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SEEKING SCIENCE

by STEM Action Teen Institution

A MONTHLY
STEM NEWSLETTER

ASTEROID IMPACTS

EXPLODING STARS

TASTES UNLOCKED

and more...



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Table of Contents

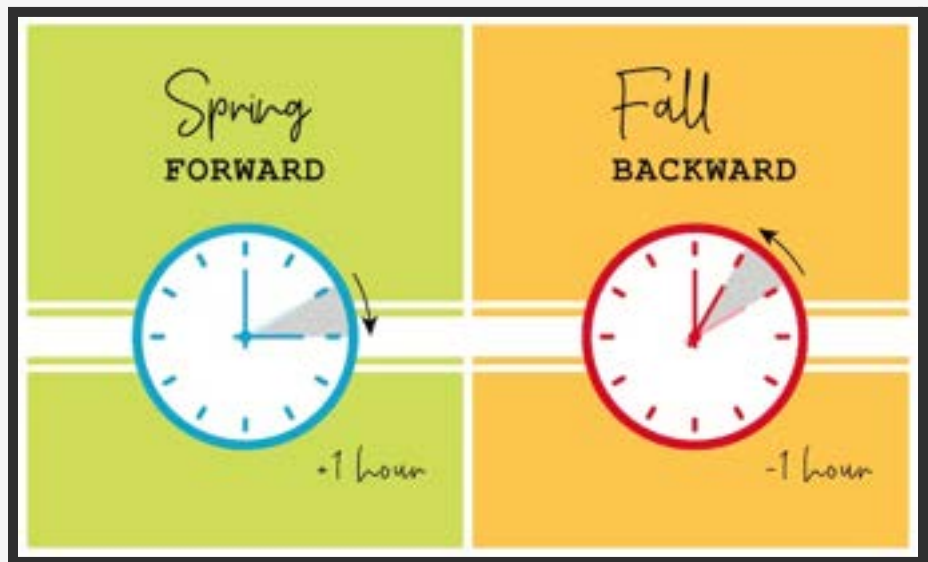
Daylight Savings Time	3
When The World Actually Ended, Twice	4
JITAI: AI And Psychology Connected	6
The True Cost of Social Media	7
CO ₂ Found in an Exoplanet's Atmosphere	10
The Chemistry Behind Taste	11
Electric Potential and Its Uses	13
Estuaries - Nurseries of the Sea	14
NSF Funding for Pandemic Prediction	15
Chemistry of Wine Fermentation	17
A Simple, Cheap Material for Carbon Capture	19
The Death of a Star	20
The Science Behind Black Holes	22
The Science Behind the World's Most Expensive Coffee	23

Daylight Savings Time

Cody Duan

Daylight savings time occurs twice a year. Once in the spring, and once in the fall. During the spring, some countries change their clocks forward one hour, or to “spring forward,” and change their clocks back one hour during the fall, or to “fall back.” The purpose of daylight savings time is to make better use of the daylight in the summer. However, this change has disrupted many Americans.

The change in one hour has dramatically impacted car accidents, heart attacks, and strokes. Some are more tired, which leads to more car accidents. Eliminating daylight savings time will save more lives.



Another effect of daylight savings time is stroke. In the following two days after daylight savings time, hospitals have seen an overall increase in stroke by 8%. Studies have shown that this increase in stroke is caused by the disruption of peoples' circadian rhythm, which are physical, mental, and behavioral changes during a 24-hour cycle.

