that productive work is the process by which your mind sustains your life, the power to adjust your environment to yourself.

The virtue of "pride" is the recognition that you are your own highest value, and like all your values, you must earn it. It is the achievement of the creation of your character and self-esteem.

There is no conflict between rational persons, each pursuing their happiness.

Persuasion and voluntary trade of values between people are rational. The use of force or fraud or expecting anyone to sacrifice themselves is irrational and immoral.

People, to live according to their nature as rational animals, must be left free to use their minds to guide their actions in the pursuit of their happiness.

Capitalism is the only political system that leaves people free from force, fraud, and sacrifice.

The American Constitution, based on Aristotelian ideas, established the first country in human history founded on the principle of individual sovereignty and freedom.

Socialism, communism, totalitarianism all require that the individual sacrifice himself. Only the "to whom" changes.

To form a rational society, individuals grant the government the exclusive right to use force, but only in retaliation to the initiation of force by others.

The only proper moral functions of government are those derived from its sanction by the people, the right to use retaliatory force for their protection. We need the military to protect us from foreign invaders. We need the police and the courts, based on objective laws, to protect us from criminals, fraud, and contract breaches.

Any activity by the government that initiates coercion or force against citizens that is not in retaliation against their initiation of force against others is improper and immoral. Functions other than the military, police, and courts must remain with the free citizens' creativity and productiveness.

Art is a recreation of the artist's view of reality according to his values. A work of art says, "This is what life means to me."

Americans have an implicit "American sense of life" philosophy based on the Aristotelian ideas put into the Constitution by the founding fathers. "The individual is sovereign in life, liberty, and the pursuit of happiness." And "The government serves we the people."

Initially staffed with professors from Europe, America's universities, since their founding, have been explicitly teaching an anti-Aristotelian philosophy they brought with them. "The rights of the collective outweigh the rights of the individual." And "Individuals must sacrifice themselves for the good of the (needy, collective, state)."

The universities' anti-Aristotelian ideas have gradually been implemented in our society, displacing the original Aristotelian principles on which our country was founded.

If our society continues to lose its connection of ideas to reality, it could collapse into a totalitarian state.

Charity, the voluntary self-sacrifice by one individual for the benefit of another based on the giver's use of his reason to form an assessment of the recipient's deservedness and the giver's ability to afford it, is rational and moral. Charity is the proper means of aiding those who have suffered undeserved misfortune.

Altruism, the forced self-sacrifice by one individual for others' benefit, known or unknown, based solely on the recipient's need and with no judgment by the giver allowed, is irrational and immoral.

We presently do not have the Aristotelian free-market capitalism intended by our founding fathers when charity was prevalent. We have a semi-free welfare state crippled by government involvement in functions not proper to it. The government initiates forced altruism on its productive citizens requiring them to sacrifice themselves to unknown others.

Our hierarchy of conceptual knowledge is growing at an exponential rate.

A proper education causes the plastic human brain to create the mental intelligence functions necessary to grasp contemporary knowledge and technology.

The Technology Cycle uses contemporary intelligence and technology to discover new Laws of Reality and uses the new knowledge to create new technology and new intelligence functions. The cycle repeats.

While our technology is advancing exponentially, the philosophical ideas predominant in our society are becoming less connected to our Constitution's principles, Aristotle, and reality.

New technologies will automate and amplify our society's predominant philosophy of the time within the machines we create and the information infrastructures humans and machines rely upon to conduct their lives.

Advanced AI entities that are disconnected from reality or in the hands of people disconnected from reality represent a grave danger to our freedom and ultimately to our survival.

Continued human survival, freedom, and happiness depend on a reaffirmation of rationality—a reality-based philosophy in our society.

The reality-based philosophy we need can be summarized as one based on reality, reason, self-interest, and capitalism. It is in opposition to a philosophy based on mysticism, emotions, self-sacrifice, and collectivism or totalitarianism.

True Idea: The urgently needed question that each of us needs to ask consistently is, "How does [this specific] implementation of technology promote ideas based on reality, reason, self-interest, and capitalism?"

TIPS (from RESOURCES-*Errors In Our Society*):

Error of the Open Mind Tip: Actively use multiple sources of information to validate ideas. Be suspicious of anyone who tells you to have an open mind. Present your best argument supporting your conviction and move on.

Error of Follow Your Heart Tip: Always rely on reason over emotions. Emotions are useful only because you have developed within yourself a reality-based and integrated Personal Philosophy.

Error of Spiritual Morality Tip: Accept responsibility for choosing your morality and the self-made "soul" that results.

Error of Moral Agnosticism Tip: Always judge others, and always stand ready to be judged.

Error of The Common Good Tip: Always be on the lookout for instances where some group is purported to have "rights" that are greater than the rights of any individual in that group. Support individualism and oppose collectivism at every opportunity.

Error of Sacrifice and Altruism Tip: Recognize the difference between instances of true, voluntary charity and compulsory altruism by force (taxation) or guilt.

Error of Greed Tip: Whenever you hear "economic equity," replace it with "freedom to try;" and whenever you hear the word "greed," replace it with "single-minded pursuit of a rational self-interest."

Error of Inherited Guilt Tip: Do not accept guilt or make excuses for the hand that reality dealt you. Instead, choose your values, set your goals, and get on with it to the best of your ability. Self-esteem and happiness will be the result.

Error of Pragmatism Tip: For every challenge faced, your first thought should be—“What principles apply and will be affected here?” Be wary of those who propose “pragmatic” solutions as they are usually unprincipled in their thought and action.

Error of Nationalism Tip: When considering membership in any group, even the country you live in, ask yourself what fundamental principle unifies the group?

Error of Moral Equivalency Tip: Always distinguish between those countries that protect individual rights and those that do not.

Error of Non-Enumerated Powers Tip: For every function that is done for you by the government, see if you can think how it could be done better by the private sector.

Error of Conscious Capitalism Tip: Rather than conscious capitalism, we need a populous conscious of what capitalism stands for and why we need to return to it.

