

# SEEKING SCIENCE

## How Do Fireworks Get Their Color?

Learn about the science behind how fireworks work and how the magnificent colors are shown to the world!

**Astronomy**

**Starlink: Space Age Internet**

**Gamma Ray Bursts: Space Snipers**

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# How Fireworks Get Their Color

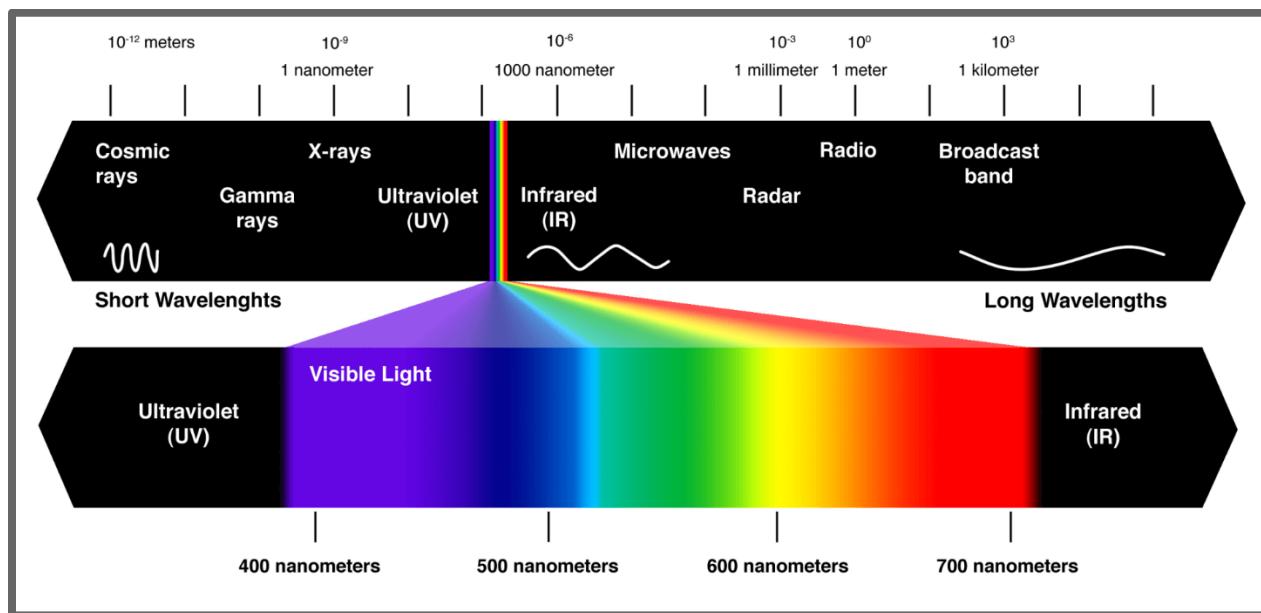
Edward Huang

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Loud, bright, and colorful, fireworks are a staple of many holidays and celebrations around the world. One of the main reasons why is since they come in a large variety of colors. From red to purple, to silver and white, fireworks use their diverse colors to surprise and awe spectators. While people do not tend to think much of them, creating the colors for the fireworks is extremely complicated and technical. The science behind the colors of fireworks goes surprisingly deep.

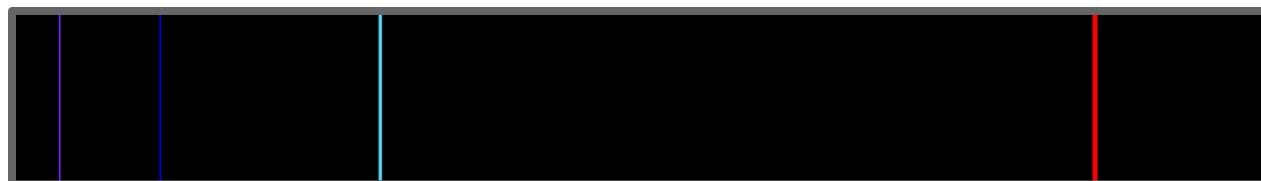
The main basis of firework colors is how atoms release energy in the form of light. Atoms contain electrons, which reside in the atom's energy levels. Sometimes, electrons can get excited and jump between energy levels. This happens when external energy is applied to the electrons. Electrons prefer to be in lower energy levels, so when given the energy to do so, they will jump down to a lower energy level and release energy. This energy is released in the form of a photon, or light, which can fall anywhere within the electromagnetic spectrum. Light with wavelengths between 740 to 380 nanometers falls in the range of visible light. Within this range, light with wavelengths towards the upper end will produce red light, and those with smaller wavelengths will produce violet light. The wavelength of the light released by the electrons depends on its initial and final energy level in its "jump".

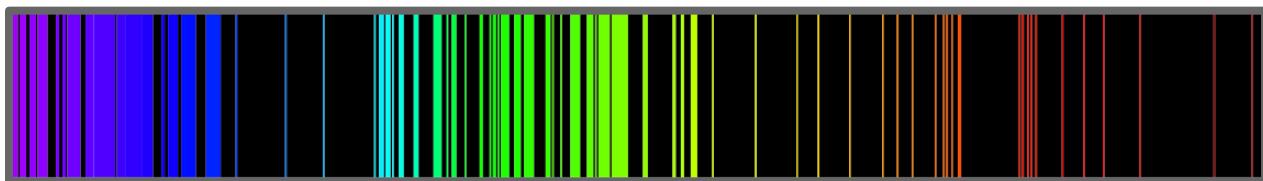




Typically, electrons that end up in level 1 or energy levels 3 and higher will produce ultraviolet light and infrared light, respectively. Electrons that jump down to energy level 2 fall within the visible light spectrum. The colors that these electrons emit also depend on the chemical used, and each type of chemical has its own “emission spectrum”. Spectroscopy is used to determine the emission spectrum of every single element, with some elements producing specific colors easier than others. By using these emission spectra, scientists can test and discover which combinations of chemicals to use to create different colors in fireworks. This same principle is also used in neon lights, where chemicals that are specifically noble gases (helium, neon, argon, etc.) are used to emit light from tubes.

### Emission spectrum of Hydrogen:



**Emission spectrum of Iron:**

Through repeated testing and discovery, firework makers know which chemicals to use for different colors. For example, creating a red color is commonly done with strontium salts, while blue color is usually done with copper chloride. Some colors like purple can be created by mixing other chemical compounds. Silver and white can also be created by including burning hot metals like magnesium, aluminum, and titanium. Additionally, chemicals like chlorate and perchlorate, which are “chlorine donors”, are used to make some colors stronger and more vibrant.

- Red: Strontium salts
- Orange: Calcium salts
- Yellow: Sodium salts
- Green: Barium salts
- Blue: Copper salts
- Purple: Combining copper and strontium compounds
- Gold: Molten iron
- Silver: Hot magnesium and aluminum
- White: Burning magnesium, aluminum, and titanium



