JANUARY 4TH, 2024 *Seeking Science* VOL 30

SEEKING SCIENCE

by STEM Action Teen Institution

A MONTHLY
STEM NEWSLETTER

VOLCANO SNAILS

REDSHIFTING

GREEN PRACTICES

and more...

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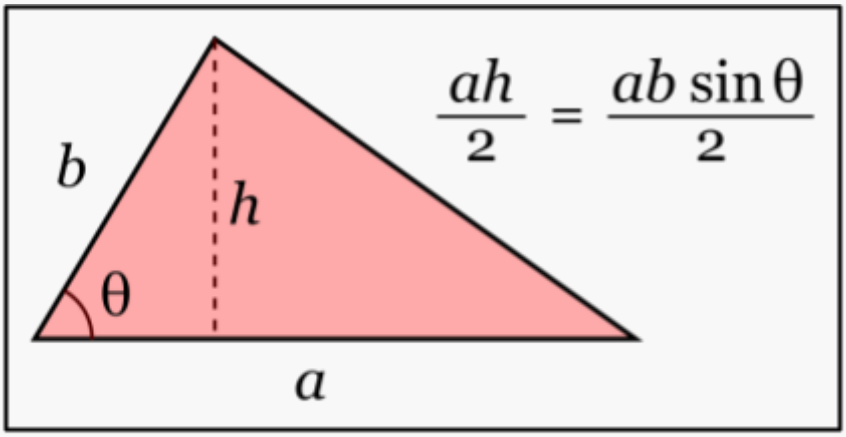
More Ways to Find a Triangle's Area

Edward Huang

We all know the iconic formula $A = bh/2$. The area of a triangle is simply its base times its height, divided by 2. In fact, this applies to all sides of the triangle. Pick a side to be a *base*, find the altitude from that side to the opposite vertex to be the *height*, and simply use the formula we all know.

But what if you don't have the information needed to apply the equation? For example, if we're not given the altitudes but we know the angles, we can't use $A = bh/2$. In this case, we use a different formula: $A = ab \cdot sin(\theta)/2$. This is essentially a modified version of our previous formula. Given two sides a, b and the angle θ between them, we can use the sine function to calculate the triangle's area. We're substituting h, the altitude, with $a \cdot sin(\theta)$, because multiplying a side by $sin(\theta)$ will give us the base's altitude.



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What if we don't have the angles, but we instead have all three side lengths? The *SSS theorem* states that every triangle has its own unique set of side lengths. In other

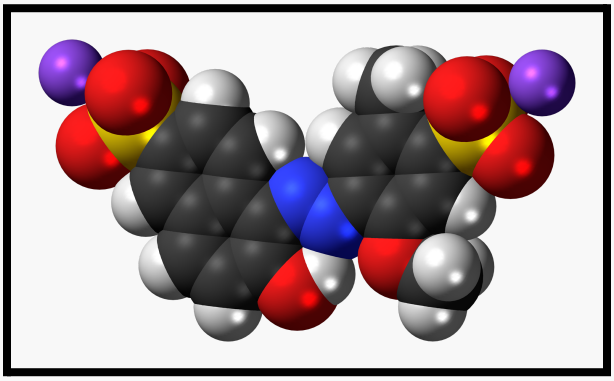
words, every triangle has its own unique set of side lengths. Two triangles that have the same set of side lengths are congruent – they're the same. Can we use this unique property to find that triangle's area? Yes, we can, with *Heron's formula*. Given the three sides of a triangle a, b, c, the area of the triangle is $A = \sqrt{s \cdot (s-a)(s-b)(s-c)}$, where s is the half of the triangle's perimeter, equal to $s = (a+b+c)/2$.

Before applying these formulas, remember to know when each of them can be used. The first formula $A = bh/2$ can only be used if we have a side length and that side's altitude. Typically, in real world settings, the altitude is not explicitly labeled while the angles are. In those cases, we can use $A = ab \cdot sin(\theta)/2$, where we select 2 sides and the angle between them. Lastly, we can use Heron's formula if all the information we have are the three side lengths.

Creating Color: How Dyes Are Made

Angela Chin

From food to fashion, dye has always been a part of human history. One primitive source of gathering dyes is natural, such as flowers, berries, and even insects and minerals. This dates back to the New Stone, or Neolithic, Age, when the first dyed textiles were discovered. After discovering the New World, the Americas and Europe traded materials for dyes through ships. Now, in modern-day society, dyes are primarily manufactured with petrochemicals. Though, what are the specifics of how dyes are processed into usable ingredients?



Azo dyes make up approximately 70% of all modern food and material dyes. Azo dyes are synthetic, and an example of the shape of a dark red dye (Food Red 17) can be shown on the right. There are several steps to producing azo dyes. First, diazonium salt is added to an electrophilic component. Nitrosation then occurs and is kept cool with ice. After this, the result is confirmed on a piece of iodide paper. Repeating this process will yield more than one type of dye. The substance is filtered and salt crystals are formed. The dye should now be high in viscosity, with 50% water. The water is removed in the next step, where the paste is spread out on a tray. Lastly, the batch is modified until satisfactory. However, the steps for making different dyes are not always the same.

Whereas before the 1800s, dyes were obtained from plants, animals, or minerals, with little processing, now, dyes are manufactured in five steps: diazotization, coupling, filtering, drying, and grinding.

The Rise of Diesel

Arick Hong

Back then in the early 20th century, railroads used a wide variety of steam locomotives. They were the sight of a bright future for the railroad, and many people were big fans of them. However, it came with trade-offs. The fumes from all the steam caused trouble, and the loud noises they created were way louder than today's trains. They needed people to tend to their locomotives often, which was a hassle. So in the mid-20th century, the concept of a diesel locomotive was introduced.

Electro-Motive Diesel was the first for diesel transport. With the EMD FP-45, steam locomotives were quickly outmatched and beaten by this sleek, clean new locomotive. Railroads such as the ATSF and the PRS quickly ordered them in bulk. By the 1960s, steam locomotives were mostly gone, with diesel being their replacement.

General Electric came into the diesel business by making the famed F40PH for the company known today as "Amtrak". This outmatched EMD's locomotives for passenger service, and the P42-DC made several years later did not help EMD at all. However, EMD made their GP38-2s and SD40-2s in 1990 to help boost their popularity. These "Second Generation" diesels ended up being a smash hit, with multiple railroads such as the Union Pacific and the Burlington Northern ordering them. Other railroads that ordered these included the ATSF, Norfolk Southern, CSX Transportation, and the Chicago and Northwestern.