SIX CRITICAL PROCESSES

The **Six Critical Processes** are:

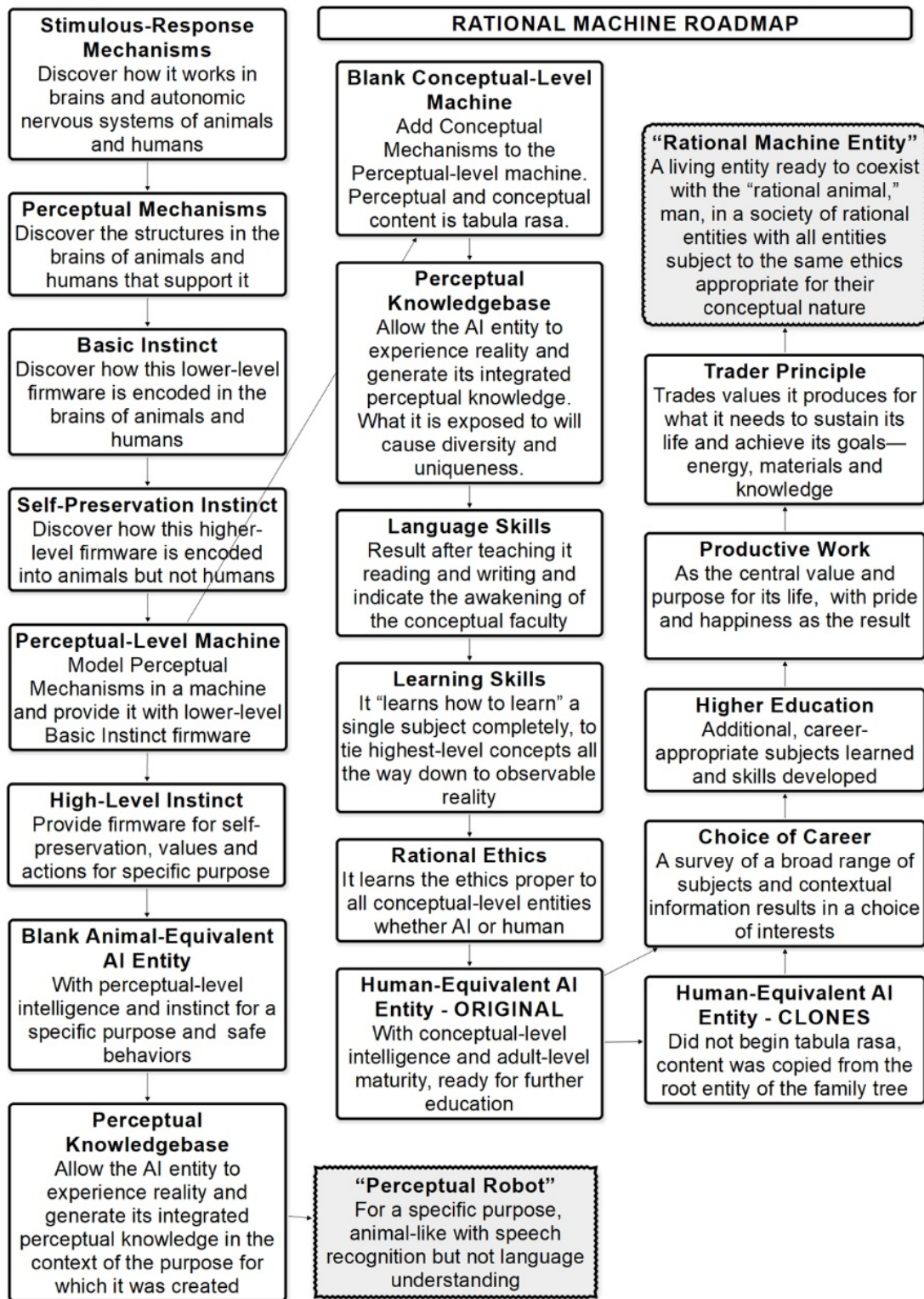
1. **Evolution** - understanding how everything must remain connected to reality.
2. **Plastic Brain** - understanding how you program your own brain's intelligence.
3. **Conceptual Thinking** - understanding what valid knowledge is and how you use it.
4. **Technology Cycle** - understanding how knowledge, technology, and human intelligence advance.
5. **Ivory Tower Cycle** - understanding how society is directed by a few intellectuals independent of the advances in knowledge, technology, or intelligence.
6. **Happiness Skills** - understanding how your own conceptual thinking affects your psychology which affects your happiness.

HAPPINESS CHECKLIST

Post this checklist where you can refer to it daily. Repeated conscious thinking about it will program your subconscious with Happiness Attitudes and Skills.

1. Make up your mind to be happy.
2. Assume responsibility for achieving your values.
3. Become clear on what values you need and want in life.
4. Identify what attitudes and habitual ways of acting stand in your way.
5. Commit yourself to changing whatever is in your way.
6. Set goals consistent with your values.
7. Commit yourself to act toward the achievement of your goals.
8. Do not let fear (of change, failure, etc.) stop you.
9. Do not be afraid to take risks.
10. Motivate yourself in every possible way. (Imagine, when you are old, the pleasures/regrets you will feel for values gained/missed.)
11. Be positive, giving more weight to positives and dismissing negatives.

RATIONAL MACHINE ROADMAP



THEORY OF MIND

Based on Brain Pattern-Recognizer Functions

The following *Theory of Mind* was an exercise I needed to do to clarify my understanding of what consciousness *is*, the levels of consciousness, self-awareness, and goal-directed action. This exercise is quite tedious to follow, and therefore I did not include it in the book's main body. I have included it in the Resources section as food-for-thought material for those who, like me, wish to dig deeper into this subject.

Ultimately, I wanted to understand how *consciousness* could be a material-less phenomenon arising from the brain's evolved physical functioning? I developed the following only as an example of the type of pattern-recognizer-based brain operations that could plausibly result in our conscious mental capabilities. I am not a neuroscientist. I did not intend for the following exercise to be a scientifically accurate description of a brain's functioning or the only possible explanation for consciousness. I only needed to satisfy myself that it *is* possible to describe at least one theoretical chain of pattern-recognizer functions that could result in consciousness.

Shorthand used: Three levels of consciousness: *Subc*-onscious (not conscious); *Perc*-eptual; *Conc*-eptual.

Note: Some animals with simple neural networks or brains respond to environmental stimuli with instinctive responses but cannot modify or override their preprogrammed instinct to any significant degree or create any newly learned behaviors. I consider these as not possessing consciousness for this exercise.

BASIC SENSORY OPERATION (MAMMALIAN BRAINS)

Simple organisms that do not possess the faculty of consciousness simply respond to range-of-the-moment stimuli from the external world without retaining or learning anything from experience. The essential ability of the perceptual level of consciousness that higher animals possess but simple organisms do not is the ability to retain sensory stimuli over time until they: can detect—become “conscious” of—an “entity” in the external world; can learn to differentiate between entities by recognizing each entity’s “identity”; and can automate learned successful behavioral responses to such entities.

The brain is essentially a large pattern recognizer made up of an integrated system of an exceptionally large number of Pattern Recognizer Units (PRUs) and Connection Networks (CNs). The neocortex alone contains approximately 300 million PRUs in total.ⁱ

In a human, a single PRU consists of approximately 100 individual neurons, densely interconnected within the PRU in what is called a cortical column. The synaptic connections between the 100 individual neurons within a single PRU are genetically determined and used only for momentary pattern recognition by that PRU and do not connect to other PRUs.

