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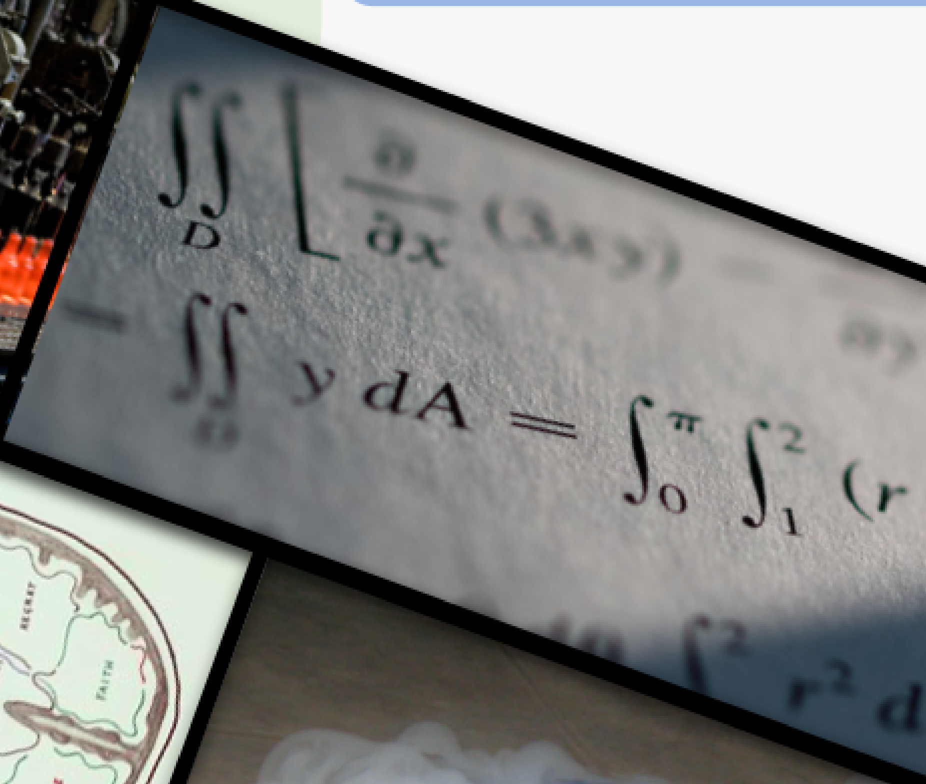
SEEKING SCIENCE

by STEM Action Teen Institution



A MONTHLY
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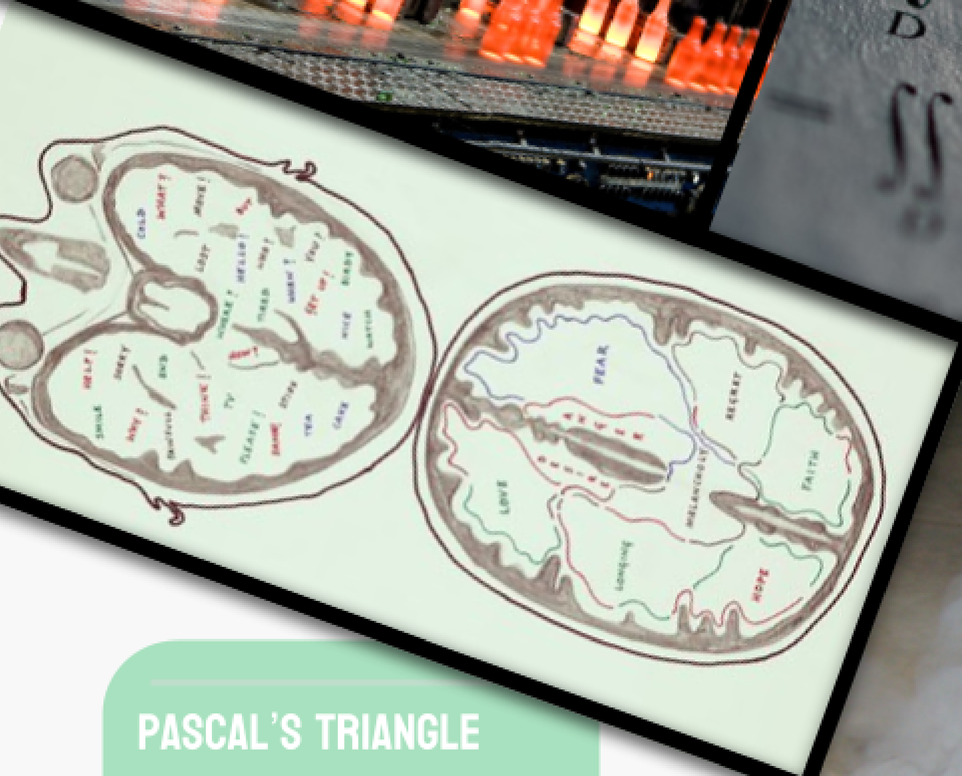

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and more...

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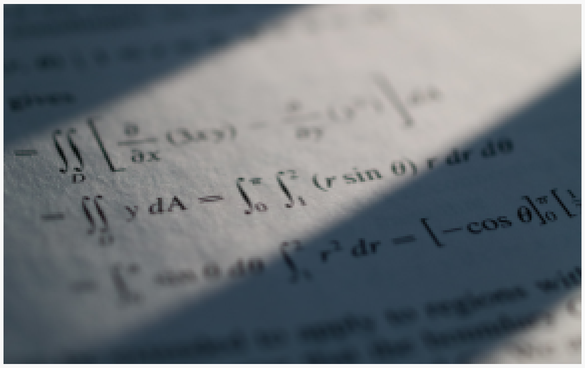
What are Derivatives?

Aidan Hong

Calculus is one of the hardest math courses a high schooler can take. One of the key fundamental concepts of Calculus is derivatives. Despite sounding hard and having confusing notations, the concept of derivatives is relatively simple: the instantaneous rate of change.

Before we dive into what a derivative is, we first must understand what rate it is. Rate is the amount of change between one point and another. The average rate of change is how much a function changes on average between one point and another. Derivatives take that concept and make the difference between two points infinitely small, to the point it is instantaneous. Instead of finding the average rate of change between, for example, 0 and 2, derivatives would find the instantaneous rate of change at 2.

The concepts of derivatives seem easy, so why do many people need help with it? The answer lies in the function. Since some functions can get complicated, rules were created to combat this issue. However, when using rules, sometimes rules may have to be combined with other rules, or a function may be so big to the point that a lot of simplifying may be needed to solve the problem. During this process, many issues may be made. Another reason why people may struggle with it is because they may need help to identify which rule to use. Since some rules may seem similar or have similar purposes, people may mix them up.



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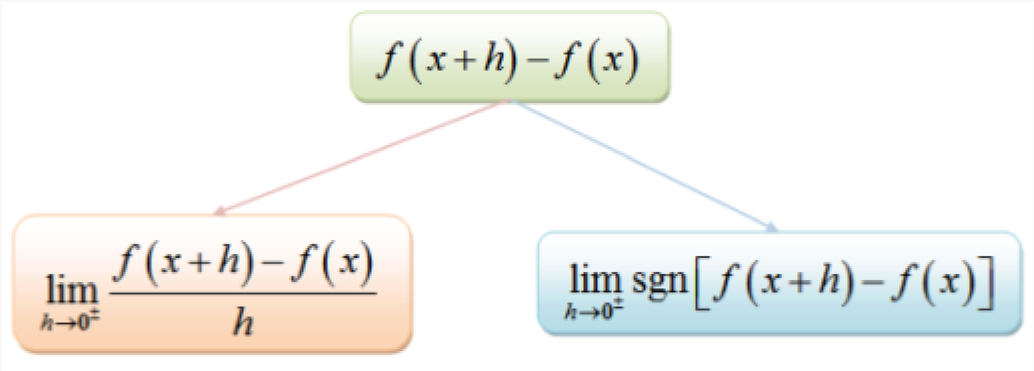
It is no wonder why many people opt to use online derivative calculators to help solve problems.

Calculus is a key study of math and is one of the hardest math class in high school. Derivates are one of the key parts of calculus. Despite having a relatively simple concept, the hidden complexities behind it makes it harder than what it may seem.



