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SEEKING SCIENCE

by STEM Action Teen Institution

A MONTHLY
STEM NEWSLETTER

FUTURISTIC TRAINS

THE FAMOUS JWT

MAKING CHOCOLATE

and more...

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Beneath the Iceberg of Game Dev

Brian Wang

Even if several exciting works are produced every year, such as Detroit: Become Human, Assassin's Creed, or Mario, hundreds of hours are spent behind the scenes. For game production, a wide range of abilities are required, such as modeling, drawing, coding, making music, deriving physics equations, mastering angular formulas, and many more. Video games first appeared in October of 1958, and through time they developed into a popular form of entertainment for players all around the world. Over time, these television programs might grow to be very captivating.

Lead video game developers hone their abilities in a specific field, whether it be 3D or 2D. Life finally appears when they click a button as they learn how to produce various elements for their games. However, what lies alongside all of these sets of skills that truly show life is the game structure and design. User engagement is impossible without a compelling concept. A basic piece of software might have the appearance of realism because it uses lovely models or artwork along with authentic sound effects and surroundings. But is the game enjoyable without these guiding pillars? The game's design is poor if the response is negative.

Unreal Engine, a graphically demanding game creation tool used by many to produce an immersive experience for gamers, is one of the dozens of game engines utilized by the overwhelming majority of game developers. In fact, it performs its duties so efficiently that the majority of movie renderings are produced using this tool. The project's creators, Epic Games,

debuted it in 1998 for their first-person shooter. The main competitor is Unity, which was created by Unity Technologies. Since its 2005 debut, it has become one of the most well-liked game engines, supporting a number of platforms. Unity runs entirely from C#, whereas Unreal Engine combines C++ and blueprint scripting. Usually, it boils down to the preference of the game developer on what language they want to code in, and what type of game they want to create

The Making of Chocolate

Edward Huang

Chocolate is commonly known as a very diverse and delicious treat that millions of people enjoy. Whether eaten by itself or used as an ingredient, chocolate is no doubt one of the most common and beloved treats in the world. Just as cool as chocolate itself is the process of making it. Converting cocoa beans into chocolate is a surprisingly complex and interesting process. Spanning multiple steps, making chocolate from its raw ingredients includes a world of science and technology.

The first step in making chocolate is harvesting the cocoa pods. Being a tropical crop, it has a specific harvesting

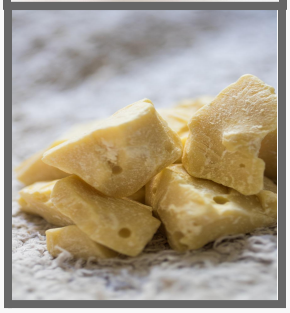
season and can only be collected during specific periods. Cocoa is usually harvested between April to September and between October and March. After it has been harvested, the cocoa beans will go through a lengthy examination and cleaning process. The beans must be inspected so that they fit various international requirements and standards.

After beans have been deemed usable, they are then fermented. The pulp is discarded, and the beans are fermented for about 36 to 72 hours. The fermentation process contributes heavily to the flavor of the chocolate. Flavor development in chocolate is still being studied and analyzed so that the fermentation process can be optimized to produce the best-tasting chocolates. The fermented beans must then be dried. Their moisture levels have to decrease from 60% to a goal of around 6%. This is usually done through sun-drying, and the length of the drying relies heavily on the weather.

After drying, the beans are then roasted. The roasting of cocoa beans largely depends on the flavor goals of the company producing the chocolate. Every company differs in their roasting process to produce its own unique flavor of chocolate. After roasting, the beans are then separated into their shells and nibs, the nibs being the meat of the beans. This process is called winnowing. After winnowing, the nibs are then ground up, sometimes mixed with other ingredients to produce a paste.

The cocoa paste formed after grinding the nibs can be thought of as pure cocoa mass. This paste is melted to form cocoa liquor. The cocoa liquor sometimes undergoes an optional alkalization process in which it is mixed with an alkaline compound in a solution that is heated under high pressures. This is done to modify the flavor further and is also called Dutch processing. Cocoa liquor can then be shipped off to consumers to be used as an ingredient for many products, or it can undergo further processing.

Once the desired cocoa liquor has been made, it is then pumped into a hydraulic press to be converted into cocoa press cake and cocoa butter. It is pumped at a very high temperature, about 200 degrees Celsius. The hydraulic press then compresses the cocoa liquor into two products: cocoa butter and cocoa cake. The cocoa cake is then milled into the desired particle size and ground up again to become cocoa powder.



Finally, the manufacturing of chocolate treats begins. Cocoa liquor, cocoa butter, and sugar is combined with the addition of fats and flavorings, and particle size is reduced to the optimal level in order to produce smooth, creamy chocolate.