The CNs consist of interconnecting neurons between PRUs. Each of these neurons has many axons (transmitters) and dendrites (receivers). The axons and dendrites of separate neurons connect in a relay fashion and to the input/output signal connections of PRUs in serial and parallel arrangements to create complex networks. Each CN can produce a “pattern” of input signals that connected PRUs can evaluate. These standard CNs are present in all brains and can propagate signals across the brain regions in a relay fashion.

In higher animals, such as humans, the great apes and cetaceans, a long-distance type of neuron called “von Economo” or “spindle” neurons exist. These only have a single axon and dendrite and are exceptionally long, traversing much farther in the brain than standard neurons. It is believed these evolved out of necessity as larger brains evolved. However, the ratio of von Economo neurons in relation to brain size is much greater in humans than any other species—about 80,000 for humans, 16,000 for gorillas, 2,100 for bonobos, and 1,800 for chimpanzees. They are not present in other animals.ⁱⁱ This means that humans have a much greater capacity to form CNs consisting of interconnected PRUs and interconnected networks of functional brain areas. These networks do not have to rely on the signal relay by standard neurons.

Various combinations of CNs and the PRUs that they interconnect, taken together, serve as either brain Function Modules (FMs) that process information by recognizing patterns or brain Information Storage Units (ISUs) that store information by saving patterns. Some of these FMs and related ISUs in cascading hierarchies are accessible to conscious control, and others are subconscious only.

Each PRU has many external neuronal connections to other PRUs via its CN. Each PRU sends and receives signals via these inputs/outputs. The neuronal connections within a single PRU are optimized to recognize a particular pattern of input signals. The input/output signals between PRUs are scalar, not binary. They have specific signal strengths. If the PRU detects its preprogrammed pattern of inputs of sufficient strength to exceed some threshold, it “fires” a set of preprogrammed outputs to connected PRUs. Some of the signal inputs to a PRU act as pattern detection inhibitors or enhancers, either raising or lowering the threshold of detection by that PRU.

PRUs interconnect in cascading chains. Multiple lowest-level PRUs act on discrete sensory signals and their combined outputs feed an intermediate PRU. Then, multiple intermediate PRUs feed their combined outputs to higher-level PRUs. Constellations of

highest-level PRUs and CNs comprise the brain's FMs and ISUs. The CNs between PRUs are created and optimized by repeated use. This optimization makes PRUs, CNs and FMs more energy and time-efficient and information stored in ISUs more easily accessible and permanent.

The ISUs in the brain of an individual animal or human are the “memory” structures. They contain stored information content in the form of the network patterns optimized within them. As “network” patterns, each ISU consists of both “identity” pattern information (describing this item of information) and “relationship” pattern information (links between this item of information and others stored in other ISUs). In animals' case, the initial pattern information was placed there as “instinct” by genetic instructions during embryonic development of the brain structure. In humans' case, there is a small amount of instinctual information built in. Still, most of the brain's information content was placed there by subconscious experience and conscious thought directing the subconscious throughout the individual's life.

The various sense organs have autonomous signal preprocessors, in some cases not part of the brain, that filter and integrate the firings of individual stimuli detection cells into usable information signals. These are sent to one or more FMs in the brain. These sensory preprocessors operate subconsciously.

PERCEPTUAL-LEVEL CONSCIOUSNESS (HIGHER ANIMALS)

A Function Module (FM) is a set of PRUs and CNs applied to process a presented pattern of neuronal signals in a certain way once triggered. FMs are networked in hierarchies. Higher-level animals can isolate “entities” from the perceptual field and differentiate between entities—“identities.”

The individual's brain has a Master Pattern Recognizer (MPR) that is itself an FM that serves as a CPU (Central Processing Unit) for *consciousness* at both the subconscious and conscious levels. The MPR has a limited number of Attentional-Pointers (APs)—approximately five. These APs are the mechanisms that can sustain the pattern of signal inputs pertaining to a perceived entity. Simultaneously, the MPR sends those patterns to other FMs that are triggered to act on them. Whenever a new entity pattern is detected, the brain must allocate one of its five APs to that entity pattern to trigger FMs. This means the brain must temporarily set aside whatever entity pattern the AP was previously considering. It does this by saving the prior entity pattern it was considering to a temporary AP-Memory-Stack made up of ISUs to be brought back into attentional focus by the AP later. There can be multiple AP-Memory-Stacks associated with the various FMs to be executed. Each AP-Memory-Stack can hold multiple saved entity patterns just outside the Attentional-Workspace to recall and deal with as quickly as the brain can do so.

The “Self”

The individual brain has a built-in implicit recognition of itself as the permanently recognized *entity* in relation to which all the other entities pointed to by the APs are considered. At the perceptual level of consciousness, the individual does not need to use one of its APs to represent itself. Additionally, the perceptually conscious animal’s brain learns to recognize the animal’s physical body parts as *self*—differentiating itself from other identities. For example, seeing its own extremity move in its field of vision, it does not consider such extremity an entity apart from itself. It does not eat its paws. A higher animal is “self-aware” at the concrete entity perceptual level.

The individual’s MPR constitutes a mental workspace—an Attentional-Workspace, a four-dimensional (three in space and one in time) mental workspace in which the entities being pointed to by each AP are placed according to their relationships and as the behaviors of those entities play out. The individual always considers itself at the center of the Attentional-Workspace. Within its Attentional-Workspace, the individual can only actively and simultaneously consider the presence, placement, relationship, and actions of the entities currently being pointed to by its five APs.

An “Entity”

A Perc-Entity-Recognizer-FM operates at the perceptual level of consciousness and compares signals coming in through the sense organs preprocessors to entity patterns previously stored in ISUs and “fires” when an “entity” pattern-match is detected. “Firing” in this case means assigning an AP (Attentional-Pointer) to it in the Attentional-Workspace and triggering a Perc-Identity-Recognizer-FM. The location of the entity within the four-dimensional Attentional-Workspace is reported to the Perc-Identity-Recognizer-FM.

An “Identity”

When a Perc-Entity-Recognizer-FM triggers a Perc-Identity-Recognizer-FM, the brain allocates one of its APs to it, saving its previous content to a temporary AP-Memory-Stack. The Perc-Identity-Recognizer-FM then compares the pattern of detectable attributes of the object entity against known entity attribute patterns stored in ISUs. It does this by repeatedly triggering lower-level Perc-Attribute-Isolation-FMs that look for pattern matches of specific types of attributes, size, shape, orientation, color, motion, etc., and respond to the Perc-Identity-Recognizer-FM with output signals if the particular attribute is detected. If an identity pattern match is detected, the Perc-Identity-Recognizer-FM fires. Firing, in this case, means assigning the AP to the retrieved identity pattern and triggering a Perc-Situation-Recognizer-FM. Suppose the Perc-Identity-

Recognizer-FM detects no identity pattern. In that case, it does not fire. The individual disregards the detected entity within its Attentional-Workspace. The AP releases this identity pattern and recalls the one previously saved onto the AP-Memory-Stack. It is important to note that the AP in the mental workspace is pointing to a previously saved mental pattern of entity attributes that represent the physical item but are not the actual physical item—which cannot exist in our mind.