The rise of so-called "Third-Generation" diesels in the 1990s helped shape the trains we know today. They were so popular that a good chunk of their numbers still exist today. General Electric's GE C44-9W became a legendary piece of equipment on the railroad, with almost every railroad ordering that locomotive during that time. The "Dash-9" was one of the best of its time, being equipped with microprocessor chips along with a wide-nose "Safety Cab". EMD responded by creating the SD70MAC in 1992,

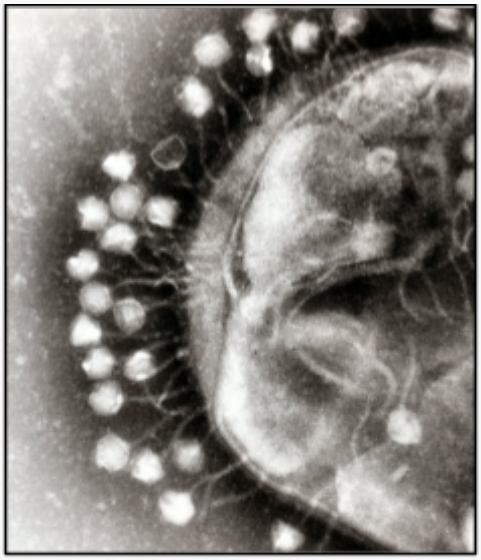
and it too was a legendary addition to the railroad. Companies like Union Pacific and Burlington Northern Santa Fe Railway quickly snatched it up. BNSF's "Executive Macs" became well known for their white and black color, along with their sleek controls. General Electric made the "Comfort Cab" starting on their Dash 8 series to have a more comfortable space when operating locomotives. To this day, the comfort cab is still used on all sorts of diesels.

In 2005, EMD created the SD70ACE which quickly outmatched the Dash 9. This modern, cool-looking train was like the "future" of rail. General Electric responded by making the Evolution Series, dubbed "Gevos" by train spotters. These are still being made as of 2023, and are more common than ever. On the other hand, EMD's SD70MAC, SD70M, and SD70ACE are huge competitors as of this day.

Bacteriophages: Nature's Tiniest Killers

Arthur Liang

One of the deadliest organisms on Earth, alongside humans, is also one of the smallest and most interesting. Bacteriophages, also known simply as phages, are small microscopic viruses responsible for the deaths of millions every day. Lucky for you, they only target and hunt bacteria, hence the name. Recently, scientists have begun intensely researching microorganisms due to their efficiency as bacteria killers. Their unique abilities have the potential to provide humans with a stronger and better way to kill infections over antibiotics.



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Antibiotics are also potent bacteria hunters, but introducing them into the body is akin to carpet bombing the bacteria. The harmful bacteria are killed, but helpful bacteria such as digestive bacteria in our intestines are also killed, which is not optimal. Bacteriophages provide an advantage in this regard because they are incredibly specialized, only hunting one specific family of bacteria.

When the bacteriophage finds bacteria of the family that it is targeting, it first attaches itself to the outside of the membrane before puncturing it and injecting its genetic material. Bacteriophage genes hijack the bacteria and force it to produce new

bacteriophages inside of itself. In the end, the phages produce a special enzyme that causes the bacteria to explode, releasing new phages to start the cycle again.

Bacteriophages may also save humanity from one of its most threatening predators. Certain antibiotic-resistant bacteria, known as superbugs, have started appearing around the world. In the future, they have the potential to take thousands of lives as traditional medicines do not affect the superbugs. However, bacteriophages offer an avenue for the development of new antibacterial treatments which can kill these superbugs. It seems absurd, but utilizing one of the deadliest organisms on the planet could save millions of lives.

Volcano Snails

Ben Liang

Volcano snails are strange creatures. They are also known as sea pangolins, scaly-foot gastropods, and scaly-foot snails. They live far down in the ocean around 1.5 miles below sea level. Their bodies are red and black. They live in hydrothermal vents and they can survive below 750 degrees Fahrenheit. The snail also does not need to eat because bacteria in their body produce the nutrients for them. The snail also has a very big heart which is 4% of its volume compared to a human's which is 0.3% of its volume. It is that big because they need to have oxygen in their system for the animals and the bacteria that feed them. They got the name scaly foot snail. They got the name because they have foot sclerites. They were first found near the central Indian ridge in 2001. They live in parts of Africa and the ocean. They were first seen in the Eocene epoch which is around 47.8 million years ago to around 41.3 million years ago. They can also self-fertilize. It means they do not need to find a mate to reproduce. Volcano snails did not evolve much in the past 540 million years. The snail's shell is made of iron and can survive high pressure. They are at risk because of deep-sea mining. They do not have eyes and tentacles. They are the prey of venomous snails and crabs that live there. Volcano snails are very strange.

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What are Eclipses?

Brandon Pian

Eclipses are an amazing sight to see. Seeing the moon align with the sun and earth creates a blend of the moon's shadow and the sun's light. Many types of eclipses look different and can happen in several ways. Some eclipses damage your eyes while others don't. Some appear different based on their position.

Lunar eclipses happen when the earth is positioned between the sun and the moon, creating a full moon as the sun's light casts the shadow of the Earth onto the moon, leaving a ring of light around the moon. Lunar eclipses have hints of red, orange, and white. Only half of the Earth can view the Lunar eclipse at a time. You can watch a Lunar eclipse without the requirement of safety glasses.

Solar eclipses happen when the moon is in between the sun and earth creating a new moon and the sun's light casts the moon's shadow onto a certain part of the earth. This makes solar eclipses only visible from a certain part of Earth. A Solar eclipse has a white ring of light around a dark circle that is unsafe to view without special eye protection.

There are also partial and annular eclipses. Partial eclipses happen when part of the moon blocks part of the sun leaving only part of the moon being lit up. Annular eclipses happen when the moon is at its furthest point. It does not cover the sun totally but this is where you can see a thin ring of light peeking out from around the moon.

Finally total eclipses. Total eclipses happen when the moon passes in between the Earth and the sun, completely blocking the sun's light. Only a certain part of the earth is visible to the total eclipse. Just like a solar eclipse a total eclipse can also cause permanent eye damage if not protected.