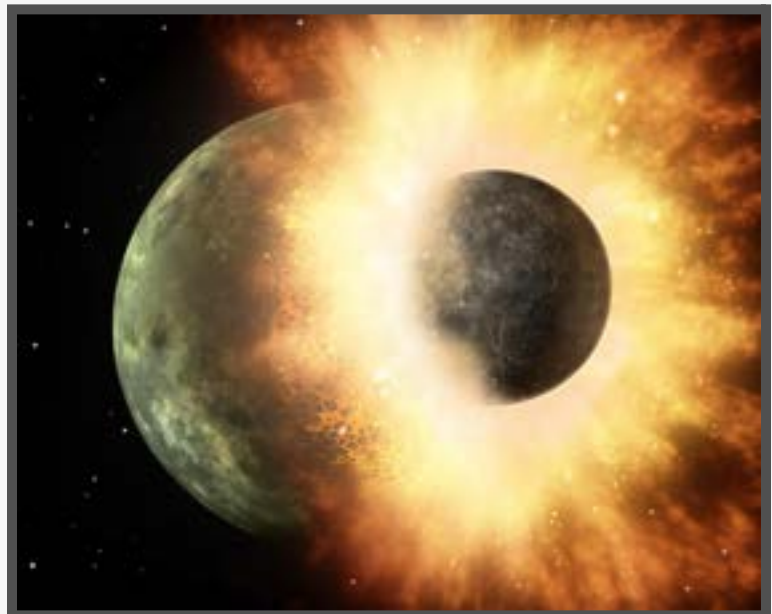
In addition to stroke, research has shown a 24% increase in acute myocardial infarction during the time change in spring. Although the reason has not been identified, those already with heart issues are predisposed to this change.

As a result, in March of 2022, the United States recently decided to make daylight savings time permanent. All states, except Arizona and Hawaii, will not have their clocks changed at 2:00 a.m. on November 6th.

When The World Actually Ended, Twice

Ethan Chen

It's a quiet, steaming hot day on Earth, a recently formed planet too hot to contain liquid oceans, its surface notably covered in lava and not much else. Out of the darkness of space, a shadow so great in size that the sun and all the stars in the sky seem to vanish one by one as the shadow relentlessly encroaches further. As mountains seem to penetrate the heavens, then piercing the land, a nearly planet-ending collision takes place, merging Earth with a



Mars-sized proto-planet called Theia.

Many of the remains of this astronomically violent encounter happened to stay in orbit, gravitationally coming together to eventually form the moon. The moon is also the primary piece of evidence in the Theia collision theory. There are many anomalies between the moon and Earth that aren't found in other planets, those which likely obtained their moons by attracting random rogue bodies as opposed to forming them from a massive collision.

More famously, there was the asteroid that ended the reign of the dinosaurs over 66 million years ago. Striking the Yucatan Peninsula in Mexico, the Chicxulub asteroid caused a worldwide winter as a result of the debris it flung into the atmosphere, similar to the effects of a super-volcanic eruption. This



ultimately killed larger species that relied on massive plants or massive herbivores for food, as too little sun was reaching the surface to grow larger plants.

There's a clear trend among world-ending events. Though the planet and the life on it may find itself in precarious, worst-case scenarios, history shows us that our world is a tough cookie to crack. So even if, at times, it feels like everything is hopeless and the end of the world is truly inevitable, the challenges we face today are a drop in the bucket to the truly apocalyptic catastrophes that the world has been through.

JITAI: AI And Psychology Connected

Brian Wang

Ever since medicine has been of interest to humans, we've always been experimenting with new ways to cure the lives of individuals. Much trial and error finally formulated new technology for physical abnormalities, leaving mental problems with many variations among different methods of treatment. JITAI is an algorithm used to support many under their own context and time, called *the just-in-time adaptive intervention*.

Among the many capability differences that technology can only go so far to reach, many medical professionals have already gathered to create communication across many components to create scientific change and collaboration among the team members.

Unlike other pieces of technology used in the medical industry, this algorithm will adapt to user's particular needs at certain times accommodate instead of a piece of machinery that



its
to

operates for one specific purpose.

Because of the functionality of JITAI, it is very useful for psychological problems such as addictions. In fact, an article by JMIR Research Protocols on the development of an app to reduce addictions states, “ITAI is effective...with a recent meta-analysis reporting moderate to large effects for improvements in a range of outcomes.” Since it has been proven to work among addicts, JITAI has been used in many new apps and technologies made for psychology purposes. JITAI development provides support at the right times but eliminates any behavior that is not beneficial to the user.

To summarize, JITAI is a wonderful piece of technology that should be used among many medical professionals in their industries to provide new support systems. The old treatments for mentalities vary from person to person, whereas this method provides more stability among reactions.

The True Cost of Social Media

Aidan Hong

With the popularity of smartphones rising within the last decade, social media is one of the most popular apps that are downloaded among those phones. However, despite being priced “free,” the cost of social media is costly, from trackers, poor mental health, and peer pressure.