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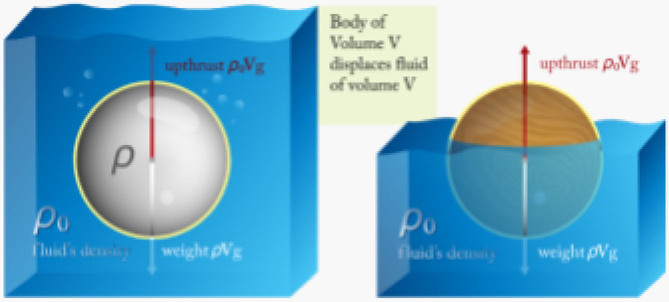
Buoyancy of Boats

Angela Chin

Have you ever wondered how boats effortlessly glide across water? The answer is in buoyancy, the force that allows objects to stay afloat. A physics law, more specifically Archimedes' principle, says that "The volume of displaced fluid is equivalent to the volume of an object fully immersed in a fluid or to that fraction of the volume below the surface for an object partially submerged in a liquid." In other words, an object submerged in a fluid experiences a force equal to the volume of displaced fluid.

The materials used for boats impact their buoyancy. Boats are designed to be less dense than the water they displace. That way they will be pushed upwards and keep floating as their weight is less than the weight of the water they displace. Gravity is also unable to pull them down. The buoyancy is greatly affected by shapes as well. The hulls of boats are usually wider at the bottom, increasing the amount of water displaced. Moreover, the use of proper materials is essential. Some materials commonly used to maintain buoyancy are wood, fiberglass, and aluminum. Other factors like weight distribution are taken into consideration while designing; the center of gravity lies on 2/3 of the vessel.



Buoyancy from Wikimedia Commons

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All in all, Archimedes' theory underlies buoyancy, explaining why boats stay afloat. Firstly, boats' shape, materials, and design are intricately planned to guarantee their ability to float. Secondly, they have to have less density than the displaced water. Boats are an example of physics learned in school that can be applied to real-life scenarios.

Life of a Glass Bottle

Edward Huang

The ordinary glass bottle is used in a variety of commercial products, from Coca-Cola to wine bottles. To keep with the ever-expanding consumer industry, glass bottles have to be mass-produced, with specific shapes and designs. The process from raw material to finished product is lengthy, but it all begins from *sand*.

Sand, more specifically *silica* or silicon-dioxide, is the primary ingredient of glass. Aside from silica, limestone and soda ash are added to the mix before heating. Limestone helps reduce the viscosity, or thickness, of the molten mixture, making it easier to mold into bottle form. Soda ash is added as a *flux*, allowing the combination to have a lower melting point. Recycled glass, or *cullet*, is also added. Though there are many varieties of glass, *soda-lime* glass is one of the most prominent kinds.

The soda-lime silica combo is then heated in a furnace to extreme temperatures, upwards of 1,500 degrees Celsius. The molten glass is piped and cut into equal weights called *gobs*. The gobs are now ready to be blown into bottles. Gobs fall into bottle-shaped molds, while compressed air is blown in to press the glass against the sides of the mold and form a hollow interior. The shape is further refined with another mold, expanded like a balloon to the correct size. Details and finishing touches are added, and a bottle has been created. Some bottles are injected with gases that

Maschinelle Behaelterglasproduktion from Wikimedia Commons
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enrich its chemical resistance. Thanks to automated machinery, this process can take only 15 seconds.

Finally, bottles must cool down. Known as the annealing stage, an annealing oven heats and then cools the bottle evenly. This process is vital, since cooling a bottle on its own without annealing can cause tension and cracks. The surface cools before the interior, and as these different components shrink at different rates, this can damage the bottle. Annealing prevents this from happening, and can take more than an hour.

Coatings of tin(IV) oxide, titanium tetrachloride, and polyethylene wax are added to give the glass some extra strength, reducing its ability to be scratched. They are then investigated, packaged, and shipped off.

To sum up, the glass bottle is formed through a complex process, including mixing, heating, and cooling. At each stage, our knowledge of chemistry and physics aids us in optimizing the bottle creation process to be as efficient and consistent as possible. The glass bottle serves as a reminder that everyday objects we take for granted typically have complex origin stories that depend on our scientific knowledge and engineering.

The Shark Fin Trade

Arick Hong

The struggling shark is being hauled up on the side of a boat. Men bring it on board and begin to bring out sharp knives, meant to cut flesh. They take turns brutally slicing off fins of the creature, and toss the still alive fish back into the deep. The shark, now without fins, drowns at the bottom.

If you have ever been to Hong Kong or other places in Southeast Asia, you would definitely notice that they sell a kind of soup called “Shark Fin Soup”. This soup has been in restaurants for centuries, and has been recently banned in the United States. Still, many companies provide fins to China and other countries. However, the effect it has on the environment is devastating.

Sharks play a major role in the oceanic ecosystem. Types like the Great Hammerhead and the Scalloped Hammerhead are often a major target because of their large fins. Great Hammerheads play a major role in the Great Barrier Reef, where they prey on stingrays. If these sharks are wiped out by the shark fin trade, then the stingray population would explode in great numbers. These stingrays prey on crabs, which prey on tiny creatures and fish. These tiny creatures feast on plankton and algae during the day. If the stingray population explodes, then they will eat a lot of crabs, causing the crabs to get wiped out as well. The stingrays will eat all the crabs, and there will be no more food left, causing them to become extinct as well. The tiny creatures explode in numbers, because there are no more crabs to eat them. All the plankton and algae is killed, and the tiny creatures become extinct after there is no more to eat. After all this, not a single species is left and the ecosystem is dead.

Many new campaigns to end the shark fin trade have been popping up all over Asia. More and more of the population have begun to reject shark fins in their meals, and the shark fin trade is starting to decline. However, it has not ended entirely, and the effect

Shark Fin Seizure - USFWS Office of Law Enforcement
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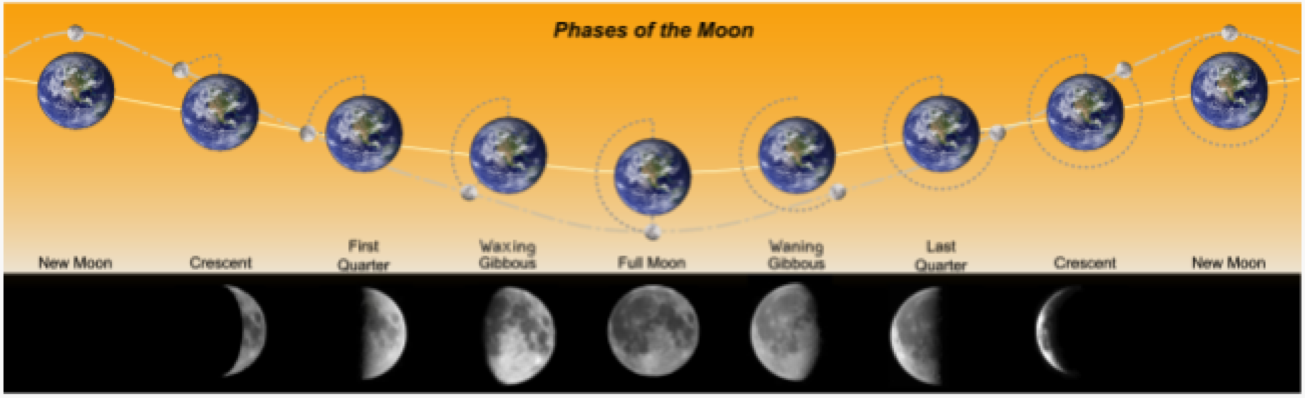
it has left is still prominent. Great Hammerheads are now officially an endangered species, with their numbers dwindling. Other species such as the Tiger Shark and the Mako Shark have also been affected, with their numbers declining as well. Some species such as the Pondicherry Shark and the Ganges River shark are thought to be extinct because of this horrible act. We must stop it before the ocean is destroyed.

What are the Moon Phases?

Audrey Don

I'm sure everyone has seen the moon at least once in their lifetime, no matter how old or young. We all have seen the moon in different shapes every day with a bright light shining upon us. But what exactly is it called when the moon changes shape?