Fourth Dimension: Journey Beyond Space & Time

Brian Wang

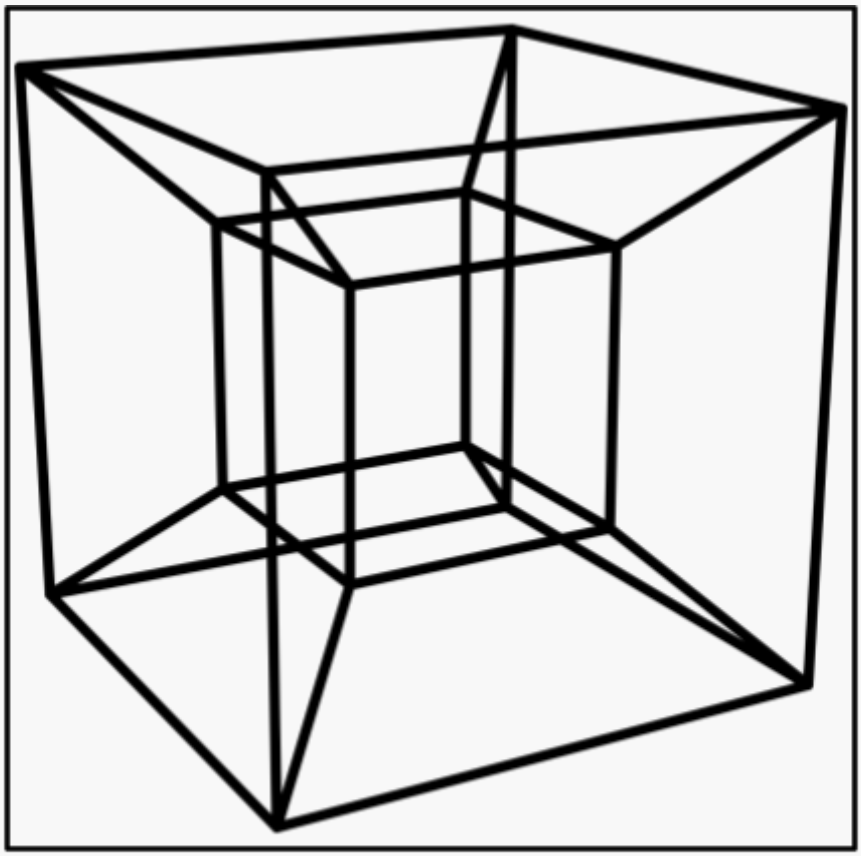
Humans perceive items in our world as 2D objects, ranging from rectangular-shaped books to the most circular spherical basketballs. However, underneath 2D consciousness, there lies a 3D layer that all of us thrive in, yet we cannot see. In a 4D world, a 3D consciousness is represented under an abstract 4D layer, which we have yet to comprehend. Moreover, the visualization is beyond what we can imagine, and it may never be known if it exists in this 3D space.

To understand what the fourth dimension is, it is necessary to realize that all dimensions are dependent on one another. In our 3D space, we perceive 2D objects, as they have a height and width. In 2D space, 2D characters view objects in front of them in a 1D space, only the height, as they are unable to see the width or length of the object. The length is perceived as we move around an object, and light is reflected on the object, which makes us believe an object has a “front” and “back”, when in reality, what we view is only 2D.

Following this trail, a 4D character views objects in 3D and therefore would be able to see us as puppets, similar to how we view 2D characters as puppets viewing 1D objects. In other words, we cannot envision 4D objects with 2D perception, as it would only looks like an optical illusion. An example is the “tesseract”, which looks like a 3D cube inside another 3D cube connected at each of its vertices.

In the past, many have argued that time is the 4th dimension, though with great uncertainty. Most note the reason for this argument is that the 4th dimension is the unique one out of the 3, and thus singles time out. Both space and time compromise “dimensions”, as noted in the Special Relativity theory, which notes how speed affects mass and size - something is perceived as moving faster or slower (time changes too)

depending on the speed something moves - has to be close to the speed of light - and the reference frame of the object. This means that since it is hard to find the “space” in a 4th dimension, we single out time as the 4th dimension until further notice - meaning once we find a space, time will yet again be singled out for the 5th dimension.



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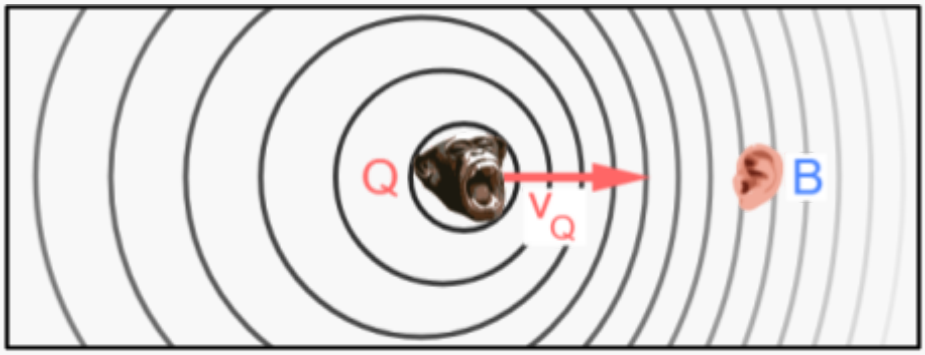
Nevertheless, the idea behind multiple dimensions with multiple perceptions of objects can largely affect our studies on science and what it has to offer. The question, left unsolved, will pass on to generations of 2D observers in this 3D world.

Doppler Effect and Redshifting

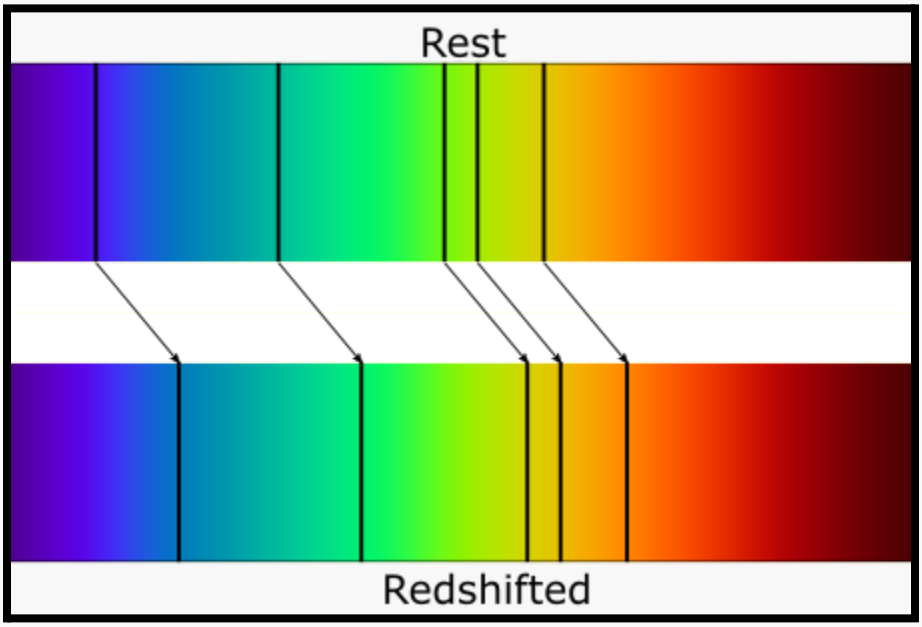
Cody Duan

Sound and light have fascinating properties when they interact with the world. In motion, light and sound can be stretched or compressed, resulting in a different color or a lower or higher frequency in sound. Despite concerning two different topics, redshifting is only an example of the Doppler Effect.