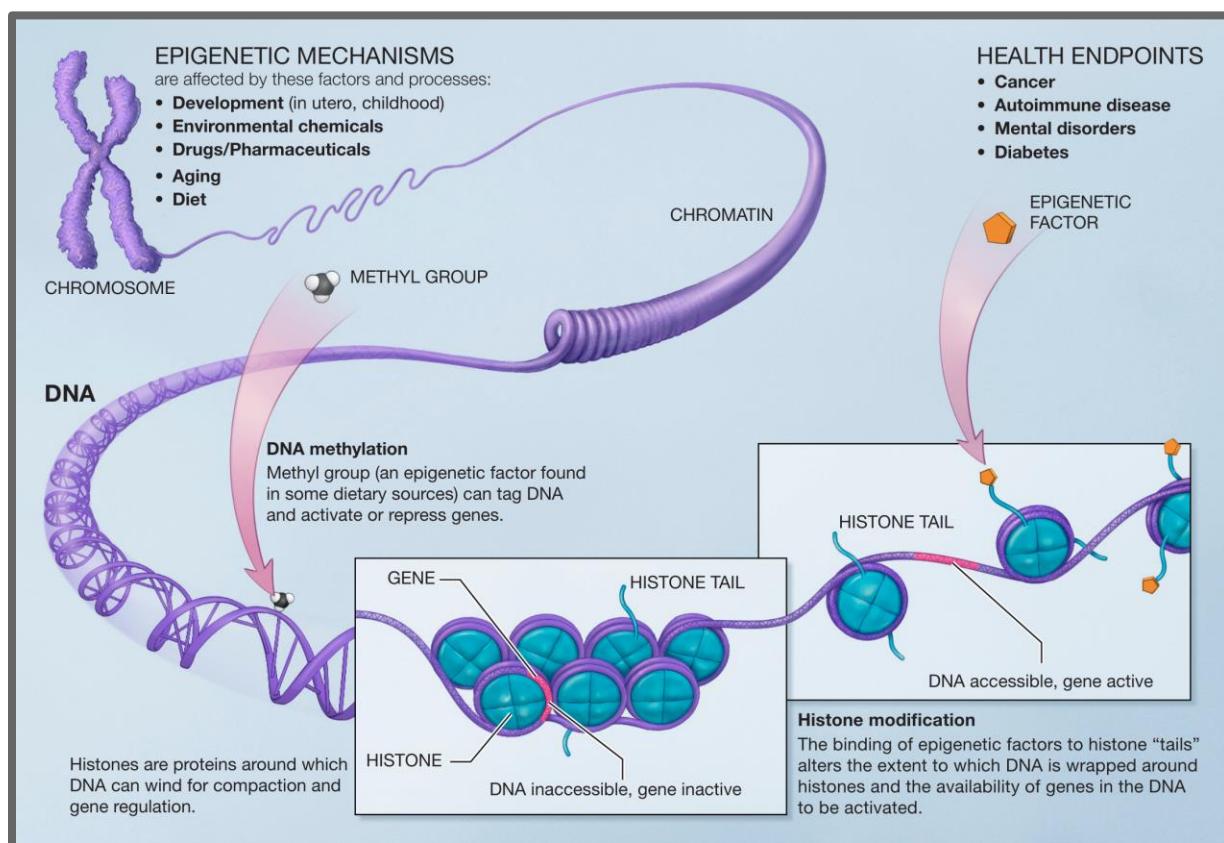
In conclusion, fireworks have a surprising amount of science behind them, including chemistry and spectroscopy. The main principle behind the colors of fireworks is the fact that electrons in an atom can jump from their energy level to a lower one, releasing energy in the form of light. Different colors of light are emitted based on the chemical used. Spectroscopy is used to determine the emission spectrum for a multitude of chemicals, allowing firework makers to generate different colors by using these chemicals. While they may look magical and mystical, fireworks are the products of combining a variety of scientific principles and methods.

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# Epigenetics - Above the Genome

Eddie Zhang

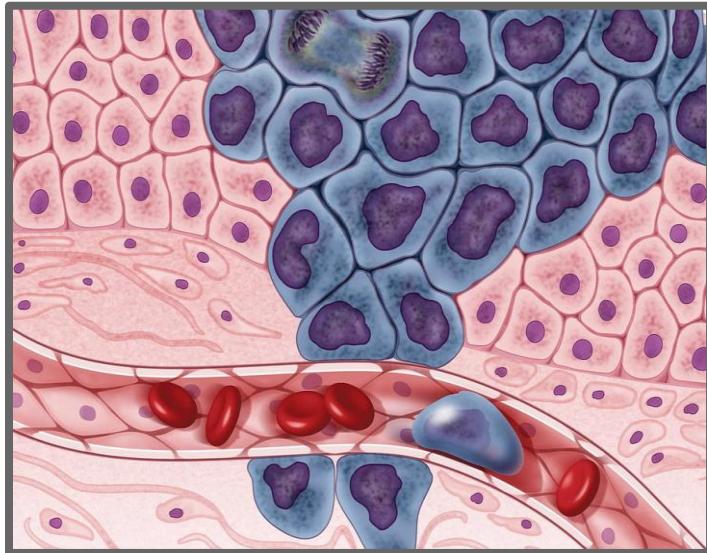
Introduced in 1942, epigenetics is the study of modifying gene expression without altering the gene sequences themselves, but instead through the subject's environment or diet. Methylation, acetylation, phosphorylation, ubiquitylation, and SUMOylation are all processes that can alter gene expression. Gene alterations may occur naturally, due to the environments we live in, or artificially with the processes mentioned earlier. As scientists have studied this subject throughout the years, we have begun to realize the significant potential that epigenetics has for benefiting various organisms, including us



humans.

Various phenomena can be explained by epigenetics, namely cancer. Cancer causes damage, and often death, by multiplying rapidly and metastasizing (leaving the area of origin), and inhibiting organ function. Our bodies have responded to this by sending proteins that can inhibit any of the many steps in metastasis. However, according to

Cancer Quest, a program led by the Emory Winship Cancer Institute, "cancer cells have been shown to epigenetically silence metastasis suppressors, often by hypomethylating these genes". The main way to combat these epimutations is through our environment and behaviors. Carcinogenic chemicals as well as other chemicals and drugs are prone to increase epigenetic mutations linked to cancer. By studying epigenetics, scientists are hoping to find new ways to treat cancer.



Although we once believed that epigenetic modifications disappeared through subsequent generations, research has proven this wrong. The article, *Epigenetics: The Science of Change*, by Bob Weinhold, details a study that was done on pregnant rats that revealed essential information regarding the effectiveness of epigenetics. The study, which was conducted by Michael Skinner, director of the Center for Reproductive Biology at Washington State University, showed that the effects of epigenetics could persist for up to four generations. Weinhold writes, "they found altered DNA methylation of two genes. As they continued the experiment, they discovered the adverse effects lasted in about 90% of the males in all four subsequent generations they followed, with no additional pesticide exposures".

Other studies show epigenetic effects occur over an entire human life cycle. An example of this is a study performed on twins. Bob Weinhold writes, "Younger twin pairs and those who shared similar lifestyles and spent more years together had remarkably similar DNA methylation and histone acetylation patterns. But older twins, especially those who had different lifestyles and had spent fewer years of their lives together, had much different patterns in many different tissues, such as lymphocytes, epithelial mouth cells, intra-abdominal fat, and selected muscles", proving that our daily actions, as well as the environment we live in, can influence our health and future generations.

Currently, many scientists believe our knowledge of epigenetics is still too limited to be used, but many are working on improving our understanding of its mechanics. As of now, these drugs are not perfect as they can turn hundreds of genes on or off, causing side effects. However, our technology is evolving, and epigenetics are steadily becoming useful. Azacitidine, a drug that treats myelodysplastic syndrome through epigenetics means, has been approved in the United States, demonstrating the advancement and potential epigenetics has. We cannot be certain what epigenetics will lead to, but many are optimistic for its future.