The moon phases are the different shapes of moon that we see each month. In total, there are 8 moon phases, 4 primary and 4 secondary. The primary phases are called new moon, first quarter, full moon, and last quarter. The secondary phases are waxing crescent, waxing gibbous, waning crescent, and waning gibbous. The Moon's ecliptic longitude is at an angle to the Sun (viewed from Earth) of 0, 90, 180, and 270



Phases of the Moon from Wikimedia Commons
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degrees respectively. Each of these phases appears at slightly different times at various locations on Earth. The duration from full moon to new moon is approximately estimated from 13 days 22 ½ hour to 15 days and 14 ½ hours.

Between the principal phases are the intermediate phases, during which the apparent shape of the Moon is either crescent or gibbous. On Average, the intermediate phases last one-quarter of a synodic month or 7.38 days. The term waxing is used for an intermediate phase when the Moon’s apparent shape is thickening, from new to full moon. Waning is when the shape is thinning, the duration from full moon to new moon 13 days 22 ½ hours to about 15 days 14 ½ hours.

A new moon appears highest at the summer solace and lowest during the winter solace. A first-quarter moon appears at the highest at the spring equinox and lowest at the autumn equinox. A full moon appears highest during the winter solace and lowest during the summer solace. A last-quarter moon appears highest at the autumn equinox and lowest during the spring equinox.

From what we could see on Earth, the Moon’s eccentric orbit makes it both slightly change its apparent size, and to be seen from a slightly different angle. The effects are rather subtle to the naked eye, from night to night, yet it's still rather obvious in time-lapse photography.

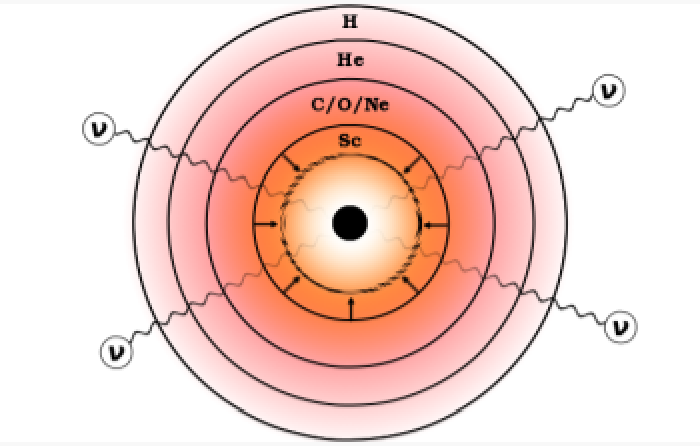
The Newton-Leibniz Controversy remains one of the more intriguing debates in mathematics history. The debate stresses the complexities of scientific discovery and the disputes that may arise. Both Newton and Leibniz left memorable marks on the world of mathematics and science, and their legacies are still celebrated today. The controversy highlights the collaborative and competitive nature of scientific achievement, which can give rise to historic rivalries.

What are Neutrinos?

Brandon Pian

Neutrinos or “Ghost Particles” are a neutral subatomic particle that really closely resembles that of an electron but has a mass of or close to 0 and no electrical charge. Neutrinos are the most common particles in the universe but since they interact with very little matter they are difficult to detect. Nuclear forces treat neutrinos and electrons the same but neither particles have strong nuclear force and both are equally week in nuclear force. Particles that are like the neutrinos and electrons in nuclear forces are called leptons. Charged leptons include the muon which has the mass of 200 times more than the electrons and the tau which is 3500 times the mass of an electron.

Both the tau and muon have accompanying neutrinos called tau-neutrinos and muon-neutrinos. These three particles are very distinct. Such as when muon-neutrinos interact with something they will always produce muons instead of taus or electrons. With particle interactions even though electrons and electron-neutrons can be created or destroyed the sum of the amount of electrons and electron-neutrons is maintained. This leads to the dividing of the leptons into three families, each with a charged lepton and its accompanying neutrino. Detecting neutrinos requires very large and sensitive detectors. A low energy neutrino will travel through many light years of normal matter before interacting with anything.



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All terrestrial neutrino experiments rely on measuring the tiny fraction of neutrinos that interact in reasonably sized detectors. In Sudbury Neutrino Observatory, a 1000 ton heavy water solar-neutrino detector picks up about 1012 neutrinos per second, which also has about 30 neutrinos per day. Wolfgang Pauli first postulated the existence of neutrinos in 1930. At the same time the problem of energy and angular momentum were not being conserved in beta decay. Pauli pointed out that if a non interacting particle, a neutral particle or neutrino were being emitted one could recover the conservation laws. The first detection of neutrinos did not happen until 1955, when Clyde Cowman and Frederick Reines recorded anti-neutrinos emitted by a nuclear reactor. Natural sources of Neutrinos can be found in the radioactive decay of primordial elements within the earth, which generates a large flux of low energy electron antineutrinos. Calculations show that about 2 percent of the sun's energy is carried away by neutrinos produced in fission reactions. Supernovae are also predominantly a neutrino phenomenon, because neutrinos are only particles that can go through the very dense material produced by a collapsing star. Only a bit of energy is converted to light. It is possible that a large amount of dark matter in the universe consists of primordial, Big Bang neutrinos.

The Art of Procedural 3D Animation

Brian Wang

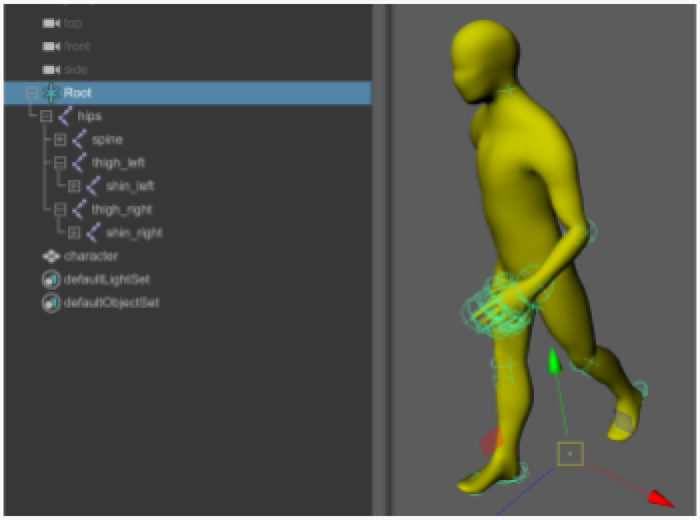
Many 3D animations we see nowadays are crafted by the most experienced animation designers, but has it ever functioned dynamically? In an ever-growing world of using technology to do crude work, animation has hit the target for some people. However, even if animation might be dynamically created, real art still lies within genuinely talented artists. The goal of procedural animation, as video game and movie designers now call it, is to provide seemingly natural movements to animation while ensuring it is created efficiently and effectively.

Procedural animation comes down to a few easily replicable steps across many platforms. Starting from the most basic foundations, inverse kinematics must be used. More details will be provided on the specifics of inverse kinematics next month, but as a general rule of thumb, it is used to calculate joint angles from known end positions of a line. In this way, we will have the joints and bone structure that we humans have. Next, send a ray cast - or simply a "target"- downwards to the ground, and set the leg's direction towards that position - with the leg stuck to the ground initially. In simple terms, this is essentially looking down at the

Verge3D for Blender: Animation — Soft8Soft

https://www.soft8soft.com/docs/files/animation-blender/skeletal-animation.jpg ground, setting a point to it, and retrieving the first point at which our views strike the ground.

With our legs set up, now comes the movement. We detect the distance between the target ray cast and our body. If it gets too far, then our legs will move up a notch. However, our legs must move in opposite directions to make it look natural, the same way we humans walk with our legs in opposite positions. We can dynamically change how our bodies are oriented by taking the average leg position - usually the mid-point of our ankles - and setting our bodies equal to that position's Y value with some offset. Finally, rotate the body based on leg height differences. If our front leg is farther downwards than our other three legs, we should rotate our bodies more in the forward left direction. In this way, procedural animation is created.