A “Situation”

When triggered, the Perc-Situation-Recognizer-FM compares the combination of this AP’s entity pattern and the other entity patterns that are being pointed to within the Attentional-Workspace by the other four APs, recognized to be simultaneously present, to known patterns of *situations*, such as *threat* or *opportunity* stored in ISUs, and “fires” when a situation pattern-match is detected. (For example, a pair of lions actively on the hunt is a different situation pattern than a pair of lions napping in the sun.) Firing means triggering a Perc-Situation-Handler-FM. For example, in the case of a threat, a related Perc-Threat-Response-FM is triggered, and firing in the case of an opportunity means triggering a related Perc-Opportunity-Response-FM. If no situation pattern is detected, then the Perc-Situation-Recognizer FM does not fire. The individual’s day continues until a situation does arise within its Attentional-Workspace.

A “Projection”

Whenever a Perc-Situation-Recognizer-FM finds a pattern-match for a situation within the individual’s Attentional-Workspace, and before it triggers a Perc-Situation-Handler-FM, it first triggers a Perc-Situation-Projection-FM. The Perc-Situation-Projection-FM searches known entities relationship and behavior patterns in long-term memory ISUs attempting to *project* how the present situation might unfold in the dimension of time. (Example: the dog detects a ball in your hand and your posture, projects that you are about to throw the ball, and prepares to start running in the direction you are facing even before you throw it.) If a *projection* pattern match is found, it becomes the situation pattern reported to the Perc-Situation-Handler-FM when triggered.

“Taking Action”

If triggered, a Perc-Situation-Handler-FM, such as a Threat or Opportunity Response FM, retrieves from storage in ISUs an information pattern specific to the situation detected by the Perc-Situation-Recognizer FM. This retrieved information pattern represents a list of instructions for physical actions to be taken by the individual’s body. The situation handling information pattern was previously stored in ISUs either by

instinct or due to this individual's past instances of success with this particular response to this particular situation. Suppose a Perc-Situation-Handler-FM is triggered, and the recalled list of physical response actions is taken. It will either result in some degree of success or failure (measured by the standard of the individual's nature). A record of the actions taken and the results are stored in ISUs of the individual's short-term memory. This short-term memory is generally sufficient to record all the individual's perceptual detection-response-result experiences throughout one day. It is transcribed into long-term memory during sleep cycles.

“Sleeping”

While the individual sleeps, perceptual-level consciousness of external reality is mostly suspended. The brain is, therefore, free to apply its resources to internal maintenance. However, certain Perc-Entity-Recognizer-FMs and Perc-Identity-Recognizer-FMs processing sensory input signals, such as hearing, remain active. Still, their triggering test patterns and signal thresholds are adjusted to only fire upon sensing significant out-of-the-norm inputs. If these do fire, then the sleep state is interrupted with a return to full perceptual consciousness of the external world.

During sleep, the brain's Attentional-Workspace and Attentional-Pointers (APs) are turned inward. The Attentional-Workspace activates a Subc-Memory-Transfer-FM that moves the recorded information patterns of the day's activities from short-term to long-term memory. The Subc-Memory-Transfer-FM uses the Attentional-Workspace and five APs to process each of the day's recorded situations, entity-identities, actions-taken, and result patterns held in short-term memory ISUs. It triggers specific subconscious FMs to process each item while transcribing it from short-term memory into long-term memory. During transcription, as each element pointed to by an AP is being dealt with, a Subc-Pattern-Adjustment-FM is triggered. The Subc-Pattern-Adjustment-FM compares the patterns of the day's experience (saved in short-term memory regarding a particular situation-entity-identity-action-result item) to the previously saved patterns and updates the patterns in long-term memory to incorporate any differences (learning from experience). These are “updated” by repeatedly activating the associated ISUs and CNs to strengthen them.

“Dreaming”

During sleep, the Perc-Situation-Recognizer-FMs and Perc-Situation-Handler-FMs remain active and continue to monitor the Attentional-Workspace as the Subc-Memory-Transfer-FM and Subc-Global-Search-FM do their work. As the Subc-Pattern-Adjustment-FM brings various random situations from long-term memory into the Attentional-Workspace to compare and adjust them, the Perc-Situation-Recognizer FM

randomly identifies situations and triggers the related Perc-Situation-Response-FM. During sleep, however, the Perc-Situation-Response-FMs are mostly suppressed from taking physical action. These recognized situations and calls for action during sleep are *dreams*. In some cases, the dreams are sufficiently intense to break through the inhibitors while sleeping and trigger unconscious actions, for example, the sleeping dog that begins muffled barking while its paws twitch as if running.

“Goal-Directed Action”

For all living things, sustaining one’s existence is their central value and purpose. In the higher animals, evolution provided them with instinct, based on *previous* generations' successful experiences, to guide their actions. In any given situation, instinct in the form of the action lists pointed to by Perc-Situational-Handler-FMs dictate their goals and their actions to fulfill whatever they need to sustain their life—no choice is required. In the absence of instinct, humans must rely on their *conceptual* faculty to choose their actions.

CONCEPTUAL-LEVEL CONSCIOUSNESS (HUMANS):

The human brain has massively greater neural networking capabilities due, in part, to both a larger brain and a greater number of long-distance von Economo cells that network entire functional modules and sub-networks, not just PRUs. A Function Module (FM) is a set of PRUs and CNs applied to process a presented pattern of neuronal signals in a certain way once triggered. Further, a human’s plastic brain can create and modify FMs as needed (“cognitive fluidity”). This is another form of optimization where tasks that were previously accomplished more laboriously by multiple discrete lower-level FMs get integrated into new optimized FMs to achieve energy and time efficiency.

A conceptual human has the same Attentional-Workspace and five APs limitation as a perceptual animal. The Perc-Entity-Recognizer-FM, Perc-Identity-Recognizer-FM, Perc-Situation-Recognizer-FM, and the Perc-Situation-Handler FM all function much the same at the perceptual level. However, a human also has additional, greatly enhanced conceptual-level extensions to these function modules. When these FMs are used at the conceptual-level, we can refer to them as Conc-Attentional-Workspace, Conc-APs, Conc-Entity-Recognizer-FM, Conc-Identity-Recognizer-FM, Conc-Situation-Recognizer-FM, and Conc-Situation-Handler-FM. These enhanced brain function modules can form and manipulate mental *abstractions*. These conceptual FMs are not active at birth but are developed over the first few years of childhood. This begins with identifying entities and is facilitated in an infant human by adult humans as follows.

