

SEEKING SCIENCE

by STEM Action Teen Institution

A MONTHLY
STEM NEWSLETTER



NASA DART MISSION

MUSK'S HYPERLOOP

3D RENDERING

and more...

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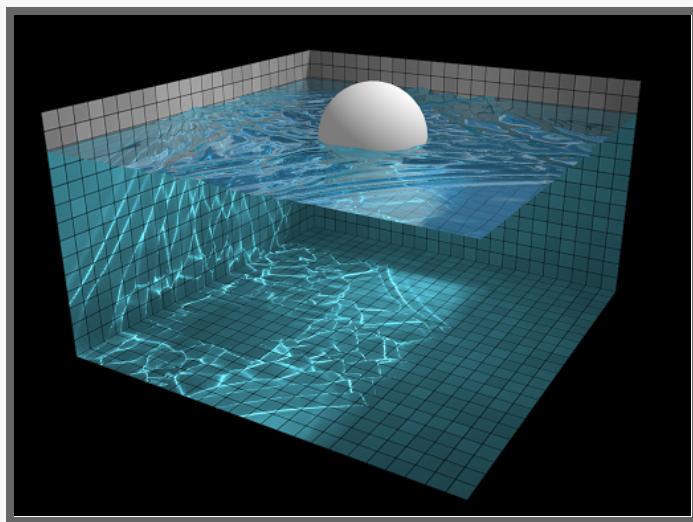
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How Does 3D Rendering Water Work?

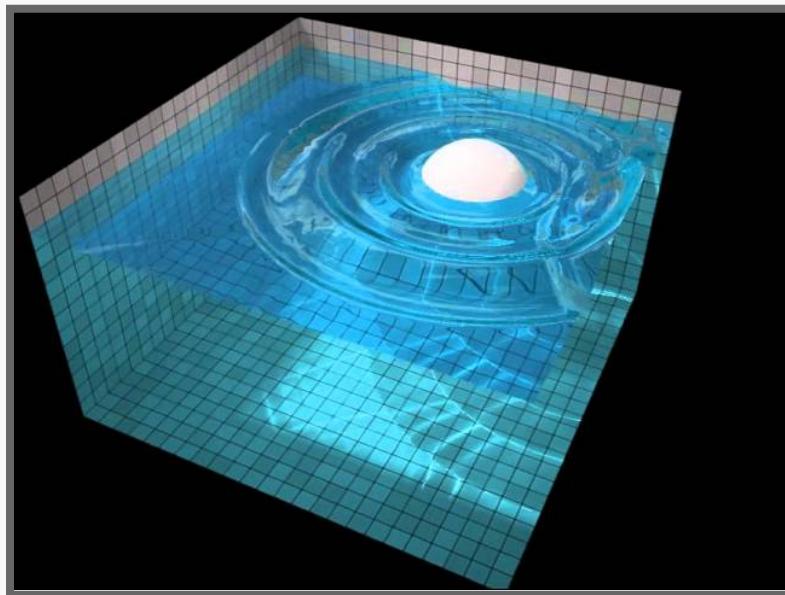
Brian Wang

Since the invention of video games, the rendering of dozens of water and grass has been a problem for many. From the surface, the main reason for this conflict may be the sheer amount of rendering needed to create this effect. Although that may be true, the bottom of the iceberg is really the sense of “realism” created from multiple normal mappings from 3D rendering software. All of these factors that combine together make the creation of water so tricky to perfect, one of the main problems game developers face.



The most basic way to create water is from normal mappings, which are certain planes that can be changed in various ways to add detail. For example, you can add lighting, scratches, or carvings to add a sense of realism, when in fact, all it shows is a simple plane. When multiple normal maps are applied to the plane, you can create a simple water effect that moves back against one another, which is an illusion of two textures moving back and forth.

The most important method to make water realistic would be the waves. There is a very prominent method used among popular games called vertex displacement, where the initial position of many vertex points is stored in the CPU. In the words of Jordan Stevens, Director of Engineering, “Vertex displacement is possible to control the positions of a mesh's vertices via a shader.” The GPU will then oscillate these vertex points to symbolize “waves” for our visual preference. Based on the player’s movement or objects being thrown into the water, the displacement of the vertices should oscillate accordingly. When in a neutral state with no interaction, these points should sway back and forth in a slower manner (based on the given scenario).