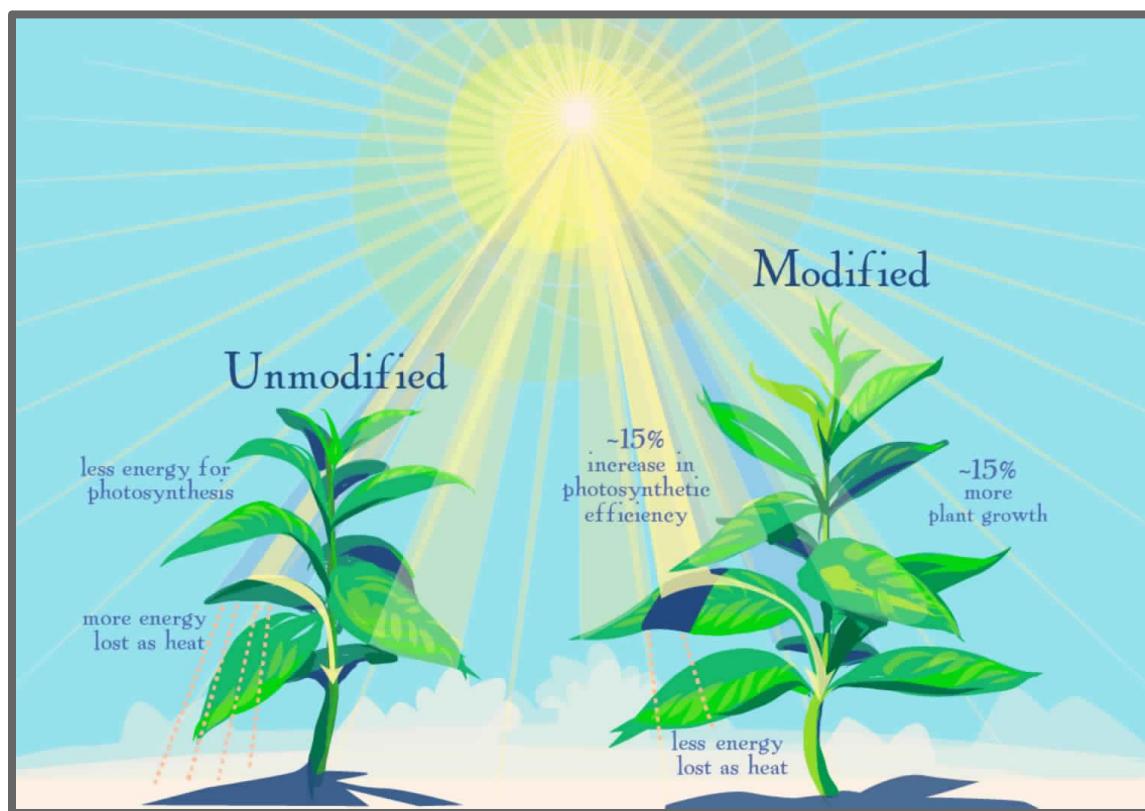
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# The Controversies of GMOs

Cathie Zhu

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What are GMOs? "GMO" stands for genetically modified organisms and refers to any organism whose DNA has been modified by genetic engineering. Many crops within the food industry have been genetically modified for a variety of reasons, such as improving their growth, nutritional value, sustainability, ease of farming, and more. While it is possible to use selective breeding to naturally modify organisms, this process must take place over many generations and is much more difficult to regulate. However, many people are concerned about GMOs' potential effect on the environment, the safety of the consumers, as well as the ethical implications.



GMO crops, although convenient for farmers to handle, bring concerns for the environment. Melissa Waddell, Editor of Living Non-GMO, explained, "Most GMO crops are engineered for herbicide resistance, so fields can be sprayed liberally with weed killers that eliminate everything but the cash crop. Weeds are a huge problem for farmers — they compete with cash crops for nutrients, water, and light. But diverse plant life also protects the soil from erosion and nutrient loss." Weeds sustain certain pollinators and



insects that are vital in preserving biodiversity and keeping the habitat stable. While weeds are a big problem to farmers, using mass amounts of chemicals to subdue them can cause its own environmental problems. Many GMO crops are resistant to herbicide so that farmers can use the toxin without the fear of it harming their

own crops. However, due to evolution, many weeds have also developed resistance to herbicide over time. Consequently, an increasing amount of herbicide is being sprayed on crops to kill weeds. The increased use of herbicide may negatively impact the environment, potentially contaminating the soil and water nearby. The weed killer also contributes to potential health risks to the consumer of GMOs. Due to the increased use of herbicide, there may be traces of the chemicals found in the crops, which are then ingested along with the crop.

Furthermore, many people are concerned about the ethics of genetically modifying organisms. They are worried about the negative impact of traditional farming practices, excessive corporate dominance, or they may simply feel the process of modifying an organism's genetics is unnatural. With the rise of GMOs, traditional farming practices may be impacted due to the increase of 'unnaturally' grown crops. Many people dislike the idea of 'natural' and sincere farm practices being replaced by technology. Furthermore,

the idea that foods considered natural may contain harmful substances conflicts with many people's moral and cultural beliefs of food. GMOs also increase corporate control over our food. Although some may not mind, others are distressed at the realization that dozens of brands in a grocery store are owned by a few parent companies. Companies with complete control over such a wide variety of agricultural products in a store may begin to care less about the consumers of the product and more about their profits as a business.

While GMOs include many debatable topics to discuss, only long-term experiments will be able to tell the true nature of genetically modifying organisms and if they are utterly worth supporting. As this technology is still relatively new, many people are uneasy about it and not yet ready to accept this large advancement of technology as such a crucial factor in their lives.

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# Starlink: Space Age Internet

Stephen Hung

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Starlink is a satellite system developed by SpaceX to provide internet coverage to most of the Earth. By deploying massive amounts of satellites in low Earth orbit, transceivers on the ground can get internet access from anywhere in the world. Currently, internet data is transmitted through cables, but Starlink uses radio signals through space to transfer data and send that information back to Earth. As of 2022, over 2000 Starlink satellites have been deployed, with 42,000 more satellites planned for future launch.



More than half of the world's population do not have reliable access to the internet. Countries that have poor access to the internet have delayed development and a disadvantage compared to others. Developed countries will get even richer and more

advanced, while developing countries slowly inch forward in terms of technological and economic progress. Starlink satellites may help close the gap between developed countries such as the United States, and developing countries, such as Ethiopia. Additionally, Starlink satellites can provide high-speed and low latency internet connections in population-dense areas. Starlink's official website claims that "customers can expect to see download speeds between 100 Mb/s to 200 Mb/s and latency as low as 20 milliseconds in most locations." Currently, SpaceX is providing its internet services as a beta test in select areas around the world.

It is important to address some of the concerns that have arisen about the effectiveness of these satellites. Scientists are worried that the satellite's reflective properties will affect twilight images taken by sensitive instruments located on the Earth's surface. Observations of the night sky may be impeded by these satellites. However, others argue that the Starlink satellites will affect twilight images no more than typical weather patterns. Additionally, satellite internet has been notorious for being slow, which leaves many concerned. However, Starlink satellites are located exceptionally low in orbit, allowing data to travel faster, which means that this is unlikely to be a problem.

The future of fast communication and Internet connectivity looks promising with the development of SpaceX's Starlink satellites. The deployment of these satellites can benefit all of humanity, including countries that are slow to develop due to the lack of Internet connectivity. Although there are a few concerns about this project, many are faithful that Starlink will be a success, and that people all around the world will be able to enjoy its fast Internet speeds and reliable coverage. If all goes well, Starlink is expected to be operational in less than a year.

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# Fungi, the Overlooked Organism

Nick Li

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When the word “fungus” is brought up, people tend to think about mushrooms. While these are a common type of fungi, most people do not realize that fungi are remarkably diverse and complicated, just like animals and plants. Fungi are eukaryotic organisms that decompose organic matter, including microorganisms like molds and yeasts, as well as the familiar mushrooms one can find in a supermarket. There are about 144,000 known species of fungi, which includes, but is not limited to, yeast, plant rust, mildews, mushrooms, and molds. Not only are they diverse, but they can also be found everywhere, from the ground we walk on, to the air we breathe, and they play some important roles in our health.

Due to its distinct and unique structural and physiological features, fungi are not included in the plant kingdom and are in their own separate group. For example, organic matter is digested by fungi externally, which is then absorbed into the fungus’s mycelium, a rootlike structure that can span large distances underground. Plants are unable to do this and process nutrients using photosynthesis. Additionally, fungi cells get their structure from chitin, as opposed to cellulose, which is used in plant cells.