Most apps on the app store are priced free. However, this is far from its true cost. According to TVTech, “The research found that TikTok app had 14 trackers, 13 of which were third party contacts that Atlas VPN said are the most concerning in terms of privacy.” The purpose of these trackers is to track your data to sell to advertisers. As a result, apps are able to keep their app “free” because instead of charging money, developers are now charging your personal data.

The price of social media doesn’t stop at privacy. It is well known that social media is correlated to an uptick in mental health issues. McLean Hospital, which is an affiliate of Harvard Medical School, reports that people use social media to get validation. However, this leads to a comparison between users, which can lead to anxiety and depression.

Also, a 2018 British study concluded that social media was linked to poor sleep, mental health issues, decreased academic performance, headaches, muscle tension, and tremors. Although social media claims to make people more social, it falls far from that goal, if not making people less social. Social media devastated users’ mental health.



Finally, social media can cause peer pressure, which can lead to deadly incidents. According to The Verge, TikTok’s “blackout challenge” has now killed 7 kids. Although friends and family didn’t share the challenge with others, the app’s algorithm exposed the kids to the challenge. Due to the fact that it was widespread and common on the app, peer pressure urged them to join in on the challenge. As a result, peer pressure leads to their death. However, all of these could’ve been avoided if they did not use social media. Social media could have fatal consequences.

Despite its popularity, social media is a danger to society. From the invasion of privacy to poor mental health, the consequences of social media are devastating, if not fatal. It is clear that social media is not “free” to use.

CO₂ Found in an Exoplanet's Atmosphere

Cathie Zhu

The James Webb Telescope has found the first sighting of carbon dioxide in the atmosphere of a planet outside the solar system. Planetary Scientist and study coauthor Peter Gao of the Carnegie Institution for Science in Washington, D.C. says “It’s incontrovertible. It’s there. It’s definitely there. There have been hints of carbon dioxide in previous observations, but never confirmed to such an extent.”



The finding was submitted to arXiv.org on August 24 and marks the first detailed scientific result published from the new telescope. It may also help in finding the same greenhouse gas in the smaller, rockier planets’ atmospheres.

The planet, named WASP-39b, is slightly wider than Jupiter and as large as Saturn. It orbits its star every four Earth days, meaning it is extremely hot. Due to this, it is not an

ideal place to search for evidence of extraterrestrial life. However, its atmosphere and orbit make it easy to be observed by telescopes and scientists.

James Webb, also called JWST, was launched in December 2021 and had its first images released in July 2022. For approximately eight hours in July, the JWST observed starlight that filtered through the planet's thick atmosphere as the planet crossed between its star and the telescope. During this, molecules of carbon dioxide in the atmosphere absorbed specific wavelengths of that starlight.

The Chemistry Behind Taste

Edward Huang

Everyone has a favorite food. Whether it is ice cream, pizza, chocolate, or pasta, everyone has a favorite food and a favorite taste. But why do some foods taste differently from others? What causes each delicacy to have its own unique taste?

There are 5 basic tastes: sweet, sour, salty, bitter, and umami.

Sweetness in foods are caused by the presence of sugars. For example, sucrose is a sugar that is commonly found in sweet foods. There are also a few compounds that are not considered sugars, but also taste sweet, including saccharin.



Sourness is caused by the presence of acid. For example, some fruits contain citric or malic acids, making them sour. Tartaric acid can be found in wine, resulting in their sourness.

Saltiness is mainly caused by the presence of sodium (Na^+) or lithium (Li^+) ions. For example, table salt, which is NaCl , dissolves in water. When a person consumes salt, the salt dissolves on their tongue, breaking into its Na^+ and Cl^- ions. The Na^+ ions will make the person taste salt.

Bitterness is caused by a class of chemicals called alkaloids. Some alkaloids include caffeine and quinine. Coffee often tastes bitter due to its caffeine content.

Umami is a lesser known type of taste. It is often described as savoriness, or the taste of meat. Umami taste is mainly caused by glutamate or compounds containing glutamate. These are often found in meats.

Spice is another attribute that foods can have. The chemical responsible for most spiciness is capsaicin, commonly found in most peppers. There are, however, other types of spiciness. For example, in many Sichuan foods, there is a numbing type of spice. This numbing effect is caused by the chemical hydroxy-alpha-sanshool, which reacts with the tongue in a different way than capsaicin.