Water also needs to have a sense of reality through interaction, reflection, waves, distortion, and much more to symbolize that of water in real life. When light is shined near water, you can see a ray of light underneath and above the water, as well as a distortion of the rays of light at the bottom of the water. Adding this feature to water can sell the effect of detail. Examples of the lighting-to-water effect relationship are seen in games like Genshin Impact, Sea of Thieves, and more.

As more and more solutions appear within our ring of game design, more industries will use them to their advantage. The rendering of water is just one of many problems thought of by game enthusiasts. GPU and CPU usage will go down substantially when rendering different objects in the future.

Elon Musk's Hyperloop

Stephen Hung

The economic growth of the United States has led more and more people into urban areas. As a result, there have been discussions regarding better forms of transportation to be implemented. One idea proposed is the hyperloop, which are pressurized underground tunnel with pods powered by magnetism. These pods are capable of transporting people at high speeds, perhaps exceeding Mach 5. The Boring Company, a company created by Elon Musk to carry out his idea plans to have routes from San Francisco to Los Angeles, as well as Austin to San Antonio.



Hyperloops can transport people from San Francisco to Los Angeles in less than an hour. Currently, these tunnels built by The Boring Company will not be pressurized and will be mainly focused on developing tunnel boring technology while reducing traffic in densely populated areas. This loop system is already in place in Las Vegas. Once better methods of building this hyperloop technology have been created, efforts will be made to convert the routes.

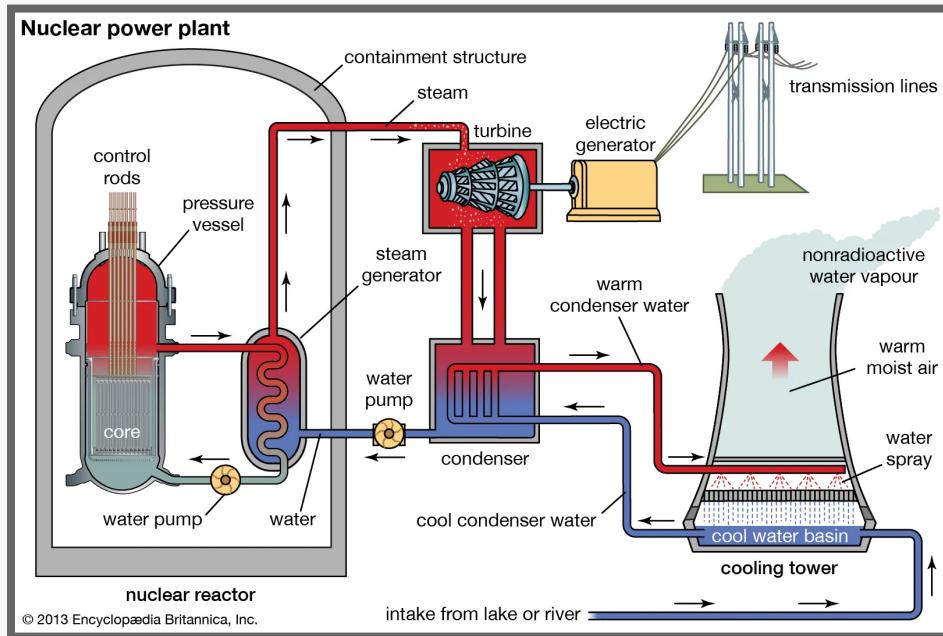
Another benefit of hyperloop technology is its sustainability. Being powered by electricity, it has no carbon emissions that help keep the atmosphere clean. High-speed transportation systems are coming very soon and will make lives much easier.

Nuclear Energy

Eddie Zhang

Currently, our society requires mountain loads of energy to sustain functionality. Advancements in technology—lights, cars, air conditioning, computers, etc.—have created a massive demand for power, which is not satisfied through burning fossil fuels and using renewable energy. Thus, a new source of energy had to be found—nuclear energy.

Nuclear power plants rely on the process of nuclear fission to operate. Nuclear fission is the process whereby atoms are broken down into smaller atoms, releasing energy. In nuclear reactors, neutrons are shot at Uranium atoms, breaking them apart, releasing energy in the form of heat and more neutrons. These neutrons repeat this cycle again, creating a self-sustaining chain reaction.



Inside reactors, there are control rods and the core. The core stores uranium fuel used to start and sustain fission reactions and the control rods slow down neutrons as they pass through them, allowing for fission reactions to occur. If the neutrons were at full speed, they would pass straight through the uranium atoms without causing fission.

