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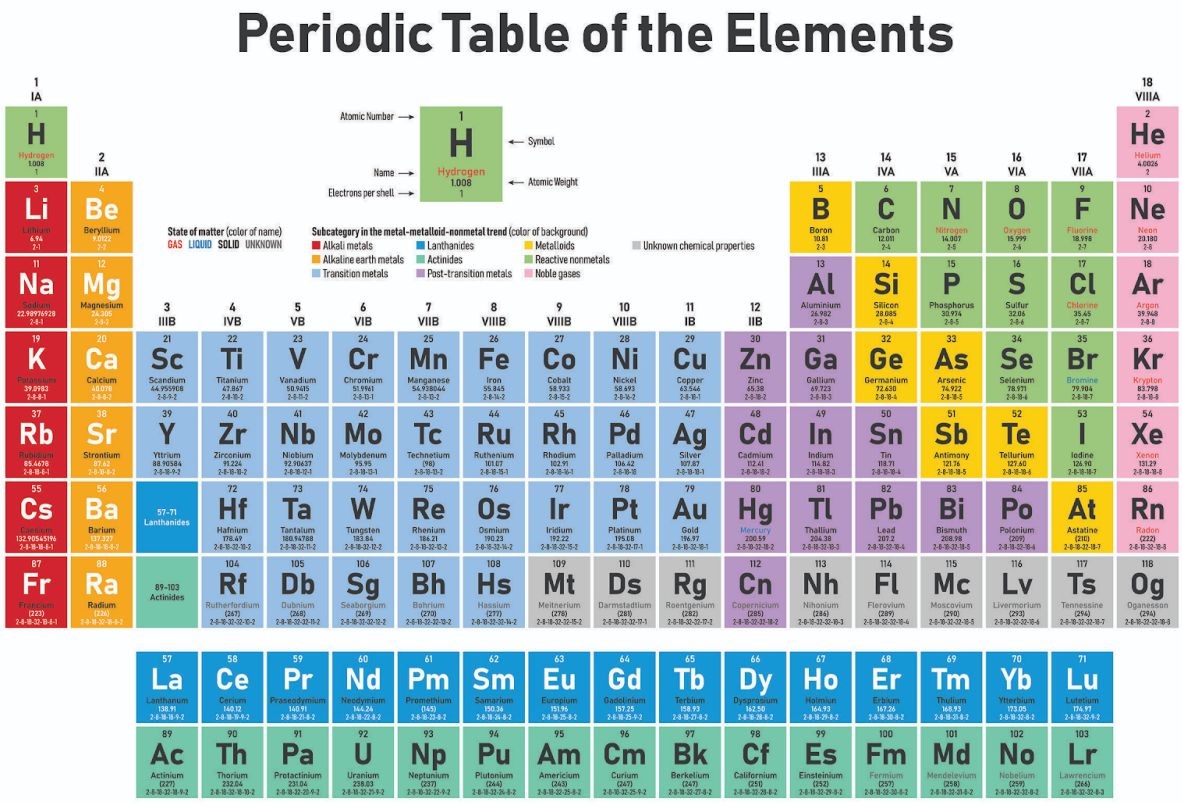
The Power of Exponential Growth and the Coronavirus

A story for Homo Sapiens, inspired by recent events.

The Creator was tired in the Garden of Eden. Repeatedly he rubbed his temples. Under normal circumstances he had infinite patience. Mother had given him a new Lego set for his latest birthday, telling him that it would teach him a lot about creativity, and the exponential growth function. Persistence was what he needed now. By coincidence, the kit was named “The Creator Set”. Rarely had he gotten such an engaging toy. In the set were 118 different kinds of bricks, called atoms, with a mind boggling total of 10^{80}. Never had he dealt with such larger numbers before. Good that he had an infinite amount of space and time to work with his new toy. Some of the atoms he had already assembled to larger crystals. Doing the assembly by hand, one by one, the atoms in the box did not show any visible reduction, even though he had put together billions of designs. Each of the kinds of atoms showed particular chemical and physical properties that made them distinguishable. All of them showed specific abilities and desires to connect to particular others, forming molecules. To this day, he had not seen such a complex kit. He mused that with the 118 different kinds of atoms and 10^{80} total, there were essentially infinite numbers of possibilities to put them together.



So many that even with his infinite amount of intelligence and time he would not be able to explore all the possible designs. Off all the atoms in the kit, he liked the ones from box one and box sixteen the most. Seeing one atom from box sixteen react with two from box one, when they created a little flash of light, was amazing.

The Creator named the molecules that formed in this reaction Water. They showed very interesting properties. Below 273 Kelvin they crystalized to solids, creating beautiful structures.

Above that temperature, they melted into little droplets that liked to merge into large bodies of water. One of the Creator's most favorite experiments was to create a large set of water droplets, and to then shine his white powerful flashlight against them. This created a beautiful band of reflected light, separated into a rainbow of colors.
The Creator had found that many of the other atoms also liked to connect to one another, or to other atoms in the kit, forming complex molecules. Many of these molecules then liked to organize themselves into repetitive patterns, also forming crystals. He also learned that many of these crystals happily dissolved when they were put into the magic water.

Never had he worked with anywhere close to so many Lego pieces before. He was tired of putting them together by himself, and anxious to see meaningful progress, and how the final design would look like. He started to doubt that he would ever be able to discover the full potential of this building kit, even in the infinite amount of time that his mother had set aside for his play. Exhausted, he threw the box on the table.

At that moment, something amazing and terrifying happened. All the atoms started to collapse and melt into their raw materials, electrons, protons, neutrons, and quarks. Some of the particles that he saw had not even been mentioned in the long list

of ingredients on the kit! Their temperature grew exponentially as they collapsed, or even faster. A supernatural glow was streaming from the box. The Creator got scared, which had never happened before! As his mother had taught him, he quickly executed a “Duck and Cover” maneuver under the table, hoping that the indestructible Kryptonite plate was strong enough for whatever might follow. The collapsing behavior had not been mentioned in the lengthy safety advisories that came with the play set. It had mentioned that the kit contained lead, which could cause brain damage in children. It talked about the danger of creating asbestos. And there were warnings that it could be used to create substances that could cause cancer, similar to the warnings that you find on the door to every coffee shop in California. But nothing had prepared the Creator for what came next. Maybe he should have paid more attention to the section that was labeled “Fragile, handle with care”? But then again, who really reads the instructions to a Lego kit after the many smaller ones he had enjoyed before?! At just that moment, the box exploded in an unbelievable Big Bang. All the particles flew into the infinite sky above the table. The Creator looked up at the underside of the indestructible kryptonite plate, and saw the deep dent that had been formed. His mother would be less than thrilled. Then again, she might be happy that nothing worse had happened to him.