The making of chocolate is a very complex and scientific process, relying on chemistry and engineering to produce the desserts that so many people love. From the initial process of harvesting cocoa beans to the final step of combining the necessary ingredients to make chocolate, the making of chocolate is a lengthy procedure that has been developed and studied for the past century. The next time you eat chocolate, make sure to appreciate the complex operations that took place to create the product that so many people enjoy.

Hot Ice - Sodium Acetate

Kenny Wu

Hot Ice or Sodium Acetate is the solution of an exothermic reaction. As the name states, “Hot Ice” is a substance that’s giving off heat due to being exothermic and resembles ice. Many are tricked by its snow-white icy appearance and surprised by the concept of hot and cold at the same time. However, it's simply a scientific magic trick.

The process of this experiment involves the use of white vinegar and baking soda. Starting by dissolving the baking soda within the vinegar via mixture, it is natural for the fizzing to occur as a reaction of the mixture. With that being done, what you got is called Sodium Acetate; continue to heat the solution, then cool and dissolve the solute to make

supersaturated. With all that done, you will be treated with a magical liquid that forms an ice-looking solid through crystallization, which also gives off heat at the same time.

Sodium Acetate is also called C2H3NaO2, which is basically sodium salt; this chemical compound is often used for heating pads or food additives, or textiles. Sodium Acetate is a basic solution due to OH- ions formed during the reaction. Despite Sodium Acetate being labeled as highly safe for use for preventing bacteria, being a buffer solution, or as an additive in food, it is proven scientifically that this chemical compound can bring harm when contacted through inhaling or skin.

All in all, Hot Ice is an effortless and fascinating reaction to experiment with. Though, it is important to know that what you have created isn't real ice but a scientific chemical compound that came out of the lab, so be cautious with it while showing off to your friends your new magic trick.

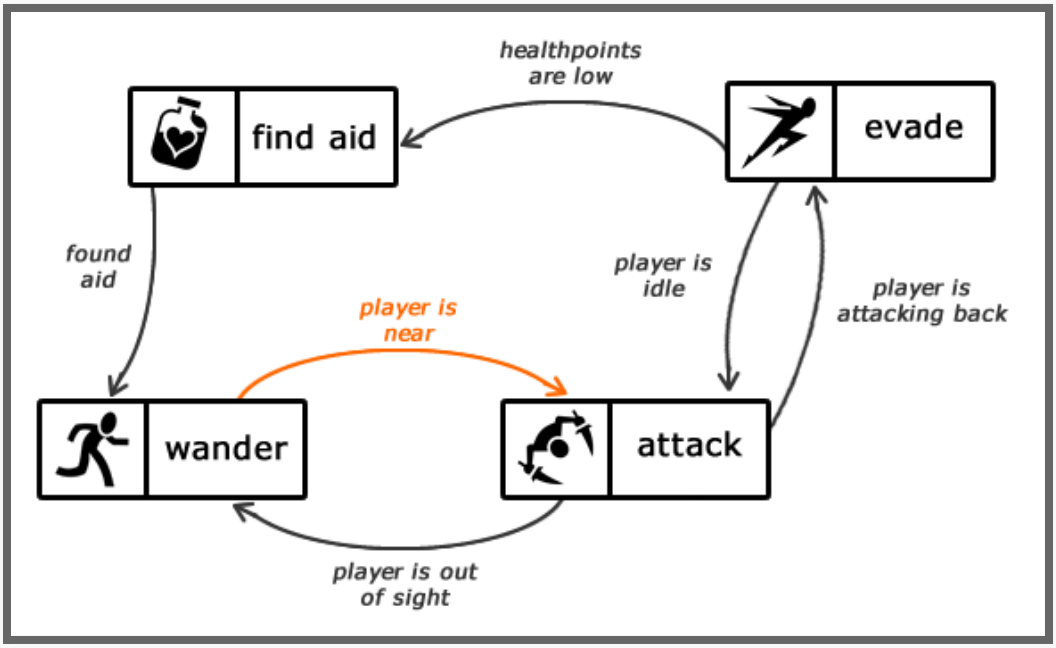
Abstracting Behaviors with Finite State Machines

Ethan Chen

Any time a program needs to make a decision, that process can be convoluted and involve tightly coupled routines, formulae, and systems. This reduces the flexibility and readability of a program, slowing down and overcomplicating development. A straightforward design pattern called the Finite State Machine helps simplify, condense, and visualize decision trees and behaviors.

A finite state machine (FSM) is any model where a program has a finite number of distinct states, of which only one may be active at a time. For instance, a program that

simulates a chef with an FSM would have states such as “Walk”, “Bake”, and “Stir”. The pattern ensures that the chef can never be doing more than 1 of these things at a time. In practice, this involves using a data type called an “enum”.