Fungi come in many forms and functions, and the most common and earliest known are mushrooms. Before the microscope was invented, the only known fungi were mushrooms because they were easily noticeable. The microscope made it possible to discover and identify new, distinct types of fungal species.



Although some mushrooms are safe to eat, there are some species that look completely identical, but are extremely dangerous and harmful. Since many dangerous mushrooms resemble edible mushrooms, many people consume them by mistake. For example, "Destroying Angel" mushrooms are so deadly that 60-80% of the people do not survive after eating them, and they are commonly mistaken as edible puffball mushrooms.

There are other ways that fungi can be extremely harmful to people; they can destroy crops, cause diseases in humans, and ruin clothing and food with mildew and rot. Additionally, they can be responsible for poisonings, parasitic infections, and allergic reactions. Invasive fungal infections kill three times as many people as malaria and can even cause fatal diseases in perfectly healthy people. A common type of fungus that affects crops is the powdery mildew that can occur on some ornamental plants. They are one of the most widespread and easily recognized plant diseases, characterized by white, powder-like patches. Consuming plants that are infected with powdery mildew can be harmful to one's health and could even lead to respiratory infections and lung diseases.

like aspergillosis. However, plants with powdery mildews could be easily treated by spraying a combination of baking soda, non-detergent soap, and water onto the plants, mouthwash, and sulfur-containing organic fungicides could also treat and prevent existing infections.



Not all fungi are harmful; many types of fungi are useful and important to our lives. Fungi, in collaboration with bacteria, break down organic matter and release crucial gases like nitrogen and phosphorus into the environment. Many foods that people eat daily are made with diverse types of fungi.

Yeast is a fungus which plays a significant role in the making of bread as it allows the bread to rise and acts as a leavening agent. Fungi are also relevant in the medical fields after Scottish bacteriologist Alexander Fleming discovered *Penicillium notatum*, eventually leading to the discovery of penicillin, a type of antibiotic. Penicillin is used to treat certain infections caused by bacteria such as pneumonia and other respiratory tract infections. Many more medicines would be created due to discoveries about fungi.

Despite being commonly overlooked and ignored, fungi are everywhere and are incredibly diverse. Some fungi can be harmful and cause diseases to both plants and humans. At the same time, they play a very substantial role in our health and are responsible for the food and medicine that millions of people depend on. Without them, humanity would not be the same as it is today.



# Gamma Ray Bursts: Space Snipers

Ethan Chen

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Gamma-Ray Bursts, shortened to GRBs, are some of the most intensely concentrated electromagnetic events since the Big Bang. GRBs are enormous, light-speed jets of gamma-ray radiation spewing from the magnetic poles of a dying star. Within a span of milliseconds to minutes, a gamma-ray burst can release as much energy as our Sun will emit in 10 billion years, according to Space.com, and illuminate the night sky as much as the full moon. These beams of energy can make their way across galaxies, cooking the atmosphere and surface of planets in the way. Some GRBs come from events powerful enough to emit gravitational waves, literal wrinkles in time and space.



## Causes of Gamma-Ray Bursts

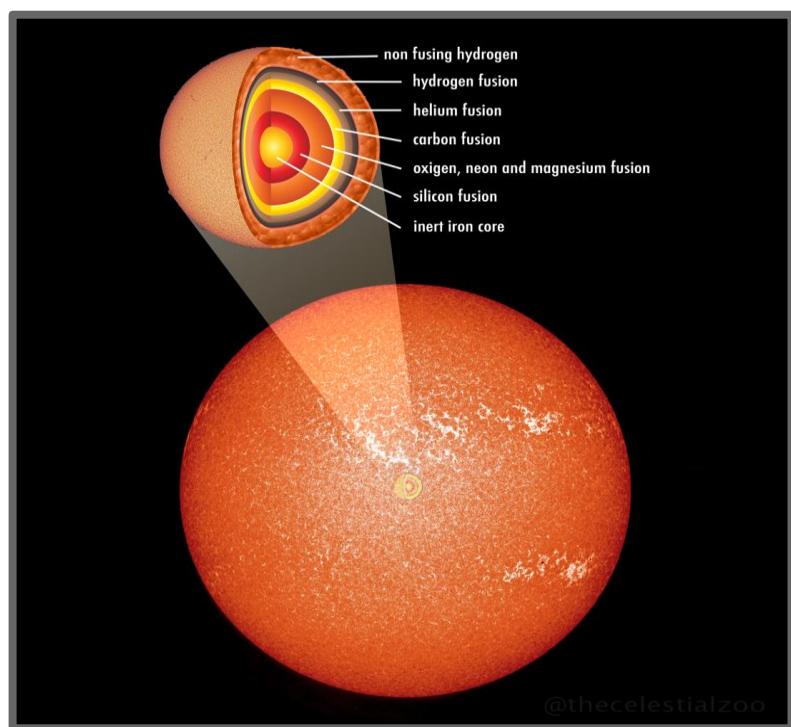
To put it succinctly, two types of GRBs are produced through two main processes. According to NASA's website, long bursts, which last from a few seconds up to several hundred seconds, "are associated with the deaths of massive stars in supernovas". The second type of GRB, short bursts, is produced by "the merger of two neutron stars... or a neutron star [merging] with a black hole to form a larger black hole". These usually last

for under one second but can have more extreme and violent consequences than long bursts.

## Why Some Stars Produce Supernovae

The death of a star is an incredible process, with larger stars moving an incredible amount of matter in a brief period. The reason gamma-ray bursts primarily happen in large stars, and especially ones with powerful magnetic fields or spins, is because of the mechanism by which large stars die.

Stars are powered by fusion in their inner core; here, elements are pushed so tightly together that new, heavier elements will be created, releasing energy in the process. For instance, two hydrogen atoms will be forced together to form helium. However, once the core runs out of hydrogen and can only fuse iron and up, excess energy is no longer being released by the fusion process. This creates an imbalance between the weakened outward force of fusion and the inward force of gravity, causing the star to collapse inward.



@thecelestialzoo

The “collapse” of a star spells its demise, as all the matter outside of the core starts to fall toward the core. One theory states that if the star is spinning extremely quickly, or the magnetic field is incredibly powerful, then there may be enough energy for the matter to be pulled toward two opposite ends of the star, creating two highly

concentrated areas of mass and energy. This potentially acts as the catalyst for the beam of gamma-ray light that comes from the supernova and is what sets the lower limit on the kinds of stars that can produce GRBs.

The science behind these intense bursts is still under active scrutiny and investigation, so while astrophysicists continue to ponder these cosmic sharpshooters, the people of Earth can continue to be glad that no such beams are currently pointed at the planet.

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# A Brief History of Computers

Aidan Hong

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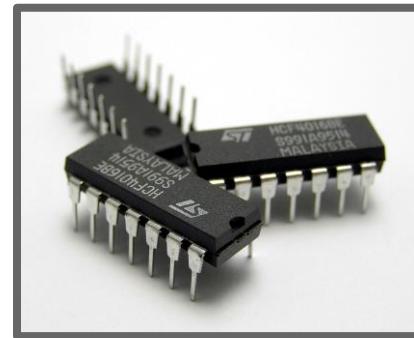
Throughout history, technology has made lives much better, from the IBM personal computer to the modern smartphone. Let us revisit some of the accomplishments that have been made in computer technology!

The first computer was the ENIAC, which was built in 1945 in the United States. Unlike modern-day computers, they did not have a screen or a keyboard. Additionally, it required much more space, taking up more than 1,800 square feet (about half the area of a tennis court) and weighing more than 29,000 pounds. This computer was not designed for the average person. Instead, it was used for running extensive calculations for U.S. intelligence during World War 2.