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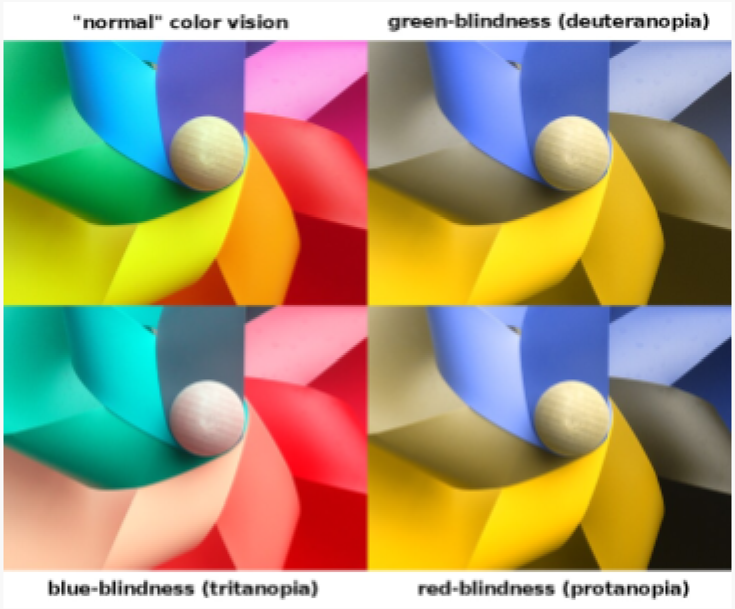
Color Blindness

Denise Lee

What is color blindness? Color blindness is a condition where people can only see certain colors. It can not be cured, but there are treatments such as special glasses made to help people with color blindness. Color blindness is usually inherited from your parents. It happens when photopigments, the molecules that detect color in the cone-shaped cells in your retina, are distorted. Sometimes color blindness is caused by physical or chemical damage to the optic nerve.

Color blindness was first discovered by John Dalton, the 'Father of Chemistry'. John Dalton and his brother were born with color blindness. John Dalton was a physicist and a chemist. When he realized he had color blindness, he started many experiments and research. He discovered that he mixed up his green with purple and his blue with pink because his vitreous humor was tinted blue, which meant it absorbed longer wavelengths. Color is the visual perceptual of a wavelength of energy in the electromagnetic spectrum. There are three types of color blindness; red-green color blindness, blue-yellow color blindness, and complete color blindness. Deuteranopia is the most common color blindness, which is when you see dark yellow for red and light yellow for green. Protanopia is extremely similar to



Simulation of Different Color Deficiencies - Johannes Ahlmann
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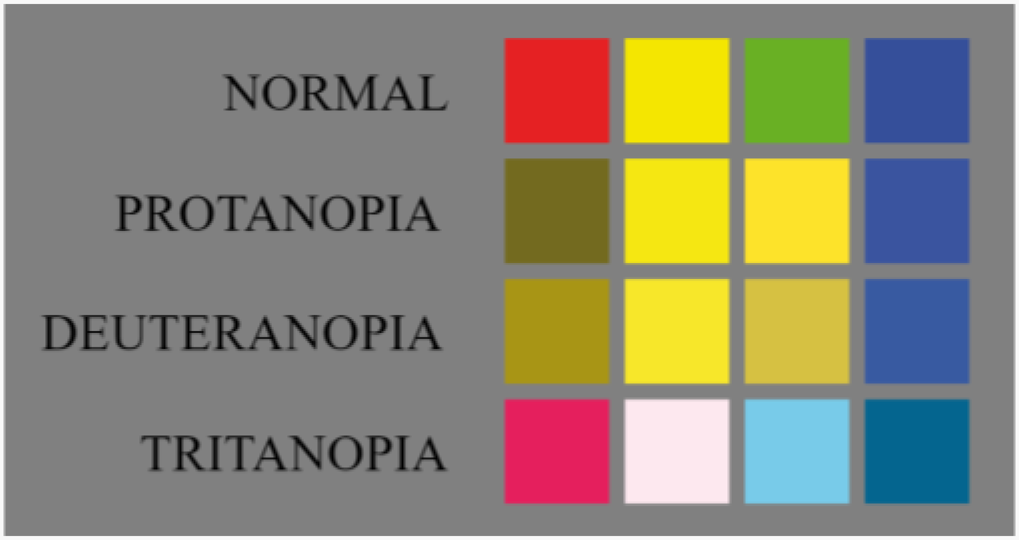
deuteranopia, but the yellow shades seen for red are darker which makes red impossible to see without special colored glasses or lenses. Tritanopia is a blue-yellow color blindness where yellow looks like pink, purple looks like red, and green looks cyan. Lastly, monochromatic is when you have complete color blindness and you can't see any color; only black and white. It is the rarest color blindness someone could have.

All in all, color blindness is the inability to see certain colors because of faulty photopigments from genes or damage to the eye.



Colour perception in different types of colour blindness from Wikimedia Commons

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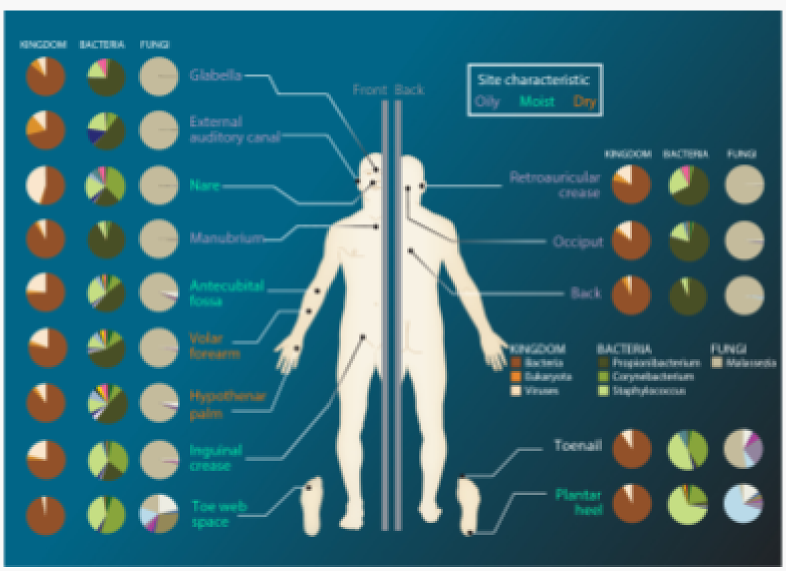
The Human Microbiome: Our Unseen Allies

Eddie Zhang

Our bodies are remarkable ecosystems, where life thrives on a microscopic level. Beyond what the naked eye can see, our bodies host a vast and diverse array of microorganisms. This collective community, comprised of bacteria, viruses, fungi, and more, is known as the human microbiome.

The human microbiome is a dynamic and intricate network mainly in our gastrointestinal tract. However, it also exists on our skin, in our mouths, and in various other parts of the body. This community is composed of trillions of microorganisms, representing a staggering diversity of species. These microorganisms coexist alongside our own cells, participating in a symbiotic relationship.



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One of the primary roles of the human microbiome is aiding in digestion. Within the gut, these microbes assist in the breakdown of complex carbohydrates and produce essential nutrients, including vital vitamins and short-chain fatty acids. These compounds are absorbed into our bloodstream and contribute to our overall health. Additionally, the microbiome helps protect against harmful pathogens by competing for resources and space.

The human microbiome also significantly influences our immune system. It contributes to the development of a robust immune response, and a balanced microbiome helps prevent the immune system from attacking our own tissues, reducing the risk of autoimmune disorders. It serves as a crucial educator for our immune cells, allowing them to distinguish between beneficial and harmful entities.

Recent research has highlighted the connection between the human microbiome and various health conditions. An imbalance in the microbial community, termed dysbiosis, has been associated with ailments like irritable bowel syndrome, obesity, and mental health disorders such as depression and anxiety. Scientists are exploring the potential of microbiome-based therapies to treat and prevent these diseases.

In summary, the human microbiome is an unseen world that plays a critical role in maintaining our health and well-being. It contributes to the digestive process, influences our immune system, and impacts our susceptibility to various diseases. As our knowledge of the microbiome expands, we may discover new strategies to enhance our health and prevent illnesses, making these microscopic allies increasingly essential in our pursuit of a healthier and happier life.