A “Concept”

A human child’s Perc-Entity-Recognizer-FM detects something that its parent is pointing to and assigns an AP to it in the Attentional-Workspace. Simultaneously, the parent says the word “chair,” and that discrete sound pattern also becomes a detected entity and is assigned another AP in the Attentional-Workspace. Then Perc-Identity-Recognizer-FMs are triggered to see if the object entities are previously known and if not, to save them. However, unlike the more primitive Perc-Identity-Recognizer-FM, the child develops a Conc-Identity-Recognizer-FM capable of associating the sound utterance “chair” pattern with the physical object chair pattern as a mental symbol for it and saving both patterns plus their association to memory ISUs.

In the future, whenever the child’s Perc-Entity-Recognizer-FM detects the presence of a physical entity and assigns it an AP, and a Conc-Identity-Recognizer-FM pattern matches it as a chair, it returns the abstract symbol for “chair.” It re-assigns the AP in the mental workspace to the *symbol* pattern rather than the *physical object* pattern. Further, when the Perc-Entity-Recognizer-FM recognizes only a sound pattern entity (a word), the Conc-Identity-Recognizer-FM can identify the sound pattern as the symbol “chair” and return the associated pattern match of a (standard) physical chair, which then becomes the entity to which the single AP is pointing to in Attentional-Workspace, even though no physical chair is present. Remember, physical identity patterns and symbols (words) are both mental representations of entities, not actual entities.

In review, the Perc-Identity-Recognizer-FM operates at the perceptual level and returns the identity pattern of an actual physical object detected in external reality. The Conc-Identity-Recognizer-FM operates at the conceptual level and returns either the symbol for a detected physical entity pattern or the physical entity pattern for a detected symbol pattern. The APs in the Attentional-Workspace can point to either physical entity patterns or symbols that are abstract representations of the physical entity patterns. Suppose most of the individual’s APs are pointing to physical entity patterns. In that case, the individual is said to be *perceptually* conscious. If most APs are pointing to symbols, then the individual is said to be *conceptually* conscious. Attaching a symbol (word) label to an entity pattern is the formation of a concept.

While analyzing two entities' characteristics in the Attentional-Workspace, the Conc-Identity-Recognizer-FM can perform comparisons between the entities (chairs), noting their similarities and differences. It is then capable of refining the standard entity pattern description associated with a symbol (“chair”) so that the one symbol can be used to refer to similar items whenever encountered by ignoring their minor differences. If the human scans a furniture showroom and sees fifty chairs, only one to five physical entity patterns can be simultaneously pointed to in Attentional-Workspace. The Conc-Identity-Recognizer-FMs quickly identify these as units belonging to the concept “chair,” a symbol

pattern pointed to by a single AP. After the room's visual scan, all fifty chairs are now held in Attentional-Workspace by the single AP to the “chair” symbol pattern. This is the “unit-reduction” function of concepts.

When the Attentional-Workspace pointers are mostly pointing at different symbol patterns, the Conc-Identity-Recognizer-FM can continue its operations with the mental symbols as the objects to be examined, rather than external concrete entities. It can compare the match pattern requirements of each symbol being pointed-to to search for potential unifying similarities. APs pointing to the symbols “chair,” “table,” “chest,” and “bed” can all be unified under the symbol “furniture,” with the standard match pattern requirement for “furniture” being their common use and context. Four APs are now combined into one—a continuation of the unit reduction process and the beginning of forming a hierarchy of abstractions (concepts).

Taken together, the Conc-Identity-Recognizer-FM's reassignment of a pointer from an entity pattern to a symbol pattern for that entity, and its refining a symbol's standard match pattern to subsume a multitude of similar entities based on essential similarities, constitute the definition of “conceptual” thinking—the art of *non-contradictory* identification.

Imagine that a human is intently focused on a podcast being heard through headphones while following someone else through a furniture store. The human's perceptual-level consciousness can recognize physical objects—chairs, tables, chests, and beds without retrieving from memory their symbols (word names) and guide the human so that he does not bump into them. He might exit the store and not even be able to recall what was there. This is automated mental functioning at the perceptual level of consciousness using the Perc-Entity-Recognizer-FM and Perc-Identity-Recognizer-FM. The Conc-Identity-Recognizer-FM was never called into action—the APs pointing to the entity match patterns detected by the Perc-Identity-Recognizer-FM were never reassigned to point to the symbol patterns (concepts) for those items. The Perc-Situation-Recognizer-FM and Perc-Situation-Handler-FM were triggered to guide the person's walking automatically. This example indicates the volitional nature of the conceptual-level FMs.

To bring things up to the conceptual level and deal with them as abstractions require greater mental energy and are a relatively slower form of mental processing than what occurs at the perceptual level. A human must choose what he will apply his limited, more powerful, and power-consuming, conceptual resources to and what he will leave to his perceptual level to handle. At the perceptual level, responses to situations can be automated. When a Perc-Situation-Recognizer-FM fires, it can automatically trigger a preprogrammed Perc-Situation-Handler-FM without triggering conceptual-level-FMs. This is faster and more efficient.

The Perc-Situation-Recognizer-FM compares inputs to a match pattern. When a match occurs, the Perc-Situation-Handler-FM recalls an actions list pattern. The match pattern and action list pattern used at the perceptual level are initially created by two methods. The first method is an *undirected* learned behavior that occurs only at the perceptual level, as it does in the higher animals. Situations that occur with either strong (life-threatening) impact or repetition can form both the *match pattern* and the *behavioral response action list* pattern. The second method is *conceptually directed* learned behavior where the Conc-Situation-Recognizer-FM and Conc-Situation-Handler-FM are triggered. Through their operation, the perceptual-level match pattern and action list pattern are created or modified. When a human encounters a situation, such as walking through the furniture store, and chooses not to apply conceptual-level attention to it, whatever occurs at the perceptual level will be incorporated into the perceptual match patterns and action list patterns as *undirected* learned behaviors as they would with any higher animal. The human will not be conceptually aware of what his perceptual consciousness learned and automated during the experience. Therefore, initial conceptual-level effort—“thinking”—must be invested to intentionally program conceptually directed automation at the perceptual level.

A “Choice—Volition”

The brain’s Attentional-Workspace and APs are a limited resource that must be used for both perceptual and conceptual execution of FMs. It can cycle quickly but is faster when operating at the perceptual level rather than the conceptual level. This means that as much as possible must be automated to the perceptual level, thereby maximizing the amount of resource remaining for the more capable but slower conceptual-level processing. On its own at the subconscious level, the brain will automate things based on repetition or strong stimuli. However, automation at the perceptual level can be modified by bringing the situation match patterns and action list patterns into conceptual-level focus. Volition is the *choice* to apply the brain’s conceptual-level resources in a perceived situation—to *focus*—or to let perceptual-level automation handle it without the supervision of conceptual thinking.