Computers used to be bulky, until the mighty transistor was invented! Back then, big vacuum tubes were used in computer circuitry, taking up massive amounts of space. The transistor, however, was much smaller and resulted in computers becoming smaller and more compact. After its invention in 1947, transistors replaced vacuum tubes in computers to control electrical signals.

Even with transistors, computers were still exceptionally large at that time. This would soon change with the invention of silicon chips. Developed by Jack Kilby and Robert Noyce in 1961, the use of silicon chips as well as compacting multiple computer parts into small integrated circuits massively reduced the size of these computers. Using these modern technologies, other pioneers stepped in to revolutionize the computer even further. Not long after, companies like IBM revolutionized and dominated the computer market, selling countless PCs to consumers. The late 20th century was characterized by massive developments in computer technology and industry.



While commercial PCs were quite popular among tech-savvy individuals, they were error-prone and hard to use for the average consumer. Steve Jobs and Steve Wozniak wanted to change that. On April Fool's Day, 1975, Apple Computers was founded, and they made the first home computer that had a color display. Not to fall behind, IBM made their own PCs. Apple, not to be outdone, made the Macintosh. However, these were still not as popular as IBM computers at the time. Bill Gates's Microsoft then developed Windows, and the computer industry was advancing at an ever-accelerating rate. Various companies all competed against each other, making, and distributing PCs to countless consumers.

Before 2007, smartphones were boring and limited in functionality. One could only call and text, and if they were lucky enough, the phone would include a game or two. Fortunately, Apple made the iPhone. The iPhone was revolutionary, changing how we communicate and work. Their futuristic and smooth interface made them massively popular. Google, taking note, made Android in 2009. Ever since then, the two have been competing, making new hardware and software every year.



Ever since the transistor, computers have never been the same. They shrunk from gargantuan refrigerators to small, handheld devices. No office is complete without a desktop. Smartphones have been getting thinner and thinner, while gaining increased features. Computers have had an extraordinary rich history, evolving from large and bulky machines to tiny, handheld devices, and they are one of humanity's greatest technological achievements. Only time will tell what the future has in store for computers and phones.

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# Neurodivergent Conditions

Brian Wang

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According to the Diagnostic and Statistical Manual of Mental Disorders, or DSM-5, there are more than 300 types of mental disorders. These disorders include autism, schizophrenia, bipolar disorder, and many more. While many people have heard about these disorders, few people are truly familiar with what they are. To better understand how to support those who deal with mental disorders, it is important to explain what these disorders do and how they affect people who have them.



Autism spectrum disorder (ASD) occurs when the development of a person is interrupted, leading to a neurological defect in how they communicate, study, and behave. Those with autism find it difficult to imagine other people's perspectives and

point of view, often leading to rude sounding conversations without the intention of doing so. They also get extremely nervous in social situations and tend to not make many friends. Autistics do well in paying attention to minute details, rather than looking at the whole picture. This means that while they may struggle to perform some regular activities, they can excel in art or other activities that require looking at intricate details. According to an organization called Autism Speaks, "the CDC (Centers for Disease Control) reported that approximately 1 in 44 children in the U.S. is diagnosed with an autism spectrum disorder (ASD) according to 2018 data".

Schizophrenia is another mental disorder that can affect how a person lives their life. This is a mental disorder in which people see and interpret life in an abnormal way compared to others. Often, this disorder occurs due to some stressful or traumatic situation, such as abuse during one's childhood. Many see or hear hallucinations, believe in delusional topics, and behave in a disorganized manner. Although it is thought to be a genetic disorder, there is no specific gene that is responsible for it. In fact, it is usually the combination of dozens of genes that work together to create this disorder.

Bipolar disorder, also known as manic depression, can be quite dangerous to the person who has it. Although the source for this disorder is not currently known, it is usually thought that environmental practices, developmental disarray, and genetics all play a role in this. This disorder is more common in females than in males. One of the most prominent symptoms is extreme mood swings. For example, one can display energetic joy, excitement, or happiness, which would soon be intercepted by depressive states, in which there is low enthusiasm, motivation, and a hopeless lifestyle. Therefore, it is known as manic disorder. Those who have this disorder can suffer these manic states anywhere from one to four times a year, sometimes even more. During these manic states, they may think depressing or suicidal thoughts, which is why mortality rates of those with bipolar disorder is twice as much as those without it.

Eating disorders are quite common, and dozens of categories are listed. Anorexia Nervosa is a disorder where a person always fears being overweight. Often, victims have an abnormal body image, known as dysmorphia, unbalanced body weight, and many episodes of starving. A very interconnected idea is Binge Eating Disorder, an illness that includes many episodes of binging (eating extensively). Bulimia is when a person not only eats extensively (binging), but also reduces weight by vomiting, exercising intensely, or starving (purging). Common causes for this condition include family history and fear of others' opinions.

These conditions only include the beginning, and there are many more mental disorders listed in the DSM-5. There are no cures for these disorders, so it is important to provide help to those who have these conditions. Understanding how conditions like autism work can help decrease mistreatment of those who have them. Those with disorders such as bipolar disorder can be helped if the people around them are supportive and understanding of them. Some disorders like bulimia can take years of perseverance and external support for a person to get out of. Therefore, it is important to be educated about these disorders and supportive of those who have them.

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# The Science of Service Animals

Cody Duan

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Evidence suggests that humans and animals have had symbiotic relationships in the past 40,000 years ago. Our relationships with animals have evolved drastically from ancient days, but some things have stayed the same throughout the years. Dogs were domesticated about 20,000 years ago and are still, to this day, partners of humans. Animals and their relationships with humans can show the science behind bonding. Additionally, some animals like service dogs can assist people with day-to-day tasks and protect the owner.



Oxytocin is a hormone that is responsible for bonding. It is mostly known for being released when mothers give birth to help create a close bond between mother and child. When a person pets their emotional support animal, oxytocin is released by both them and the emotional support animal. This increases the bond, and according to an article called *About Oxytocin*, on Psych Central, "greater amounts of oxytocin hormone levels appear to be associated with greater relaxation, more willingness to trust others, and general psychological stability". These kinds of interactions can help relieve stress and anxiety, making people feel more relaxed. Therefore, spending time with an emotional support animal is beneficial to your positive well-being.

Service animals, or service dogs, are dogs who are trained to help those who are disabled. For example, a service dog can help a blind person walk through an area by giving signs of their surroundings. If there are stairs or a similar obstacle, a service dog will stop to notify the blind person of a step. Service dogs can sometimes perform other tasks, like assisting people who have seizures, alerting a person with a mental illness to take medication, and much more. Each service dog has been tasked with a job that is related to their training.

Under the ADA, Americans with Disabilities Act, state and local governments, businesses, and nonprofit organizations must allow service animals to accompany people with disabilities to all public areas. Service dogs should not be disturbed and will usually have a covering alerting people that it is a service animal. Since service animals are important to disabled people, they must not be disturbed or bothered. Do not pet a service animal without the owner's permission, and do not distract it or it will lose focus on its task. However, if one is trying to get you to follow it, do so. It may be trying to alert you to someone in need of help.

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# Lead in the Soil

Annabella Luo

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Lead is a naturally occurring constituent of the earth's crust. It can be found in soil, plants, and water at low levels, and it is immobile if left undisturbed. However, once it is mined and used in man-made products, it gets dispersed through environments via human activities and has the potential of becoming highly toxic.