Sublimation: From Solid to Gas

Edison Zhang

Sublimation is a fascinating phase transition in which a solid substance transforms directly into a gas without passing through the intermediary liquid state. This process occurs under specific temperature and pressure conditions, where the substance's vapor pressure surpasses the atmospheric pressure. Unlike common changes of state like melting or boiling, sublimation skips the liquid phase entirely, allowing solid particles to escape their structured arrangement and enter the gas phase.

Dry Ice Sublimation from Wikimedia Commons
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One of the most notable examples of sublimation is dry ice, which is solid carbon dioxide. At normal atmospheric pressure, dry ice doesn't melt into a liquid; instead, it sublimates, transitioning from a solid to a gas. This unique property makes dry ice incredibly useful in various applications, including cooling and special effects.

Sublimation is not limited to dry ice; numerous other substances exhibit this behavior under specific conditions. Iodine, for instance, readily sublimates, transforming from a solid purple-black crystal to a violet-colored gas without becoming a liquid. Camphor, a white, crystalline substance commonly found in medicine and flavorings, sublimates at room temperature, releasing its distinct odor as it transitions into vapor.

Understanding sublimation is crucial in various fields. In the realm of chemistry and physics, it provides insights into the behavior of different substances under varying conditions. In meteorology, sublimation plays a role in cloud formation, as water vapor in the air can directly sublimate into ice crystals without first becoming liquid droplets. Additionally, in material sciences, controlling sublimation can be vital for the production of thin films and the development of advanced technologies.

In essence, sublimation showcases the intricate dance between molecular forces and external conditions, revealing the diverse and intriguing behaviors of matter as it transitions between its different states.

Sublimation of dry ice pouring a solution of NaOH on it from Wikimedia Commons

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Black Holes

Ethan Liu

Black holes happen to be one of the strangest things in existence, it doesn't seem to follow any logic. to understand it better, we need to know how black holes formed. We know that when stars break over the balance between radiation and gravity, its core collapses. The star implodes and releases all of the core's energy, and supernova explosions are created. Depending on the mass of the star, it can turn to one of the smallest and densest known classes of stellar objects, a neutron star. If the star is massive enough, all energy that supernovae group together and collapses into singularity, known as black hole's core. a In Albert Einstein's 1915 Theory of General Relativity it defines singularity "a point of infinite density and gravity within which no object inside can ever escape, not even light. The current knowledge of physics breaks down at the singularity and can't describe reality inside of it." Three different parts form black holes, the outer and inner event horizon, and the singularity. outer, then inter cover singularity, anything that crosses the event horizon needs to travel faster than the speed of light. Black holes have a different time management than the universe, time moves much slower in the event horizon that it is like time is frozen in black hole. Everything will turn into plasma in the event horizon. States of matter will heat up and eventually get so hot that atoms lose their electrons, creating a plasma that will carry magnetic fields.

Black Holes - Monsters in Space - PICRYL
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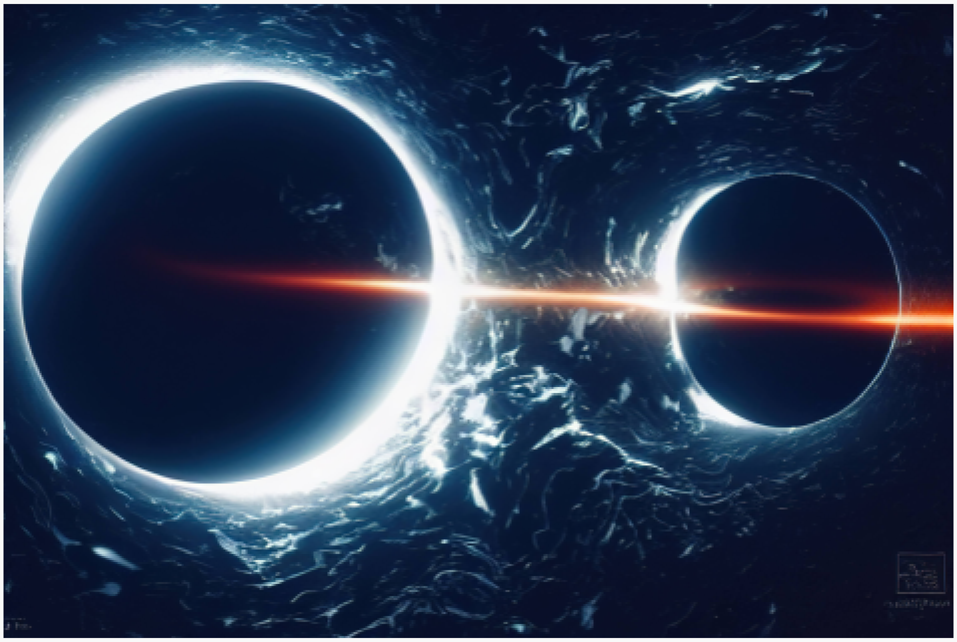
Even black hole don't seems to follow any rule at all, but it is still not a eternal. it's energy can be evaporate one day, it is called Hawking radiation. Hawking radiation is when virtual particles popping into existence and annihilating each other, when it happens right on the edge of a black hole one of the particles will be drawn into black hole and there will escape and become a real particle that causes the black hole to lose its energy. It happens very slowly, as the black hole gets weaker and weaker Hawking radiation gets faster and faster. At last when the black hole cannot hold the rest of its energy any more, it radiates away with a huge explosion to commemorate the end of its life. The process is incredibly slow, every black hole take up a long long long time to evaporate.



Black Holes - Prompart

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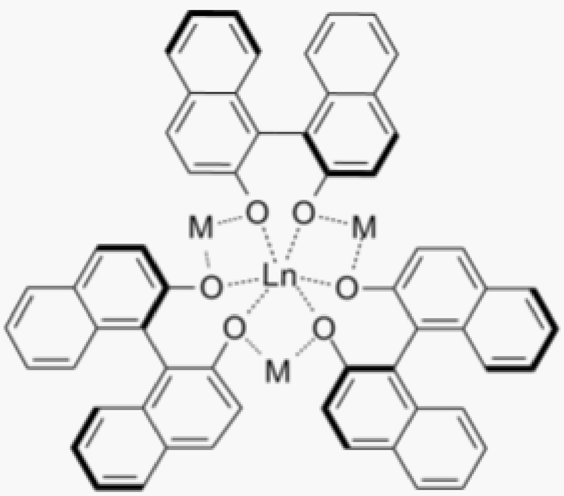
Chemical Catalysts: Gears of the Ticking Chemistry Clock

Kenny Wu

To start off, Catalysts are substances that lower the activation energy for chemical reactions. The activation energy is essentially an energy barrier that reactants must exceed to convert into products. Catalysts have a role as molecular matchmakers, their job requires them to enable reactions that might otherwise proceed at the speed of a sloth. Remarkably, they do not get used up throughout the process and live on for more reactions; Therefore making catalysts highly efficient and sustainable tools.



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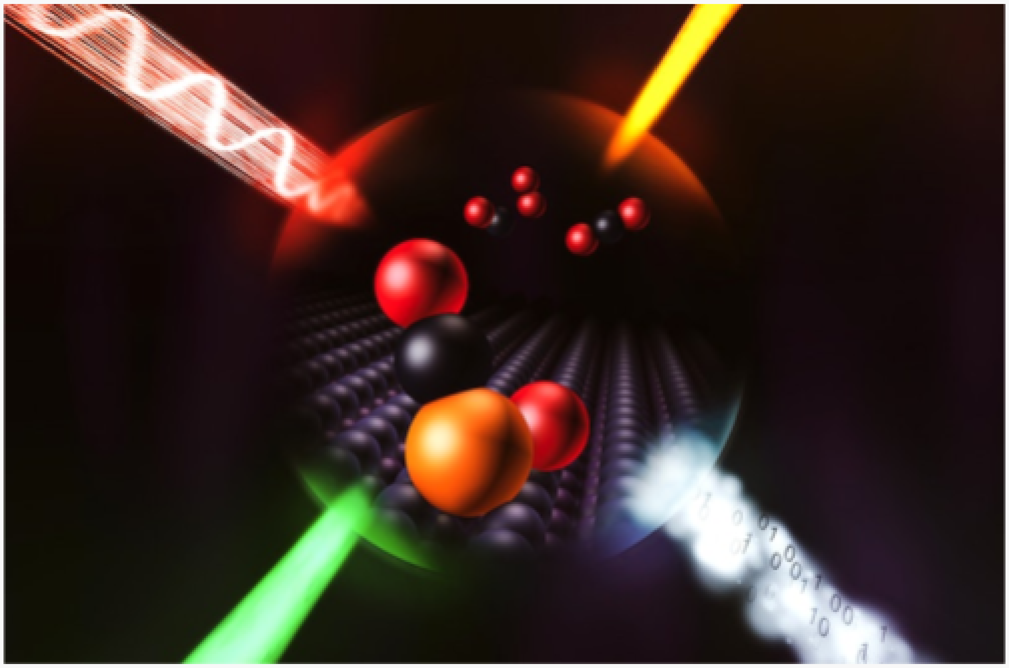
Furthermore, catalysts exist within biotic factors. An example of biological catalysts, enzymes, advocates a variety of reactions inside of our bodies. These molecules are vital to be alive, they aid processes like breaking down food for digestion and allowing the transfer of genetic information during DNA replication.