The Doppler Effect is a phenomenon mainly based on the direction of motion. When the observer and the sound source move closer to each other, the frequency appears higher because the waves are a lot more compressed, and the frequency would appear lower if the source and observer move away from each other because the waves are stretched more. In physics, the Doppler Effect can be generalized into the equation $f' = f(v \pm v_o)/(v \mp v_s)$, which f' denotes the frequency heard, f denotes the original frequency, v denotes the speed of sound, and v_o represents the speed of the detector/observer and the speed of the source respectively.



Redshifting is similar to the Doppler Effect in that it uses light instead of sound. Similar to sound waves, light waves can also be stretched in the same manner. When stretched, the wavelengths increase, giving it a redder shade, and blue when the wavelengths seem shorter. However, Redshifting is not something experienced in daily life. Redshifting only applies to the galaxy as the universe continually expands and galaxies move further away from us. The light these galaxies emit is stretched, giving it a reddish color, hence the name Redshifting.

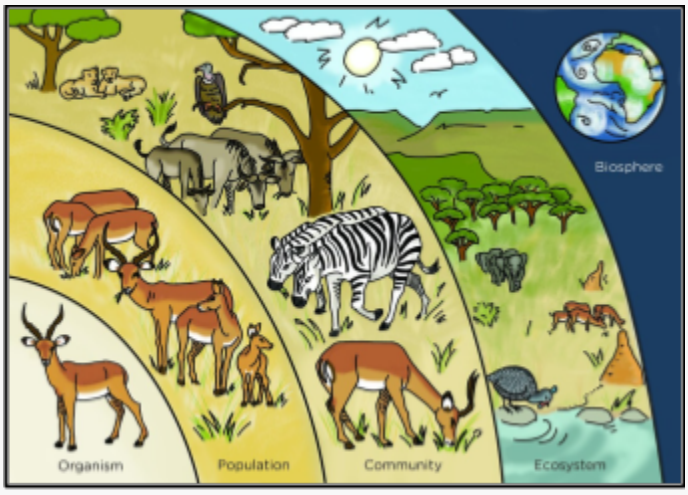


Although Redshifting is not commonly seen, the Doppler Effect can still be used in many ways. For example, emergency vehicle sirens can be distinguished and the police use radar guns to check the speed of a car. The Doppler Effect is simple, yet it remains one of the most useful and practical physics phenomena that is commonly seen today.

Ecology Unveiled

Denise Lee

Ecologists study environments at different levels of organization. Ecology studies the interactions among living things and between living and their surroundings. It helps us understand how living things, from tiny bugs to big animals, work together with their surroundings.



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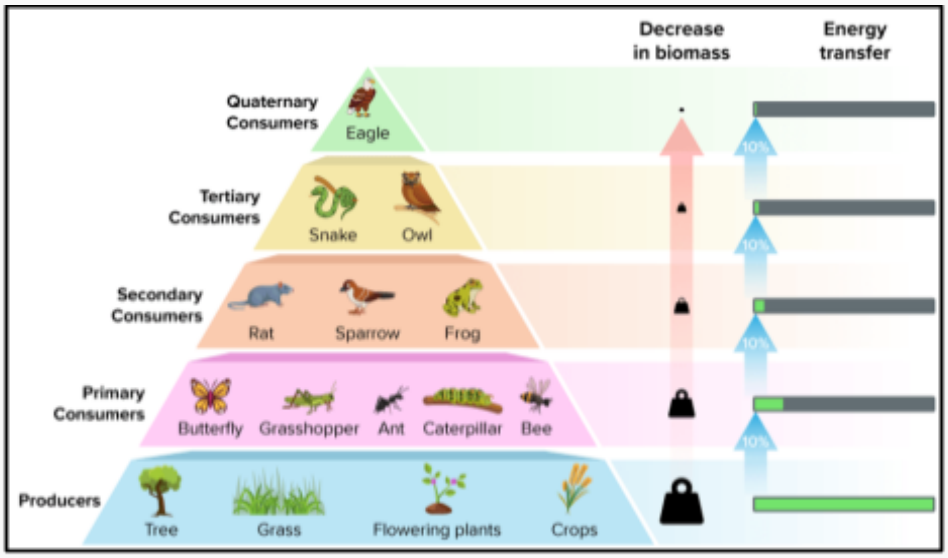
An organism is an individual living thing and a population is a group of the same species that lives in one area. A community is a group of different species that live together in one area. An ecosystem includes abiotic factors which are nonliving components of an ecosystem (sunlight, precipitation, temperature, water, atmosphere, etc.), and biotic factors which are living components of an ecosystem (organisms). A biome is a major regional or global community of organisms characterized by the climate conditions and plant communities that thrive there. Earth's four global systems are constantly interacting biosphere, atmosphere, hydrosphere, and geosphere. The biosphere is the part of the environment where life exists. The atmosphere contains all the gasses that surround the Earth. The hydrosphere is all Earth's freshwater and saltwater, including water vapor and rain in the atmosphere or water underground. Deep inside the Earth, portions of the geosphere are liquid.

An ecological pyramid is a diagram that shows the relative amounts of energy or matter contained within each trophic level in a food chain or food web. Ecological

pyramids show the relative amount of energy at each trophic level (kcal); only part of the energy at each level is passed on to the next level. Numbers pyramids show the relative number of organisms at each trophic level. Biomass pyramids compare the total amount of living tissues at each trophic level and represent the amount of potential food available for each trophic level. Biomass is grams of organic matter per unit area. 4.3 of



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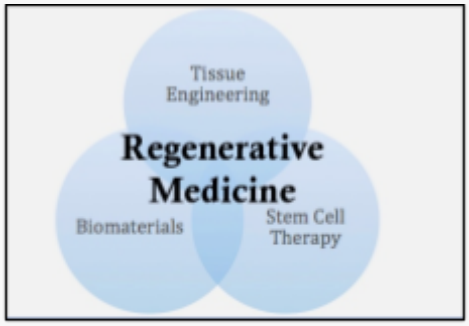
In wrapping up our exploration, ecology reveals the intricate dance of life on Earth. Ecology helps us see how living things, like plants and animals, work together with their surroundings. This field of study emphasizes the importance of understanding and preserving the delicate balance that sustains our planet's biodiversity for the benefit of current and future generations.

Regenerative Medicine: Unlocking the Future of Healthcare

Eddie Zhang



Regenerative medicine is an exciting frontier in healthcare, promising to transform how we treat diseases and injuries. This essay will explore the basics of regenerative medicine, its potential applications, and the ethical considerations it brings to the table.

In simple terms, regenerative medicine aims to help the body heal itself. Unlike traditional medicine which focuses on managing symptoms, regenerative medicine uses techniques like stem cells and tissue engineering to repair or replace damaged tissues and organs.

One significant application is in treating diseases like Parkinson's and injuries that are hard to heal through conventional methods. The idea is to stimulate the body's healing mechanisms, either by encouraging the regeneration of tissues or by replacing damaged cells with healthy ones.