Human beings have a long history of mining and using lead of over 6000 years. However, it is in the last hundred years or so that lead has become one of the most widespread toxins ever made. The two most important sources of lead poisoning in America are paint and lead gasoline. Lead in household paint was identified as a toxin early in the 20<sup>th</sup> century but was not banned legally in the United States until 1970. Therefore, houses built before the 1970s need to be tested for lead concentration. Another source is the lead additive, TEL, in gasoline that had been used and dispersed widely for over seven decades, until in 1990, it was finally removed from gasoline. A study from Tulane University provides estimated tons of 'legacy lead' from vehicles in 90 US urban areas released from 1950 to 1985. The impact of the removal of the lead additive in gasoline was immediate, with the mean blood lead concentration in children decreasing significantly from 13.7mcg/dl in 1976 to 3.2mcg/dl



in 1994, showing a direct positive relationship between the blood lead concentration in children and the lead additive in gasoline.

Lead in soil is a vital component of the overall environmental lead exposure. Lead is one of the best-studied toxic substances, and therefore, the adverse health effects of lead are extremely well documented. Exposure to lead is a health concern, especially for young children and pregnant women. Lead can affect every organ and system in the human body. The nervous system is the main target for lead poisoning in children and adults. Exposure to lead can cause developmental effects in children, including but not limited to reduced IQ and attention span, hyperactivity, impaired growth, and learning disabilities.

Unfortunately, lead is stable and does not break down over time. Therefore, lead deposited and dispersed into our environment in the past can still be a problem for people today. Higher levels of lead in soil are more likely to be found near roadways because of air emissions from vehicles that use lead gasoline, near the perimeter of buildings that use lead paint, or from past renovation activities that have dispersed lead. Lead may also be found in high concentrations in soil near toxic waste sites and other areas near industrial areas that emit lead into the environment.

Playing in bare soil, gardening, eating fruits and vegetables grown in contaminated soil, ingesting soil, and touching hands to mouths can all expose children and adults to lead in soil (typically in young children). There are several methods for testing soil for lead. The most common method is to send samples to a laboratory that can determine the concentration of lead in the soil. The US Environmental Protection Agency's current upper limit for child play areas is 400 ppm, though scientific studies have raised some concerns about gardening in soils with lower lead concentrations.



Mitigating risk of lead exposure does not stop within homes. Recent studies on lead concentration in soil in different cities in the U. S. suggest some urban soils still contain the highly toxic metal in levels that exceed federal safety guidelines for children. A Duke University study published in 2021 discovered that, while soil lead levels have decreased since the 1970s, they have decreased much less near residential foundations than along streets. The environments outside of homes need to be continuously monitored to identify and mitigate areas of higher lead concentration.

Lead exposure is a dangerous and harmful condition that can occur due to high lead concentrations in a person's surroundings. Although lead has been banned in some household products, some homes still have high lead levels, and it can still pose a danger when it is dispersed in the environment. Fortunately, the dangers of lead poisoning can be mitigated through awareness and proper testing of sites. By spreading information about lead poisoning, more people can understand it and less people will have to suffer from it.

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# Complexities of the Eye

Anna Dai

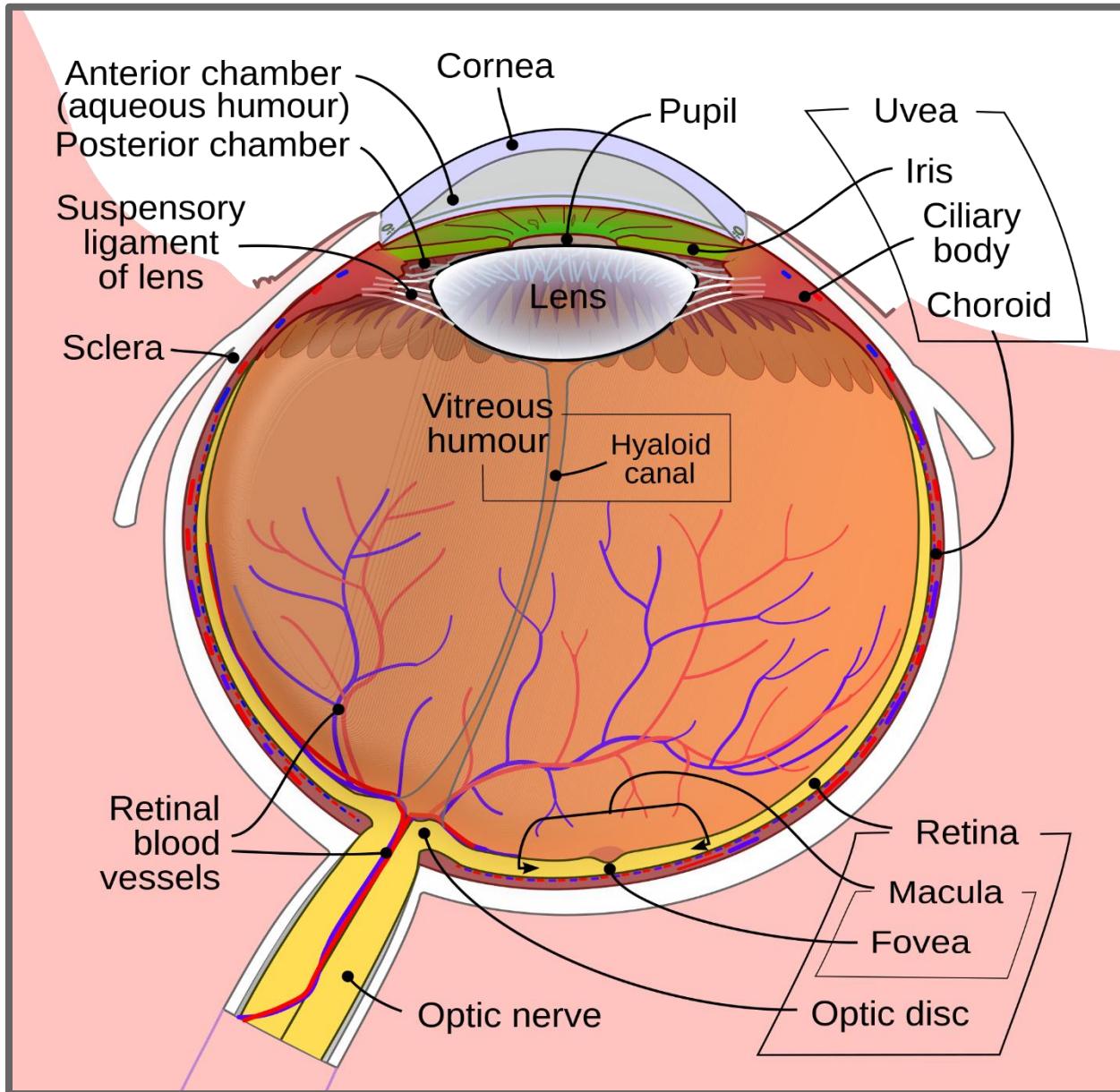
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As many are aware, eyes are used by a person to observe their surroundings and the world. This organ is incredibly vital to a human, as without it, the world would be dark and empty. The human eye operates by capturing light rays that reflect off objects. People often underestimate the complexity of the eye, which allows it to perceive objects. The eye's anatomy is far more complex than one might expect.

A little background about the anatomy of the eye is needed to understand its complexity and importance. There is a spherical structure called an eyeball. On the eyeball sits the protective and fragile cornea, a transparent dome-shaped sheet full of nerves. The pupil is located at the center of the eyeball and acts like a camera aperture, controlling the amount of light entering the eye.

Besides the pupil, the iris is the colored ring around the pupil. Each person has a different color eye due to different amounts of melanin pigments. The iris contracts or dilates the amount of light entering the eye. Behind the eye is a tissue of 10 thin layers called the retina. The retina is what makes vision possible since the tissue detects color. It is fragile and easily torn or hurt by a harmful impact, much like the cornea.

In the end, the eye is indeed a complex organ. Compared to other organs in the human body, the eye is highly productive by being capable of adapting and consuming information at an extremely high speed. Beyond that, the eye varies genetically or over time. Some people may be short-sighted or long-sighted genetically.