Enums are a list of constant values that a variable can be assigned to. An enum for the chef could be called “ChefState”, and the values within would be “WALK”, “BAKE”, “STIR”, and any other constants that are needed for the program. One variable, of type ChefState, holds the chef’s current state. If the chef were to finish baking and start walking somewhere else, changing its behavior would be as simple as changing the variable's value from “BAKE” to “WALK”.

With these concrete, well-defined, and separated states that finite state machines offer, developers can easily create many different behaviors that a program can potentially have. Complicated, literal actions become abstracted away and boiled down into a digestible, expandable system.

Risks of Modern Agriculture

Eddie Zhang

As new agriculture technology was developed, old practices, such as crop rotation, were largely abandoned for profit. Before synthetic fertilizers, farmers planted different crops throughout the year, replenishing the nutrients in the soil. However, today, many farmers only grow one crop, largely due to customer demand. This is called a monoculture, and its effects on the environment as well as its risks are tremendous.

First, monocultures are far more susceptible to disease. Planting the same crop all year long means the genetic variability of those crops is close to zero. This means all of

the crops require the same resources and share the same weakness. Thus, if a disease broke out on or near the field, it could potentially wipe out the entire yield for the field. In contrast, if the crops were genetically varied, only some crops would be susceptible to the disease, allowing for the other portion to survive.

Next, monoculture also damages the environment. Farmers growing monocultures plant the same crops all year long, even when the environment is not suitable for their crop. So, they compensate by using chemical fertilizers and other synthetic products to supplement the soil. This not only damages the soil (if used excessively), but also causes runoffs, since the soil does not absorb 100% of the fertilizer. The excess chemicals are carried by rain and water down into rivers and lakes, causing eutrophication and pollution.

Even worse, the chemicals we use on our food has the potential to harm people. Because we spray crops with chemicals and use chemical fertilizers, trace amounts of those compounds get stored in the crop. When we eat those crops, those compounds are absorbed into our bodies. This is important as recent studies show that some of these compounds may cause cancer and other diseases.

Even with all these risks, many farmers are still growing monocultures to keep up with customer demand. Thus, it is up to the people to demand changes to the system.

How Stephen Hawking Talked

Cody Duan

Stephen Hawking is one of the greatest scientists of our time, making many contributions to our understanding of black holes. Unfortunately, at the young age of 21, he was diagnosed with amyotrophic lateral sclerosis (ALS). His condition worsened and slowly lost movement, bound to a wheelchair, and his speech began to slur. Unfortunately, in 1985, he lost the ability to speak.

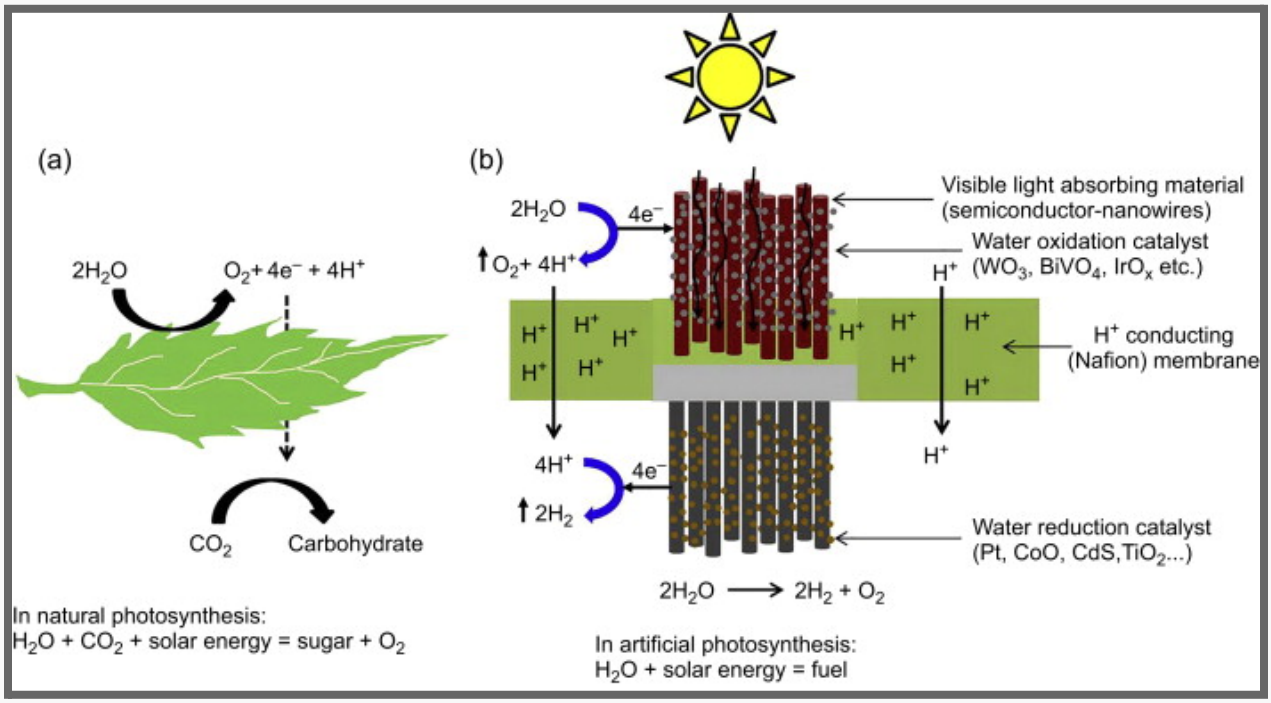
Before losing his ability to speak, he caught pneumonia. To help Hawking breathe, they performed a tracheotomy, in which they cut a hole in his neck and placed a tube in his windpipe. Which caused him to lose the ability to speak.

