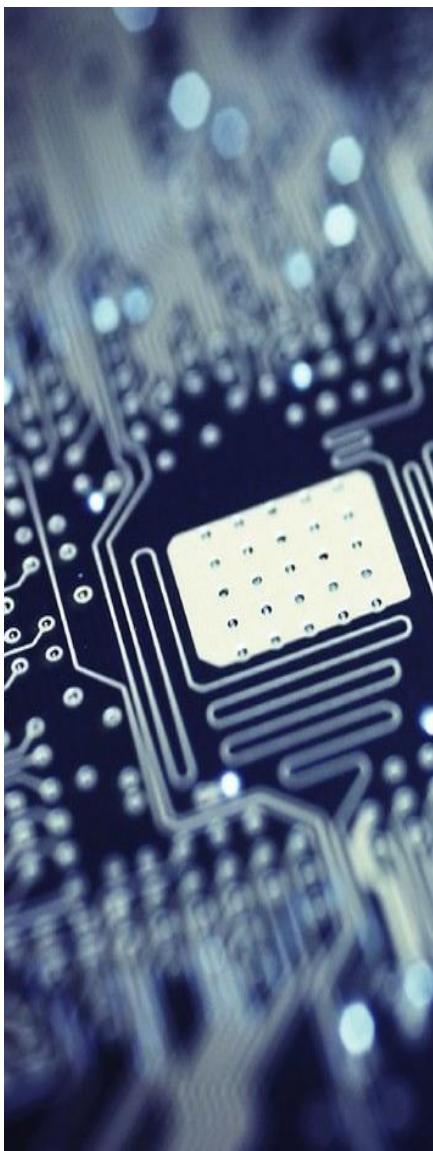

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Table of Contents

Astronomy

- ***The Dyson Sphere*** by Arthur Liang..... 3-5
- ***How the Universe Will End*** by Edward Huang..... 5-8
- ***The Most Dynamic Telescope*** by Anna Dai..... 9

Technology

- ***Recent Advances in AI Technology*** by Eddie Zhang..... 10-12
- ***A Cautionary Tale of Gene Editing*** by Ethan Cheng..... 13-14
- ***Technology and COVID-19*** by Aidan Hong..... 15-16
- ***Aerogel - A Little ‘Weight’ to Insulate*** by Kenny Wu..... 17-18
- ***A Study on Pavlov’s Dogs*** by Nick Li..... 18-19
- ***Vaccine Myths*** by Angelina Chien..... 21-22

Environmental Science

- ***Algal Blooms: Impacts and Solutions*** by Annabella Luo..... 21-24
- ***Renewable Energy*** by Stephen Hung..... 24-25

Community Report

- ***Report on Scientists’ Pay Gap in California*** by Stephen Hung.... 26
- ***Irvine’s Renewable Energy Efforts*** by Annabella Luo..... 32-33

Climate Change

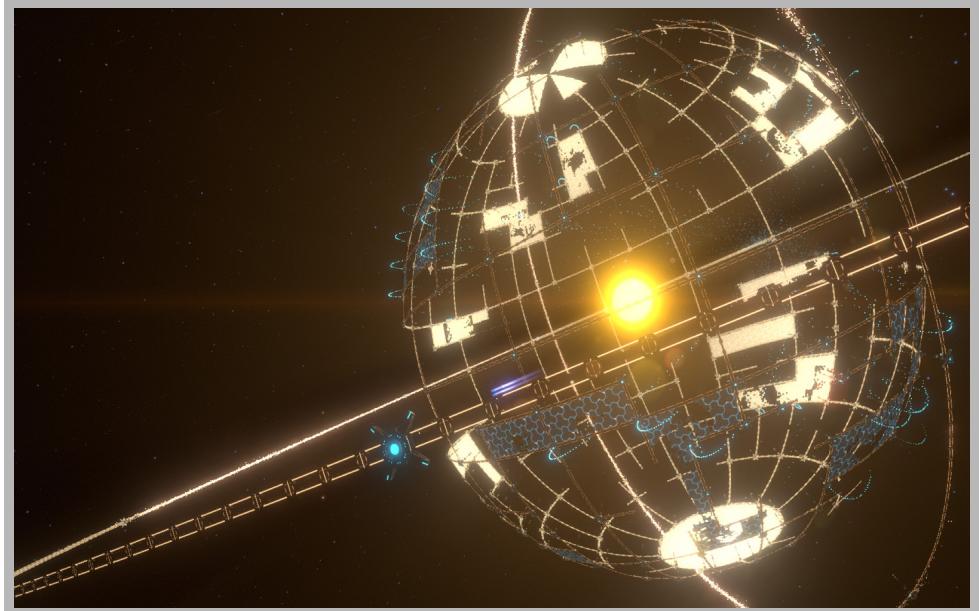
- ***Are we Ruining Our World?*** by Cody Duan..... 27-28
- ***Global Warming, A Global Warning*** by Cathie Zhu..... 28-29
- ***Climate Change*** by Brian Wang..... 30-31

The Dyson Sphere

Arthur Liang

Throughout human history, we progressed with the use of energy. At first, all we had were our own muscles, until we learned how to control fire. We then advanced to coal, oil, nuclear energy, and renewable energy such as wind, solar, or hydropower. Eventually, we humans will be able to gain complete control over our planet. At that point, the only option would be to look outwards into space. However, this transition will be a long and difficult process. Our biggest obstacle is that reaching the other planets in the solar system requires enormous amounts of energy. Fortunately, we have the biggest producer of energy right at the center of our solar system: the sun. A furnace 100 quintillion times more powerful than our best nuclear reactor, shining with the energy of a trillion nuclear bombs every second. But the big question is: how can we harness this energy?

The answer lies in a megastructure known as the Dyson Sphere. The Dyson Sphere is a structure that surrounds the entire sun in order to capture all of its power output. The Dyson Sphere would not be a complete solid sphere. A structure like that would be hard to build, and it would be vulnerable to impacts from asteroids.