Vision defects can be prevented by protecting the eye from harmful things such as sharp objects, computer screens, smaller screens, and too much sunlight. Eyes should be valued because it is crucial to living and their complexity makes it easy to be injured. The human eyes not only perform their duties but also enlighten themselves. Next time you rub your eyes or strain to see the writing on a sign, remember that vision is not to be taken for granted.

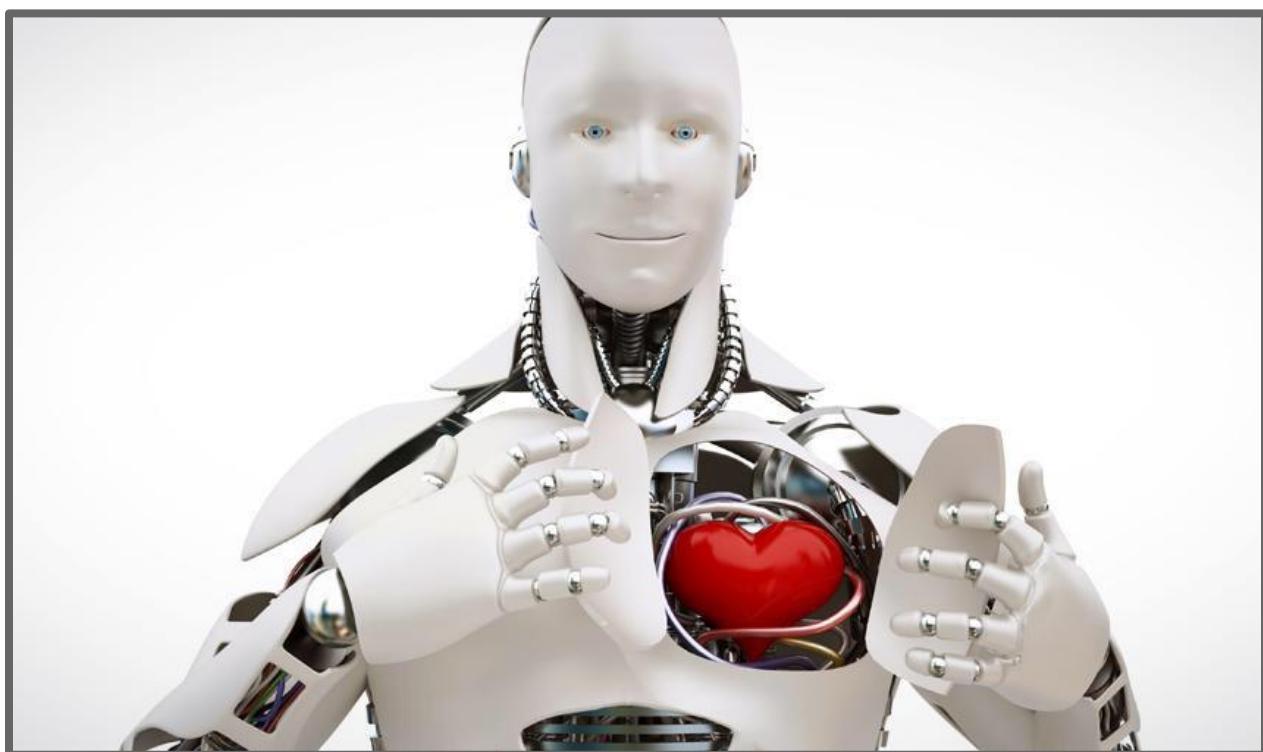
# A.I. Consciousness and Robot Rights

Arthur Liang

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In today's world, we are surrounded by artificial intelligence, and we may not even notice it. AI makes sure stores are restocked, scours the internet to find an advertisement to show you, and some are even able to create newspaper articles.

Right now, artificial intelligence is still in the workings and needs more technological advancements. We look at chatbots like Siri and do not really see them as intelligent. However, the world is changing fast, and soon we may have to deal with a machine that borders the line between simulated and real humans. And here we run into the problem of consciousness. Is a highly intelligent AI who can act similarly to a



real human actually “conscious”? Unfortunately, nobody truly knows what consciousness is, which makes it ridiculously hard to decide whether AI is conscious.

Many people will believe that any sufficiently advanced system can generate consciousness. If your microwave’s hardware was powerful enough, it might become self-aware. If so, would it deserve rights? We have rights because Humans are conscious beings who can feel and are aware of pain. Rights are there to protect us from abuse, neglect, and isolation. However, robots cannot feel pain or emotions, unless we specifically programmed them to. If we program a robot to feel emotions, to prefer justice over injustice, and pleasure over pain, would that make them “human” enough to deserve rights?

Some people argue that robots do not deserve rights, that they are brainless, thoughtless machines. This is especially true for those who want to profit from robot labor. If someone created a bunch of slave-like robots to do all their work for them, of course, they would not want them to have rights, because they would lose money.

Others believe robots should deserve rights such as not unplugging them against their will or not changing their programming against their will because artificial Intelligence can do many things that humans cannot. It is a tough argument to fight for and there are many people on both sides. Currently, our AI is not advanced enough to generate consciousness. But it is important to spend this time exploring diverse ways that AI can help us to get a better understanding of how they work, just in case there is ever a time that robots do gain consciousness and need their rights. When that time comes, we had better be prepared.

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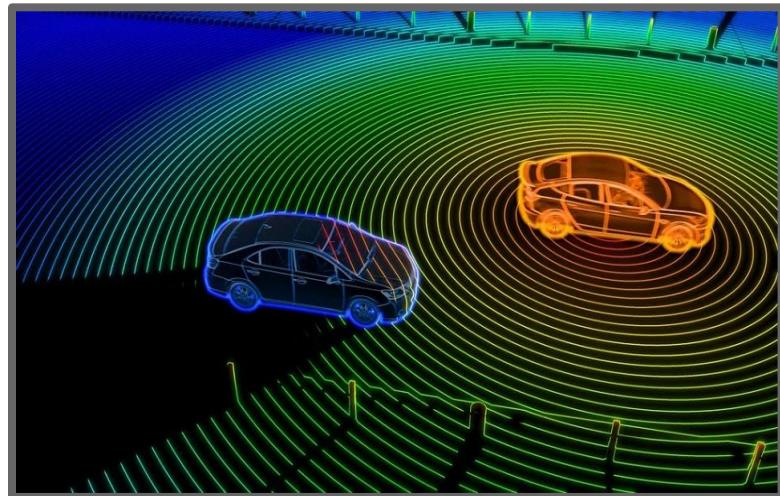
# A Report on Autonomous Vehicles

Stephen Hung

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Statistics from the US Department of Transportation show that 94 percent of all car crashes are due to human error, which reflects a major issue that we have in our modern society today. Human-driven cars have been a leading cause of damage to our society and environment for years. Studies have shown that the introduction of autonomous vehicles is one of the best solutions to this issue at hand that is not only safe but also environmentally sustainable. As autonomous driving technology develops and becomes more commonplace in our modern society, it will develop a safer driving environment on the road. The recent development of autonomous vehicles will be able to minimize emissions, reduce traffic congestion, and lessen the number of accidents on the road.

Autonomous vehicles are vehicles that can sense the environment around them and operate accordingly without the control of a human driver. These vehicles are typically electric-powered and behave differently compared to gas-powered, human-driven cars, and one of the benefits that electric-powered vehicles have been that they produce a significantly lower amount of



carbon dioxide. According to the US Department of Energy, gasoline-powered cars produce more than three times the amount of carbon dioxide annually compared to electric cars. Carbon dioxide emissions cause the flow of traffic to slow down, which causes frequent accelerating and decelerating, resulting in even more carbon dioxide emissions. As a result, this vicious cycle continues causing many harmful effects on the environment.