Stem cells play a crucial role in regenerative medicine because of their ability to transform into different types of cells. However, the use of embryonic stem cells raises ethical questions, prompting ongoing research to find alternative sources.

Regenerative medicine is not just about cells; it also involves creating artificial organs or tissues for transplantation. This could help address the shortage of donor organs and reduce the risk of the body rejecting transplants.

While regenerative medicine holds great promise, there are challenges and ethical dilemmas to consider. Questions about where to source stem cells, the safety of

gene editing, and ensuring equal access to these advanced therapies need careful attention. Striking the right balance between scientific progress and ethical responsibility is crucial for the responsible development of regenerative medicine.

In conclusion, regenerative medicine opens new possibilities for treating conditions we once thought were untreatable. However, as we explore these opportunities, it's essential to navigate ethical considerations carefully. The future of healthcare holds exciting potential as regenerative medicine continues to advance, offering hope for improved and lasting solutions to various health challenges.

e – Euler's Magical Number

Emily Ma

The number e, also known as Euler's number, is a mathematical constant that is approximately equal to 2.71828. It is one of the most important and widely used mathematical constants, along with pi. Like pi, e is an irrational real number, meaning it cannot be written as a fraction, and its decimal expansion goes on forever with no repeating pattern. The number e has many interesting properties and applications in mathematics, science, and engineering. One of the most significant applications of e is in exponential growth and decay. For example, the number e appears in the formulas for radioactive decay, population growth, and compound interest. It is also used extensively in calculus, differential equations, and probability theory. In addition to its many scientific applications, e appears in many important equations in physics. For example, it appears in the Schrödinger equation, which describes the behavior of quantum particles, and in the uncertainty principle, a fundamental principle of quantum mechanics. The history of e is fascinating as well. The number was discovered and studied by many famous mathematicians, including Leonhard Euler, whom it is named after. Euler first introduced the number e in a letter to a colleague in 1727, but it was not until the 1800s that its significance was fully understood. In summary, the number e is a versatile and essential mathematical constant that plays a crucial role in many science, engineering, and mathematics areas. Its fascinating properties and applications make it a subject of interest for mathematicians, physicists, and other scientists around the world.

Bioluminescence – Glowing Life

Emily Wang

Bioluminescence is a fascinating natural phenomenon where living organisms produce light from chemical reactions. Bioluminescence is most commonly observed in the ocean on marine animals; most commonly jellyfish, but it is also found in bacteria, fungi, and insects such as fireflies. These animals use this function to confuse predators and lure prey.

There are three main components in producing bioluminescence; luciferin, oxygen, and luciferase. Luciferin, coming from the Latin word 'light-bearer', is the light-emitting compound found in organisms that create bioluminescence. A molecule or pigment that produces light when in contact with oxygen and luciferase. Luciferase is an enzyme that speeds up the reaction between the oxygen and luciferin. Oxygen, as we all know, is the most abundant element on earth, and is crucial for the processes that generate energy and sustain life. As these three components combine and react, it results in an excited-state molecular formation. As this molecular formation returns to a ground state, it releases excess energy through visible light. This light is what we perceive as bioluminescence.

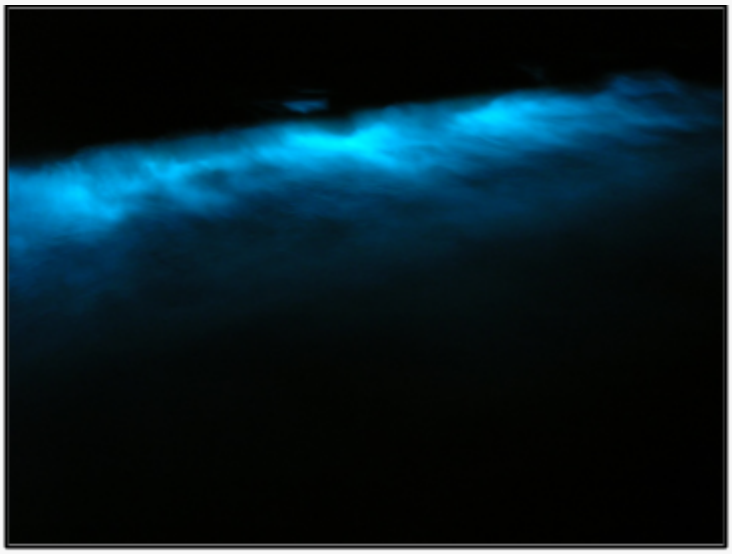
The intensity and duration of the light depend on specific details of the reaction and the organism involved. For example, fireflies usually light up for 20 minutes at dusk, while the planktonic organisms we usually see on ocean shores can last for weeks on end because it's usually affected by water disturbances and nutrient availability. Dinoflagellates are mostly what create the light you see on ocean shores. The more dinoflagellates there are, the brighter the water will seem.

Bioluminescence is most commonly viewed at night because it is when it's most visible. The surrounding darkness enhances the visibility of the light and makes the ocean appear to be shimmery and glowing. If you are lucky enough to observe this

phenomenon, it can be a mesmerizing and memorable experience. Several places on earth display this event, the best ones including the southern shore of the island Vieques, Puerto Rico, the cave system of Waitomo, New Zealand, and the oceans by Titusville and Merritt island in Florida, United States. The peak of the bioluminescence season is between July and September.

Although the beautiful scenery of these glowing organisms may tempt you to touch them, it is important to remember that dinoflagellates and bioluminescent algae are potentially harmful, and consuming or coming in contact with them can cause health problems, skin infections, and even death. Bioluminescence itself is not harmful, but the organisms that produce it can be. Glowing fungi can be mistaken for edible mushrooms, so it is crucial to do thorough research whenever you consume anything.

Bioluminescence is a beauty of the natural world, and not only showcases luminous spectacles but also provides vital ecological roles that help organisms and scientists to create better tools for our lives.



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Digital Cryptography

Jerry Yang

Every blog you post, every text you send, and every video you watch, data is sent across a fault-tolerant network, through various points and paths, as your data is broken into multiple parts called packets. But how do you make sure that your data is not intercepted and read by a third-party member? The answer lies in cryptography, the scrambling of data that can only be translated back into plain text with a key.

There are many processes of encryption, but the main categories are symmetric and asymmetric encryption. Symmetric relies on both the receiver and the sender to have the key to encrypt and decrypt the coded message, and a good example of symmetric encryption is the Caesar Cypher, where letters of the alphabet in a message are shifted to the next few letters, with the key being the amount of shifting done. A major flaw with the Caesar Cipher is its ability to be brute forced due to the alphabet only having 26 letters, meaning there are only 25 variations of the encrypted message you have to guess. Another major flaw is the need for both recipients to know the key, which requires them to meet up in person to share the key, a privilege unavailable online.