As the rumble of the Big Bang started to quiet down, he dared to peak out from underneath. He looked at the matter that was racing up into the sky. He could not see any of the atoms that had originally been in the box. Only the raw materials were flying at an incredible speed out into the darkness, radiating back an incredible heat at him. The leading wave of ingredients was already far away from the Garden of Eden. The Creator took a telescope from his pocket to look at some of the details in the distance. Electrons, protons, and neutrons were racing away. After some time, as the particles cooled down, the electrons and protons started to pair together to hydrogen atoms, one of the more frequent building blocks that had been in the box. The creator observed how the hydrogen atoms attracted each other, forming ever larger and denser clouds, heating up again, finally creating hot, glowing stars in the sky above. The Creator thought they were beautiful. As he watched over a few billion years he saw how some of the stars started to convert their hydrogen into helium, and then into all the other atoms that had originally been in his box. It was amazing to watch how all the matter that had been destroyed in the Big Bang was now being reconstituted starting from only the hydrogen atoms and other particles that had been released when he had sheltered under the table. He could really binge-watch this process. It was much more fun to watch the transformations of the dynamic system than the painstaking process of putting the designs together one atom at a time! What a great and entertaining toy this was!

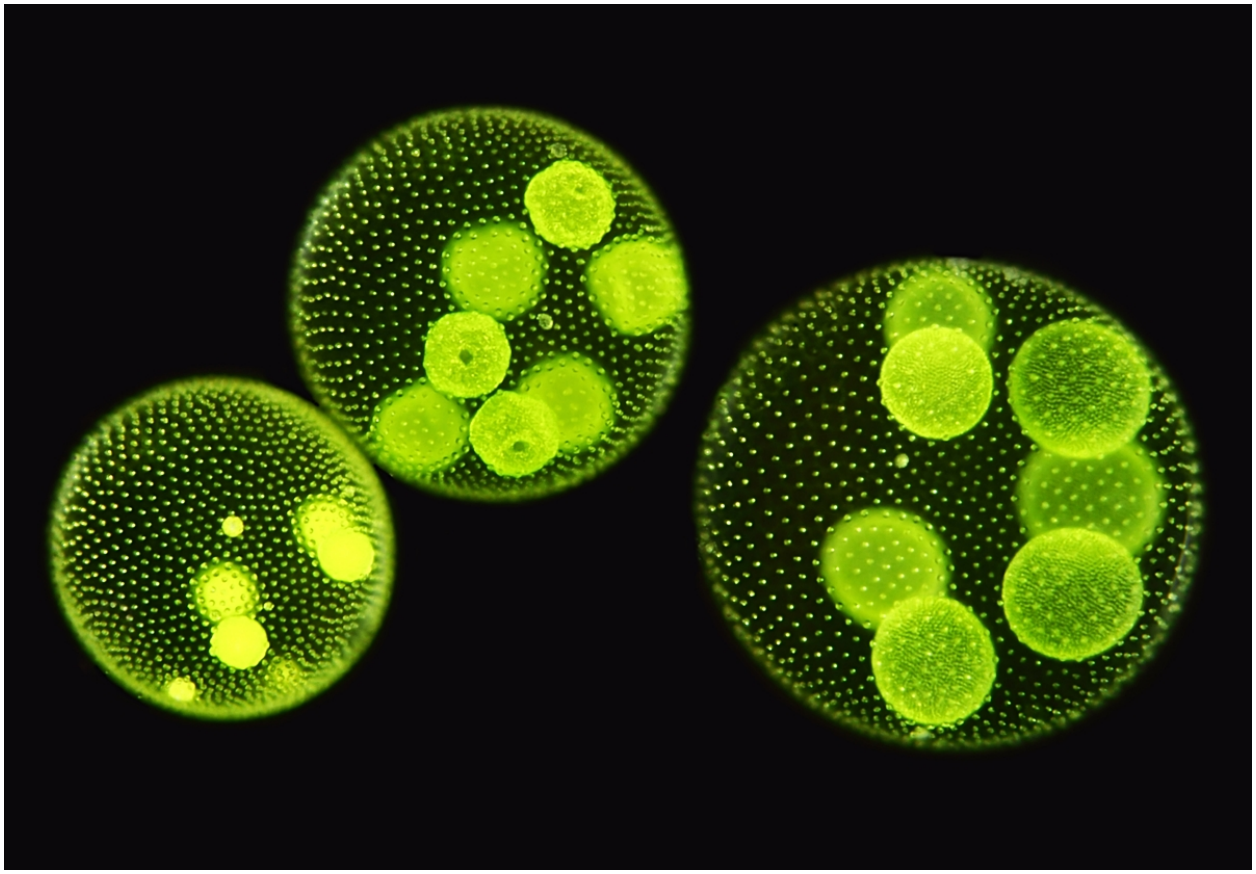
There were different kinds of stars. Depending on their size they would exist for different times, and at the end of their lifetime they ended in different ways. There were red giants, and white dwarfs. Heavier stars developed into red supergiants that would ultimately blow up and eject their atoms back into space, providing material for rocky objects that could rotate around newly formed stars. The Creator called these objects planets. He also saw some of these smaller, colder objects rotate around some of the planets themselves. He called those moons. As the development progressed, the stars were forming giant spiraling superstructures in the sky which the Creator called galaxies.

He named one of them the Milky Way after his favorite candy bar. One day, as the Creator was observing the Milky Way through his telescope, he noticed a star that was circled by eight planets. He named this star the Sun. And he named the planets in the order of their distance from the Sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. When he started to observe Earth in more detail he noticed something very peculiar. Earth had received a large amount of hydrogen and oxygen atoms when it formed. Like in his early experiments in the Garden of Eden many of those oxygen atoms had attracted and bonded with two hydrogen atoms each, forming water again. He noticed that a vast expanse of liquid water was sloshing around on Earth's surface. He named these expanses of water the oceans. In the oceans there was a rich soup of other atoms and molecules from the Creator Set. He realized that Earth was just at the right distance to the sun to have liquid water as the temperature window where water was liquid is actually pretty narrow. A little further away from the sun, and all the water would have been ice. The Creator saw a lot of the ice at the northern and southern pole of the Earth where the temperatures were lower. They received a lower energy density from the sun. A little closer to the sun, and all the water would be hot steam.
The molecules that were dissolved in the water formed larger and larger molecules when they were attracted to each other, especially when high energy lightning strikes where hitting the water. Above the oceans was a layer of mostly nitrogen gas and carbon dioxide, about 15 miles thick, with exponentially decreasing density. There were also clouds from water that had evaporated. He saw a round globe of rocky matter circling around Earth and named it the Moon.