All of these chemicals react with our tongue's papillae, which are little bumps on our tongue. When tasting foods, these papillae will become stimulated and messages will be sent to the brain, creating the sensations we feel as taste. Some have more sensitive taste buds, while some have less sensitive ones. There are mental disorders where people taste foods differently from other people. This is because taste is just a sensation that our brains produce while eating.

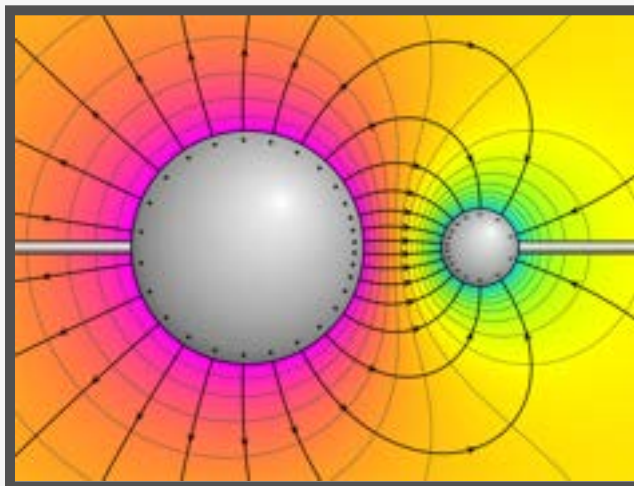
The next time you eat your favorite food, try and think about why you love it so much. Think about what kinds of chemicals are in the foods, like sugars, acids, and spice. Try to think about the complex chemistry behind your favorite foods.

Electric Potential and Its Uses

Stephen Hung

The world around us is run by electrical devices, from cell phones to electric lights. The way that electricity works are almost like magic, and sometimes we must take a moment to ponder: how does it even work?

Upon further discovery, one may find that electric potential, also known as voltage, is one key component of an electrical system that powers our world today. Electric potential is the energy needed to move a charge against an electric field.



However, what is more, important is the difference in electric potential. The electric potential difference has many applications such as controlling the motion of electric charges. As a result, a current is formed that powers our televisions or cell phones.

Another example of the uses of electric potential is when a light bulb is off, the charges have a lot of electric potential energy, but when the circuit is connected and the light bulb is turned on, the electric potential energy from the charges is all converted into light energy. As people continue to enjoy the benefits that electric-powered technology brings to their lives, they should stop and think about the amazing power of electric potential.

Estuaries - Nurseries of the Sea

Eddie Zhang

Although not well-known, estuaries are actually a critical part of many ecosystems. Estuaries are regions of coastal waters where freshwater from rivers and streams mix with salt water from the oceans. Simple as they are, estuaries provide many benefits to humans and other species.

First, estuaries are vital natural habitats for many species. Animals ranging from birds to fish depend on estuaries as a place for living and reproducing. This is because estuaries are rich in nutrients. Flowing downstream, river waters pick up nutrient-rich wastes left behind by decaying organisms and various minerals from sediments. Not only does this benefit marine life, but it also benefits land species as the nutrients fuel plant growth around the area, providing food.



Second, estuaries provide economic benefits. Their natural scenery is a magnet for tourism. The natural abundance of fish supports fisheries in the area. Furthermore, estuaries support public infrastructures, such as harbors and ports. Since these facilities require workers, estuaries also indirectly create employment for millions of people, contributing to the economy.

Finally, estuaries protect our land and oceans. Plants growing along the coast in estuaries can absorb flood water and act as a natural barrier against storms. This protects land habitats and real estate from flood and storm damage. These plants also filter out pollutants, such as sediment and run-offs, from river water before they flow into our oceans, providing humans and marine animals with cleaner water.

Overall, estuaries are a vital part of our ecosystem, nursing life, supporting our economy, and filtering our water. However overlooked they may be, we can't ignore their significance on our planet.