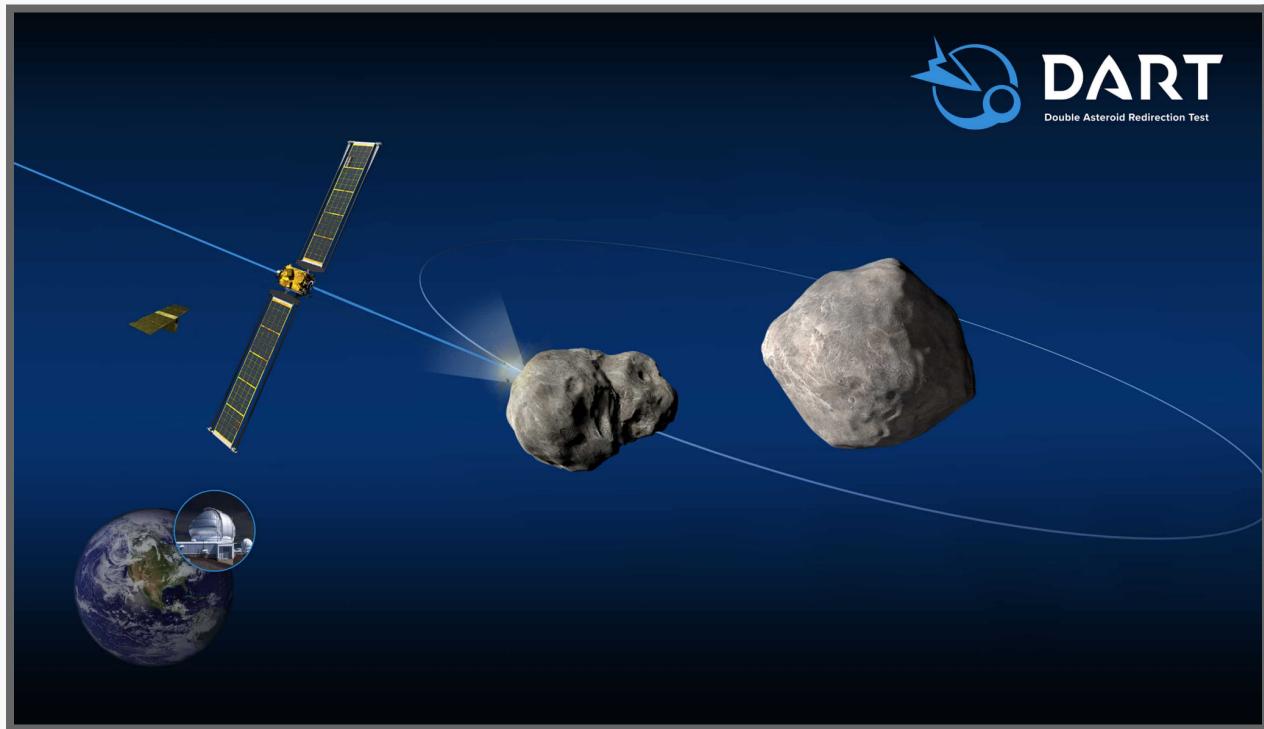
The heat released by this reaction is used to heat water, creating steam, which turns turbines located inside the reactor (similar to a dam, but a dam uses water). These turbines generate electricity for us to use.

The Importance of DART

Aidan Hong

All major extinctions have one thing in common - asteroids. No matter what goes on in Earth, one major asteroid is all it takes to take all life out on Earth. It is no wonder

why many people are concerned about the scenario if an asteroid strikes Earth. NASA has a solution to all this - DART.



DART, short for Double Asteroid Redirection Test, is NASA's first attempt at planetary defense. Although the asteroid DART struck, Didymos, posed no significant threat to Earth, it serves as a model NASA could use in the future to defend Earth. DART functions by colliding itself into an asteroid, and knocks it out of its path. Using Didymos Reconnaissance and Asteroid Camera for Optical navigation, also known as DRACO, DART was able to maneuver itself to position it to hit Didymos. The result was a success - it penetrated it and knocked it out of its path. By knocking it out of its path, NASA can hopefully avert a mass extinction event by making the asteroid miss Earth.