The Creator enjoyed watching the early Universe. Like in a giant pinball machine, asteroids (small rocky things), moons, planets, stars, and even whole galaxies would crash into each other.
After a few billion years, the Milky Way galaxy became more stable and orderly. The planets rotated around the sun. The moons rotated around their planets. This tranquility was only occasionally disrupted by asteroids who seemed to come out of nowhere and would crash into any of the objects in the otherwise fairly stable formations. None of these small crashes were anywhere close to the power of the Big Bang, but they were still entertaining. However, compared to the initial phase the system had become somewhat boring again. The creator

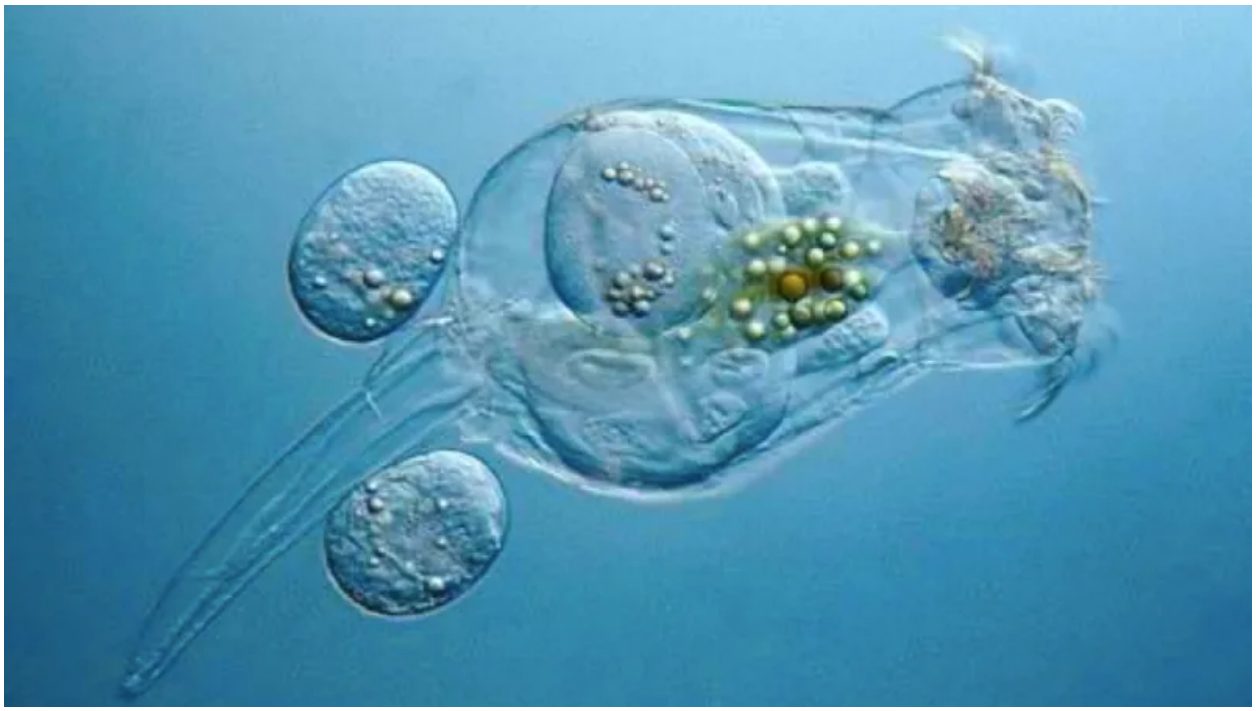
wondered if this was the intended final state of the Lego Creator Set, and if he should ask his mother for another more entertaining toy. The smaller Lego sets that he had received before were essentially collector items. After assembling them, he placed them onto the shelf in his play room and asked his mother for a new kit. That was great for the economy. At this point, even the exciting dynamic properties of the Creator Set seemed to have run its course.

One day, as the Creator was aiming his telescope and analysis instruments towards Earth, he noticed that the chemical composition of the atmosphere had changed since his last reading. It showed a significant amount of oxygen. Further study revealed that the inert matter that had coalesced to form Earth had started to create structures that would grow and replicate themselves if they could get energy from the sun and the right mix of atoms and molecules to create an almost perfect copy of themselves. This was a truly amazing scheme. The Creator called it “life”. He named the self-replicating structures cells. Somehow the atom lego pieces had figured out a way to store the information how to build themselves, combine it with a mechanism that could read and execute this information, and also include the means to acquire the raw materials and energy to create these copies of themselves from their environment. This was an unbelievably powerful concept. The structures were also amazingly beautiful when observed under a microscope.



Early in this process, the creator could only find single cell organisms. These contained about a trillion (10^{12}) atoms each. Some of these cells could replicate in about a single day. The Creator estimated that all the atoms in the “Creator Edition Set” that had exploded to form his universe

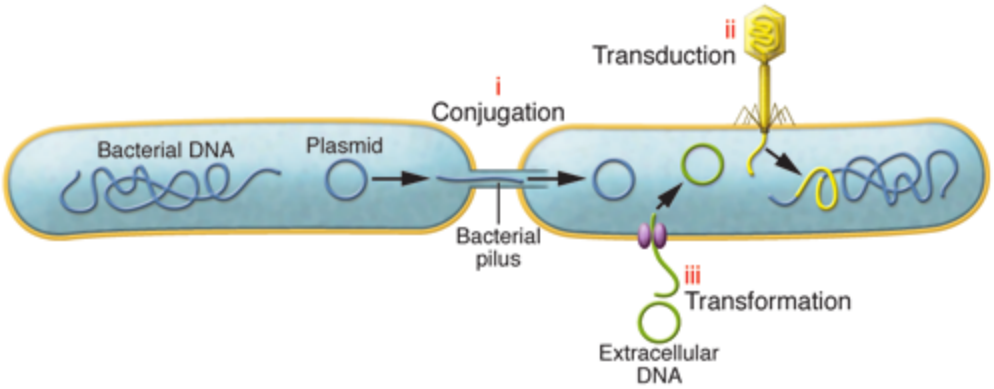
could be converted to about 10^{68} cells. Building these at a speed of one a day by himself would take an unimaginably long time of $2.7*10^{65}$ years, where a year was the time it took Earth to rotate once around the Sun. That was a number so large that even he could not grasp it. And finishing a Lego kit with a trillion atoms every day would be quite a difficult task, even for him. Even with a lot of patience this seemed impossible for the Creator. It would definitively get tiring very fast. He wondered how long it would take the living cells to do this Herculean task, if they found the right conditions to grow. On the first day there would be one cell, then two the next, then four, eight, sixteen… After how many days would the number of cells, growing at a speed of 2^d be equal to 10^{68}? The answer was astonishing! After just d=68/log(2)=226 days or less than ⅔ of a year! Wow! That was incredibly fast! The Creator realized that exponential growth is unbelievably powerful, even more powerful than he himself.



The Creator kept observing life on Earth. Starting from those single cell organisms, life grew more and more complex. Multi-cell organisms appeared, growing more and more complicated over billions of generations. Branching out into many different species, with increasing complexities, sizes, and abilities. Specialization in cell groups appeared. The organisms had organs, with specific capabilities to execute tasks that were beneficial to the whole organism! The whole process appeared random, but whenever a change proved beneficial in its particular environment the power of exponential growth helped to widely propagate these beneficial developments and displace less favorably equipped organisms. They were plainly eaten up as raw material for the more successful building plans. It was truly survival of the fittest. The Lego “Creator Edition” was the coolest toy that had ever been invented. With it’s self-evolving and self-creating properties it was more entertaining than anything the Creator had ever seen. Over time, the Creator observed how the organisms acquired increasingly complex senses like smell, touch, taste, hearing, and vision. By the boost of the exponential growth function the detailed implementation of these senses in the organisms was improving over time and resulted in

amazingly complex and perfectly specialized sensory organs. The organisms were leveraging these organs to acquire the raw materials to create their next generation by ruthlessly devouring the other organisms around them as food. If a member of a species showed degraded performance on one of it's sensory systems due to a replication error in the molecular structure that coded the implementation of that organ, this error was unlikely to get carried forward to future generations. The carrier of the bad information was less successful, and more likely to end up as food for other, more successful, organisms.