These flaws are patched with the usage of asymmetric encryption, where each individual has 2 different keys, a public key, and a private key. The public key is seen by everyone and is used by any sender to encrypt a message for the recipient, while the private key is seen only by the receiver and is used to decrypt messages given to them. A good terminology for this is a mailbox, where senders can leave a message that is inaccessible to anyone else but the person with the key to unlock the mailbox. This is the more commonly used style of encryption online to ensure the security of an individual's personal information.

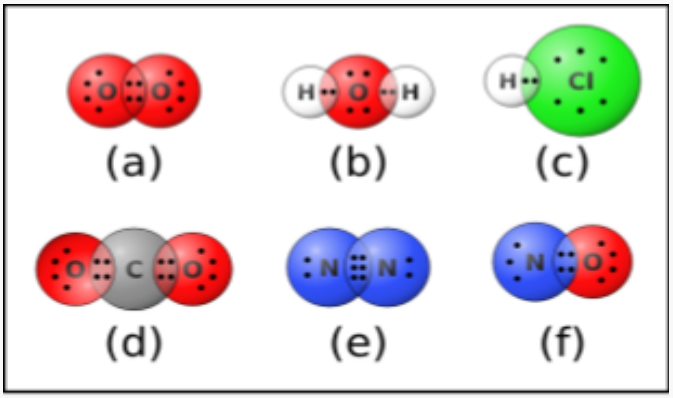
Atom Bonds

Owen Chen

Atoms, the fundamental units of matter, engage in a dance governed by their valence electrons, seeking stability through specific electron configurations, as described by the Octet Rule. This rule drives the formation of bonds, essential for maintaining stability in various substances

When atoms with different electronegativities meet, the transfer of electrons occurs, leading to the creation of ions bearing opposite charges. This electron exchange forms strong ionic bonds that hold the ions together. These bonds are pivotal in the creation of compounds like table salt (NaCl) and contribute significantly to the stability of various substances.

In contrast, when non-metal atoms share one or more electrons to complete their outer electron shells, covalent bonds emerge. This sharing results in the formation of molecules, exemplifying the robustness of substances like water (H_2O), where hydrogen and oxygen atoms share electrons to achieve stability.



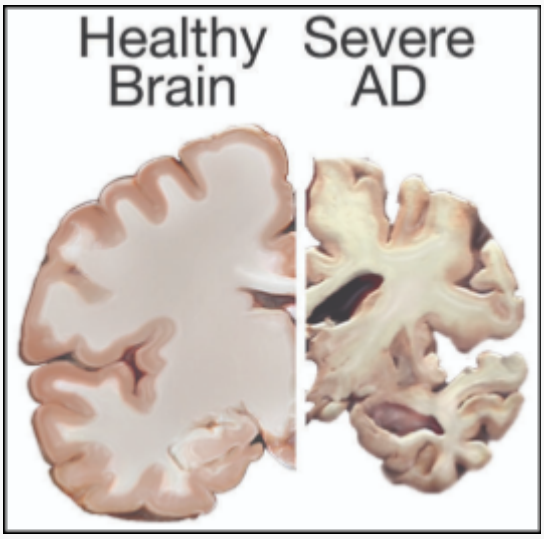
Occurring when atoms have an unequal sharing of electrons due to differing electronegativities, polar covalent bonds display a unique characteristic. This uneven sharing creates partial charges on the atoms involved, leading to a strong bond aligned along polar directions, with one side bearing a negative charge and the other a positive charge. An illustrative example is found in molecules like hydrogen fluoride (HF).

These diverse bonds not only sustain matter at the atomic level but also resonate on a larger scale, contributing to the complexity and functionality of living organisms. Biological systems thrive on these intricate bonds, facilitating processes crucial for life. The significance of chemical bonds extends beyond natural phenomena; it's a cornerstone of human innovation. Scientists leverage this understanding to engineer new molecules with tailored properties, driving advancements in medicine, materials science, and technology. From life-saving drugs to innovative materials, the manipulation of atomic bonds heralds a brighter, more promising future for humanity.

Unlocking the Enigma: Navigating Alzheimer's Impact on Memory

Richard Wang

Alzheimer's disease is a neurodegenerative disease that stands as a troublesome global health challenge. Around 6.5 million people in the United States older than 65, live with the disease, and the older the age cohort, the more of them have Alzheimer's. This essay explores the different keys and sides, emphasizing the urgency of increased awareness and support for Alzheimer's.



Alzheimer’s is believed to be caused by an abnormal building of amyloid beta as amyloid plaques and tau proteins or neurofibrillary tangles in the brain. As a result, neuron function and connectivity are affected resulting in a progressive loss of control of brain function. The inability to clear the build-up is attributed to age.

There are three stages of Alzheimer's. Before the progressive pattern of impairment starts, there are first symptoms. These first symptoms include short-term memory loss and small but noticeable problems with functions such as attentiveness, flexibility, and abstract thinking.

In the first stage, there is a rising impairment of learning ability and memory. In terms of language problems, it is characterized by a smaller vocabulary and less fluency. At this stage, the person with Alzheimer's can probably do basic communication still and motor tasks.

In the middle stage, independence to do certain activities deteriorates. Speech difficulty becomes more obvious and wrong words are used in speech. Coordination in complex movements decreases and this time it isn't only short-term memory but long-term memory that gets affected. There are changes in emotion and common changes include wandering, irritability, and emotional lability.

Ultimately, comes the final stage with the worst symptoms. This is called the late stage or severe stage where there is a complete dependence on the caregivers. Language has shrunken down to as low as simple phrases and words. Extreme apathy and exhaustion are common symptoms and there can even be aggressiveness. Muscle mass and mobility also deteriorate to the point where they render bodily tasks useless. Affected people in this stage are bedridden and can't feed themselves. People who die from Alzheimer's die from it, rather they die from an external factor such as pneumonia.

There are no treatments to cure Alzheimer's itself. It is of utmost importance to scan in the early stages of Alzheimer's to help alleviate future risks. Currently, research is going on to focus on interventions to prevent the progression of Alzheimer's.

The Ant's Worst Fear: Zombie Fungi

Riley Lee

Nature is full of wonders, and one of its most mysterious and fascinating phenomena is the ability of certain fungi to turn insects into zombies. Many people don't believe this event can happen because this event sounds like it comes from movies.

"Ant killed by Ophiocordyceps fungus" by Katja Schulz, licensed from Flickr under CC BY 2.0 DEED
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Fungi are unique organisms that play crucial roles in various ecosystems. While some fungi form beneficial partnerships with plants, others have developed awesome strategies to increase their chances of survival. One such example is the fungus *Ophiocordyceps unilateralis,* commonly known as the zombie ant fungus. The life cycle of the zombie ant fungus begins when its spores land on an unsuspecting ant. The fungus then takes control of the ant's central nervous system, compelling it to leave its colony and climb vegetation. Once the ant reaches an ideal height, the fungus forces it to attach itself to a leaf or twig with its mandibles, securing a prime location for spore dispersal.