An increase in carbon dioxide in the atmosphere creates a “greenhouse effect” that directly contributes to the increase in global temperatures observable today. The Natural Resources Defense Council states that the effects of greenhouse gas emissions include

“causing more frequent and/or intense extreme weather events, including heatwaves, hurricanes, droughts, and floods, exacerbating precipitation extremes, making wet regions wetter and dry regions drier, raising sea levels due to melting glaciers and sea ice and an increase in ocean temperatures (warmer water expands, which can contribute to sea-level rise), altering ecosystems and natural habitat, shifting the geographic ranges, seasonal activities, migration patterns, and abundance of land, freshwater, and marine species”.

This does not seem to directly affect humans, but there are many adverse effects. Diseases like Zika can spread, infecting humans around the globe. Crop yields will decrease and hunger can spread. These can bleed into political issues, and political instability will occur. The carbon emissions that autonomous vehicles can reduce are very influential to the environment and society.

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# Elephant Toothpaste

Kenny Wu

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Elephant's Toothpaste is a foamy substance that is produced through a unique chemical reaction. This substance got its name since it resembles foamy toothpaste squeezed from a tube, but it is so large it appears like it is suitable for an elephant.

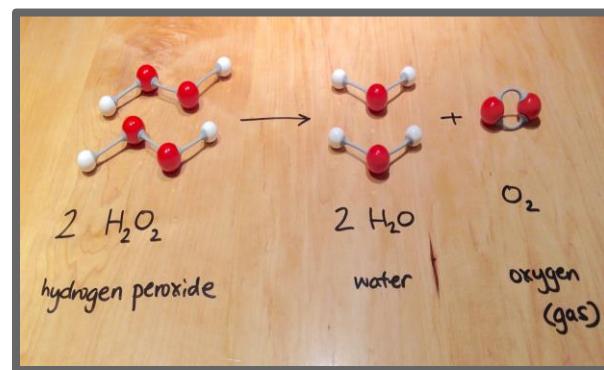


Elephant's Toothpaste is caused by a rapid decomposition of hydrogen peroxide using sodium iodide and soap. When the sodium iodide reacts with the hydrogen peroxide ( $H_2O_2$ ), an oxygen atom is removed and therefore produces water ( $H_2O$ ) and oxygen gas ( $O_2$ ). The oxygen gas is trapped in the soap and produces a big foamy substance that then expands as more oxygen is produced, causing the mixture of water and foam to burst out of its container.

The chemical reaction can be seen below:



The sodium iodide acts as a catalyst, helping the reaction take place.



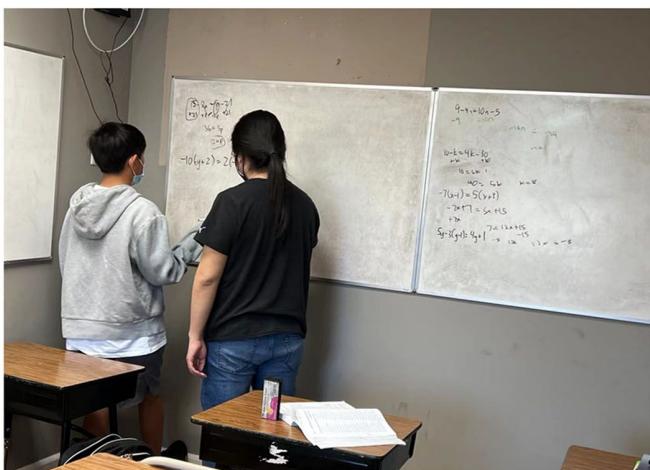
Elephant Toothpaste was first brought to attention by the famous YouTuber and former NASA engineer Mark Rober. It is usually made by children at parties or school due to how simple and fun it is to produce. To perform this experiment, you will need hydrogen peroxide, dry yeast, warm water, detergent or dish soap, and food coloring, which is optional. Additionally, a small cup, plastic container, and some safety goggles are needed.

Despite how innocuous in appearance this foamy substance may appear, it is considered a dangerous reaction. This reaction employs a much higher concentration of hydrogen peroxide, which can result in chemical and thermal burns. While it produces more foam, it is not safe for children and should only be done by an adult with suitable safety equipment. However, there is no need to worry, as a kid-friendly Elephant Toothpaste recipe does exist and utilizes harmless chemicals.

The Devil's Toothpaste is the biggest Elephant Toothpaste reaction ever, invented by Mark Rober. Elephant toothpaste is like devil toothpaste in that they both have a foamy appearance. Devil toothpaste, on the other hand, is a mass explosion that starts with a catalyst like potassium iodide or yeast, hydrogen peroxide, and soap. As a result, the reaction is overwhelming and extremely large. This is a dangerous stunt that should only be performed by experts.



Elephant Toothpaste is an enjoyable spectacle that anyone of any age can appreciate. From the process of learning the chemistry, to the explosive finale at the end, elephant's toothpaste is an adventure from the beginning. Science like this opens the door of creativity for youngsters. Experiments like these show that science is not always plain and tedious.



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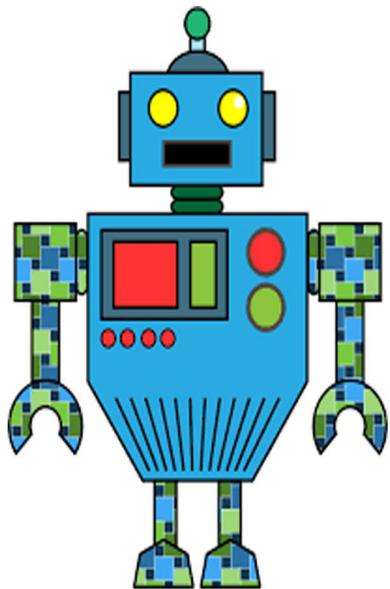
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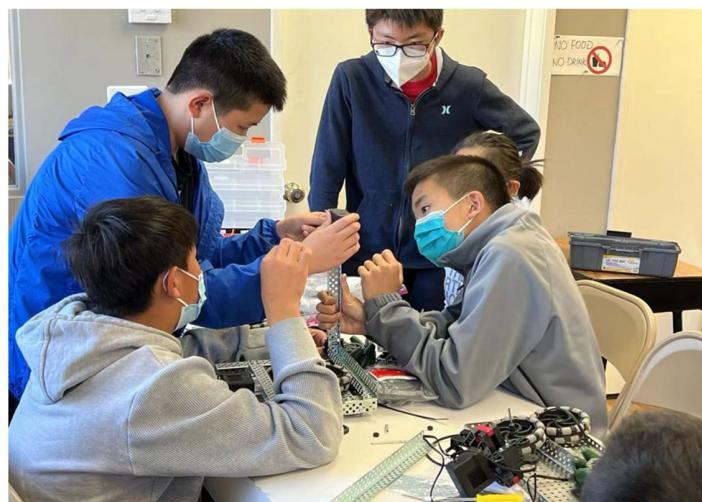
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每年由 UCLA, UCSB, UCR 等本地名校學府,電腦電機專業科系,優秀研究生與本科生領導的 STEM Action Teen Institution 免費 AI 人工智能科學營已開放報名。6月4日至6月26日連續4個週末上課，以充滿趣味的方式陪伴 9-14 歲青少年展開未來科技的探索之旅，課程由淺入深分為 MIT Scratch 、C++ 、Java 三種電腦語言。AI 人工智能，取代成本高昂，效率低下的人工勞動，將是無可抵擋的，所有行業的一大趨勢。

從小學習 Coding，不僅提高邏輯思維水平,更在輸入演算的分析訓練裡，培養解決問題的能力.有興趣安排孩子學習新科技，培養孩子往電腦、工程或醫學專業發展的家長，請儘快上網註冊報名。已參加過的小朋友，請勿填表，將機會留給其他也想體驗新科技的小朋友。由於座位有限，僅限選擇一項參加。

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