After some time, the Creator observed how two members of the same species would get together and combine their building instructions by randomly mixing and matching each "parent's" information. The Creator had discovered sex!



This information sharing proved another amazingly powerful concept. It enabled the combination of beneficial, complex design changes of the building instructions for that species to quickly propagate throughout its future generations. For example, a parent that had a better visual system, but lacked a sense of smell, could get together with a parent that had an excellent sense of smell but poor vision. Some of their offspring would inherit both improvements. As these combinations occurred randomly there were also offspring that had neither good vision, nor the good sense of smell. Since those inferior combinations were less successful in the search for food and fight for survival, their offspring, if they even were able to create any, quickly vanished from future generations of the species. Exponential growth favored the better designs. The "better" always won over the "good". So the secret of life was not just to "Be Best"[1], but how to become different. And if different was better it would take off. By carrying the risk of being different, the children had the opportunity to be better, and dominate the future of their species.[2] The failure of some of the children in this scheme is an accepted feature, not a bug.

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[1] If you are thinking about Melania Trump at this point you are excused.

[2] Have you ever asked yourself why your teenage children are trying so hard to be different from you? Nature made them this way! And nature embraced the outcome that they would not all be "better" than you are. Different! And "better" is a totally subjective judgement, and depends on the situation. If you look around how many sociopaths make it to powerful places in society you must realize that being nice to others is not the only way to survive. The rapists' genes are alive and well.

The Creator watched in awe how these simple strategies produced an increasingly complex set of successful organisms on Earth. Different environments favored different species, and whoever had the best adaptations thrived and developed further by creating better offspring. Some species were stationary. The creator called them plants. They would produce seeds as their offspring. The seeds could move to new locations by either traveling with the winds in the atmosphere, or in the digestive systems of the organisms that could move. The seed was essentially a package with the building instructions of the plant, plus an initial amount of food so that the plant could start to grow when initial conditions were favorable. Plants took the building blocks to grow from the ground and the air. Once a plant had set root in a particular location by sprouting from its seed, it had to make the best of it. If it found favorable conditions, it could thrive, creating offspring to fill the favorable habitat. If the conditions were less favorable, other plants with better adaptations would take over.

The Creator also found parasitic plants like witch's hair. Rather than engaging in the strenuous process of mining nutrients from the ground, they would just grow on top of other plants, enjoying the fruits of their hosts' labor.[3]

[3] If there is an association in your brain with the number "45" when you see this picture this may not be a coincidence. There must be something sinister with the color of orange and parasitic behavior ...

Then there were organisms who could actively move. The Creator called those animals and insects.
The Creator observed that, over time, intricate food webs between all the living organisms, plants, and animals developed. Within the animals he found predators - animals that ate other animals - and prey which were eaten by other animals. Most predators were also prey for larger predators. Apex predators were at the top of their food chains. Even they were eaten by scavengers after they died because of old age or a microbial infection that their immune system was not able to fend off. Herbivores would eat the plants who could not move. Each individual of a species had to acquire food, i.e. the atoms that it required to live and produce offspring. Each individual also had only a limited lifetime before it became weak and died. The lifetimes could vary from short periods of hours and days to thousands of years for some very large plants that created large, dead scaffoldings with the cells they had produced in the previous year. The creator called those plants trees. On these growing scaffoldings the trees would outgrow plants that only lived for shorter times, like for example grases that regrew every year from a seed. Therefore, they could collect more of the energy that the sun was constantly sending to Earth in the form of light. When an individual died at the end of its life, other organisms would start to grow using the atoms and molecules of the deceased as food to create their own bodies and offspring.
The Creator saw that the atoms in the Lego Creator set had figured out how to form a “circle of life”. Actually many intertwined circles that connected all living and not yet living matter on Earth.

The Lego pieces had discovered structures and building plans that even the most ingenious Creator could not have discovered, even in an eternity. They had done this by using the energy from the sun, or energy stored in molecules that had been formed in other organisms, randomly combining features when they created their offspring, exponential growth with a strong desire[4] to take atoms from their environment, and the selection by the properties of that environment. Almost any environment that had energy and atoms had some form of life. The Creator observed that animals weighing a few pounds consisted of about 1 trillion cells. That meant that the whole animal related in its complexity to its cells similarly to how the cell related to its atoms. The Creator marveled at the essentially infinite number of different cells that could be built with a trillion atoms, and then be combined again in an infinite number of ways into different animals. Anything seemed possible! In total the animals were essentially composed of around 10^{24} Lego atoms. He chuckled at the thought how none of the 10^{24} atoms in an animal had any idea where they were in the big picture. They did not know, and did not care, and happily took any position in the puzzle of the circles of life where they played a temporary role. Even in his wildest dreams the Creator could not imagine how many different kinds of animals, plants, and organisms could ultimately be built with sets that contained such a large number of atoms. Calculating the possibilities lead to numbers many times larger than the total number of atoms in the Creator Edition of the Universe itself! There was only one way to find out! Binge watching Earth, and letting the Lego pieces continue the discovery. This was going to be an endless process that

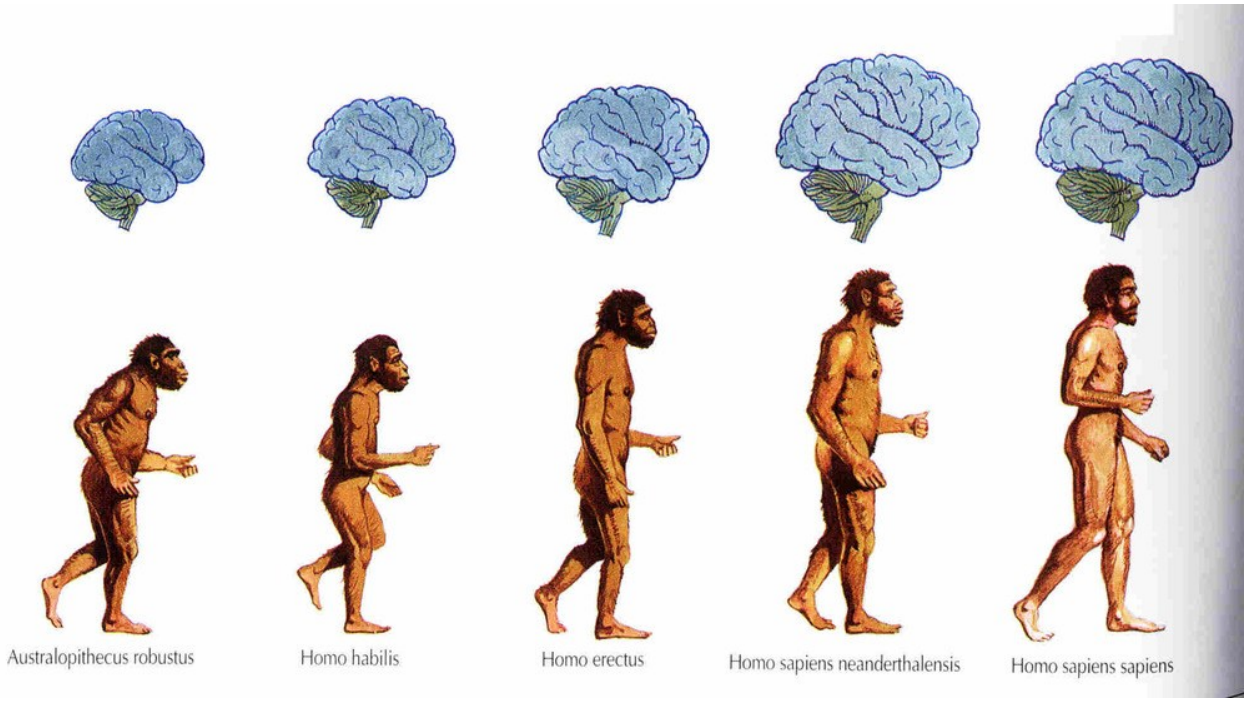
[4] I believe this is ultimately the source for greed in living things. If an organism is not greedy in acquiring atoms to grow and form offspring it will not be successful.