Although DART was a success, it still poses many questions for NASA. Although it struck its target, it may not have been knocked out of orbit as much as NASA would've envisioned. Despite these questions, NASA now knows that it holds the capability to

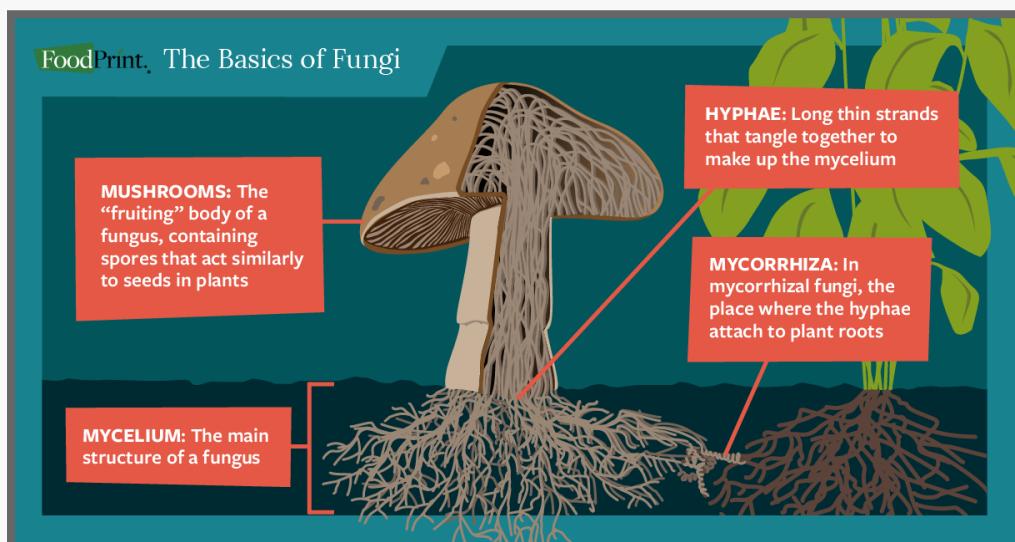
avert mass extinction. With further testing and iteration, we will one day be able to completely avert a mass extinction.

Why Aren't Mushrooms Plants?

Edward Huang

Mushrooms have roots, grow from the ground, and are stationary. So, why have they considered fungi instead of plants? In fact, what makes organisms fungi or a plant? While fungi and plants may seem similar on the surface, they are fundamentally different types of organisms.

On the microscopic level, there are major differences between fungi cells and plant cells. Firstly, fungi cells and plant cells have different cell walls. In plants, their cell walls are made primarily of cellulose. In fungi, however, cell walls are made of a molecule called chitin. Chitin is harder and more stable than cellulose. Fungi cells can also contain multiple nuclei, while plant cells only contain 1.



Additionally, plant cells must undergo photosynthesis to convert sunlight into energy. How are they able to do this? Plant cells contain organelles called chloroplasts, which are directly responsible for the plant's ability to photosynthesize. Chloroplasts contain multiple different components that all contribute to the process of photosynthesis. These chloroplasts cannot be found in fungi, which is why fungi cannot photosynthesize.

So, how do fungi function if they cannot photosynthesize? They absorb and convert the substrate they grow on into ATP, molecules that can supply energy and nutrients to the fungus. Fungi can be found on soil, other plants, and even food that we eat, like bread! Depending on what they grow on, fungi can absorb the ground material and break it down into ATP to get their energy. This is the reason why plants are called producers (they make their own food) and fungi are called decomposers (they break down their substrate into food). Also, plant cells store food in the form of glycogen, while fungi store food in the form of starch.



More differences between fungi and plants can be found in the way they reproduce. Plants typically reproduce with the use of seeds, while fungi reproduce with spores. The difference between seeds and spores is that seeds already contain nutrients inside of them, while spores do not. In fact, spores are unicellular, which means they are literally just a single cell! Seeds, on the other hand, are much more complex structures, and they are much larger than spores. The coco-de-mer is a type of palm tree that can grow seeds that can reach 30 centimeters long!