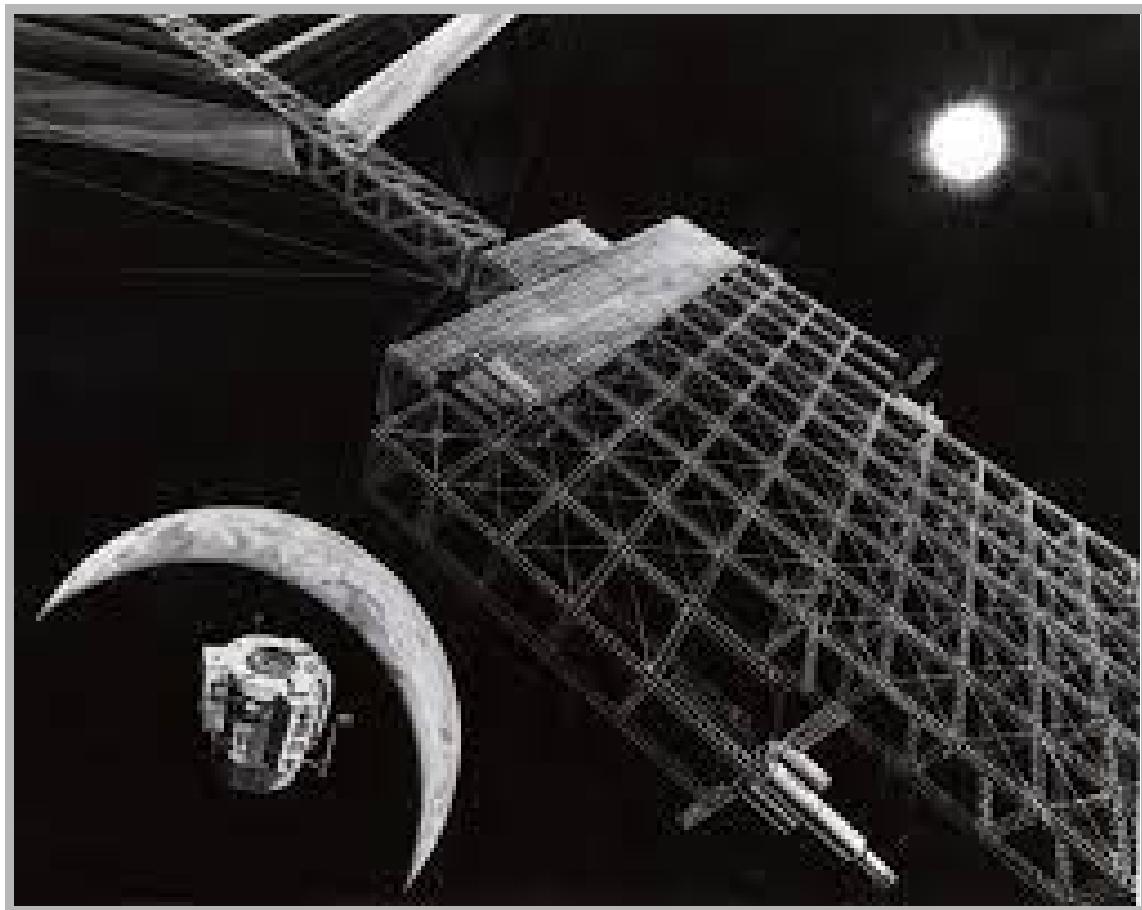


A more effective design would be a Dyson Swarm, a swarm of mirror-like panels that orbit the sun, reflecting its energy and beaming it elsewhere. If humanity is able to successfully build a Dyson Swarm, it would provide practically limitless energy. We could explore and expand through space on a scale that is hard to imagine today. But building this structure would not be easy. The sun is huge. If every mirror panel is a square

4

kilometer, we would need about 30 quadrillion panels to surround the sun, equating to around 100 quintillion tons of material. After crafting the panels, we would need to spend even more energy launching them into their orbit around the sun.

Let's start with our first roadblock in construction; the materials. In order to get enough materials to create the Dyson Swarm, we would need to basically harvest an entire planet of its resources. Here, it would seem that Mercury is the perfect planet. It is the closest to the sun, and rich in minerals. Mercury also has no atmosphere and only around a third of the surface gravity on Earth, making it easier to launch our panels into space. In constructing our panels, it would seem that the best design would be to make them as simple as possible, making them cheap and quick to build. Our panels will most likely be giant mirrors that will refocus sunlight towards solar collecting stations. On Mercury, there will be four major pieces of technology that will be needed: solar collectors, miners, refiners, and launch equipment. Solar collectors will give the energy needed to power everything else. The miners will mine the surface of Mercury and the refiners will extract elements needed and construct the satellites.



5

To launch our satellites into space, we cannot use rockets. They are much too expensive and difficult to reuse. Instead, we will use a railgun, a long electromagnetic track that shoots our satellites at high speeds into space. Once we put our first satellites in position, it gets easier from there because of exponential growth. One satellite powers the creation of another one, those 2 create 2 more, those 4 create 4 more, etc. Eventually, 1 becomes 2, 2 becomes 4, 4 becomes 8, 8 becomes 16. This way, we would only need around 60 doubles to fully surround the sun.

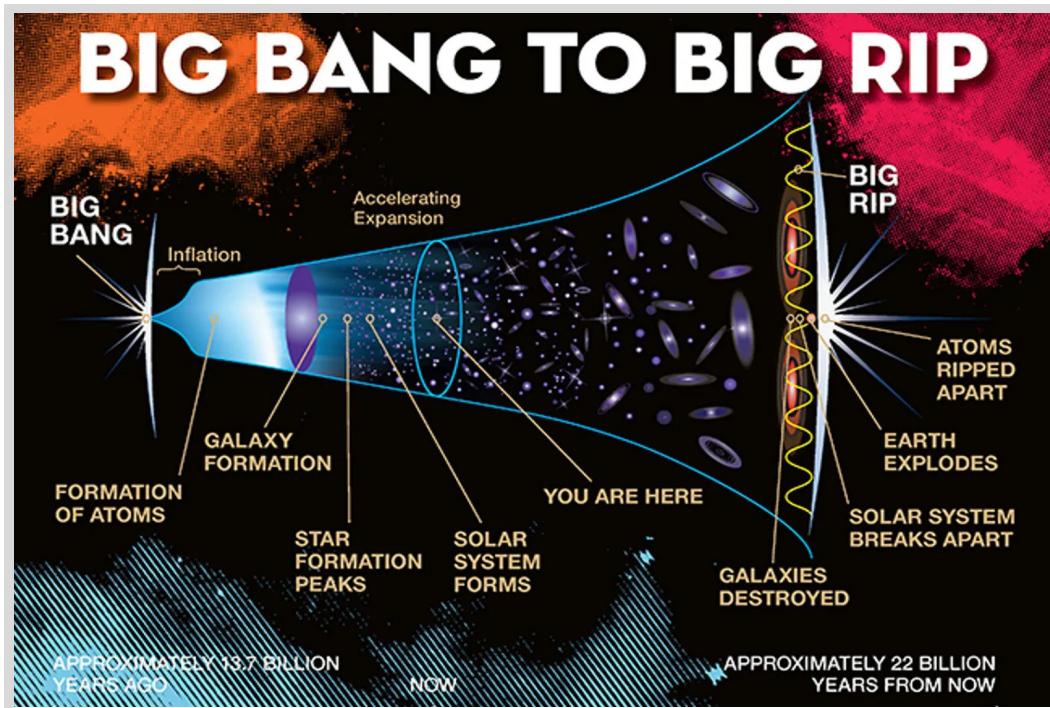
Once the structure is complete, humanity would be changed forever. We could beam huge amounts of sunlight and energy around the solar system for all sorts of projects. It could be the start of interstellar civilization. We could establish planetary colonies, terraform entire planets, build more megastructures, and travel to distant stars. With a Dyson Sphere completed, the only limitation left would be our own imagination.

How the Universe Will End

Edward Huang

How will the universe end? Will it get ripped apart by accelerating speeds caused by dark energy? Or will everything fall together and compress due to gravity? There are multiple theories as to what will happen to the universe billions of years in the future: The Big Crunch, The Big Rip, The Big Freeze, and The Big Slurp.

The Big Crunch is the theory that eventually, the universe will stop expanding due to gravity and start shrinking. Gravity will then pull everything together towards a single point. An extension to this theory is known as The Big Bounce, which states that gravity will pull all mass into a single point, resulting in another Big Bang. Essentially, the universe is trapped in an endless cycle of exploding in the Big Bang, and then contracting in The Big Crunch. This theory has been disproved, due to evidence suggesting that the expansion of the universe is not decreasing, but accelerating. This means that gravity is not powerful enough to hold the universe together in order for The Big Crunch to occur. Instead, the universe is expanding at an accelerating rate, due to a mysterious force that scientists call “dark energy”.



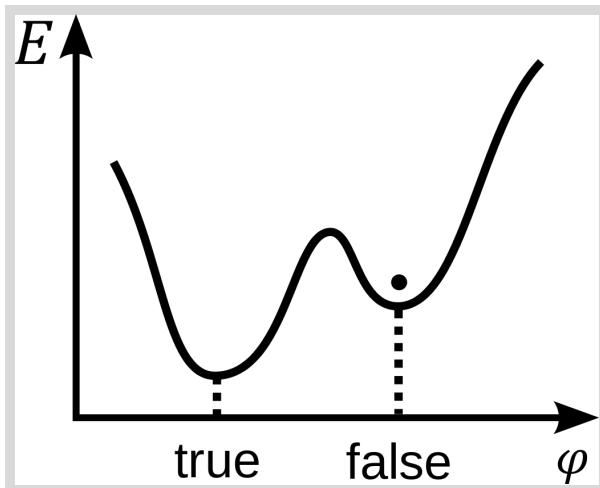
A second theory is The Big Rip, which suggests that the universe will expand at an ever-increasing rate until eventually, individual stars and planets get torn apart. Dark energy is the main cause for the universe's accelerating expansion, and eventually, it will overcome gravity and everything in the universe will be ripped apart. Some scientists believe that given enough time, dark energy will become so strong that individual atoms will get broken apart. While this may seem far-fetched, evidence collected by scientists have shown that the universe will continue to expand at an exponential rate, making the theory plausible.