To add on, Catalysts are the backbone of a clean environment. Scientists exploit catalysts to decrease the frequency of toxic chemical reactions. Catalysts are often utilized by the petroleum industry to purify crude oil into gasoline. The advocacy from catalysts piqued scientist's interest, leading to new approaches to renewable energy, chemistry, and medicine.

In addition, scientists are conducting more research about catalysts to develop ones that are more efficient and sustainable; namely nanocatalysts. It possesses a high surface area and advocates lower temperature chemical reactions. An interesting type of catalysis is photocatalysis, which catalysts get powered by light to purify water or convert solar energy.

All in all, catalysts are the gears that keep the world ticking. It's incorporation ranging from operating vehicles, purifying the environment, handling reactions inside an alive being, etc... Catalysts are instrumental in shaping our modern world. As scientists get further and further with their understanding of catalysts, we can expect greater impact from catalysts to our life, shifting ways of living for all organisms.



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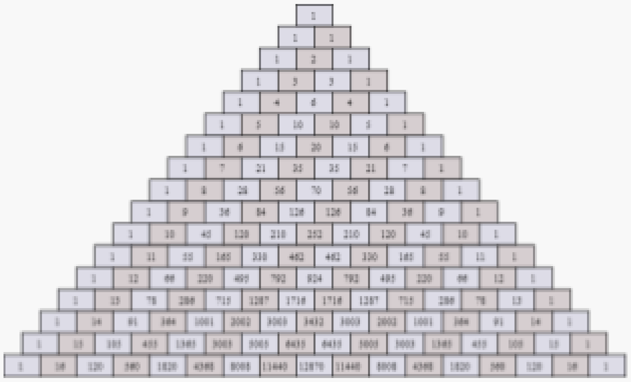
Pascal's Triangle

Owen Chen

Pascal's Triangle is a mathematical arrangement of numbers widely recognized for its use in solving high-degree binomial equations and various mathematical problems. While it is commonly associated with the French philosopher and mathematician Blaise Pascal, its roots extend back to ancient China, where similar mathematical patterns were developed long before Pascal's time.

The triangle is constructed by starting with the number 1 at the top, and each subsequent row is generated by adding the two numbers directly above it. Each layer of the triangle represents different coefficients needed to expand binomial expressions, with each row corresponding to a different degree of the expression.



Pascal's Triangle rows 0-16 from Wikimedia Commons
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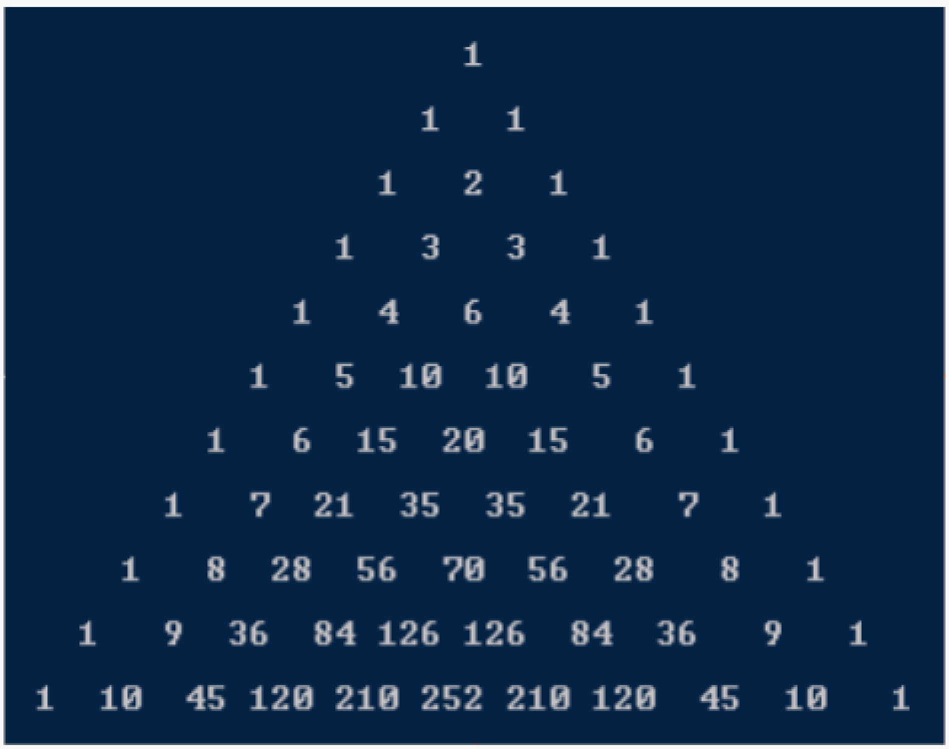
The concept of this triangular number pattern, however, predates Blaise Pascal's work. In the 11th century, Chinese mathematician Jia Xian created a triangular figure with properties similar to today's Pascal's Triangle. Jia Xian's contribution to this concept is sometimes referred to as the "Jia Xian Triangle."

Further advancements in this field were made in the 13th century by another Chinese mathematician, Yang Hui. Yang Hui's work not only expanded upon the properties and applications of the triangular pattern but also led to it being commonly referred to as "Yang Hui's Triangle."

Blaise Pascal, although a renowned figure in mathematics and science, did not originate the triangular number pattern now known as Pascal's Triangle. He did make significant contributions to probability theory and mathematics in general, but the misattribution of the triangle to Pascal is a common misconception.

The history of Pascal's Triangle is a testament to the global nature of mathematical development, with ideas and concepts traveling across cultures and centuries, ultimately enriching the world of mathematics.



Pascal Triangle from Wikipedia

https://en.wikipedia.org/wiki/File:Pascal_triangle.gif

CTE in Sports

Richard Wang

Imagine a brain disorder that could arise from sports: a disorder that can not be treated; a disorder that can not be diagnosed after death; a disorder that involves deterioration of the brain. Well, this disorder is called Chronic traumatic encephalopathy (CTE) and has been rising in popularity as it has claimed the lives of many athletes. CTE comes about by repeated blows to the head in contact sports such as football, boxing, and wrestling. Due to the inability to diagnose this condition in a living human, it is poorly understood.

CTE is thought to occur through many years of repeated head injuries, and it can be scary because an athlete can experience the symptoms of CTE but cannot be diagnosed with it. Common symptoms include depression, difficulty with thinking, memory loss, impulsive behavior, unstable emotions, aggression, substance abuse, and suicide. Despite knowing little, one of the biggest patterns seen is that there is an abnormal buildup of tau proteins. It might sound contradictory that CTE is characterized by this pattern, but it is important to note that this pattern is hard to find in a living brain with the current scans doctors have. However, when the person has passed away, that is when a sample of brain tissue can be used under a better tool such as a microscope to examine the pattern of the tau protein buildup.