Hawking was given a device by Intel, which allowed him to choose words on a screen mounted to his wheelchair. In the 1990s, Hawking was managing to input about 15 words per minute. However, as time went on, he slowly lost feeling in his thumb. Instead of using his hands to select words, the new system provided words or phrases, which Hawking selected by twitching his cheek muscle. With the new system, Hawking could only manage about one or two words per minute. Intel gave Hawking a voice, and on March 18, 2018, Hawking sadly passed away.

Artificial Photosynthesis

Cathie Zhu

Scientists have discovered a new way for plants to bypass the need for biological photosynthesis. Using artificial photosynthesis, plants can create food independent of sunlight. This became possible with technology using a two-step electrocatalytic process converting carbon dioxide, electricity, and water into acetate. This acetate is then consumed in the dark by food-producing organisms to grow. This hybrid organic-inorganic system may increase the conversion efficiency of sunlight into food by up to eighteen times.



The inefficient process used by plants to turn water, carbon dioxide, and energy into plant biomass is called photosynthesis. Only approximately 1% of energy found in sunlight ends up in the plant. Scientists at UC Riverside and the University of Delaware discovered a way to bypass biological photosynthesis by using artificial photosynthesis.

The research, published in *Nature Food*, displays a two-step electrocatalytic process that receives carbon dioxide, electricity, and water and returns it in the form of acetate, the form of the main component of vinegar. The acetate becomes consumed in the dark, and with the addition of solar panels to generate electricity, the efficiency of converting sunlight to food is up to eighteen times greater.

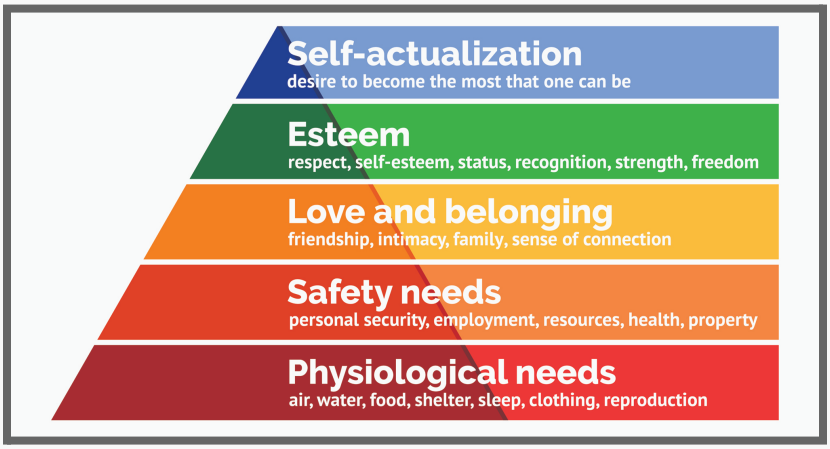
To integrate all of the components within the system, the output of the electrolyzer was optimized to support the food-producing organisms' growth. Electrolyzers are devices that convert raw materials such as carbon dioxide into useful molecules and products using electricity.

Maslow's Hierarchy of Needs

Anna Dai

Maslow's Hierarchy of Needs is a theory established by Abraham Maslow, an American psychologist. The theory he came up with included 5 levels of specific needs to satisfy one person's order to live. These 5 levels are categorized by importance from physiological needs to self-actualization needs. Visually, the needs are placed into a pyramid with the most important at the base.

Starting at the bottom, physiological needs are the first major need. Maslow was sure that every person needed air to breathe, water to drink, and food to eat. Additionally, humans needed to sleep to have energy, shelter for protection, and reproduction for continuing the human species. If a person lacks physiological needs, then they would have a difficult time in life.