7

Another popular theory, The Big Freeze, states that the universe will result in a heat death. Due to the expansion of the universe, galaxies and stars will spread out across vast distances. Star formation will cease since gases are so far apart that they cannot condense into stars. Galaxies will stop growing, and they will eventually get sucked into black holes. Energy will become evenly distributed across the universe, meaning a decrease in temperature and an increase in entropy. An increase in entropy basically means that energy will be spread out in a random and disordered way. There will be no places with large amounts of energy, meaning that there will be no energy gradients, and there will be no reason for energy to flow from one place to another. Because of this, the universe will become inactive, since all of the energy is in a complete equilibrium and no more energy can be used for other processes. The universe will simply freeze and die, in a cold and slow manner. Eventually, all matter would have been consumed by black holes, but even they will not survive. Black holes evaporate by releasing particles, due to Hawking radiation, and all black holes will eventually die off.

The last theory is called The Big Slurp, sometimes called false vacuum decay. This theory says that the universe is in a stable state, but not completely stable, and it may not be stable in the future. In other words, the universe is in a “metastable” state. A **vacuum** is essentially a space in which there is the least amount of energy possible. A **false vacuum** is a space in which there is the local minimum of energy possible, but not the global minimum energy possible. In other words, a false vacuum is not the best possible vacuum.



If the circle in the graph represents our universe, our universe would be a false vacuum, meaning that it looks like a good vacuum, but it is not the best possible one (it is at the local minimum of the curve, not the global one). There are also particles called

8

Higgs-Boson particles which are crucial to the stability of the universe. The theory states that at any moment, it is possible for the Higgs-Boson particles to be configured in such a way that a bubble of true vacuum can form. This true vacuum bubble is essentially a new universe, with completely different properties.

This bubble will then expand, converting the old universe into the new, true vacuum, universe. Everything in the old universe will be wiped out and replaced. The expansion of this bubble will take place at the speed of light, and the entire process will take place practically instantly. This can happen at any time, starting at any location in the universe, due to a variety of possible causes. However, we do not know whether our universe is actually a false vacuum. All we can do is wait for more scientific developments and hope for the best.

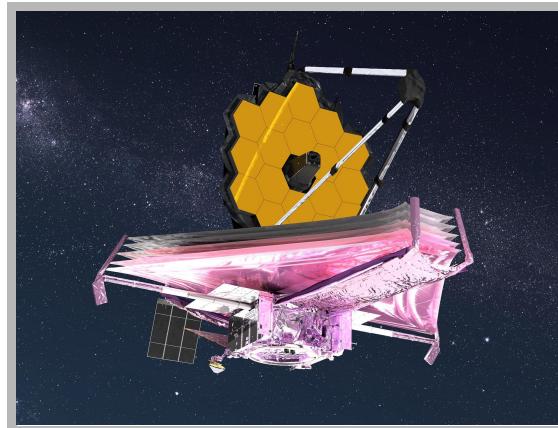
To summarize, there are four popular theories that answer how the universe will end. The Big Crunch is the theory that gravity will pull all matter towards one point. This theory is disproved due to dark energy, and a different theory, The Big Rip, is more reasonable. The Big Rip states that the acceleration of the universe due to dark energy will eventually overcome gravity, and all things, including atoms, will be torn apart. The Big Freeze is another theory, which says that eventually, all energy will be evenly distributed across the universe, and no more activity will occur. Lastly, The Big Slurp tells us that at any random point in time, an unlucky arrangement of particles can result in a bubble of what is essentially an alternate universe, and this bubble will expand, engulfing our current universe. Although each of these theories have their own evidence, we still cannot say for sure what will happen. Remember that the end of the universe will take place billions of years in the future, and we humans will be long gone by then.

The Most Dynamic Telescope

Anna Dai

To have a better understanding of the universe, we need to discover what lies beyond the 5% that is already known. It would take too much time and research to absorb the remaining 95%. The James Webb Space Telescope (JWST), named after James E. Webb, was designed to dig deeper, to find the earliest stars, and to conduct infrared astronomy. The Webb has longer wavelengths to take a look at the first galaxies. Using infrared astronomy, astronomers analyze objects in space such as nebulas, revealing the hidden beauties inside.

With 18 hexagonal mirrors, it collects infrared light from a distance. On December 25, 2021, the JWST was launched at 7:20 AM on an Ariane 5 ECA rocket, a contribution from the European Space Agency. It was intended to orbit the L2, which is about 1 million miles away from Earth.



The telescope's mission to take pictures of the universe has begun! It took about 2 weeks for the JWST to enter its final form, meaning its sun shield was fully deployed. Its true form had been unfolded on January 4, 2022. Images were finally released on February 11, 2022 expressing its operation as a success. The 18 mirror segments each captured 18 points of a single star, the HD 84406. NASA looks forward to better pictures in the summer!

Recent Advances in AI Technology

Eddie Zhang

With new technology being innovated every day, one might wonder, when will AI be a major player in society? Well, believe it or not, AI has already been incorporated in many aspects of our daily lives, though sometimes you might take these inventions for granted. You can find it in bots, like chatbots, and home assistants, like Alexa, Siri and Google Home. Plus, it can be found in various services we use, like health care and banking.

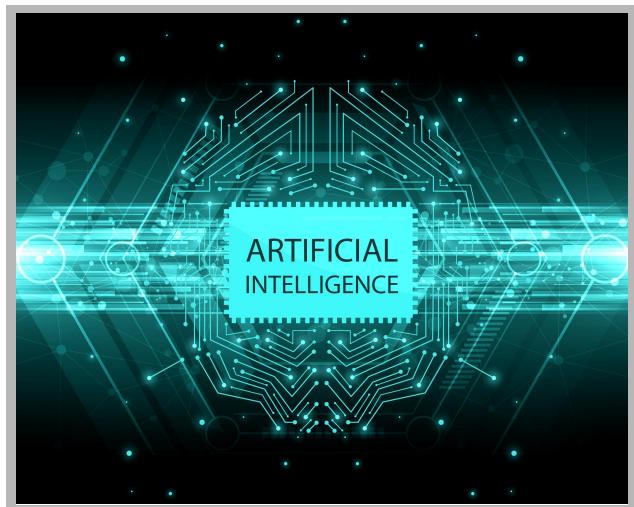
First of all, what even is AI? Many people are unfamiliar with the term AI, so let's clear it up. AI stands for Artificial Intelligence, and machines that incorporate AI become self-learning. There also exist many types of AI-based on functionality and or capabilities. According to the Hewlett Packard Enterprise website, AI is grouped by functionality:

"Reactive Machine – This AI has no memory power and does not have the ability to learn from past actions. IBM's Deep Blue is in this category.

Limited Theory – With the addition of memory, this AI uses past information to make better decisions. Common applications like GPS location apps fall into this category.

Theory of Mind – This AI is still being developed, with the goal of having a very deep understanding of human minds.

Self-Aware AI – This AI, which could understand and evoke human emotions as well as have its own, is still only hypothetical."



11

AI can also be categorized based on capabilities. According to the website, AI is separated into three main sections:

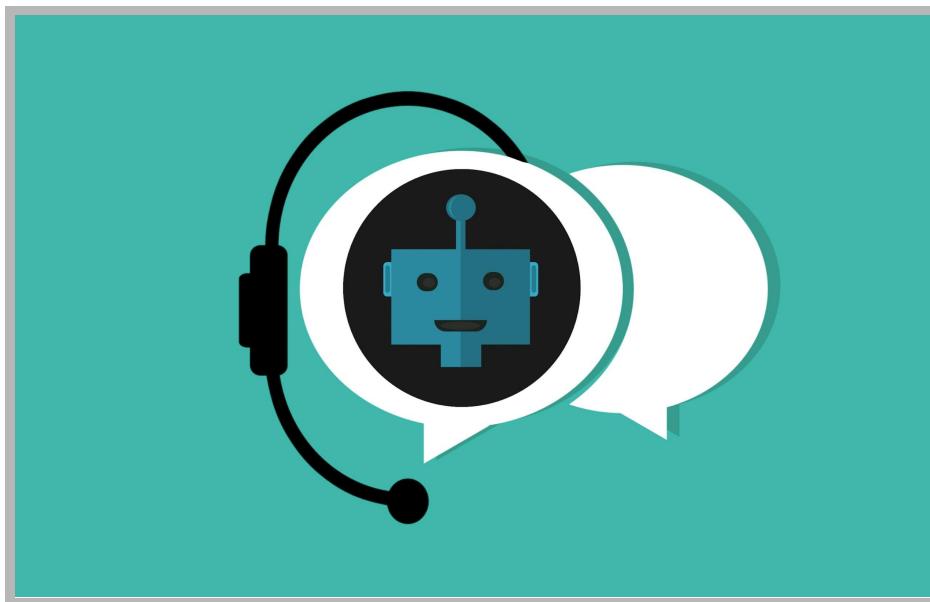
“Artificial Narrow Intelligence (ANI) – A system that performs narrowly defined programmed tasks. This AI has a combination of reactive and limited memory. Most of today’s AI applications are in this category.