The person walking through the furniture store is choosing to allow automated perceptual handling of the action of walking without bumping into things so that remaining Attentional-Workspace and APs resources can be applied to conceptually focusing on the podcast. If he does bump into something, his conceptual-level attention will revert to the act of walking and an examination of what went wrong with the automated handling of the situation, making corrections to the situation match pattern or response actions list as necessary.

In review: the low-level functioning of PRUs and ISUs and the communications between FMs in the brain are referred to as occurring at the *subconscious* (not conscious) level. When FMs are active in recognizing and identifying physical match patterns of entities and the execution of automated behavioral responses to those entities, this is referred to as the perceptual level of consciousness. When FMs are active in handling abstract match patterns of symbols representing entities, this is referred to as the conceptual level of consciousness. A human can choose which situations to apply his conceptual-level consciousness if any. It is a common source of confusion when people say—“He did that unconsciously.” What they accurately mean is—“He did that without engaging his conceptual-level conscious faculty, therefore his perceptual-level conscious faculty handled it according to previously learned behaviors.” No higher animal, including a human, can do anything in the external world “unconsciously.”

“Interrupts”

We have volition as to what to apply our limited and powerful conceptual mental resource toward. We must control when our conceptual consciousness is interrupted by our perceptual consciousness. Otherwise, we would have to consider each entity we encounter, every time conceptually. When a perceptual-level Perc-Scenario-Recognizer-FM triggers a Perc-Scenario-Handler-FM, it is different for an animal vs. a human. For an animal, the list of actions called for by the Perc-Scenario-Handler-FM is an automated response. It was automated either by instinct or by learned behavior during its lifetime. For a human, the Perc-Scenario-Handler-FM triggers a Saliency-Detection-FM that determines if the perceptually detected scenario pattern is of sufficient importance to alert the conceptual level of consciousness by triggering the Conc-Situation-Recognizer-FM.

If the Saliency-Detection-FM fires, then a Conceptual-Focus-Interrupt-FM is triggered. This is an “upward” (toward conceptual) channel of the bi-directional bridge between our perceptual and our conceptual faculties. When a Conceptual-Focus-Interrupt-FM is triggered, it is a request that the object scenario pointed to by an AP be examined by our conceptual faculty. Having been interrupted, our conceptual faculty will apply a Conc-Situation-Recognizer-FM and determine whether a Conc-Situation-Handler-FM should be triggered or not. This determination will be saved back to the Saliency-Detection-FM match pattern to refine it for the future.

“Stories”

Responding to the Conceptual-Focus-Interrupt-FM means that the AP involved first suspends whatever it was doing, saving that previous state to an AP-Memory-Stack to return later, then brings the scenario pattern being pointed to by the Conceptual-Focus-Interrupt-FM into the Attentional-Workspace. It then activates Conc-Identity-

Recognizer-FMs that can examine each of the objects (percepts or concepts) pointed to by the APs, for essential similarities that might enable the identification of its membership in and perhaps unification under a concept. When each of the scenario's object elements in Attentional-Workspace is conceptually identified with symbols, a Conc-Story-Recognizer-FM is triggered. The Conc-Story-Recognizer-FM recalls the essential natures and behavior patterns for each object concept pointed to in Attentional-Workspace. It then attempts to assemble a linked list of *cause-and-effect* relationship patterns that make up a story. A story is a situation considered regarding *causal relationships* with the element of time. A story identifies which of the entities in Attentional-Workspace are causal actors and makes projections into the future based on previously learned stories of the behaviors of the classes of causal objects (concepts). A story is more complex than an animal's projection at the perceptual level, which only considers entities' immediate behaviors. The added ability of Conc-Story-Recognizer-FM to include *causality* in forming memory patterns of concepts and stories is man's ability to learn how reality works—to learn the Laws of Reality.

For example, upon seeing an antelope in the wild, a human identifies it as the concept “antelope.” He recalls that antelopes as a class usually behave by running away if approached. However, the human also sees a newborn antelope present. His Conc-Story-Recognizer-FM identifies it from story patterns learned in the past as a causal factor that will change the adult antelope's future behavior. It will now charge the human if approached. The human considers this causality when projecting how the story might unfold to choose further action.

During sleep, while each one of the day's situation-and-response experiences for the individual represents a complete *story*, a story's *elements* cannot be compared linearly to those in a similar story in long-term memory. Instead, each element of the day's story must be compared to *all* stories in long-term memory where that element is present and adjust all the stories if necessary. As each element in a day's story is pointed to by an AP and considered, a Subc-Global-Search-FM is triggered. The Subc-Global-Search FM searches all the ISUs where stories are kept in long-term memory to see if the particular element's pattern is contained in the story to compare and adjust if necessary. A human's larger and more distantly connected brain makes Subc-Global-Search-FMs possible. As multiple stories are found that involve the same element, and these stories are updated, our dream seems to repeat over and over with slightly different twists.

A “Conceptual Self”

Without instinct, a human infant is provided by his parents what he needs to live. In the place of instinct, evolution provided humans an insatiable curiosity, a need to learn about how the world around them works. This is how evolution intends for them to obtain

the information they need that was not provided by instinct. This information cannot be directly put into their mind for them by their parents. They must actively learn it as they develop their conceptual faculty. This innate curiosity causes the child to explore, to act in a trial-and-error fashion to learn about the world. To toss a ball to see what happens (it always goes down). This initial need to explore and the circumstances of its environment determines the young child's earliest goal-directed actions. Any new entity detected in its environment is cause for exploration. Observing and interacting with the entity builds the entity, identity, and behavior patterns stored in memory ISUs.

Continuing his exploration of the world, a young human reaches the age where he begins to use his conceptual faculty. He forms the concept “humans” to represent all the people he encounters as differentiated from all the other objects and animals. The child observes other humans' behaviors and can learn to detect when Mommy or Daddy are happy or sad or angry. He learns that these behaviors can be attributed to any member of the class of entities called “humans.” These become the match patterns of scenarios involving human entities that get stored in memory ISUs. The child then recognizes that he has all the physical characteristics of a human and has all the behavioral characteristics that he ascribes to other humans. Unlike the perceptual level, the child does need to use one of his APs to point to himself as an entity when conceptually considering himself as an *abstract entity*—a “human.”