NSF Funding for Pandemic Prediction

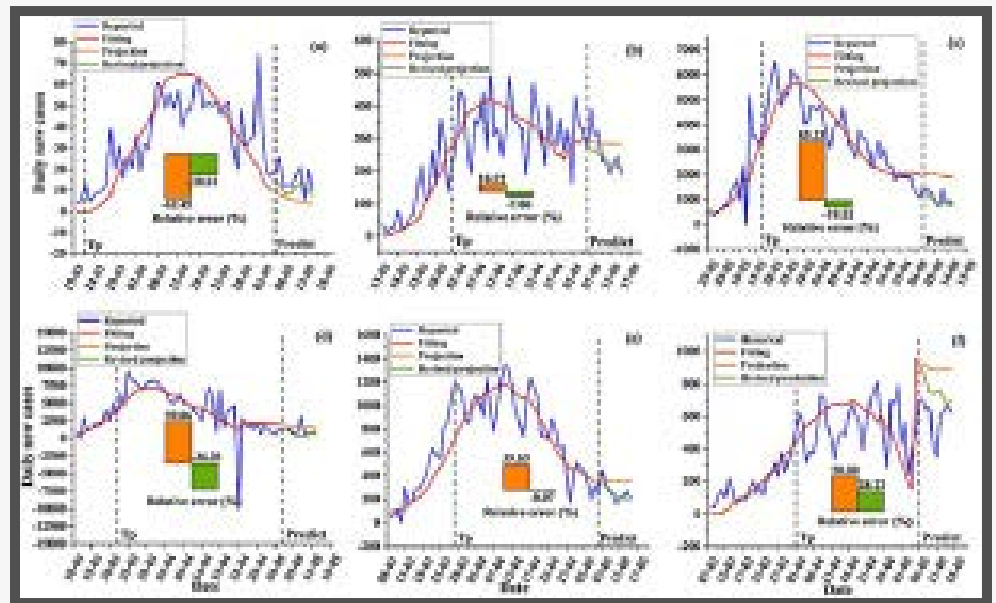
Annabella Iuo

A multidisciplinary team of researchers from UCLA and UC Irvine have received an [18-month, \\$996,000 grant from the National Science Foundation](#) to develop a comprehensive, early-warning system to predict the emergence and spread of the next pandemic.

The 10-member team includes experts in biology, social sciences, epidemiology and computer science. The principal investigator of the grant is Wei Wang, the Leonard Kleinrock Professor of Computer Science at the UCLA Samueli School of Engineering and a professor of computational medicine, a department affiliated with both UCLA Samueli and the David Geffen School of Medicine at UCLA. At UC Irvine, Chen Li, a professor of computer science in [the Donald Bren School of Information and Computer Sciences](#), will lead research efforts.

The team's goal is to develop a predictive system powered by artificial intelligence, machine learning, data science and other open-source technologies that can spot signs of new and evolving infectious diseases in real time, predict their potential spread and continuously monitor their risk factors around the globe.

The NSF funding will support the development and demonstration of the technology, and place it in contention for additional funding through a full-fledged research center in the project's next phases.



Chemistry of Wine Fermentation

Annabella Luo

The first traces of wine-like substances go back to sixty-million-year-old fossils, which means our pre-human ancestors may well have come to realize older grapes are more desirable. For thousands of years, wine has played a big role in many cultures, starting with the oldest-known winery in Armenia discovered in 4100 B.C. through the Greek, Roman and Egyptian empires all the way up to today.

So what is wine and how is it made? Wine is an alcoholic beverage made with the fermented juice of grapes. Fermentation is the process by which grape “must” (a fancy winemaking term for unfermented grapes or juice) transforms into wine.



There are two basic ingredients needed to ferment the juice of grapes into wine: sugar and yeast. Like all fruit, sugar is found naturally in grapes, with the sugar level increasing as the grapes ripen on the vine; a process in the wine-making world called veraison. Ripening can take one to two months, depending on the climate. The right balance of rain and sunshine ensures good sugar levels in the grapes. When ready, the grapes are picked and crushed, leaving the juice, known as must, for fermentation.

The second ingredient needed for fermentation, yeast, consumes the sugar in the must, and as a byproduct, it releases three components: ethanol, CO₂ and heat. The

CO₂ and heat escape, and the ethanol remains. At its simplest, fermentation is often described as the conversion of one molecule of glucose into two molecules each of ethanol (or ethyl alcohol) and carbon dioxide: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$.

The yeast needed for fermentation can be found naturally in the environment and on the grapes themselves. This natural yeast dies off, however, when grape juice reaches 4 to 5 percent alcohol by volume, before fermentation is complete. In order to ferment the must completely, typically an anaerobic (no oxygen needed), cultured yeast called *Saccharomyces cerevisiae* is added to the must. Depending on the temperature, the process can take one to two weeks.