Artificial General Intelligence (AGI) – This AI is capable of training, learning, understanding, and performing like a human.

Artificial Super Intelligence (ASI) – This AI performs tasks better than humans due to its superior data processing, memory, and decision-making abilities. No real-world examples exist today”

A great example of AI are chatbots and assistants. Chatbots use voice recognition to recreate human-like conversations with the user. This is achieved through voice recognition software combined with preset answers. The AI would recognize, interpret and process the user’s input, then generate a pre-set output.

Other companies have utilized the AI for customer assistance, like Siri. This program is able to take requests from human speech and accurately generate a response. This is possible because, according to “How Siri Works” by Jameco Electronics, “Siri records the frequencies and sound waves from your voice and translates them into a code. Siri then breaks down the code to identify particular patterns, phrases, and keywords”. However, despite these benefits, they all have one major flaw, they are unable to recognize the context of human conversations. People often change tones or the format of their speech based on the people they are speaking to. For example, if they speak to a higher-up, they would adopt a very formal tone, but if they speak to children, they adopt a friendly tone. This is what the AI can’t understand, resulting in similar responses to all situations. Now, will this problem be fixed? We just have to wait and find out.



We can also find AI in everyday services like health care, customer service and banking. Contrary to popular belief, many agree that AI bots are not likely to replace human workers, but instead, enhance human performance in different fields. For example, in the article *The rise of artificial intelligence in healthcare applications*, written by Adam Bohr and Kaveh Memarzadeh, “AI is ready to support healthcare personnel with a variety of tasks from administrative workflow to clinical documentation and patient outreach as well as specialized support such as in image analysis, medical device automation, and patient monitoring”. This is mostly due to robots not having the capacity to think like humans in interactions. Although some AI bots are able to read people’s emotions and or mood, it is not enough to completely take over because, as mentioned before, they cannot understand the context of the conversation. In banking, AI can also provide many benefits. For example, customer service, regulatory compliance, risk management, cybersecurity, and fraud detection. AI programs are able to more accurately detect fraud as well as cyber threats and manage each accordingly. They can be used to automate customer service, freeing up staff for other tasks and help keep the bank up to date on recent standards and policies.

As time flies by and new technology is invented, we will see even further enhancements to what we have today. But for the meantime, we have created AIs that are capable of supporting humans in health care, banking, and other daily events we have today.

A Cautionary Tale of Gene Editing

Ethan Chen

The history of humans genetically modifying plants and animals for our benefit goes back thousands of years to the advent of agriculture. As generations of farmers harvested and sowed staple crops such as barley and wheat, generations of crops were selectively bred and planted to maximize flavor and harvest yield. Today's modern corn crop, **maize**, appears bloated and contains an array of nutrients and accessible fruits (kernels) compared to its ancient parent, **teosinte**. These days, few take notice of the mutated, genetically modified descendant of teosinte as modern corn has proven itself to be one of the most historically important crops to human civilization.



The utility of altering organisms' DNA remains crucial in modern agriculture, allowing plants to produce their own pesticides and become immune to some diseases. However, in recent decades, it has become a bone of contention among both the scientific community and an increasingly health-conscious public. In addition, a surge in the accessibility and confidence in gene-editing technology has led some to use the science recklessly to the dismay of professional scientists.

A new age of amateur so-called "biohackers" are interrupting the serious medical research going toward gene-editing methods such as the revolutionary CRISPR

14

technology. In addition, they're staining the safety and care that established and trained biologists and genealogists go to great lengths to ensure.

Josiah Zayner, a biohacker known for selling gene-editing kits out of his garage, injected himself with the gene-editing tool CRISPR in order to grow his muscles. Despite the experiment's failure, it sent shockwaves through the biomedical community as it garnered a wave of attention on the advent of DIY gene-editing. Many scientists were fiercely critical, focusing on the complete absence of research on injecting DNA into the bloodstream and the risk of unknown health effects.

Much of the criticism of gene editing is often aimed at Genetically Modified Organisms (GMO foods). However, repeated large studies have come to the conclusion that, in general, genetically modified foods pose little additional hazard compared to their naturally evolved counterparts. The Royal Society reports that "all reliable evidence...

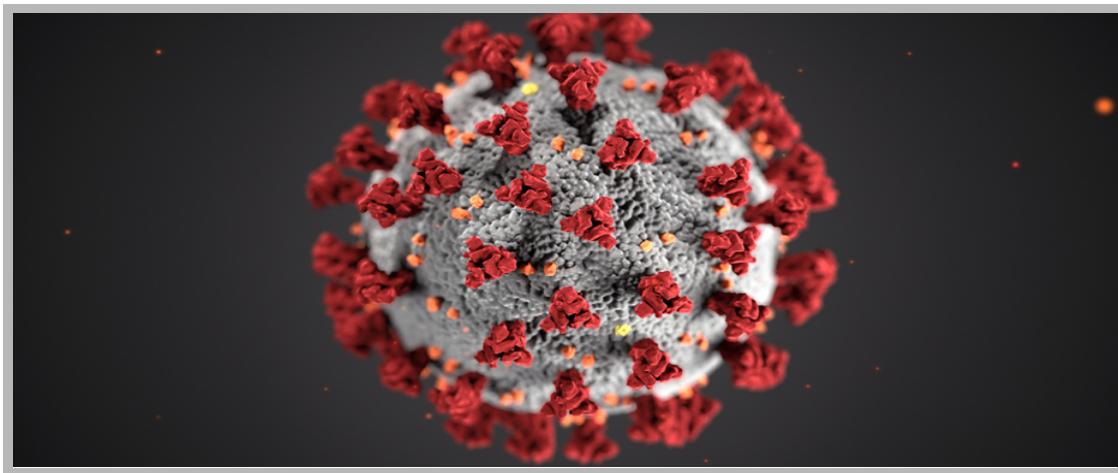


shows that currently available GM food is *at least* as safe to eat as non-GM food". While GMOs may not pose a threat to consumers' health, it has been used as a tool in financially trapping farmers and producers to mega-corporations such as Monsanto. The company, infamous for forcing farmers to use excessive pesticide on their crops engineered to resist the chemical, once held a near-monopoly on genetically modified seeds.

In part due to cases like these, when science and safety are sacrificed in the name of rapid commercialization and profit, activists are increasingly driven to the anti-GMO cause. While its history goes back thousands of years, only recently has the gene-editing process been refined to suit the modern age. Though the health effects appear minimal, and the economic opportunity it generates is invaluable, academics still understandably treat the domain with caution. Acknowledging the risks that this growing technology brings is just as important as advancing it forward to benefit future generations. When science is misused, it's mistrusted or even feared, which is why exercising due diligence is paramount in today's uncertain times.

Technology and COVID-19

Aidan Hong



There is no doubt that we have to adapt to the “new normal” amidst living with COVID-19. Technology has played a substantial role in helping us adapt to this new way of life. From QR codes to contact tracing, let’s dive into some of the new technology that helped better our lives during the pandemic.

When COVID-19 vaccination began, people were handed vaccination cards, and dosages were recorded on the card via analog methods. Verification and ease of carrying was a major issue. Technology and mobile devices have helped ease both issues. The State of California has allowed for vaccine card verification and its transfer to mobile devices. Utilizing the phone’s security features, you can now display your vaccination card without carrying a physical copy at all times. Technology has helped with security and verification issues while solving the burden of carrying an additional card.

With the ever changing status of COVID-19, government restrictions are always in flux. With the most recent change, any international traveler entering the United States must have a verified COVID-19 test within 24 hours of their flight. With the mention of COVID testing, the thought of long lines and inconvenience comes to mind. Abbott and eMed have teamed together to provide an FDA authorized solution for COVID testing.