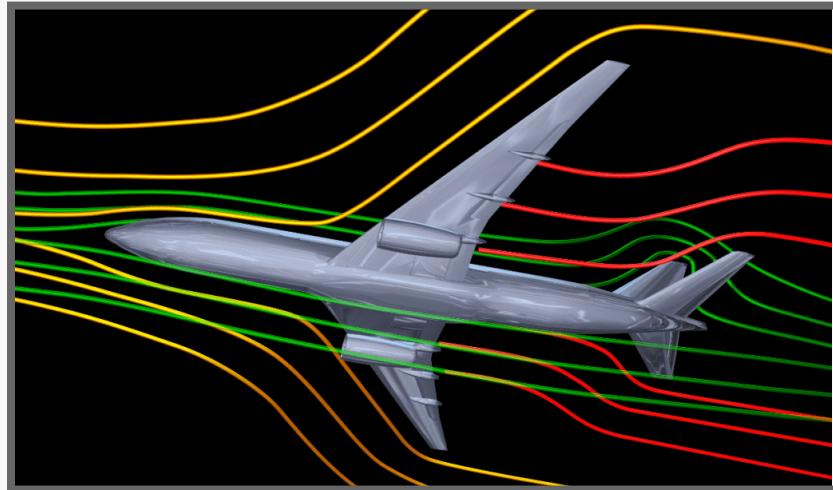
While fungi and plants may look similar from the outside, they are extremely different in the way they create energy, how they reproduce, and how their cells are structured. Just because mushrooms grow from the ground does not mean they are plants! They are a part of their own diverse kingdom of organisms: fungi.

How Airplanes Use Aerodynamics

Cody Duan

Aerodynamics is one of the many aspects considered when building a plane. Aerodynamics studies the flow of air and the interaction between solid bodies moving through air. The use of aerodynamics helps planes stay in the air and allow for less air resistance.

The four basic laws of aerodynamics include weight, thrust, drag, and lift. Each outer part of the plane involves aerodynamics. The wings affect lift. A wing's shape typically has a round top, and a flat bottom, causing air to flow much faster above the wing than below, resulting in the air being less dense above the wing. This interaction allows the plane to stay afloat.



The nose of the plane affects air resistance. Planes always have a blunt, round nose or a pointed nose. Each nose has its purpose. The pointed nose is used for faster planes. The downside to a pointed nose is that moving beyond the speed of sound, the plane can get hot, to the point where the metal can not withstand it. In these situations, it is better to have a blunt, round nose. A blunt nose creates a bow-shaped shockwave, meaning the air only touches the nose and results in not as hot temperatures.

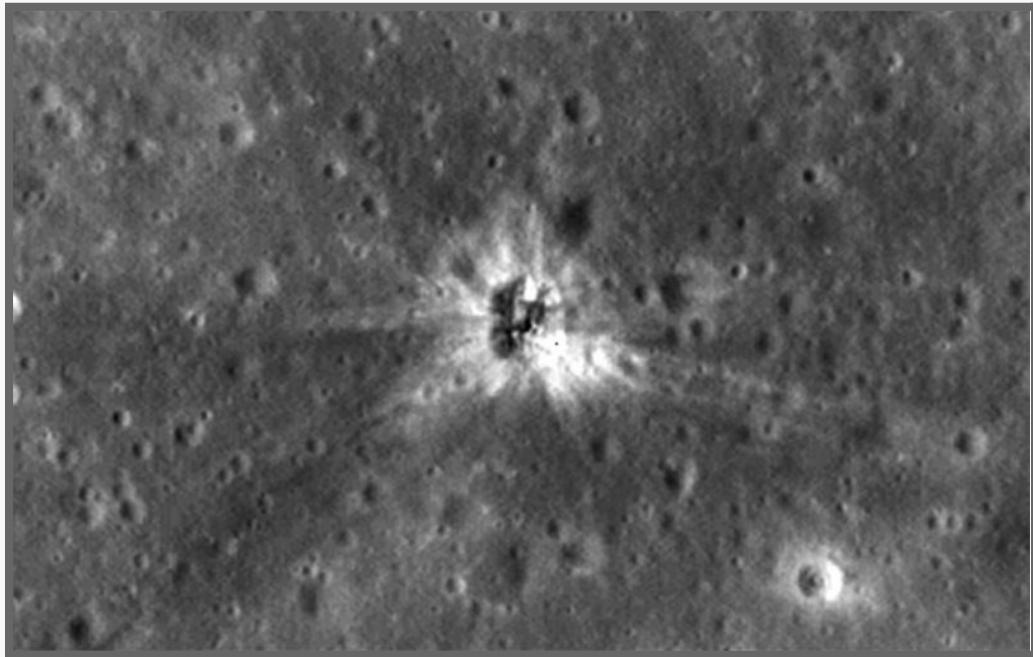
The tail of a plane is used for balance. Without the tail, the plane will lose horizontal stability, affecting the aerodynamic balance. By combining each part, the airplane achieves unity in aerodynamics. Achieving what we have today.