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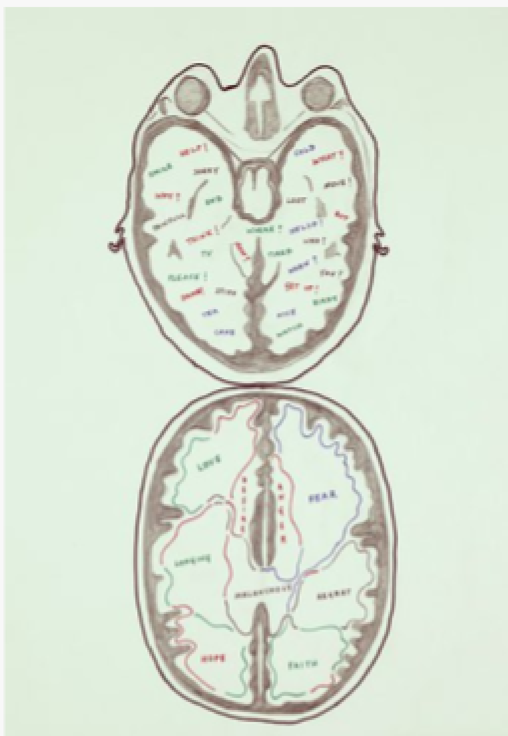
With the understanding that CTE is a complicated disorder, it is also important to see the impact of CTE in the real world. Many mitigation strategies are being put into place against CTE. This includes concussion protocols, better protective gear, and post-retirement health monitoring. There is also a culture awareness change in these sports that strives for players to prioritize their long-term health over competition.

In the world of contact sports, the threat of CTE is a reminder of the stark consequences of neglecting player health. CTE can be avoided as regulations are enforced to create a balance between competition and health. By possessing consciousness, athletes will live a better future that isn't affected by the declining effects of CTE.



Condition of Dementia - Stephen Magrath

How Do Fish Breathe?

Riley Lee

Fishes have a unique way of breathing underwater. Fishes have gills on their heads that are covered by an operculum and the fish's gills are like their lungs for breathing in water. Fishes may open their mouths to let water flow in and out their gills as they swim. Inside the gills are structures that look like fingers called lamellae. Lamellae help exchange oxygen and carbon dioxide quickly. Oxygen in the water moves into the fish's blood as carbon dioxide travels out of the water.

As oxygen in the water enters the blood of the fish, the fish's blood carries oxygen to its body cells and tissues. As the process is happening carbon dioxide is slowly picked off. The deoxygenated blood then goes back to the gills to release the carbon dioxide. Fishes use their gills to help get rid of used water from their gills to keep the process of breathing underwater going. Different fish species also have different habits and adaptations to different environments. Some fishes can survive low-oxygen areas while others can only survive high-oxygen areas. Some fishes can breathe in the air and water using gills and lungs.

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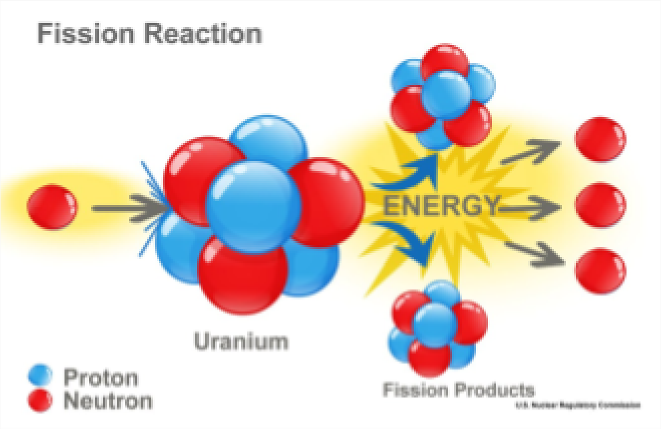
Fish gills are able to adapt to different life in different aquatic environments as they are efficient in removing oxygen from water. This process has helped fishes thrive in multiple habitats. In summary, fish gills are a hugely important example of how nature will always adapt to different environments.

Fission Versus Fusion

Spincer Wang

Though they may sound similar, there is a glaring difference between nuclear fission, and fusion. Fusion is a process that combines two atomic nuclei, releasing energy and creating a heavier atom. Fission, on the other hand, involves splitting nuclei by releasing a lot of neutrons onto a heavy atom, splitting it into two or more and releasing energy in the process.

The process of fusion was used in making the hydrogen bomb, using uranium and plutonium, as well as hydrogen isotopes such as deuterium and tritium releasing a great amount of energy. Fusion could be potentially utilized as a clean energy source, as it relies on already existing fuels and shows little to no long-term radioactive waste. However this may be much easier said than done as using fusion to generate energy may be difficult due to reaching necessary conditions, such as the extreme temperature and pressure needed to start the fusion reaction in a controlled environment.



Fission Reaction Process - Nuclear Regulatory Commission
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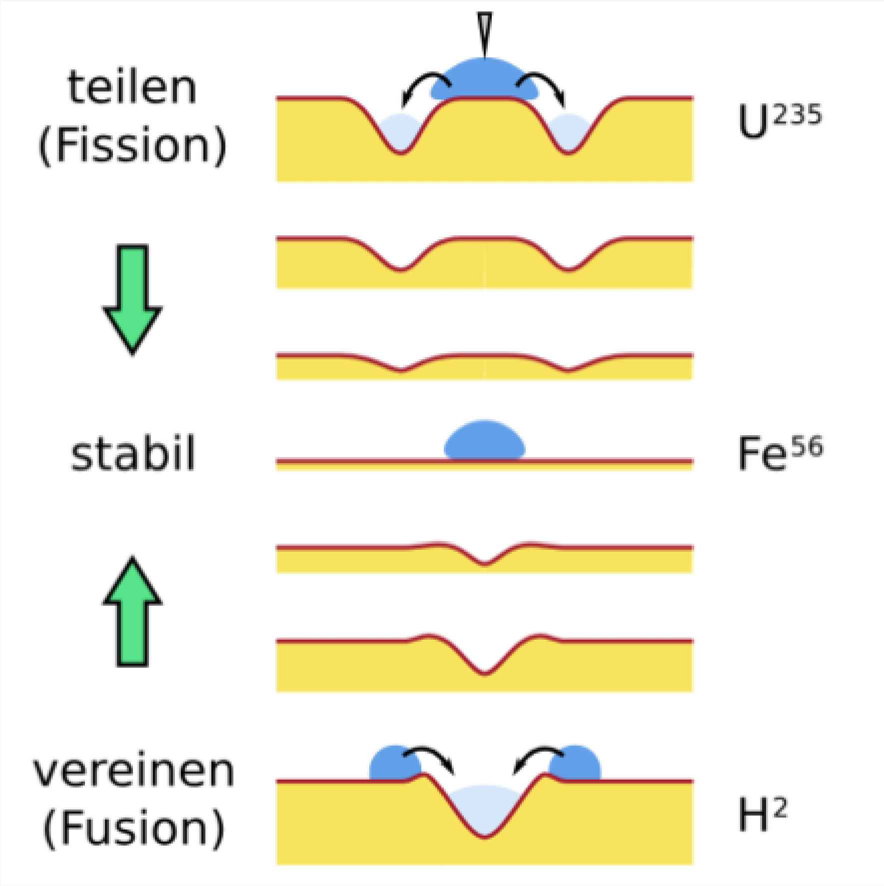
On the other side, fission was used in the atomic bomb, where conventional explosives were used to push sub-critical parts of uranium-235 to jump start the fission process, thereby releasing the energy of the atomic bomb. Fission is often used in nuclear power plants, where neutrons are released onto uranium-235 or plutonium-239 to start the process of generating energy. Fission energy can be obtained in a controlled environment, but has the drawbacks of nuclear waste disposal and potential nuclear accidents.

In summary, fusion and fission are very different in terms of nuclear energy. Fusion relies on combining lighter nuclei, while fission relies on splitting heavier nuclei. Fusion could potentially be utilized to make clean energy, but the conditions that need to be met are difficult to achieve. Fission can generate energy more easily, but leaves the problem of cleaning up nuclear waste. Both have benefits and drawbacks, and if fusion energy can be utilized, the potential for power could be limitless.



Fission and Fusion Potential from Wikimedia Commons

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How to Make an AI Program

Stephen Hung

Artificial intelligence is a new and developing technology. Artificial intelligence, also known as AI, is where machines are capable of performing complex tasks that typically require human intelligence. Examples of artificial intelligence are self-driving cars, which are cars capable of driving themselves without human intervention. Developing an artificial intelligence may sound difficult and complicated, but anyone with programming experience can do it.