16

This new testing method is done via a webcam, with a certified agent who would walk you through the testing process from opening the box to verifying your result. Imagine doing this in the comfort of your own hotel room, instead of having to wait in long lines at the airport! Technology has eased multiple issues: the burden of finding a test site 24 hours within your flight, eliminating congregating with other travelers, and having a personalized testing experience anywhere in the world.



Contact tracing is one of the most important procedures in the fight against COVID-19. This process is usually conducted by numerous phone calls from one individual to another, asking each person to recall who they have had close contact with, a process that is long in hours and relies on one's recall memory during a time of stress.

Apple has teamed up to provide a solution to this problem. iPhones send bluetooth signals to see how far away you are from someone, and how long you have been near them. If

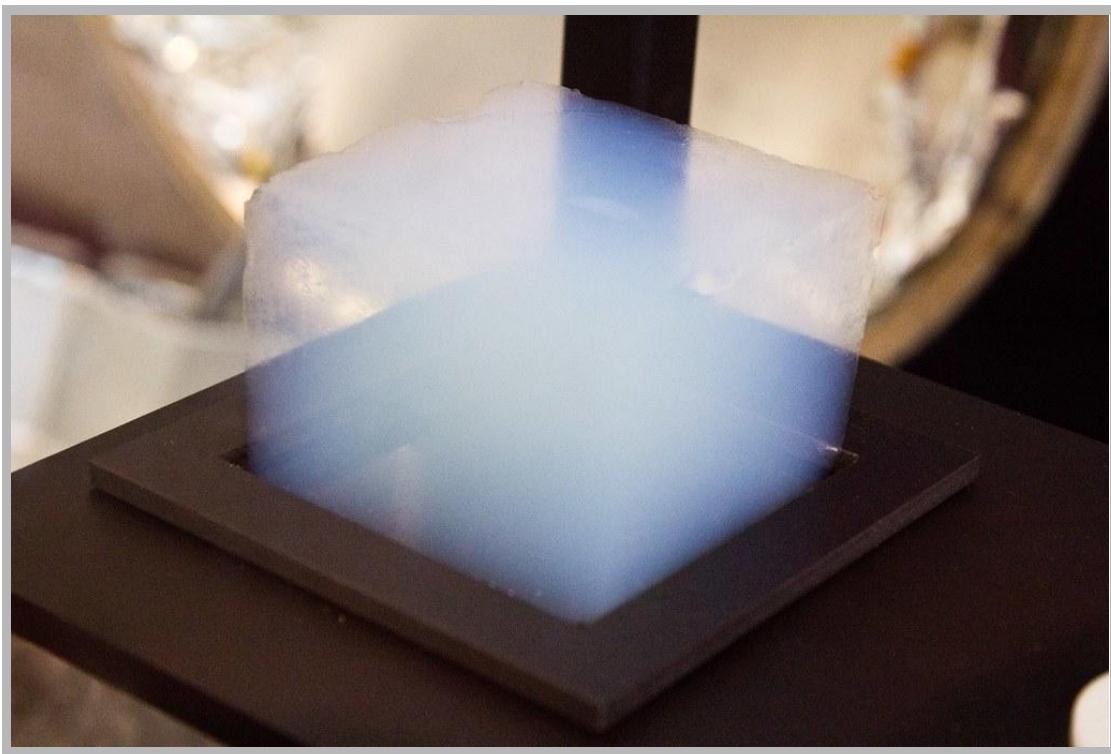
someone reports becoming positive for COVID-19, it will check its history and trace contact with other iPhones. If you had been within 6 feet from them for at least 15 minutes, it would notify you that you have been exposed to a person positive for COVID-19. With digital contact tracing, we can now do better in protecting ourselves and others.

Throughout the pandemic, technology has been used to enhance safety and convenience. This is just the tip of the iceberg as technology continues to advance, helping us in the fight against COVID-19.

Aerogel - A Little 'Weight' to Insulate

Kenny Wu

If you think plastic and aluminum are light, then don't get me started on the lightest solid on earth. Aerogel is a material that is 99.8% air and has the appearance of frozen smoke.



Despite the name, aerogels are solid and dry materials that look nowhere near a gel in their physical properties. Such a solid would be fragile and delicate you think, however it was designed to be strong and flexible. Now, on to the uses. There are many potential uses for aerogel, but it's mainly used as a thermal insulator. This is because it's made out of mostly air which already makes it an excellent insulator, but also, all the air is stored inside a network of silica.

So far, it has been used in large masses in environmental technology, physical experiments, and industrial catalysis. NASA uses Aspen Aerogels' product for cryogenic applications such as launch vehicles, space shuttle applications, life support equipment,

18

and rocket engine test stands. Monolithic silica aerogel can handle up to around 650°C, it will eventually melt after reaching higher temperatures. Aerogel may eventually appear on the surface of our daily life after more moderation and development due to its unique perks. With the utilization explained, let's move on to the production.

Aerogel was first developed in the late 1980s and was produced from silica gels. Aerogel is created by drawing out the liquid components of a gel using supercritical drying. This leads the water to dry out but also keeps the shape of the gel firm. It is possible to make homemade aerogel by drying alcohol-based silica gel, though the ingredients are quite pricey and dangerous.

Currently, aerogel has a greater cost than gold, which holds a heavy price of nearly \$23,000 per pound! As a result, aerogel has the advantage of being the lightest object on earth, while also being a great thermal insulator; It contains so much potential in so little weight.

A Study on Pavlov's Dogs

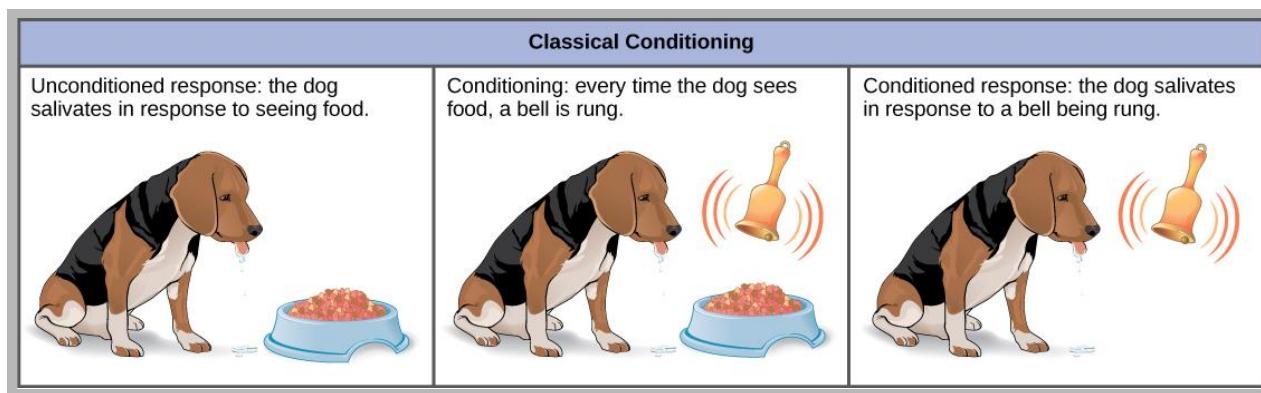
Nick Li

During the 1890s, Russian physiologist, Ivan Petrovich Pavlov was researching salivation in dogs in response to being fed, when accidentally discovered what we now call Pavlovian conditioning. In the experiment, Pavlov measured the saliva of the dogs with a small tube when they were fed. He predicted that upon seeing the food, the dogs would salivate; however, he could not help but to also notice that the dogs would salivate whenever they heard the footsteps of his assistant bringing them the food.

Pavlov realized he had made an important scientific discovery when he discovered that any object or event associated with food would evoke the same response as if the object or event were not present. He spent the rest of his career studying this phenomenon. Pavlov started by noting some things that a dog does not need to learn. For example, we do not need to train our dogs to salivate when food is placed in front of them. The salivation is 'built-in' to the dog. Food is an unconditional stimulus and salivation is an unconditional response: a stimulus-response connection that requires no learning.

19

There were four parts in which his experiment was conducted. First, the dogs were given food without any object or event. As expected, the dogs had salivation. In his experiment, Pavlov used a metronome as the object. By itself, the metronome did not have any response from the dogs. Next, Pavlov began the conditioning procedure, where the clicking metronome was brought out when he gave food to his dogs. The dogs continued to salivate when they saw the food. After several repetitive trials of this procedure, he presented the metronome on its own. As anticipated, the sound of the clicking metronome caused an increase in salivation. The dog had learned a new behavior and associated the metronome with the food.