would never get boring. The truly amazing fact was that the whole building plan for an animal with 10^{24} atoms was stored in the information carried in the first cell from which it started to grow after father and mother had combined their genetic material. That was quite amazing and miraculous. The Creator was happy!

Many times, the Creator had scanned through other Galaxies, looking at different stars and their planets. He did not find many that had similar advantageous conditions for the Lego pieces to find the circle of life as had accidentally come together on Earth after the Big Bang had settled. Having liquid water and energy seemed to be a critical combination that did not occur often, even in the vast number of galaxies that had formed after the Lego Creator Set had exploded.

A few billion years after the Big Bang, the Creator watched the amazing rise of the dinosaurs. They grew to sizes of 50 metric tons, or more, with a total atom count in the order of 10^{29}. These were quite impressive creatures. They all met an untimely end on the day that the dinosaurs died. A large meteorite struck Earth and threw up a huge explosion of Earth's crust high above the atmosphere. When this matter fell back to Earth it literally cooked all those dinosaurs within a few minutes as it created a super intense glow when it slowed down all over the atmosphere. The molten rock coalesced into rain of hot glass that fell back to Earth. Only small creatures that were living underground were able to survive this amazing armageddon. It was a tremendous spectacle from the Creators vantage point. He was really curious how the Lego atoms would evolve after such a major shock to their ecosystems.

He soon saw that the elimination of the dinosaurs opened space for the rise of the mammals. Those were small and warm blooded, and better suited for a life under a cold atmosphere where the sun was shielded for a long time due to all the dust that needed to settle.
The offspring of the mammals were very immature at birth. Their mothers had to protect and nurture them with milk for some time, until they were able to find their own food, and fend for themselves. Over time, mammal species grew larger and larger. There were herbivores, living off plant matter, and predators that lived off other animals, or omnivores that lived off a combination of animals and plants. The mammals branched out into many different species, adapted to the different environments they encountered by the powerful vectors of random combinations of the building plan details of their respective father and mother, the selection mechanism of the specific environment, and the ability to grow exponentially in numbers when an environment was well suited to the properties of a new combination of their features. All the mammals shared the features of four extremities in their building plan.



About 60 million years after the dinosaurs had been erased by the meteor strike, the Creator saw apelike creatures among the mammals that were habitually walking upright on their two hind legs. He called their species Homo Erectus. Their two front extremities had developed into arms with hands that had 5 fingers. One of the fingers was opposing the others, creating a mechanism that was perfect for gripping. The Creator called this finger a thumb. He frequently saw members of Homo Erectus hold their thumbs up when they wanted to indicate to others in their group that they were happy and everything was ok. Homo Erectus was using rocks as tools to for example smash the shells of nuts. They could also create a large number of diffrent sounds which they used to communicate with each other. As the creator followed the development of the Homo Erectus species and compared it to one of their close relatives, the

Chimpanzee, he noticed some specific differences that appeared to translate into distinct advantages in their survival and the growth of their species.

To the Creator the early Homo Erectus appeared almost as dumb as the rock that they would hold in their fists, at least from his perspective as someone who knew about the elementary atoms in the Lego Creator Set. Homo Erectus had no idea what those rocks were made off! But compared to the animals around them, they had one giant advantage. They could communicate well with each other to share knowledge. By sharing their knowledge with their offspring, they started to accumulate a larger and larger store of knowledge and skills over many generations. As a concept this was similar to how knowledge had grown inside the cells from single cell creatures to complex organisms with specialized organs and powerful sensory systems during the evolution, captured in the DNA that coded their complete genetic information at a molecular level. The Creator immediately realized that the concept of information accumulation and sharing could be a complete game changer for the trajectory of these hominides. With great curiosity, he followed their progress.

They were individually weak compared to the apex predators around them. That forced them to collaborate well and develop a strong herd mentality. The Creator called those herds tribes. The Creator saw how they would engage in strange songs and ritual dances. These did not make any sense to him, but appeared to create a shared culture for each tribe that together with their fast evolving language distinguished each of them. Using their language they made complex plans, hunted much larger prey, and protected each other.

Homo Erectus formed stable families with one father and mother. The fathers helped in child rearing duties. That allowed a family to have a new child every year with a gestation period of about 40 weeks. Only occasionally they would have two children at the same time. Before forming their own families, Homo Erectus children spend a significant time learning skills and knowledge from their parents and their tribe.

In Chimpanzees on the other hand, there were no such stable family groups. Males did not take care of their offspring. Chimpanzee mothers nursed their offspring for up to 4 to 6 years and would not conceive again during this longer interbirth period.