Next on the pyramid is safety needs. When the requirements of physiological needs have been met, the human needs to feel safe. This includes physical, financial, and emotional security. In terms of physical, insurance ensures protection, as well as law and order. Being financially secure means that a person is independent and can rely on themselves. Living in a friendly environment can allow one to feel safe and comfortable with their surroundings.

The third level of Maslow's Hierarchy is love and belonging or social needs. In this world, humans live on the same planet as others. Therefore, they must interact, which forms relationships. Humans seek interactions with others because they are social creatures. When this need is deprived, it can cause depression and feelings of loneliness.

Esteem needs come next on the pyramid after social needs. Maslow saw that it is vital to have respect from others and themselves. Humans crave attention for their efforts to feel accomplished. Gaining respect from others allows them to obtain prestige and recognition. Respect for oneself correlates with confidence, independence, and dignity.

Finally, at the peak of the pyramid is self-actualization. When all previous needs are fulfilled, humans can turn to self-actualization. This is essentially the desire to become something one wants to be. At this point, a person realizes their own full potential,

capabilities, and talents. A person may pursue their dream to work as a millionaire or work at their dream job. Others may work to become famous and well-liked by everyone. All of this is a period of self-actualization.

How Public Transportation Improved

Aidan Hong

Technology has played a vital role in modern society. From securing payments to making information accessible instantaneously, technology is everywhere. On a recent trip, I've experienced the impact technology has on public transportation.

The ease of use of public transportation is a critical factor in maximizing the infrastructure of a city. Cities such as London, Hong Kong, and Paris have revolutionized the ease of such use. In this article, I will review my recent experience in London. London has gone away with the days of ticket purchases and have allowed the user the use of magnetic cards that stores your cash value for travel, called an "Oyster Card." This card allows quick entry and exit upon all of London's transportation system. The obvious are subways, but it can also be accessed on bus and even bicycle use from point a to point b! If one is without an Oyster card, London transport has made it easy to even accept common mobile payment systems such as Apple Pay or Google Pay. The Oyster card can keep track of your length of travel and type of rate plans you have purchased.

Despite the improvements in technology for public transport, all this is useless without the knowledge of how to navigate the system. Luckily, there are multiple apps designed to tackle this issue. Besides Apple Maps and Google Maps, there are also other alternative apps, with some providing better information than the stock maps app on your device. CityMapper is an app designed to help passengers navigate public transport cities around the world. Like mentioned before, in London you have the option to walk, take a subway, bus, or even ride a bicycle. CityMapper has routes that help you combine all these modes of transportations or let you decide on the most preferred mode based on your selection.

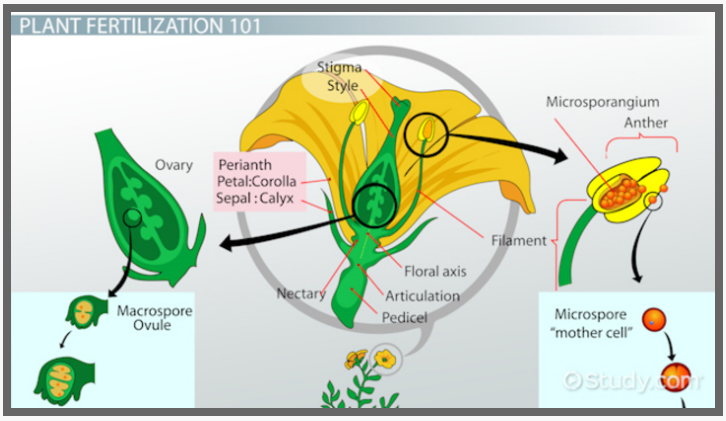
The ease of use is amazing. It can highlight how to walk to a subway station, which train to take and which platform it departs from with a full-time table schedule. With bus routes, it'll even track the bus you are waiting for so you can see how far it is away from your station. Different prices for which routes are broken down for you. If you happen to lose gps or internet connection while traveling, the app allows you to swipe through each phase of your journey as you travel and navigate manually until internet and gps connection is revived.

Technology has helped public transport make big strides in its development. From making ticketing easier to improving efficiency, the improvements are everywhere. The next few years will only bring more improvements to public transport, making it more appealing to more people.