The first step to creating an artificial intelligence program is to identify what the artificial intelligence program is going to solve. This may vary from identifying the text in an image to making a car capable of parking itself. Identifying what the artificial intelligence program is going to do is crucial because without knowing what exactly the program is going to do, it will make the development process much more tedious and complicated.

Tech companies testing morality software - Ethan Hansen
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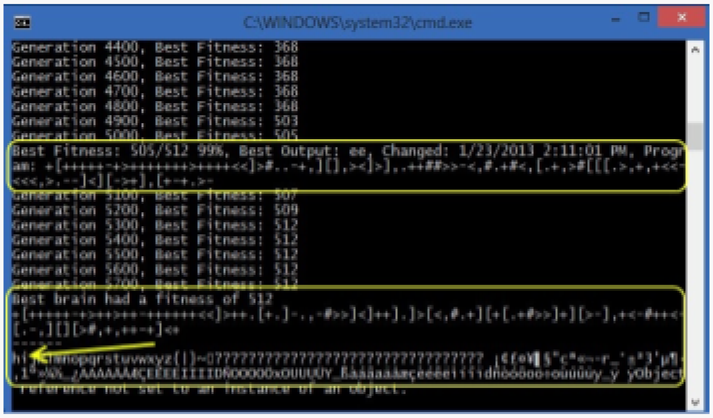
http://hiline.cfschools.org/2021/12/tech-companies-testing-morality-software/

The second step to creating artificial intelligence is to get data that the program will use. There are two different kinds of data which are structured and unstructured data. Structured data is in a specific format, whereas unstructured data comes in a form of audio, an image, or similar things. The data must be organized so that it can be used in the code. A lot of time is spent cleaning the data.

The third step is to develop an algorithm to find a pattern within the data that could be applied to other data sets. There are many different algorithms that can be used and the main 2 ways of learning are supervised learning and unsupervised learning. Supervised learning has many algorithms that are already available for supervised learning such as logistic regression, Bayes classification, and SVM. Supervised learning can be separated into two different categories such as classification and regression. Classification is a type of algorithm used to separate data into different categories. Regression is a type of algorithm used to determine the relationship between an independent and dependent variable. Supervised learning usually returns some sort of value. In unsupervised learning, there are three main tasks which are clustering, association, and dimensionality reduction.

Finally, train the algorithm and fine-tune the program until you get the desired outcomes. AI is a very unique type of programming and people interested in computer science should look into building AIs for recreational purposes.



AI Programmer from Wikimedia Commons
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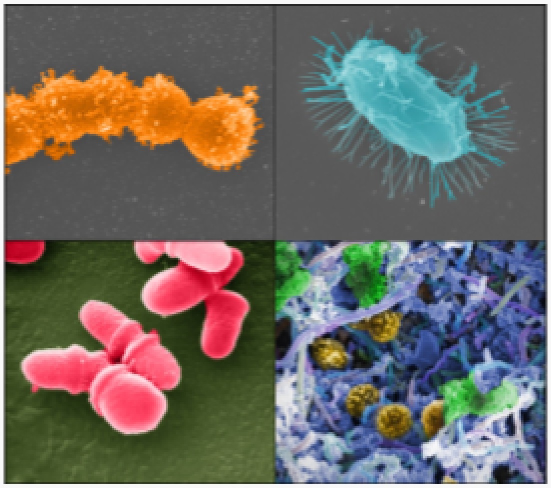
Bacteria in the Human Body

Wesley Chen

The human body depends on bacteria to do many biological processes. Human digestion is something bacteria plays a role in. The human gut mucosa consists of epithelial cells, lamina propria, and muscularis mucosa, these are populated by 1014 microbes. There are ten times more microbes than human cells. These bacteria help digest dietary fiber and polyphenols by their advanced metabolic energy-harvesting mechanism. It is based on cross-feeding and co-metabolism. These bacteria will take advantage of the protective and nutrient-rich environment of our body. Bacteria can create an effective immune response against viruses that can infect our lungs. The microbes in our gut order specialized immune cells to produce potent antiviral proteins that eliminate rival infections. This is how bacteria helps defend us against infections that might damage our health.



Human Microbiome Project (HMP) - National Human Genome Research Institute
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Some bacteria will produce essential compounds that our body cannot do on its own. For example, some gut bacteria can produce short-chain fatty acids which will provide energy source for the cell lining the colon.

Gut bacteria can provide us with good vitamins that our body needs for example, b12, biotin, and folate. B12 is helpful for healthy skin, hair, eyes, and liver; it also helps with our nervous system functioning properly. We need biotin to metabolize carbohydrates, fats and amino acids. The building blocks of our protein.

Bacteria can even help us with our mood because it states by researchers that people with certain digestive disorders have a higher risk of depression and anxiety. As I said above, bacteria can help with digestion and help with our gut. This is why bacteria can affect our mood.

These are the processes in our body that will depend on bacteria to work so we can have a healthy and good body.

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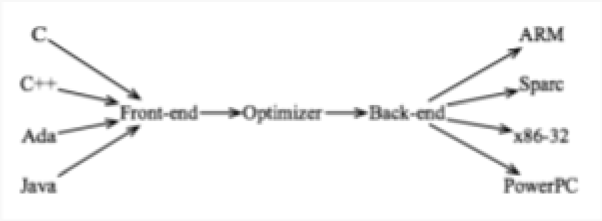
Crossing of Realms: Program Compilation

Arthur Liang

In the world of binary stored inside each and every computer, one of the processes that allows those 1s and 0s to perform meaningful tasks is compilation. Compilation, to give a short summary, is translating code into instructions for the computer. Understanding how this translation occurs is an essential step when learning software development.

Any computer programmer knows that codes are a set of instructions written in a programming language readable to humans like C++, Python, Java, etc. However, computers understand a very different language that only consists of 1s and 0s. The act of compilation begins with a programmer creating their code with an integrated development environment (IDE). This code is then fed into the compiler. The compiler's goal is to translate the high-level code into machine code, while also analyzing for syntax errors or runtime errors and translating code into a form the computer can understand.



Compiler design IPL from Wikimedia Commons
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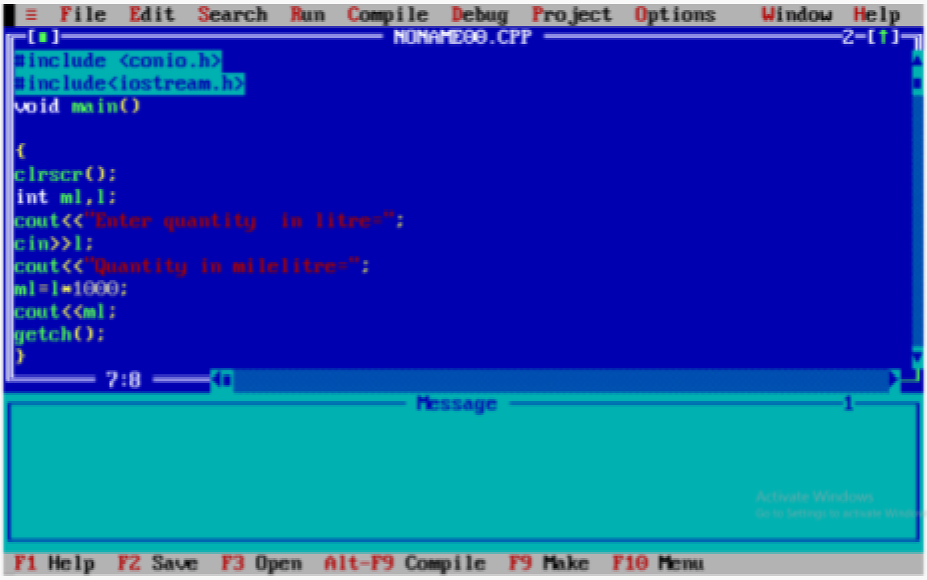
Once compilation is complete, the software is ready to be executed by the computer's CPU. The result is a functional program that can perform the tasks it was designed for. This final machine code is usually stored in an executable file, which can be run multiple times without the need for recompilation, making it ready for distribution and use.

The idea of compilation is a crucial step in bridging the gap between the realms of mankind and computers. It allows programmers to create a variety of software applications and devices that many people can use every day of their lives.



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