As the fungus grows inside the ant, it eventually kills its host and bursts through the ant's head, releasing a shower of spores onto the forest floor below. These spores then have the potential to infect other unsuspecting ants, continuing the life cycle of the zombie ant fungus. Scientists believe that the fungus releases chemicals that manipulate the ant's behavior, essentially turning it into a puppet. This level of control over another organism is both astonishing and slightly unnerving.

The fungi are filled with surprises, and the phenomenon of fungi turning insects into zombies is an anomaly in nature. While the idea of zombie ants might sound like science fiction, it is a real and fascinating example.

"Ant Killed by Fungus - Cockscomb Wildlife Sanctuary, Belize" by Bernard DUPONT, licensed from Wikimedia under CC BY-SA 2.0 DEED https://commons.wikimedia.org/wiki/File:Ant_Killed_by_Fungus_-_Cockscomb_Wildlife_Sanctuary,_Belize.jpg https://creativecommons.org/licenses/by-sa/2.0/

Should the Government Enforce Green Practices?

Stephen Hung

A growing significant problem worldwide is environmental change, such as global warming, deforestation, climate change, etc. However, solving such a problem requires a great collective effort, which begs the question: should the government be responsible for fostering green practices? Although green practices can be inconvenient and troublesome, governments worldwide should fully force their citizens to participate in green practices. In doing so, it provides many benefits environmentally and economically.

The government should encourage citizens to partake in greener practices, as it is the most ideal way to achieve our goals environmentally. People worldwide recognize that “natural resources do not exist in limitless supplies,” due to this, there must be extreme urgency regarding the protection of nonrenewable resources such as coal, gas, and petroleum. Therefore, governments should focus on helping people realize that a green lifestyle will benefit future generations. Enforcing a system where citizens must go green will be responded to with backlash due to its inconveniences at first. This lifestyle entails many new responsibilities, and an example of this is seen in Chino Hills, where residents are now required to dispose of food waste in a specific compost bin instead of the regular trash bin because doing so reduces carbon and methane emissions at landfills. However, it will eventually implement a mindset in the public that green practices should be a critical part of their lifestyle rather than a hassle, making these practices a much easier pill to swallow for them. The growing scarcity of natural resources that leads to global warming also brings up larger and more glaring issues. A need for green practices is seen in a book by Thomas Friedman that discusses the need for a green revolution, where it is stated that the Earth is getting “hot, flat, and crowded,”

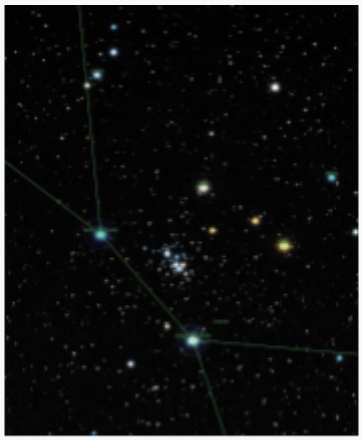
which is “tightening energy supplies, intensifying the extinction of plants and animals,” and more. Without the passing of new legislation that places regulations on energy resources, people will continue to consume Earth’s precious and limited natural resources, which could even lead to the extinction of humanity. There is already evidence suggesting that our environmentally harmful practices have led to the extinction of several species of plants and animals. If things do not change, humanity itself will be at risk. If the government acts against pollution and other environmental issues through strict enforcement, it will allow its citizens to live more environmentally sustainable lives and, in the grand scheme of things, protect humanity’s livelihoods.

What is Astrometry?

Wesley Chen

There are four distinct branches within the field of astronomy: astrophysics, astrometry, astrogeology, and astrobiology. Astrometry, a crucial facet of scientific inquiry, centers around precise measurements of the movements of stars, celestial bodies, and various entities in space exhibits. This branch provides valuable insights into the kinematics and physical origins of our solar system and the Milky Way galaxy.

The historical lineage of astrometry extends back to 190 BC with Hipparchus, who, utilizing catalogs from predecessors, discerned Earth's precession. The prominence of astrometry grew significantly during the era of Galileo Galilei, whose notable achievements include a pivotal contribution from Copernicus. By integrating physics and astrometry, Copernicus laid the foundation for a model of the universe.



Astrometry has diverse applications, particularly in supporting claims related to the detection of extrasolar planets. This is accomplished through meticulous measurements of planetary displacement, revealing changes in velocity and position. Astrometry plays a fundamental role in the construction of celestial machinery and contributes significantly to the field of galactic astronomy.

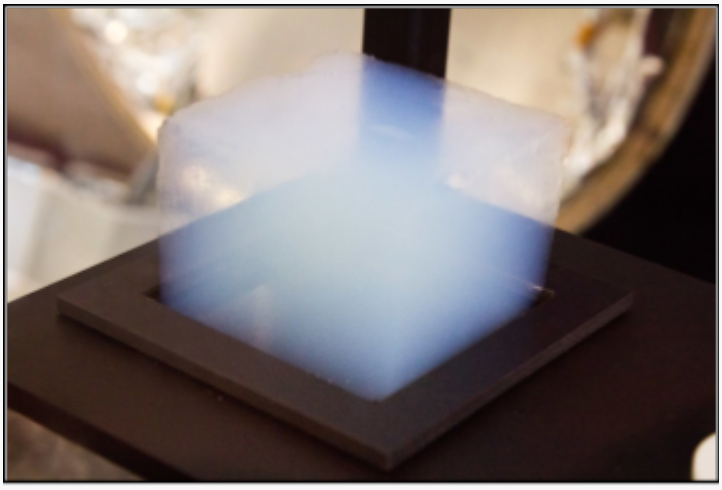
In essence, astrometry stands as a distinctive discipline, unraveling the mysteries of the cosmos. By employing astrometric principles, we gain the ability to locate and understand the positions of celestial objects, fostering exploration and understanding of the vast unknown expanses of space.

Ultralight Aerogels

Wilson Zhu

Aerogels are remarkable materials known for their exceptional properties, it has a translucent appearance and extremely low density. Aerogels are among the lightest solid materials discovered. Aerogels are made by mixing a polymer and a solvent to make a gel, and then removing the liquid and replacing it with air. Aerogels are firm when touched and regarded as one of the best insulating materials.

Aerogels have primarily been made using silica; to make a gel, silica is mixed with a solvent. The gel goes through a process known as supercritical drying, which removes the liquid component carefully, leaving behind a solid structure with minimum shrinkage. This technique yields an ultra-light, porous material with a structure made up of linked nanoscale particles that form a three-dimensional network. One of the most notable characteristics of aerogels is their extremely low density. In fact, with densities varying from 0.001 to 0.5 g/cm3, they are among the lightest solid materials known to humans. Aerogels, despite their small weight, have exceptional mechanical strength and structural integrity, making them appropriate for a wide range of applications.