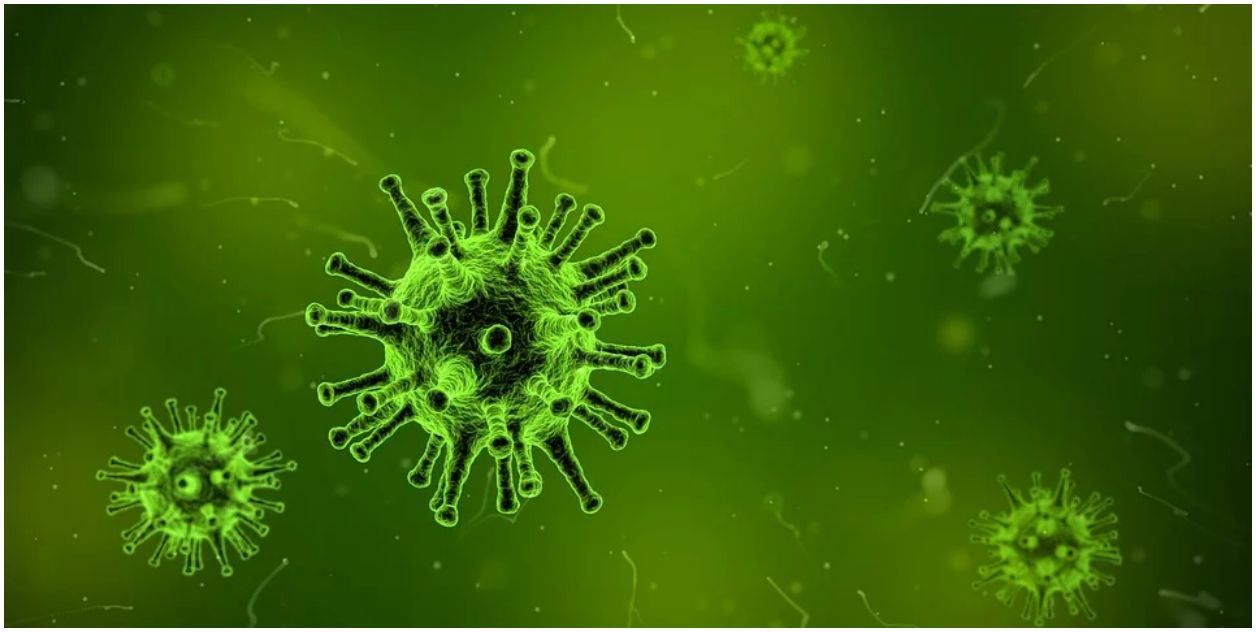
The Creator thought it would be an interesting exercise to compare how chimpanzees and homo erectus would grow in population size if they could both multiply according to their best case replication rates. A couple of humans could produce 8 children during their lifetime in a generation of 30 years. Chimpanzees could produce 6 children in a generation of 30 years due to their longer interbirth periods and younger age when they started to have babies.

That meant that in 30 years the homo erectus population was essentially growing four times, whereas the number of chimpanzees would grow three times. That meant that the homo erectus population could theoretically grow by over a million times (4^{10}=1,048,576) over 10 generations. The chimpanzees could grow by (3^{10}=59,049). That meant that after 10 generations there were more than 17 humans for each chimpanzee. After this math exercise, the Creator understood that the Chimpanzees were doomed if they had to compete with homo erectus for the same

habitat. Unless homo erectus adopted them as pets, or placed them in Zoos, the Chimpanzees' future was very bleak.[5]

As the Creator kept observing homo erectus and its populations, he saw that their numbers were not growing anywhere close to the best case growth rate. He found that their bodies were frequently invaded by living microorganisms, bacteria, and some of those would kill their host after some time by creating poisonous chemicals. However, most of these microorganisms lived in a symbiotic relationship with their host, providing useful services by for example helping with their host's digestive processes. The Creator also found that the bodies of all large living organisms had actually developed an immune system that could fight back against dangerous pathogens. Additionally, there were also small organisms that would lead a parasitic life by feeding on the larger organisms. These parasites would typically not kill their hosts as that was counterproductive to their own survival.

There were also other microbes, particles of genetic material, which the Creator named virus. They were not alive themselves. They were essentially just dead packages of information. However, they had the ability to enter a cell like a trojan horse, and once inside they hijacked the internal replication mechanism of the cell, and changed it's programming so that the cell would produce a large number of copies of the original virus. The cell ultimately died and released a large number of new virus particles which could infect more cells. If the immune system of the host did not quickly wake up to attack and eat the exponentially growing number of virus particles, this could cause the host's demise. It appeared that most viruses had specialized themselves to a particular host, and a stalemate existed between the host organisms and their viral attackers. The organisms had developed an immune system that was able to control the virus whenever it entered the host's body.



The Creator was truly in awe about the careful balancing between all the organisms in the

[5] Today there are an estimated 170,000 to 300,000 chimpanzees left, vs 7.8 billion homo sapiens. That is more than 26,000 humans per chimp.

various ecosystems that had developed on Earth. He felt it would have been impossible for him to come up with such a delicately balanced system from scratch on his own.
For homo erectus this balance meant that they actually lost on average 5 to 6 of their 8 children before those reached maturity to procreate. As they were very much attached to their children and made a great investment into them with all the knowledge they shared, losing a child was always a great loss. Life on Earth for homo erectus was definitely much worse than the Creator's life in the Garden of Eden.
Due to the smaller effective growth rate, homo erectus populations changed only slowly over time. Sometimes, homo erectus ate an animal that they had caught, and that animal hosted a virus that was unknown to the homo erectus' immune system. In that case it was possible that the virus jumped from his customary host species to homo erectus, gained the upper hand, and killed a whole tribe of them by jumping from one to the other. Such a virus would then die out with the last victim in a tribe. These deadly viral outbreaks stopped when the virus could not jump to another host. Therefore, the desire of homo erectus to not mix with other tribes protected their species from complete elimination due to such viral pandemics. The fear of the foreigner was ingrained in homo erectus' DNA and protected him. Trust only extended to close family and the tribe that shared a common appearance, language, and culture.
Over time, the Creator saw how Homo Erectus evolved into Homo Sapiens. It's brain grew, and his language, skills, and knowledge in their societies increased slowly over time. At some point the Creator saw one of the Homo Sapiens attach a rock to a stick with a leather strap that he had carved from animal hides that he had hunted. This was quite literally a milestone in human development. Therefore, he named that time the stone age. Homo sapiens had started to build complex tools. They made steady progress. Early on, they lived as hunters and gatherers. Then they started to domesticate animals, with the dog being first. Dogs helped during hunts, provided protection and guard services, and warmth and comfort. They were simply the best emotional support animals humans could find. Over time they added pigs, cattle, cats, sheep, goats, horses and chicken. Thanks to these animals there was less need to go hunting. That freed a significant amount of time. Before Homo Sapiens was constantly active to hunt or gather food. With herders, fewer people could provide all the food for the tribe, and the saved time was invested in, for example, the creation of pottery that could be used to store seeds after they were harvested and kept as food or to be planted the following year. Agriculture was born.
At some point the Creator observed that Homo Sapiens would collect yellow shiny nuggets of the 79th element in the Creator Sit. It was a metal that was soft and yellow, and not particularly useful to make tools. But homo sapiens loved to collect them for their magic shine. He found them as nuggets in rivers, and because of their rareness they were used to trade other goods for them. Sometimes a Homo Sapiens would kill another one to take his nuggets. Over time, they discovered other metals, and with the mastery of fire they were able to smelter and refine these metals like copper and iron. To help with storing the knowledge in their societies they invented writing. The population size of Homo Sapiens kept increasing and they branched out all over Earth and discovered its continents. They were curious to understand and explain any natural phenomenons that they saw around them. When they could not explain a phenomenon they would invent an abstract concept of a god that was responsible for events like thunder and lightning which they could not create by themselves or even understand. Having these gods

seemed to provide comfort to them. They started to trade with other tribes over longer distances. That opened paths for microbes and pathogens to move from one tribe to the next. A lot of the innovations that Homo Sapiens pursued were driven by the desire to have better weapons to hunt, or as protection against the attacks of unfriendly tribes. They started to build cities with protective walls. Individuals specialized in trades. They became more and more sophisticated in their abilities to shape the environment around them. They developed rules that were meant to ensure cooperative and peaceful behavior among each other as their progress as a group was maximized when there was harmony and everybody contributed to their common welfare.