Since this response was conditioned, it was called a conditioned response and known as a Pavlovian response. The neutral stimulus has become a conditioned stimulus. Pavlov concluded that for associations to be made, the two stimuli had to be presented close to each other in a small amount of time. He called this the law of temporal contiguity.

Since his early work between 1890 and 1930, Pavlov and his studies of classical conditioning have become well-known. In fact, we still use classical conditioning now when training dogs. For example, after the dogs do something following the command like 'sit' or 'stay', we would give them a treat. This would cause an association between following the command and food; therefore, the dogs would tend to follow the command because they think that food will be given.

Vaccine Myths

Angelina Chien

The COVID-19 virus has led to many creations of vaccines, but many question if they are safe for children. In the article, *The Mandatory COVID-19 Vaccination of School Children: A Bioethical and Human Rights Assessment* by Willem van Aardt, he argues that, “There is no scientific evidence that the COVID-19 variants may drive infection in children and harm them nor are there any data to support the notion that a lethal strain may emerge among the variants”. Scientists have proven vaccines are safe. This should be the reason why parents should feel safe and comfortable with their children taking the vaccine. Yet, parents trust social media more than actual experts, and spread rumors that vaccines can harm children. Even if there is no scientific evidence, there may be ethical evidence of children getting harmed because of their parents spreading false rumors to their child.



Although there is no scientific evidence that vaccines harm children, there are dangerous substances within the vaccine. There are substances like thimerosal and

21

formaldehyde which can cause poisoning or even death if the wrong amount is used. This is one of the reasons why many parents do not support vaccines due to their hazardous materials.

On the other hand, many claims that vaccinating a group of children can gain immunity in the community are false. In the article, *We Must Not Be Forced Into Vaccinating Our Children From COVID* by Paul E. Alexander, he says, “The contention that governments can only get to herd immunity by vaccinating children is absurd, patently false and denying scientific reality”. There are some groups that protest about the vaccines, who think that vaccines “denies scientific reality” and that “to herd immunity by vaccinating children is absurd”, which is false.

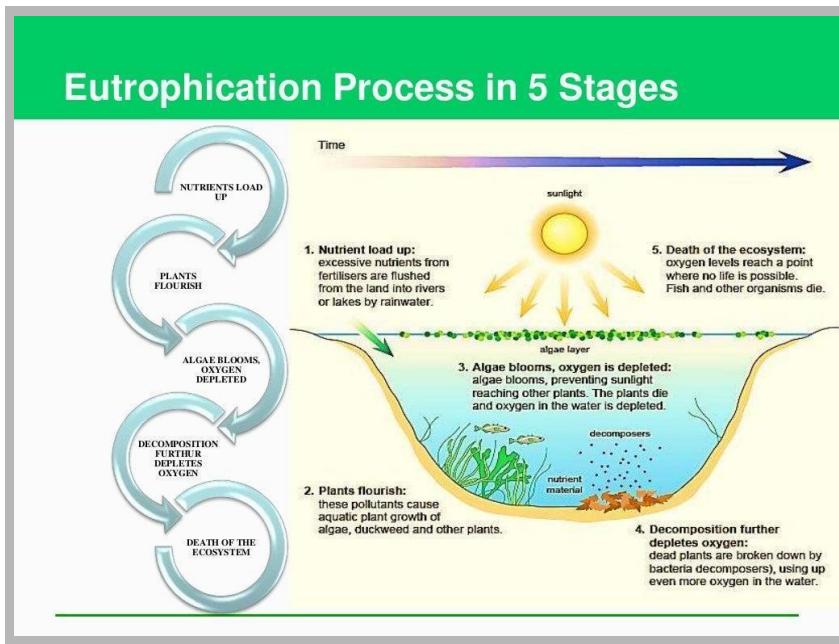
The important conclusion to reach is that there is a lot of misinformation surrounding vaccines, and many believe that vaccines are harmful. However, science shows that they are usually harmless, and doing a bit of fact-checking is enough to disprove many of these false claims.

Algal Blooms: Impacts and Solutions

Annabella Luo

Algal blooms are the accumulation or overgrowth of algae in water ecosystems. Cyanobacteria (blue-green algae) cause most freshwater blooms while dinoflagellates and diatoms cause most saltwater blooms. Algal blooms can reduce water quality and oxygen level in the water, create dead zones in the water, produce toxins harmful to organisms that are part of food webs, including humans, reduce biodiversity, create barren ecosystems, and raise costs for treatment of drinking water and other industries.

Algal bloom can be attributable to a combination of physical and chemical factors such as the level of nutrients (phosphorus and nitrogen), water temperature, water flow, water conditions like PH/turbidity, and other ecological changes. When a dense bloom occurs, it leads to blocking of the sun, depletion of oxygen and eventually, in the extreme cases, death of organisms and ecosystems as shown in the 5 stages of Eutrophication below. Algal blooms can also clog the gills of fish, shellfish, and other animals, preventing them from breathing.



Algal toxins are toxic substances in the cells of algae and are released into the water when algal blooms are present and decay/degradation of algae happens. It can be accumulated in the food web and threatens the survival of many species at multiple trophic levels such as fish, birds, alligators in freshwater, and turtles, dolphins, manatees and other marine mammals. It is estimated that 50% of UMEs (unusual marine mortality events) have been related to harmful algal blooms. Humans can be exposed to algal toxins via skin contact, breathing in toxins, swallowing contaminated water, and eating contaminated food.

Based on a 2019 update of coastal monitoring programs, reports of harmful algal blooms in U.S. water and around the world have increased dramatically over the last four decades. Increased human activities such as runoff from agriculture, dissolved chemicals introduced into water supplies via rainfall or irrigation, effluent from sewage treatment, coastal development and other factors, as well as better detection and awareness of algal blooms are attributable to such a surge.

Solutions to algal blooms can be categorized into 3 categories:

23

Prevention – Examples such as proper sewage treatment, reduction of pollution and water wastage at the personal level, optional fertilizer application, and use of non-toxic cleaning supplies.

Detection – Examples such as Algal Bloom Monitoring System developed by NCCOS (National Center for Coastal Ocean Science), and National Oceanic and Atmospheric Administration's Harmful Algal Blooms Forecast.

Treatment – Examples such as chemical measure of using barley straw, biological measure of Floating Treatment Wetlands, and high-tech measure of ultrasound bloom treatment.

Ultrasound Bloom Treatment is one of the most effective, eco-friendly, widely-used direct treatment solutions. Low power ultrasound waves emitted in the top water layer can create a constant pressure cycle around the algal cells. It targets gas vesicles in the algae to reduce its buoyancy regulation, causing it to sink, and prevents them from accessing sunlight and nutrients. Without sunlight, no photosynthesis occurs. The algae sink and decompose naturally, without releasing harmful toxins and won't harm the ecosystem in the process.



Algal blooms occur when algae — simple photosynthetic organisms that live in the sea and freshwater — grow out of control while producing toxic or harmful substances that negatively impact people, fish, shellfish, marine mammals, and birds and the

24

ecosystem they live in. Algal blooms can cause harm through several routes of exposure: biotoxins released by algal blooms, and high biomass accumulation and a chain effect of physiological stresses, increased susceptibility to disease, and feeding impairment that can lead to decreasing biodiversity, and temporarily or permanently degrade of important habitats. Increasing reports of algal blooms can be attributable, among other things, to increased pollution and other human activities. Algal blooms cannot be stopped completely, but can be managed, controlled, and mitigated. Prevention and detection are important, but direct treatments such as ultrasonic bloom treatment is an integral part of algal bloom solutions.

Renewable Energy

Stephen Hung

What is renewable energy? Renewable energy is energy that comes from natural sources and is nearly indefinite. Types of renewable energy include solar, wind, or hydroelectric power. Currently, the majority of the energy comes from nonrenewable sources such as fossil fuels, which include natural gas, coal, and oil. However, the combustion of these fuels for energy releases harmful greenhouse gasses into the atmosphere, resulting in many adverse effects.