The Falling of ELFIN

Annabella Luo

The last week of September 2022 marks the end of an era for several cohorts of UCLA students, as the twin space probes they nurtured for the past decade have finally fallen out of orbit and vaporized in Earth's atmosphere. The cat-sized satellites, named the Electron Losses

and Fields Investigation CubeSats, or ELFIN, are the first end-to-end NASA space science mission built entirely at UCLA.



"ELFIN is proof that space is accessible to students and not just big industry players," said Vassilis Angelopoulos, a professor of Earth, planetary and space sciences. "It is an immensely valuable educational experience and a tradition we intend to continue."

ELFINers, as they have come to be known, successfully met or surpassed all of their mission objectives: building custom sensors that can directly observe space plasmas, whizzing electrons, bouncing ions and vibrating magnetic fields that drive "space weather." Much like the study of winds and storms on Earth, ELFIN's unique datasets will help scientists better understand how the sun's outpouring of solar wind can generate magnetic storms in space.

These storms can energize electrons enough to damage satellites while also powering the mystical auroral lights — the aurora borealis and australis — on Earth

Oil Spill Plaintiff Pleaded No Contest

Annabella Luo

The Texas company operating the pipeline that caused a massive oil spill in the waters off Huntington Beach agreed to plead no contest to state environmental charges and pay nearly \$5 million in fines and penalties, prosecutors announced early September, 2022.

Orange County and state prosecutors this week charged Houston-based Amplify Energy Corp. and two subsidiaries—Beta Operating Co. and San Pedro Bay Pipeline Co.—with misdemeanor counts of pollution and failing to immediately report last fall's discharge of oil into state waters to the Office of Emergency Services.



The plea agreement still needs to be approved by a judge. Authorities expect Judge Larry Yellin to consider it at a hearing.

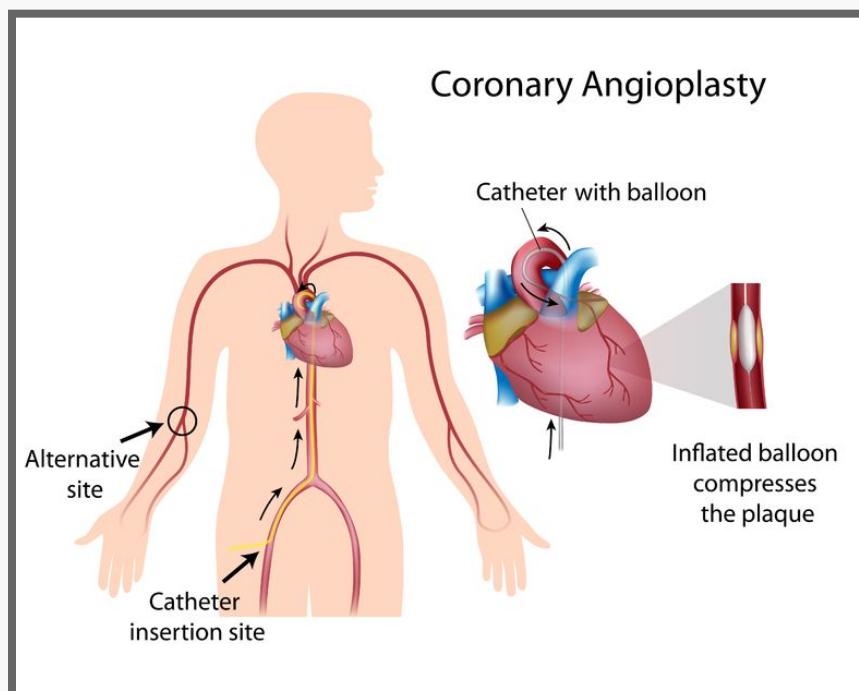
As a result of the agreement with prosecutors, Amplify Energy will be required to install a new leak detection system in the pipeline and implement new employee training

to notify regulators of every leak detection alarm to prevent future spills. The company will be placed on a yearlong probation, Bonta said.