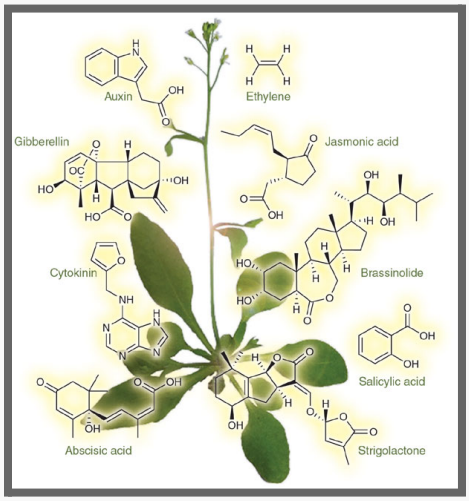
The "Romantic Journey" of Plants

Annabella Luo

Researchers in the Department of Plant and Microbial Biology (PMB) led by Professor Sheng Luan at the University of California, Berkeley have uncovered the intricate molecular processes that precede reproduction in flowering plants. The findings published in the July 6 issue of Nature document a previously unknown molecular process that serves as a method of communication during fertilization.



Researchers have previously recorded the presence of calcium waves preceding the fertilization process. To analyze how the calcium wave was produced by the female cell, the authors of this research introduced a biosensor to report calcium levels in the specific cell to look for signals from the male parts that trigger calcium waves. Pollen tubes were found to emit several small peptides—short chains of amino acids—that can be recognized by peptide receptors on the surface of the female cell. Once activated, these receptors recruit a calcium channel to produce a calcium wave that guides the pollen tube to the



ovule and initiates fertilization. The calcium waves ultimately cause the pollen tube to rupture and release the immobile sperm once it is inside the ovule, ensuring a successful fertilization process.

Understanding the intricate molecular processes of fertilization may help improve the commercial yields in flowering plants. Other researchers or plant geneticists might use the findings to break the interspecies barrier, potentially opening the door to creating new hybrid crop species through cross-pollination. But, in addition to the potential commercial application, these findings further highlight plants' miraculous ability to communicate via molecular emissions, which are unique to plants. This suggests that they invented a way to produce signals that are different from those found in animals.

California's Trees Dying Rapidly

Annabella Luo

A new research co-authored byJames Randerson, Ralph J. and Carol M. Cicerone Professor of Earth system science from the University of California, Irvine reports that trees in California's mountain ranges and open spaces are dying from wildfires and other pressures – and fewer new trees are filling the void.

Across the entire state, tree cover area has declined 6.7 percent since 1985. It's the first time that researchers have been able to measure tree population declines in California, and

attribute the changes to such pressures as wildfires, drought stress and logging.

For the study, the UCI-led team used satellite data from the USGS and NASA's Landsat mission to study vegetation changes between 1985 and 2021. They found that one of the starkest declines in tree cover was in Southern California, where 14 percent of the tree population in local mountain ranges vanished, potentially permanently.

The rate and scale of decline varies across the state. Tree cover in the Sierra Nevada, for instance, stayed relatively stable until around 2010, then began dropping precipitously. The 8.8 percent die-off in the Sierra coincided with a severe drought from 2012 to 2015, followed by some of the worst wildfires in the state's history, including the Creek Fire in 2020. In the north, there is more recovery due to the region's higher rainfall and cooler temperatures. But even there, high fire years in 2018, 2020 and 2021 have taken a visible toll.

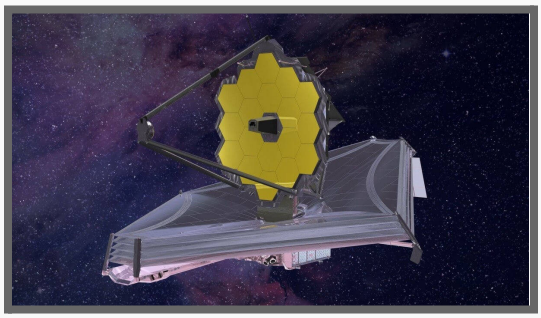
The tree decline has also affected carbon storage abilities in the state. The researchers state that the next step is to precisely quantify the impact on forests' ability to absorb anthropogenic carbon dioxide, water resources, carbon storage and fire behavior across the state.

How Does the Webb Telescope See Everything?

Annabella Luo

The rainbow of light that the human eye can see is a small portion of the total range of light, known in science as the electromagnetic spectrum. Telescopes can be engineered to detect light outside the visible range to show us otherwise hidden regions

of space. To see the galaxy, the James Webb Space Telescope detects near-infrared and mid-infrared wavelengths, the light beyond the red end of the visible spectrum.



Unlike visible light, infrared is more suitable for seeing certain bodies of matter, like humans or a young planet. By using infrared, the telescope can see new details in images, which deepens scientists' understanding of the universe. Visible light's short, tight wavelengths are prone to bouncing off dust particles, making it hard for it to escape from a dense nebula or protoplanetary cloud of gas and dust. The longer wavelengths of infrared light slip past the dust more easily, and therefore instruments that detect infrared light—like those on Webb—are able to see the objects that emitted that light inside a dusty cloud more clearly than using visible light.