The main effect of the combustion of fossil fuels is that it causes global warming. Global increase of temperatures results in an imbalance of many natural cycles. This will greatly harm the environment, and as a result, harm human economics and safety. Studies show that “Exposure to CO₂ can produce a variety of health effects. These may include headaches, dizziness, restlessness, a tingling or pins or needles feeling, difficulty breathing, sweating, tiredness, increased heart rate, elevated blood pressure, coma, asphyxia, and convulsions.” Additionally, climate change due to the use of nonrenewable energy can result in extreme weather, food insecurity, and increased wildfires. According to the California Air Resources Board, “Since 1950, the area burned by California wildfires each year has been increasing, as spring and summer temperatures have warmed and spring snowmelt has occurred earlier”.

By introducing infrastructure for the mass use of renewable sources of energy, people can help stop reducing their carbon emissions. Major technology companies such

25

as Tesla are researching the development of solar panels and electric vehicles, which greatly increase the efficiency of energy use. Furthermore, having an indefinite source of energy helps reduce costs associated with obtaining the energy through fracking and mining. However, statistics show that each year, more and more energy is used. The EIA says, ‘Energy consumed in the buildings sector, which includes residential and commercial structures, increases by 65% between 2018 and 2050, from 91 quadrillions to 139 quadrillions Btu. Rising income, urbanization, and increased access to electricity lead to rising demand for energy.’



Some may say that renewable energy cannot support the current demand for energy, but nonrenewable energy is unsustainable for the long term, and the current supplies will only keep being consumed more and more each year. Development in the efficiency of the technology is taking place and is getting better and better over time. Although the transition from the use of nonrenewable energy to renewable energy won’t be fast, change must occur to protect our future generations.

Report on Scientists' Pay Gap in California

Stephen Hung

There has been a large disparity between the pay of state engineers and state scientists in California. The union representing scientists is now negotiating to close the pay gap between the state scientists and state engineers. The U.S. Bureau of Labor Statistics shows that environmental scientists and specialists earned \$73,230 in median annual wages in 2020, compared to environmental engineers, who earned \$92,190 in median annual wages in 2020.

Some say that this pay gap is due to the majority of engineers being men, with 78 percent of state engineers identifying as men, according to the 2020 California State Employee Total Compensation Report. The main problem that occurred due to pay disparity is that scientists will be less motivated to do research on environmental problems seen in California.

To protect our environment and the citizens of California, equity in pay must take place so that scientists will be incentivized to do research and work to make California a better place. Furthermore, the pay disparity could result in environmental scientists working for California choosing to be reclassified as engineers so that they could have a much greater pay. Compromising these valuable environmental scientists will result in many problems. Every year as climate change worsens and more environmental problems arise, there will be even greater demand for scientists in this field of study.

Are We Ruining the World?

Stephen Hung

Over these few years, climate change has been one of the more important things to discuss. However it is caused, climate change is negatively impacting our world. Climate change, or global warming, is when temperatures rise. As a result, glaciers will melt more, and the melted water drips down into the oceans. Sea levels rise, and with a combination of natural disasters, such as hurricanes, the coasts will be very undesirable. To fight climate change, we need to change how we live.

Many ways cause climate change. Examples include, but are not limited to, the emission of greenhouse gasses and fires. For example, the emission of greenhouse gasses can be caused by the burning of fossil fuels, transportation, and even agriculture. Over the last 150 years, the largest source of greenhouse gasses comes from burning fossil fuels for electricity, fuel, and heat. However, according to the EPA, in 2019, transportation was the highest source of greenhouse gasses, with 29%. Followed by electricity with 25%, and the industry with 23%. The total amount of greenhouse gasses in 2019 is 6,558 million metric tons (14.5 trillion pounds) of CO₂ equivalent.

Another cause of climate change is caused by nature itself. Fire. 2020 is considered the worst year in California's history of fires. It burned a total of about 4.2 million acres of land. In 2019-2020, California's fires have released about 112 million metric tons (247 billion pounds) of carbon dioxide into the atmosphere.

Climate change has more effects than is counted. As mentioned, glaciers melting, increased temperature, and more severe storms are all effects of climate change. These effects have effects of their own. When glaciers melt, the land for animals who live in the poles decreases. Those affected include polar bears and penguins. Currently, there are about 22,000 to 31,000 polar bears left in the world and are declining due to climate change. Some penguin species, such as the Emperor Penguins, are heavily impacted by climate change. They have become vulnerable to extinction from climate change. These penguins need suitable land for breeding and raising chicks.

Temperatures have been increasing. California has been in a bad drought for the past few years, and the increasing temperature has made it worse. Hotter temperatures relate to an increased chance of wildfire. Wildfires can spread quickly, which leads back

to emissions of carbon dioxide. An increase in temperature will also cause an increase in heat-related illnesses, which will make it harder to move around and work.



In conclusion, climate change has made many negative impacts on our world. The safety of animals and humans is at risk with climate change. Climate change has been around for a while, and we need to address it more.

Global Warming: A Global Warning

Cathie Zhu

Average global temperatures have increased 1.2 degrees Celsius, about 34.16 degrees Fahrenheit, compared to that of the late 1800's average. Global warming, one of the greatest environmental challenges that the planet is facing today, continues to warm the planet due to human activity, mainly the act of burning greenhouse gasses.

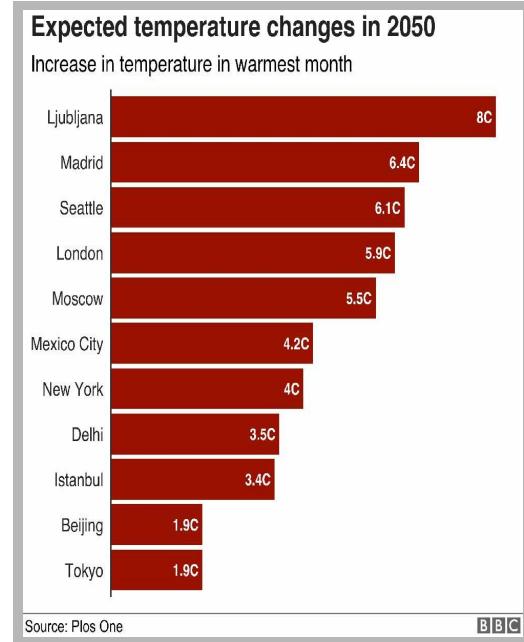
The greenhouse effect, the main cause of global warming, presents itself with both its benefits and detriments. This phenomenon confines the sun's heat within the Earth's atmosphere and is what is preventing the Earth from becoming an icy wasteland.

29

However, the pollution of this planet, burning of fossil fuels, deforestation, and much more, increase the number of greenhouse gasses in the atmosphere. This is causing an increase in the heat that is being trapped within the Earth due to the greenhouse effect and excessively warming the planet because of it. Therefore although the greenhouse effect is what is maintaining the sustainability of the Earth, it is also gradually heating the planet to an intimidating point.

Josef Werne, geology and environmental science professor at the University of Pittsburgh, says that “We can observe [climate change] happening in real-time in many places...Ice is melting in both polar ice caps and mountain glaciers. Lakes around the world, including Lake Superior, are warming rapidly — in some cases faster than the surrounding environment. Animals are changing migration patterns and plants are changing the dates of activity”(Live Science, 2022). The melting of polar ice caps in the ocean contributes to IPCC’s prediction of the average sea levels increasing by 82 cm in a hundred years. Many coastal regions around the world would be strongly affected if such change were to occur. Furthermore, many populations are being forced to migrate for survival, which often disturbs the delicate balance of nature and its resources, causing inequality amongst humans and their resources.

As oceans are carbon sinks that absorb and store carbon dioxide from the atmosphere, the constant production of burnt greenhouse gasses modifies an oceans’ composition. This causes oceans to become more acidic and threaten the life of marine animals residing within the ocean. Agricultural systems will be another factor likely to suffer greatly. While the confined carbon dioxide may increase the growth in plants, it may also significantly decrease their nutritional value. As expected, many consequences will arise if this is to happen, such as political instability and human health.