In addition to the two basic ingredients, fermentation is influenced by many other factors. Among them, sugar content and fermentation temperature. The higher the initial

sugar content of the must, the more alcohol will be present in the finished wine, if allowed to ferment to dryness. Fermentation temperature is also crucial. Lower temperatures preserve fragile, volatile aromatics in the wine, retaining a more “fruity” character. If temperatures are too low, however, the yeast will work more slowly-or they may have difficulty fermenting all of the sugar. Higher temperatures allow for better

grape skin tannin extraction, but tend to drive off fruity flavors and aromas. Finding the right fermentation temperature is all about balance.

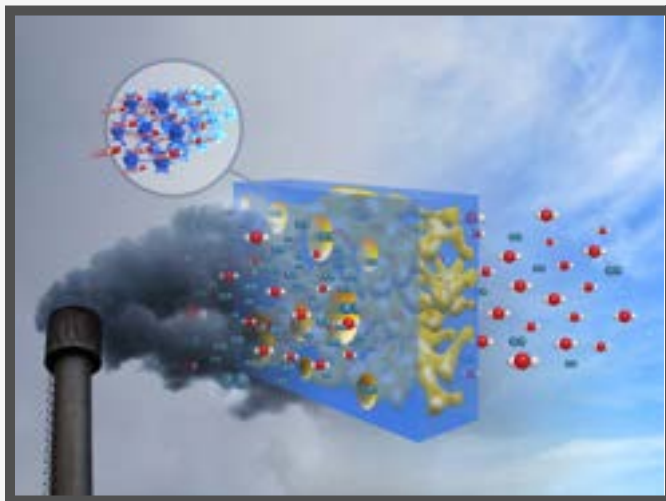
Making wine at home is a fun experience. You can buy a wine kit which include mosphere. Using an inexpensive polymer called melamine — the main component of Formica — chemists have created a cheap, easy and energy-efficient way to capture carbon es everything needed to make wine, or simply grape juice and bread-making yeast.

A Simple, Cheap Material for Carbon Capture

Annabella Luo

Carbon dioxide is the main greenhouse gas warming Earth and is emitted in large quantities in the flue gas from industrial and power plants. A new method for removing CO₂ from these flue gasses involves piping the emissions through a porous material based on the chemical melamine.

DETA, a chemical bound inside the porous melamine, grabs CO₂ and removes it from the gas, with nitrogen vented to the atdioxide from smokestacks, a key goal for the United States and other nations as they seek to reduce greenhouse gas emissions.



The process for synthesizing the melamine material, published this week in the journal *Science Advances*, could potentially be scaled down to capture emissions from vehicle exhaust or other movable sources of carbon dioxide. Carbon dioxide from fossil fuel burning makes up about 75% of all greenhouse gasses produced in the U.S. The new material is simple to make, requiring primarily off-the-shelf melamine powder — which today costs about \$40 per ton — along with formaldehyde and cyanuric acid, a chemical that, among other uses, is added with chlorine to swimming pools.

The work is a collaboration among a group at UC Berkeley led by Reimer; a group at Stanford University led by Yi Cui; UC Berkeley Professor of the Graduate School Alexander Pines; and a group at Texas A&M University led by Hong-Cai Zhou. Jing Tang.

The Death of a Star

Anna Dai

Look up into the night sky and you see millions of stars littered around up above. Most of the stars are very tiny, the largest would be the Sun in the daytime. However, far, far, away there are even larger stars that are hundreds of times larger than the Sun. Betelgeuse is about 900 times larger and Mu Cephei is about 1500 times larger.

It is known that stars have a period of living, from birth to death. Stars come from stellar nebulas, then to either massive stars or average sized stars. From that, red giants or red supergiants are formed. At the end of its life, red giants explode into planetary nebulas and red supergiants explode into supernovas. Eventually, they die down to dwarf planets, black holes, and neutron stars. But, what is spectacular about this life cycle is the supernova.

A supernova is the stage where a star gives its “goodbye” with a bang! Only massive stars that burn extreme amounts of nuclear fuel in their cores, produce tons of energy. The core increases in temperature, causing pressure to generate quickly. The star’s gravity tries to shrink the star but the pressure that is being generated exceeds the compression of the gravity.