Objects in the universe like low-energy brown dwarfs and young protostars are some of the things that would have once been difficult to observe without using infrared. In this way, the Webb telescope has the ability to reveal a "hidden" universe of stars and planet formations that are literally not visible.

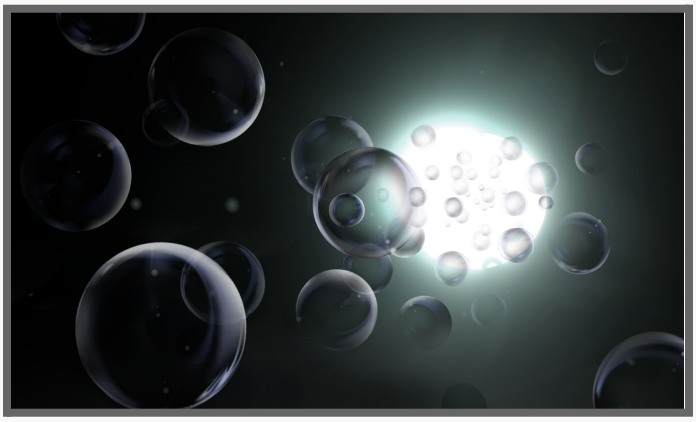
How to Reverse Climate Change?

Arthur Liang

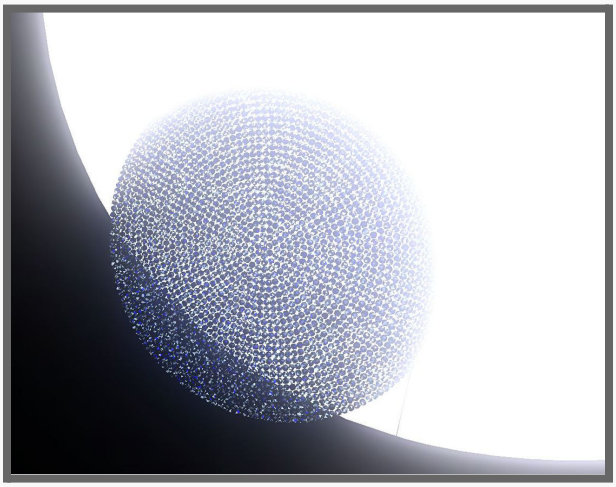
Recently, MIT Scientists think they may have found a way to reverse climate change. Or at least help slow it down, giving us precious time to stop emitting so many greenhouse gases into the atmosphere.

The idea is to create and deploy many thin silicon bubbles into space. These bubbles would join together and be around the same size as Brazil in space. These bubbles would provide a buffer against radiation that comes from the sun. These space bubbles could ease or even reverse climate change.

This plan is a concept proposed by astronomer Roger Angel. Angel originally suggested using a cloud of small spacecraft to shield the Earth from the Sun's radiation. Researchers at MIT have taken that same basic concept and improved it, though, by changing out inflatable silicon bubbles for the spacecraft that Angel originally proposed. Shielding the Earth would only be one part of it, though. We'd still need to improve on other things, too.



The basic idea requires sending the bubbles to the L1 Lagrangian Point. This is the location directly between the Earth and the Sun where gravity from our star and planet cancels out. As such, the space bubbles would theoretically be able to just float without much pull from either body.



The researchers say we'd probably still need to put some kind of spacecraft out there to help keep things on track. But, it could give us a good chance at reversing climate change or at least slowing down the changes. It is important to note that MIT does not view this as an alternative solution to our current adapt and mitigate efforts. Instead, it's a backup solution meant to help if things spin out of control.