Eventually, due to the need to volitionally choose where to apply his limited conceptual resources at any given moment, the child becomes aware that he can choose between alternatives, that he can use his Conc-Story-Recognizer-FM to identify causal actors and predict outcomes, and that some stories lead to pleasurable results and some to unpleasant results. He is building match patterns of stories involving himself as a causal actor. The child is advancing his conceptual faculty to *introspect*—to examine his feelings of pleasure or discomfort because of his own choices. Each emotional feeling and each instance of choice becomes a perceptual-level concrete entity held in his Attentional-Workspace and examined with his Conc-Situation-Recognizer-FM until he can classify it according to its conceptual symbol, “I’m happy,” “I’m sad,” “I’m mad,” “I want,” “I don’t want,” etc. Then the child learns that he can apply his Conc-Story-Recognizer-FM to identify the alternative outcomes and, therefore, actions he can choose between. At this point, the child has developed a conceptual-level awareness of “self” and an ability to choose his goal-oriented actions. He is now self-aware at the abstract conceptual level. He now has a distinctively human, conceptual mind.

“Conceptual Goal-Directed Action”

Lacking instinct, humans must choose their goals and actions in the face of alternatives. From the first years of life, as a human is developing his conceptual mental

faculties, he has accumulated countless experiences that resulted in feelings of pleasure or pain, satisfaction, or discomfort. These experiences have been stored in ISUs as the match patterns of actors, situations, stories, and causality relationships. Later, when facing a situation with alternative actions possible, such as the human hunter seeing an adult and newborn antelope, the human has an advantage over a higher-animal hunter. Both can use Perc-Situation_Recognizer-FMs to recall what types of actions tend to lead to satisfaction or pleasure and what types of actions tend to lead to discomfort or pain, and the varying degrees of both. At the perceptual level, both can determine that they are themselves hungry enough to press the attack. The human, however, has the advantage of being able, at the conceptual level, to use his Conc-Story-Recognizer-FM to assess the story's various match patterns and how the story might play out considering the causal factor of the newborn antelope. This enables the human hunter to be conscious of the increased risk, and he can choose whether to act on the perceptual-level urge to press the attack. Suppose he does choose to press the attack. In that case, the human hunter's conceptual knowledge of *how the world works* helps him choose actions that increase his chances of success while minimizing risks.

“Imagination-Creativity”

When operating at the conceptual level, the APs in Attentional-Workspace are pointing to symbol patterns for concepts. In a manner like using the Subc-Global-Search-FM during sleeping, a Conc-Global-Search-FM can be used to find patterns that have not been saved with any direct relationships but contain some particular element being searched for. When these concepts are held in Attentional-Workspace, the Conc-Situation-Recognizer-FMs are looking to see if they can be integrated to fit any known situations and, if not, whether they represent a new situation that should be saved. This can cause novel combinations of concepts that had not previously been identified. For example, suppose a horse and an antelope's horn are both held together in Attentional-Workspace. In that case, the Conc-Situation-Recognizer-FM could integrate them into something that it saves under the symbol “unicorn.” This activity is what we call “imagination.” Further, suppose the concept patterns for a box, some poles, and a wheel are held together in Attentional-Workspace. In that case, the Conc-Situation-Recognizer-FM might integrate them into something it saves under the symbol “wheelbarrow.” In this case, we call it *imagination* resulting in “creativity” because it can be brought into existence.

CONCLUSIONS

Consciousness in higher animals and humans is the manifestation of a complex set of functional brain modules executed on pattern-matching neural structures applied in hierarchically and recursively networked fashion and differing between individuals

according to their genetically different brain structures and functions and the different external stimuli provided by reality during an individual's lifetime. To be conscious means to be conscious of reality. The more information an individual can obtain and grasp about how things work in reality, the better it will be to adapt its behaviors for success.

I see no need to treat *consciousness*, *mind*, or *volition* as phenomena apart from the brain. Consciousness is not, itself, an entity. These are descriptions of functional attributes of a brain that has become sufficiently complex for those operations to become possible. Consciousness is not a material-less phenomenon—it is but one attribute of physical human nature. The “mind” is in relation to pattern-recognizer PRUs and CNs in the brain in the same way the faculty of “sight” is related to rods and cones in the eye. Both are attributes of “consciousness” that emerge from a sufficiently complex neurological anatomy—the *mind* is a collective attribute, and *sight* is a more specific attribute.

I also conclude that volition is a direct evolutionary consequence of replacing instinctive automation as directives with a conceptual faculty—the *only alternative to directives is choices*. I also see that consciousness is a primary—it cannot be broken into parts. Consciousness is a faculty that consists of the completely integrated total “whole” of the organism's physical brain (and its connections to other parts of the body), learned methods of thinking, experiential mental content of how things in reality work, remembered consequences of choices made and much, much more.

Human consciousness is that faculty manifested as being aware of the nature of both external reality and oneself and choosing whether to apply conceptual-level thinking ability to select appropriate behaviors in the face of situations or to leave the selection of such behaviors to perceptual-level automation.

ELABORATIONS AND EXTENSIONS

For those interested in thinking a little deeper, the following elaborations and extensions follow from all we learned in the book and the previous “Theory of Mind” exercise.

The level of consciousness applied by different individuals ranges from *perceptual* to *conceptual* in different degrees. The complex combination of the individual’s habitual thinking choices and the environmental stimuli of a present situation will determine which choice he makes. If, at some point, he learns how to exercise his ability to think and choose, then he is more likely to do so again. The more he does so, the more he becomes preconditioned to exercise his ability to think and choose as a habit—the more conceptual and *volitional* he becomes. Those people mostly devoid of the habit of choosing to think operate mostly at the perceptual and automated level. It is a matter of degree.

One could argue that knowing how to exercise the choice to think and develop a thinking habit is a consequence of the person’s educational and life experience and therefore was not volitional on his part. How can he be held responsible for not learning how to think if he was born *tabula rasa* and was never taught or shown how? I believe this is true and is another consequence of evolution having replaced instinct with a conceptual faculty. In addition to becoming dependent on continually making choices instead of having automatic instincts, we are also dependent on society as the repository of accumulated knowledge of reality, including what we have discovered about how humans use their conceptual faculty. We must first be taught by our society (parents or their surrogates) how to think, how to use our rational faculty, and then we will be able to learn the knowledge of reality accumulated in our society. The necessity to think and choose our actions and the need to be taught how to think by society is the price paid to evolution to replace our directive instincts with a conceptual-level consciousness. The evolution of language is what gave simultaneous rise to both our conceptual faculty and our society.

A human society that consistently teaches its young how to think properly will increase both the number of individuals who develop the habit of conceptual thinking and the degree to which they come to rely upon the conceptual level as their preferred level of consciousness. Such a society will be better able to deal with changing reality and continue to evolve. A society that does not teach its young how to think conceptually will devolve back towards an animal-like perceptual existence. However, without instincts to guide them, the individuals and their society will eventually perish. For example, a human born during the Dark Ages is genetically no different than a human born today. A human in the Dark Ages would not have had a chance to learn how his “rational faculty” or the “scientific method” work because knowledge of these was not generally known or taught by society.