The Creator watched many groundbreaking innovations in technology where one particularly smart individual of homo sapiens had brilliant thoughts that accelerated the speed of knowledge generation in humanity as a whole:[6]

- The invention of the printing press (Johannes Gutenberg, 1439) revolutionized how knowledge could be replicated. Everybody gained access to knowledge that could now be mass produced. More educated minds meant an increased speed of new discoveries for all.
- The invention of the telescope (Galileo Galilei, 1609) completely changed humans' understanding of their position in the solar system and in the universe.
- Isaac Newton's (1642-1726) discovery of gravity explained the motion of the planets in the solar system. He also made significant discoveries in the area of calculus and mathematics.
- The discovery of the steam engine by James Watt (1736-1819) created the starting point for the industrial revolution and enabled humans to burn up the vast amount of energy that had accumulated on earth in the form of fossil fuels to work for them and their knowledge creation process.
- Andre-Marie Ampere (1775-1836), the father of electrodynamics.
- The discoveries of Louis Pasteur (1822-1895) of microbes as the root cause of disease and the process of pasteurization, vaccination and microbial fermentation. The significant reduction of humans' mortality paved the way for their accelerated growth and ultimately the explosion of their population.
- James Maxwell (1831-1879), Scottish mathematical physicist famous for his work on electromagnetism.
- The discovery of radioactivity by Marie Curie (1867-1934).
- Albert Einstein's (1879-1955) discovery of relativity and the equivalence between energy and mass ($E=mc^2$) that paved the way to the atom bomb and nuclear energy.
- John von Neumann (1903-1957) with groundbreaking contributions to computer architecture.
- Guglielmo Marconi (1874-1937) who invented radio transmission.
- The first human flight by the Wright Brothers (1903) has led to air travel on an unimaginable scale hundred years later.

[6] I can only give a short list of examples here. My apologies to the great minds, innovators, and inventors that are not listed here.

- John Bardeen, Walter Brattain, and William Shockley invented the transistor (1947, 1948) at Bell Labs, starting the technology of electronics.
- Mohamed Atalla and Dawon Kahng invented the MOSFET (metal-oxide-semiconductor field-effect-transistor, 1959) that became the key building block for the revolution of electronics with exponential miniaturization following Moore's law. The exponential miniaturization of MOSFETs has enabled humans to reduce the energy for a multiplication by a factor of 10^{-12} compared to the first vacuum tube computers. Now almost everybody has access to the vast knowledge of humanity at the tip of his fingers, on the go. With powerful computers humans are developing more and more sophisticated technologies.

The Creator was truly amazed over the exponentially accelerating knowledge that homo sapiens had achieved. He felt that, as a species, they had gained almost as much knowledge about the Lego Creator Set and the Universe as he possessed. In that regard they were like him. By collaborating together in vast numbers they had discovered and decoded the basic building blocks of the Universe, the atoms. By building huge and powerful particle accelerators they even had gained significant insights into the ingredients that formed the building blocks of the atoms. Now they appeared to be poised to decode the more complicated processes that formed the basis of life, with a potential to leverage that to their advantage. It was unbelievable how the atoms in the form of human society had essentially learned all those details about themselves.

When the Creator looked closely at the physical properties of the individuals of homo sapiens they were still indistinguishable from their stone age ancestors. Their hardware had barely evolved during the short time of the technological exponential explosion. Most of them were still driven by their caveman reflexes of fight or flight when they were under pressure. They were still very tribal in their behavior. Crafty manipulating leaders were leveraging these stone age characteristics to stay in power and grow their personal influence. Hate was a stronger motivator than love. Most of them did not even appreciate the amazing growth path that their ancestors had blazed for them, under great sacrifice. The coal miners who died digging coal. The explorers who had risked their lives to find new places. The reformers who had worked tirelessly to provide more human living conditions and human rights to all. Instead of honoring the amazing scientists and innovators that had contributed and kept contributing so many breakthrough ideas, the average homo sapiens followed the lives of the rich, famous, and powerful who had done nothing for the progress of humanity, or they listened to talking heads on TV who were spewing divisive messages to further their own interests. Most were only thinking greedily about themselves, and not about the future of their country and human civilization.

The Creator saw other massive warning signs that the exponential ascent of homo sapiens was about to collapse. Their voracious exploitation of fossil fuels had added a lot of carbon dioxide to the atmosphere. The carbon dioxide pollution created significant global warming that was about to trigger several positive feedback mechanisms that would soon result in irreversible thermal runaway for the planet. Glaciers were melting. Large ice masses at the poles and on Greenland were melting and adding water to the oceans, which started to rise significantly. That would

endanger large numbers of homo sapiens who were living close to the coasts. The reduction of ice at the poles also attracted more heat from the Sun as the ocean water absorbed heat that the ice used to reflect back into space. Melting permafrost soil in the northern latitudes had stored vast amounts of Methane, a more powerful greenhouse gas than carbon dioxide. This methane was about to be released as the permafrost was thawing, adding to the significant methane emissions that humans released as they drilled for natural gas. Humans' desire for a comfortable life with a high fossil fuel use was going to destroy the beautiful civilization that had been built over many generations.

At that moment, a new Coronavirus jumped from an animal to the homo sapiens population. Due to the high connectedness in the global economy, with constant business and tourist travel, the virus was able to spread far and wide before its true lethality and high infection capability was discovered, fully appreciated, and disclosed to other countries. Some countries were initially able to locally contain the Virus by draconian quarantining measures of their populations in highly affected areas.
Other countries squandered significant lead times to prepare themselves for the ensuing pandemic. Despite their political leaders getting warned of the impending pandemic, they did not prepare their country by ramping up virus testing capabilities to enable rapid early detection and contact tracing. Instead, some of these leaders, who had early information that there was a pandemic coming, sold large portions of their stock portfolio to minimize their losses in the coming stock market collapse. These countries did not even have enough protective equipment for their health workers who were working on the front lines of the infections in the hospitals. Panic buying by the population had further depleted most of the stock of this protective equipment. The manufacturing of this protective equipment had been moved offshore a long time before, to maximize shareholder returns. Health workers without protective equipment tried to help as well as they could, but ultimately became spreaders of the disease themselves when they became carriers of the virus, unbeknownst to them. The virus could frequently spread stealthily without severe symptoms for many of its victims. Therefore, significant numbers of them were unavailable to work in the hospitals for a long time, further depressing the capacity of the overstressed health care system. Some of them died needlessly due to the unsanitary conditions in which they volunteered or were forced to work. Foolish political leaders had started social isolation measures too late, more worried about their reputation and reelection than the lives of their citizens. Then they restarted the economy too early, reigniting the exponential spread of the Corona virus that completely overloaded all the health care facilities and ultimately resulted in millions of deaths. It was a giant disaster that could have been substantially reduced if leaders had followed the advice of experts.
There were also large populations of refugees on Earth who had been displaced by wars. They lived in overpopulated refugee camps, had insufficient food, no space to practice isolation to slow down the viral explosion, and no medical systems to deal with such a threat. Once the virus reached one of these camps it burned like a flash fire through the camps and left a large percentage of them dead.