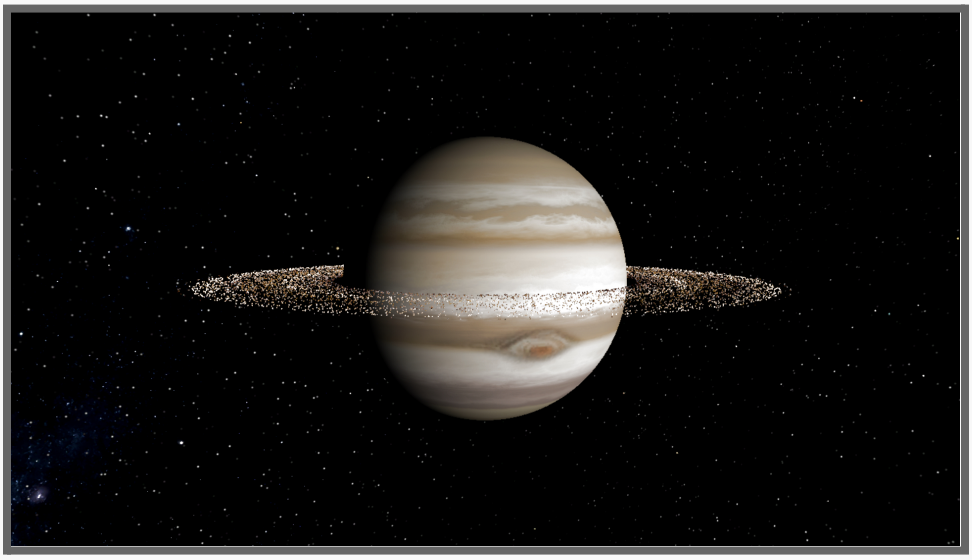
Why Jupiter Doesn't Have Rings

Arthur Liang

Because Jupiter is the biggest planet in the solar system, it should have huge rings, even bigger than Saturn's. However, new UCR research shows that Jupiter's moons prevent its potential rings from forming.

If Jupiter did have rings, they would be much brighter than Saturn's because Jupiter is closer to us. There could also be the possibility that Jupiter once had rings in the past and lost them. Saturn's rings are mostly made of ice, which may have come from comets. Large moons have gravity strong enough to toss the ice out of the planet's orbit or change the orbit enough so it collides with a moon.

All four gas giants in the solar system do have rings. Neptune's and Jupiter's rings are thin though and are difficult to view with traditional instruments. Uranus' rings are smaller but more substantial than Saturn's rings. Some believe that Uranus is tipped on its side due to a collision with another celestial body. Its rings could be the remains of the impact.



Rings in general help astronomers understand a planet's history because they provide evidence of previous collisions and impacts. The shape, size, and composition of the rings can help provide an indication of what really happened.

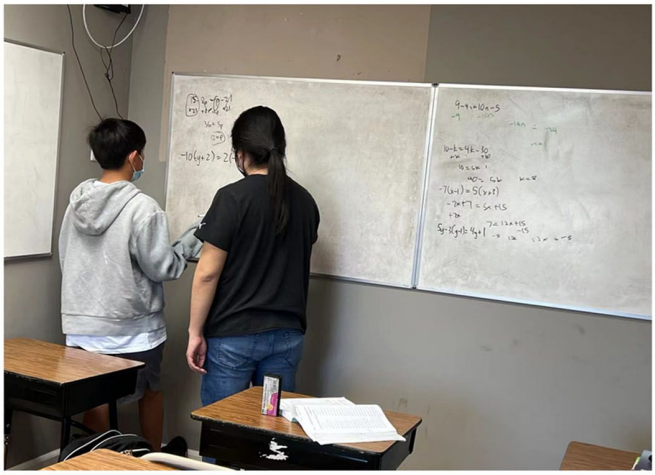
Plants That Produce Their Own Aspirin

Arthur Liang

Plants protect themselves from environmental hazards like insects, droughts, and heat by producing salicylic acid, aka aspirin. UCR scientists recently published a report on how plants regulate the production of aspirin. The report was done on Arabidopsis, but they hope to apply this knowledge to many other plants and crops, crucial for the food supply in an increasingly hot world.

In all organisms, environmental stresses cause the formation of reactive oxygen species (ROS). For example, with no sunscreen on a sunny day, ROS causes freckles and burns on human skin. At low levels in plants, ROS produces hormones such as aspirin. They generate an initial alarm molecule called MEcPP. Researchers want to learn more about MEcPP, which is also produced in bacteria.

The salicylic acid protects a plant's chloroplasts, helping them continue to photosynthesize and survive even under high stresses. The protection of plants from climate change goes beyond just food. Plants produce oxygen, take in CO2, offer us shade, and provide habitats. The benefits of helping them survive are exponential.



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* JAVA 程式語言編寫訓練 *
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AP Calculus BC, AB
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物理榮譽班
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電腦編程基礎班 Java C++ Python

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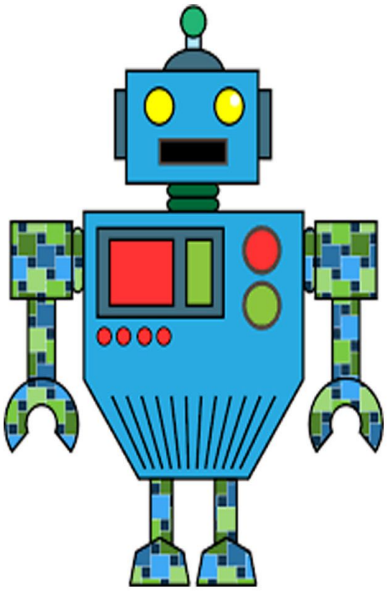
** 因才施教 突破盲點 **

教室:核桃市,羅蘭崗,鑽石吧 626-510-0458



2022年賽季將結束，每個小朋友都忙著完成自己的機器人組裝和編程