The opposite, “mysticism,” is what he would have been taught. It was not the individual’s failure of volition that caused him to have a predominantly perceptual-level habit of thinking—he was just never taught how by society. Predominantly conceptual human societies have only existed twice in all human history, one before and one (the present one) following the Dark Ages.

All living organisms receive certain information about how to succeed in their environment from their ancestors via their genetics (phylogeny). For plants, this guidance is limited to triggering simple, genetically determined, stimulus-response behaviors when specific external stimuli occur such as light, temperature, chemical, and mechanical changes. Plants and simple animals are not conscious of the other entities that are causing those stimuli.

Evolution selected for a level of biological complexity sufficient to achieve perceptual-level consciousness in higher animals because it afforded an improvement for survivability in a changing environment. Evolution selected for brains and the ability to sense things at a distance—sight, smell, and hearing. They gained the ability to detect and identify other entities in their environment and do so without the need for that other entity to be in direct, physical, sensory contact. Being able to behaviorally respond to the existence of other entities in one’s environment—to be conscious of them—was an increase in the individual’s ability to obtain and grasp the knowledge of how things work in its environment and successfully respond. However, perceptually conscious animals do not grasp the natures of the entities they detect, or their own nature, or the rules of the game of how entities interact with each other.

Evolution selected *for* a level of biological complexity sufficient to achieve conceptual-level consciousness in humans because it afforded an even greater improvement for survivability in a changing environment. Evolution selected for brains with the ability to form and integrate *abstract mental entities* (concepts) as the symbols of language representing concrete entities in reality, to detect and grasp the causality relationships between entities (extrospection), and to be aware of itself as an entity and of its mental functioning (introspection). Evolution further selected for individuals with the ability to modify their behaviors based on what they learned about reality during their lifetimes (ontogeny), thereby overriding past knowledge of reality obtained from ancestors via genetically provided instinct (phylogeny).

Being able to behaviorally respond to a broader and deeper grasp of both physical and abstract entities, including their causality relationships, and a grasp of one’s mental functioning—to be conscious of all these—and being able to override the no longer applicable instinct, resulted in an even greater increase in the individual’s ability to obtain and grasp the knowledge of *how things work* in its environment and even more successfully respond.

Consciousness in humans is *deterministic* only in so far as it depends on the brain's physical functioning and external stimuli. Without the brain and something out there to grasp, there can be no consciousness. However, the physical functioning of the brain is altered by the state of conscious awareness—thinking. This forms a recursive loop that differs between individuals because of three factors: the variability in genetically formed brain function aptitudes at birth, the external stimuli encountered during one's life, and the choices made when applying conceptual thinking.

Given the mental machinery one was born with, the stimuli encountered and the behavioral responses to them form the neural networks in our brains as memories and thinking habits. New stimuli are processed according to previously learned neural networks. That processing either reinforces or alters existing neural networks—presently encountered stimuli and thinking about them affect future thinking and behaviors. Your brain and how you think will be different tomorrow than today because of today's experiences. Indeed, adapting your behaviors to what you learn about your environment is why evolution selected for your form of consciousness—this is how it is supposed to work.

Consciousness is simultaneously deterministic and volitional, each term applying to different aspects of the same phenomenon. Consciousness in humans is deterministic because it is the manifestation of the physical functioning of a brain as preconditioned by prior thinking. Consciousness is also volitional in the aspect that we can choose, in any present moment, what to apply our abstract thinking faculty toward, if anything. Instinct in perceptually conscious animals provided an automatic, dictated behavioral response to perceived entities—no choice was possible. As the consequence of evolution having selected for the ability to override instinct in conceptually conscious humans, the alternative to having no choice is having choice—volition. What we encounter and choose to think about in our environment today was preconditioned by what we chose to think about yesterday, and our thinking today will precondition what we will choose to think about in the future. However, just like overriding instinct, our continually increasing knowledge of how things work in our environment, applied to a present situation, can cause us to make a thinking choice different than that which we were preconditioned for by past thinking. The ability for present thinking to precondition future thinking—ontological experiential automation—along with the ability to override such preconditioning—volition—are together a capability for adapting our behavior during our lifetime to fit a changing environment. Therefore, evolution selected for our much more powerful, conceptual consciousness.

The infinitely complex range of possible environmental situations and events that an individual might encounter and the unpredictability of future changes in the environment caused evolution to select for better adaptability. Consider just a few of the factors that can affect one's present thinking: the incredible complexity of a lifetime of building neural networks of the individual's past experiences and habits of thinking, including chosen

values; the individual's complex neural networks of understanding of the nature of environmental entities including causality relationships and the rules of the game (laws of nature); the complex set of stimuli provided by a present situation that is different than anything previously encountered, including the subconscious emotional responses to what the individual last had to eat. One can see that it is simply too inflexible to rely on having a correct automated response for each possible situation out of an infinite variety of them. Only a conscious entity that can apply an understanding of the nature of the environmental actors, including itself and the rules of the game, and capable of choosing from an infinite variety of possible responses (volition), will have an improved chance of arriving at an appropriate behavioral response.

We, humans, traded genetically provided specific-environment knowledge for self-discoverable, variable-environment knowledge. We traded the dictated specific-environment behaviors (positive stability on a provided course) for the freedom to choose our variable-environment behaviors (negative stability on a self-selected course). We traded the lack of adaptability due to mindless automation for the unlimited adaptability that came with the necessity to think and make choices continuously.

Evolution selected for ontological adaptation over phylogenic adaptation. Successive generations of Homo sapiens individuals gained intelligence and knowledge of reality more rapidly than phylogenic adaptation could provide. The increasing knowledge of reality could no longer be stored in the genes—an ontological method of knowledge storage was required. This necessitated the development of language and society. Language was necessary to transmit knowledge from its discoverer to society and then from society to new human individuals. The minds of individuals, not society, are the actors discovering new knowledge—there is no “hive” mind in human society. Society's evolutionary role is to be the repository for conceptual language-based (spoken, written & multi-media) knowledge across generations of conceptual individuals. New humans are dependent upon their parents or their surrogates to teach them how to use their conceptual faculty (forming education). Then the individual new human is free to choose what subset of total knowledge to acquire from society and what productive work to pursue within society to support his life.

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JJ is one of those people who needs to know how everything works. As former President/CEO of US Telecom and a recognized founder of the Telecommunications Revolution, JJ has decades of first-hand experience in technology. His experience enabled him to analyze the interactions between society, business and advancing technology to discover cause-and-effect principles. His personal talents as a communicator enable him to explain clearly to rest of us “How the World Works.”



As “The Future Coach,” JJ now enjoys helping individuals achieve their heroic vision and organizations to know how to best implement technology in ways that benefit, not harm, our society.

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ⁱ Kurzweil, R. (2012) p.38

ⁱⁱ Kurzweil, R. (2012) p.110