After, the star runs out of fuel, cools off, and decreases in pressure. Because the gravity ends up winning the battle against pressure, the star collapses so quickly it creates enormous shock waves. This causes the outside of the star to blow up! As a result, the dense core is left behind with a nebula, a cloud of hot gas, surrounding it. Eventually, this may leave a black hole in the universe.

Another type of supernova is when two stars orbit each other. At least one of the stars is a white dwarf, which is about the same size as Earth. When the white dwarf collides with the other, they explode into a supernova! Also, the white dwarf may pull matter from the other, which also causes a supernova.

Scientists study supernovas by utilizing telescopes to detect supernovas. X-rays, gamma rays, and visible light are emitted from the explosions of supernovas. This is what scientists detect with telescopes. NuSTAR is a telescope that uses x-ray vision to examine supernovas and young nebulas to learn about stars throughout its exciting life.

The Science Behind Black Holes

Kenny Wu

Black Hole is a region where gravity is acted on so heavily that not even light can escape. Due to this perk of no light escaping from Black Holes, they are completely invisible to raw eyes unless special tools are being utilized. All concepts of time and space do not apply in terms of the Black Hole and inside it matter has been compacted to a single, infinitely small point.

There are two types of Black Holes, one being stellar, and the other being supermassive. A stellar type black hole consists of a mass around 3 to 10 solar masses, they are created when the core of a massive star collapses in on itself. When this occurs, a supernova results.

A supernova is a star that explodes and sends a portion of the star into space. Scientists have



proven that every galaxy consists of a supermassive black hole at its center, for instance, the supermassive black hole in the Milky Way Galaxy (Earth Galaxy) is found and named sagittarius a. Supermassive black holes are formed by unusual collections of agitated, frigid gas that eventually head its way to stars; Later it grew up to a Supermassive black hole. However, neither type of black hole has the ability to shift itself and attack other

planets, so unless they form near a planet, stars, or moon, they won't cause any harm to the solar system.

All in all, black holes are fascinating places in space and a big step for scientists to explain and discover nature. Despite that, a lot of information about the black hole can't make sense. Scientists will keep on attempting to complete the puzzle of outside our planet Earth and black hole is just one of its puzzle pieces.

The Science Behind the World's Most Expensive Coffee

Arthur Liang

The world's most expensive coffee is known as Kopi Luwak. One cup of it can sell for as much as \$80 in the U.S. However, its unique taste comes from a strange and interesting origin. It turns out that Kopi Luwak is basically animal feces. It is made from coffee beans partially digested and then expelled by a civet, a creature found in Southeast Asia and sub-Saharan Africa.

The civet is a monkey-cat like animal who eats insects and reptiles in addition to fruits like coffee cherries and mangoes. The



civet's digestive enzymes change the structure of proteins in the coffee beans, removing some acidity to give the coffee a smoother taste.

As civet coffee grew in popularity, people began caging civets in coffee plantations. Some of these plantations had bad animal welfare practices as well. These made for a more inferior product compared to wild civets. Wild civets also pick and choose



the choicest coffee beans to eat. Even though it is the most expensive coffee, many gourmet coffee roasters believe it is overpriced and not that good to begin with. They say it removes the good acids and flavors that make a cup of coffee. Even so, Kopi Luwak will remain as the most expensive and most uniquely made coffee on the market right now.



週六下午就是數學大本營時間

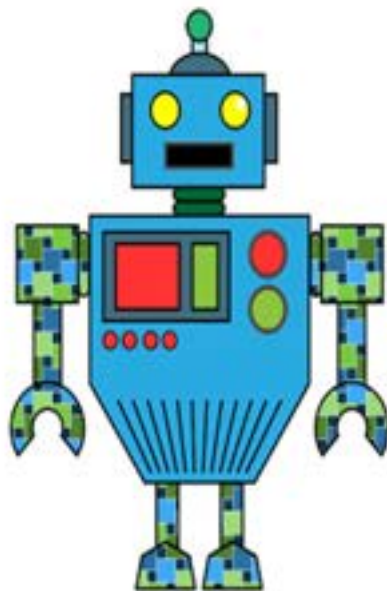
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