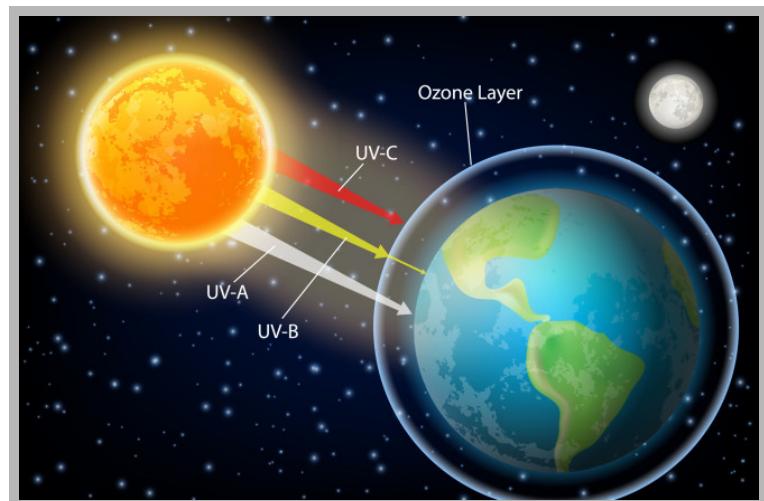
As many may expect, the only way to reduce the threats of global warming is to reduce greenhouse gas emissions. Keeping track of carbon footprints by identifying and minimizing the main sources of greenhouse gasses is a great way to begin the reduction of global warming, one step at a time.

Climate Change

Brian Wang

Despite being shrugged off by many, the idea of the world being eradicated in a few years purely from climate change is still on the line. Maybe it's not as extreme as it is said to be, but it can have a guaranteed change on the planet's current lifestyle. Humans that work at a factory to pay off their own house play a major role in this crime scene. Some of the prominent causes for this case include the greenhouse effect, ozone depletion, and human activities.

The world is bound to become endangered in light of the well known greenhouse effect. The idea of this concept is that as the sun's waves hit the planet, it passes through the atmosphere of the Earth and onto the Earth's surface to heat it. Part of these rays will be reflected back through the atmosphere and back into space. However, the greenhouse gases that reside in the clear atmosphere can disrupt this transaction. As a result, lots of the elements found in the atmosphere absorb radiation, which in turn leads to climate change. This is not all that goes on between the Earth and the atmosphere. Infrared radiation is emitted from basic objects, whether they are hot or cold. The hotter it is, the more radiation it fires. When this energy is emitted from Earth, it travels toward the atmosphere. There, some greenhouse gases absorb the radiation, while others send it back toward the surface. From a bystander's view, this may seem like some natural processes that go on. It isn't. Not only will this increase the heat the Earth stores, but it will ultimately contribute to one of the most popular topics humans have stumbled upon, climate change.



31

Ozone depletion occurs in the same fashion as greenhouse gases. There are two types of ozone, tropospheric ozone which lies down low and stratospheric ozone which flies up high. Moreover, the ozone which inhabits the lower end of the spectrum is a disturbance to mankind. It is an incredibly strong lung interceptor. In other words, it makes people acquire less oxygen. The functionality of the stratospheric ozone is different, however, as it helps absorb and defend ultraviolet radiation. In fact, it absorbs about 95 percent of the UV emitted. UV is a powerful radiation that can damage organisms on Earth. A recent study in the 1970s showed that the main reasons for declining stratospheric ozone levels were due to chemicals known as chlorofluorocarbons or CFCs. Everyday items including hairspray or air conditioners all contain this harmful substance. When it is released from its exchange pool, CFCs travel to the stratosphere where it is broken apart from the all powerful UV radiation. During this process, O₃ (Ozone) is transformed into O₂.

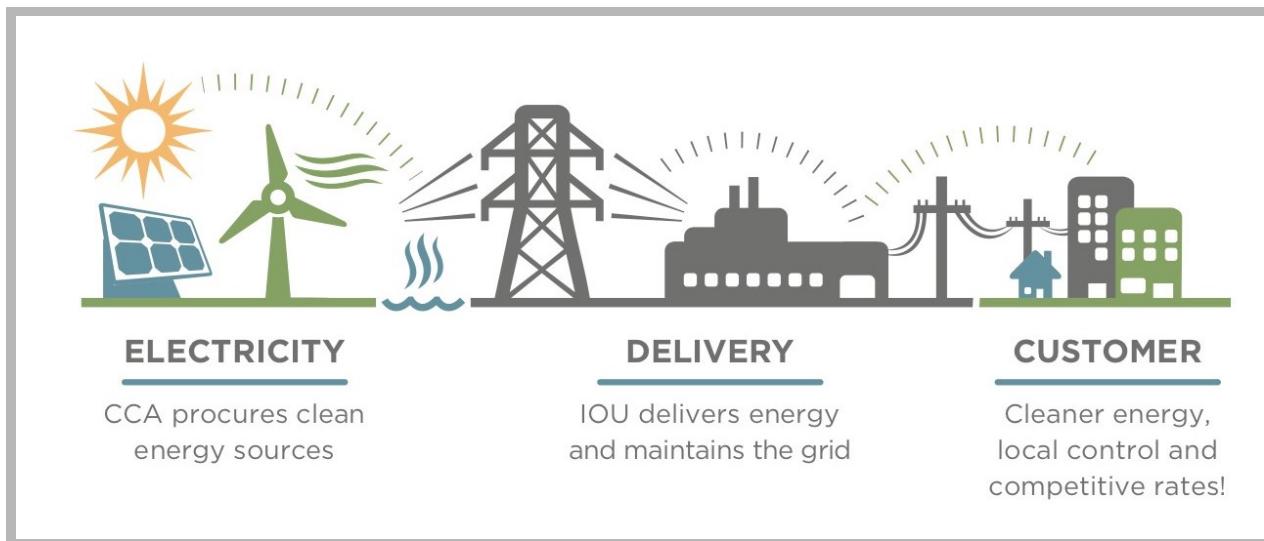
Furthermore, us humans also contribute to the conflict. As many people know, CO₂ or carbon dioxide is not good for the earth. By leaning towards fossil fuels for sources of energy, it can become increasingly difficult to sustain a comfortable Earth. When fossil fuels are combusted, or burned, CO₂ is released into the atmosphere where it is stored as radiation. As discussed before, CFCs are an enemy to society. They are human-made chemicals, however, and reducing the use of these are great for the Earth. There are great alternatives to this substance, such as hydrofluorocarbons or HFCs. Research is still being made on this topic. Many humans have already put into good practice of reducing car emissions and fossil fuel usage. If everyone took a step forward, this problem would be close to finished.

In the final analysis, the key points discussed in this passage were the effects of climate change and how humans are affecting it. By limiting everyday usage of harmful substances such as fossil fuels and items that include CFCs, we are able to reduce the amount of greenhouse gasses storing heat and reduce ozone depletion. Continuing these actions and doing even more good for the world can reduce climate change by a long shot.

Irvine's Renewable Energy Efforts

Annabella Luo

On February 8, 2022, the Irvine City Council unanimously voted to select the 100% Renewable Energy default service level for all OCPA customers in Irvine. Orange County Power Authority (OCPA) is a Joint Powers Agreement among neighboring cities currently including Irvine, Fullerton, Buena Park, and Huntington Beach. OCPA is ready to launch the Community Choice Energy (CCE) service for commercial customers in April 2022, and residential customers in October 2022.



Community Choice Energy is a program that enables California local governments control over energy procurement to purchase power, set competitive rates, and collect revenue. The electricity grid is still maintained by local utilities, as well as energy delivery and billingservice. Businesses and residences will be offered automatic enrollment in the CCE's jurisdiction, but they can opt out and continue to purchase energy from the local utilities. Customers have the option of choosing increased percentages of renewable energy. The three options are: basic Choice with 38.5% renewable energy among all energy consumed; smart choice with 69% renewable energy and the last one of 100% renewable energy consumed.

33

Currently it is expected that the electricity cost for consumers in the lowest tier of basic choice will be the same as SoCal Edison while consumers in the most expensive 100% renewable tier are expected to pay a premium of 5.6% or around \$76 more per year on their energy bill. On top of the additional cost to consumers, the city of Irvine has to spend more than 300k a year to keep the program afloat. The CCE is touted as a major step toward meeting Irvine's goals of carbon neutrality by 2030. The revenues generated from the program will be used to support local energy projects, workforce development, and community programs. Hopefully the long-term benefits from the program will outweigh the short-term cost of energy rate hike. It is unclear, though, for those residents who have already installed solar panels on top of their roofs, what would be their options.