Looking at these unmitigated disasters, the humans who lived in the more affluent countries hunkered down, put their economies into a medically induced coma, and watched in horror how the virus was wreaking havoc among the poor who could not afford to hunker down and had no kryptonite tables of wealth where they could hunker down for a year.

The Creator revised his assessment of the species of homo sapiens. Most of them should be designated as homo greedy. Sapiens was only a small subset of them all.

The Creator wondered if homo sapiens would learn important lessons from the Coronavirus Disaster and pivot to a sustainable path for his species. Or go extinct very soon as they ran out of resources for their greedy way of life and polluted the whole Earth to a point where their species was not viable any longer.

He was confident that the Lego pieces in the Creator Set would ultimately produce a truly intelligent species that would live in a sustainable way. All the ingredients were there. Earth had billions of years left. The games would go on for him to enjoy. The Creator relaxed and watched.

Final words

Get better!

The story of the evolution of life on Earth clearly shows that the secret to success in life is “Get better”.[7] With a constant drive to get better, every day in a meaningful way, success is no accident, if resources are available. That is where society becomes critical. If we do not provide the resources for young people to follow their ingrained drive to get better and compete in a positive way, their energy is likely directed to more destructive behavior.

Help others around you to get better!

All our young people are the most valuable resource for our society. Raising responsible citizens that follow the law and hold up our system is essential. By investing in all our young minds, our society will make the most rapid progress and be able to tackle future challenges. Winners are not the ones who are holding the others back. That is not progress. It sounds more like Congress. Winners are those who inspire each other and make everybody move faster than before in a sustainable direction. As a society, we have to invest in all our young people. They will pay it back many times over their lifetimes if they can pursue successful careers. And we don’t know in which brain the next breakthrough idea will pop up. By growing everybody we maximize our chance of success.

Refocus on essential values

The US has become an entertainment society. Huge compensation flows to talking heads on TV and gifted sports players who can throw balls through hoops. CEO compensation has grown much faster than the compensation of the workers in the company. As the Corona crisis shows, many of these functions are not really that essential to our lives. We have an opportunity to rebalance these inequalities as we dig ourselves out of the Coronavirus recession. The Romans already used bread and games 2000 years ago to keep the lower classes from revolting. And today, the US looks like a giant circus where a game show host without any desire to better himself calls the shots and is an existential risk to the society that was created by the sacrifices and commitments of many generations of wise people. What took generations to build can be destroyed with a match in a very short time. We must stop the arsonists!

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[7] First Lady Melania Trump created the “Be Best” initiative. That may work for the privileged few who are already born on third base. For all the others “Get Better” is the way to go. If you look at the trajectory of recent immigrants into the US where the first generation worked really hard to provide a good education for their children, and then their children worked hard on their academics and became productive and successful puzzle pieces in our society.

Invest in science

The recent, truly mind boggling progress of homo sapiens has only been possible due to our ability to identify the basic atoms that the Creator received in his Lego kit. By understanding the different ways how they can be connected (chemistry) we have become creators ourselves. Our global collaboration is key to our success. We have built humongous particle accelerators to decode the ingredients of the atoms. This progress has been possible by an exponential increase in knowledge and information that is now available to everybody who has a smartphone and connects to the ubiquitous internet. We need to accelerate this knowledge path, and at the same time put ourselves on a sustainable resource use path that does not destroy the ecosystem that sustains us, and all the living things that we rely on.

Downsize the military industrial complex

As recent experience in Afghanistan and Iraq shows, war does not solve problems. It wastes a lot of resources. Two eyes for one eye only creates an escalating spiral of violence and death. At the end there are many more dead people than the casualties that were suffered in the beginning. The significant problems in the world do not stop at country borders. We cannot shoot the Corona Virus with all the firepower that we have. Walls do not stop the virus either. They are silly medieval defence mechanisms that have been obsoleted a long time ago. Only a caveman can still believe in them.

Localization for resilience

The Corona crisis has clearly shown that Earth-spanning, global, supply chains are not resilient. They have been created with cost minimization (greed) as the only metric in mind. Increased pollution and exploitation of cheap labor in other countries have been the consequences. We need to relocalize critical capabilities like for example manufacturing of the face masks that our front line medical workers so desperately need. Global tourism carries now existential risk for humanity as a whole. It can distribute pathogens that can destroy our civilization within weeks. Humanity needs to stay vigilant to these risks and have plans and resources to prevent such crises from eliminating homo sapiens and it’s knowledge based society from Earth.

Don’t be greedy

Growth is ultimately limited by the atoms that we have within our reach. They are limited. We depend on the circle of life for our existence. We must preserve well functioning ecosystems that provide food and precious raw materials to us. Always remember that parasites that are too greedy will ultimately die shortly after they have killed their last possible host. The Sun will shine for a few more billion years. If homo sapiens can figure out how to move forward on a sustainable path that fits into the available resource envelope, there will be an awesome heritage to future generations. They may be able to binge watch the amazing progress that we can continue to make as a society of thinkers, scientists, and creators. Otherwise there will be a

major reset event in the Lego box and true intelligence will have to be rediscovered on a different branch of the evolutionary tree.

Mitigate and prepare for the next global crisis

There is no reasonable doubt that global warming is an existential risk to humanity. We have a chance to reduce its impact to all of the living organisms on Earth if we start aggressive action now. Business-as-usual will be a march of the lemmings over the cliff. As we rebuilt the economy after the Corona recession we have to focus on technologies that turn our resource use intensity to a sustainable level. Oil is a precious natural resource that we can preserve for many future generations. We have to immediately leverage regenerative energy technologies that do not waste resources that were created over hundreds of millions of years.

Understand your caveman instincts and how they are exploited against you by crafty scam artists!

Humanity has had an amazing ride on spaceship Earth by discovering new knowledge and growing it exponentially. Knowledge can grow exponentially without creating an exponential resource need as has been shown with Moore's law. Today we can store the information of years worth of photos on the area of a fingernail. Fight or flight does not work against global warming. Mars will surely be worse, and only a selected few will even make it there. Our Garden of Eden is on Earth.

Be inspired!

The Creator is watching all of us. We all can be a significant part of a long story of accumulated knowledge at the molecular level and as a species. Let's make sure to leave the world as a better place to future generations of homo sapiens. It can evolve and learn to grow beyond its animal instincts. Education is the key. Imagine future generations watching us on Youtube2020, as we tackle today's challenges. Homo greedy is doomed. Let's ditch that dude.

Thank you for reading!
Please share with your fellow homo sapiens connectus.
We are all one giant tribe!
Let’s be afraid of the aliens!
Especially the ones with the witch’s hair.

Nature is amazingly complex and mysterious.
There are lots of things we still do not understand.
We do see that we are one step away from the cliff.
Exponential growth in the wrong direction
will push us right over it.
We don’t have a kryptonite table to “Duck and Cover”
when our Lego Creator Set blows up on us!

Get Better!