Aerogels are also exceptional thermal insulators, owed to the sparse arrangement of solid components that minimizes heat transmission chances. Beyond their thermal capabilities, these materials exhibit outstanding adsorption capacities, making them valuable in environmental applications. With a large surface area and porous nature, aerogels can efficiently extract contaminants from the air and contribute to water purification, playing a role in environmental cleanup. Recent studies have explored diverse applications for aerogels, ranging from lightweight structural components in aircraft to enhancing insulation materials in buildings. As scientists continue to discover new ways to harness the unique features of aerogels, these materials are anticipated to play an increasingly vital role across various sectors, contributing to technological advancements and environmental gains.

In short, aerogels are created by mixing a polymer and a solvent to make a gel, and then removing the liquid and replacing it with air. They are known for their special properties such as being one of the lightest materials known to man. They are used in various areas because of their great thermal insulation and have exceptional adsorption capacities.

Wireless Charging

Aidan Hong

Phones are an integral part of our society, and we use them for many functions. However, phones need to be charged. There are many ways to charge a phone, including wireless charging. Wireless charging is a simpler way to charge a phone than wired charging, but it has many drawbacks.

Wireless charging seems more complex than it seems. Typically, it involves electromagnetism. Phones with wireless charging have a coil at the back of the phone that sends a signal to the wireless charger that a phone is in proximity. When that happens, the wireless charger begins to charge wirelessly. Typically, wireless chargers are slower than their wired counterparts, charging at speeds of 7.5 W. Some phone manufacturers, however, designed their wireless chargers that can charge faster, for example, Apple's MagSafe charger for their iPhone. However, typically most phones charge at the Qi standard of 7.5 W.

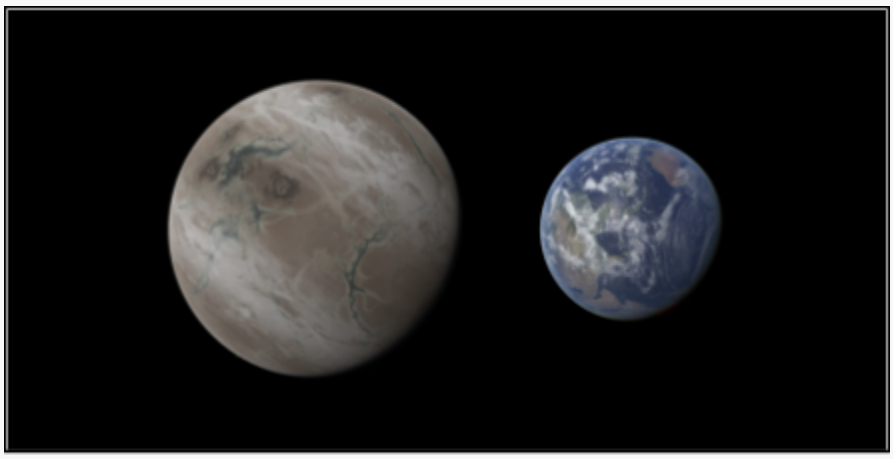
With the many conveniences wireless charging offers, it still comes with many drawbacks. For starters, wireless charging can cause a heat build-up, degrading the battery's long-term health. Also, wireless charging isn't truly wireless. The charging pad for wireless chargers still needs to be plugged into the charging outlet. Additionally, misalignment of the phone on the charging pad could lead to the phone not charging, causing significant inconvenience.

Wireless charging is a new type of charging technology that is starting to become widespread. Wireless charging offers convenience but comes with lots of drawbacks. Time will tell if technology will solve most of these problems.

Another Earth: Kepler 452b

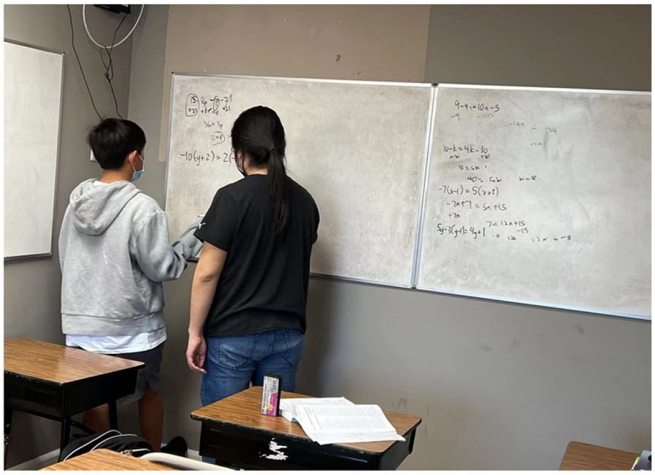
Mary Liang

In a distant galaxy, a thousand eight hundred light years away, Kepler 452b, one of the candidates competing for the title “Earth 2.0, “ ranks the most hospital planet in the universe, limited only by what we can find out with our current technology. From the many Keplers in our universe, “Earth’s cousin” has the relative temperature and air quality collated to our planet, taking 385 days to complete its full orbit around Cygnus, compared to the 365 for an Earth year. Balancing on a 1.5 billion year gap between Cygnus and our own Sun, there is a high possibility of alien life on the possibly rocky surface, though it has not been confirmed.



With our current technology, space travel takes a fair bit of time to travel to even the neighboring planets. As such, Mars, the closest planet to exist near Earth, takes 45.5 days to complete the journey. But rather than traveling to Mars, the distance between Earth and Kepler 452b is a lengthy trip, with a span of 30 million years to arrive. On the other hand, if “Earth’s cousin” really does support human life, with its 60% larger diameter, a bigger population can thrive, unlike some areas on Earth, which streets are

packed with people, cars, etc. Water, one of humanity's greatest needs, is also predicted to remain a liquid, unlike other planets, which either reach its boiling or freezing point. Kepler 452b has also attained bodies of water, but unfortunately, they have dried up in the years it has been created. Until our technology has improved to travel light years in seconds, Kepler 452 has a while to wait for a visit from the inhabitants of planet Earth.



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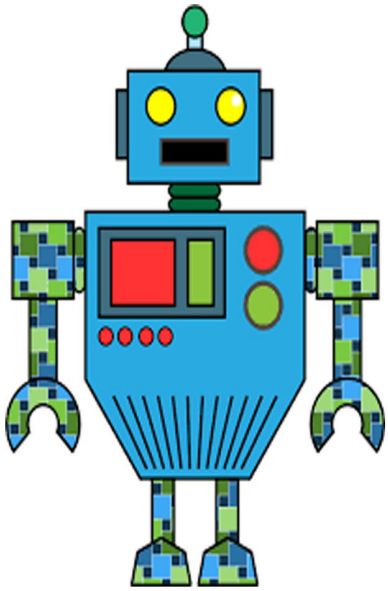

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