Unclog Your Heart the Safer Way

Annabella Luo

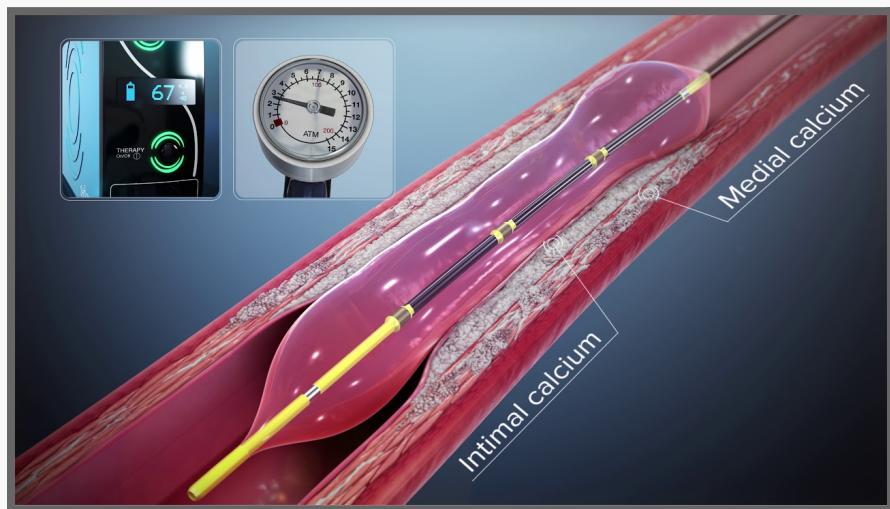
Arterial plaques form when fat, cholesterol, calcium and other substances are deposited on the inner walls of the arteries, which carry blood throughout the body. Over time, these arteries harden and narrow. This process called atherosclerosis limits the ability of oxygen rich blood to reach vital organs and increases risk for heart attack or stroke. Although the cause of atherosclerosis is unknown, a combination of habits (such as activity level, smoking and diet), genetic risk factors and age contribute to its development.



Two conventional surgical approaches for blocked arteries are angioplasty and bypass surgery. During an angioplasty, a vascular surgeon inflates a small balloon inside the blood vessel and inserts a metal mesh tube called a stent to hold the arteries open and improve blood flow. By contrast, a bypass surgery involves the rerouting of blood flow by using unblocked veins or arteries to bypass the narrowed artery.

Unfortunately, in the case of angioplasty, some stents (about 5%) can't expand fully if the artery is too hardened by calcium deposits. That's when an interventional cardiologist has to manually drill through the plaque by using a catheter with an abrasive tip or crown – sort of like a Roto-Rooter for plumbing – prior to placing a stent. Though these atherectomy procedures can be effective, there is a risk of damaging or puncturing the artery.

An exciting new technique called intravascular lithotripsy (IVL), approved by the U.S. Food and Drug Administration (FDA) in February 2021, is now available to improve the effectiveness of stents in calcified arteries.



IVL is based on technology developed in the early 1980s that uses shock waves to break apart kidney stones. Similarly, IVL employs sonic waves to create cracks in the

calcium deposits in an artery, providing just enough wiggle room for the stent to properly expand. The process improves blood flow with no pain and less arterial wall damage.

Studies leading up to FDA approval have shown IVL to be safe and effective. The Disrupt CAD II trial showed the procedure carries a low risk of potential complications, such as blood vessel damage or perforation. Disrupt CAD III further validated the safety of the procedure, leading to FDA approval.

Ice Volcanoes on Pluto

Cathie Zhu

NASA's New Horizons mission researchers discovered evidence of two volcanoes built out of frozen ice. That molten ice once oozed molten ice from inside of the dwarf planet. These volcanoes are called cryovolcanoes. This discovery indicates an internal heat source that, at some point, drove the melting of interior reservoirs of volatile ices in Pluto. These reservoirs erupt at the surface to form cryovolcanoes.



These features would be the first large ice volcanoes in the solar system, Jeff More, New Horizons scientist at NASA, says. However, they have not explicitly said that the discovery is definite. “These sure look very suspicious and we’re looking at them closely,” he says.

These volcanoes named Wright Mons and Piccard Mons, are mounds of ice with rims that are as high as 5 or 6 kilometers above the surface. They are located just outside the southern tip of the smooth, bright, “heart” of Pluto, Sputnik Planum. The rims stretch more than 150 kilometers across and encircle pits that are almost as deep as the mountain’s heights. “When you see a big mountain with a big hole on the top, it generally points to one thing,” Moore says, explaining its unmistakable volcano-like shape.

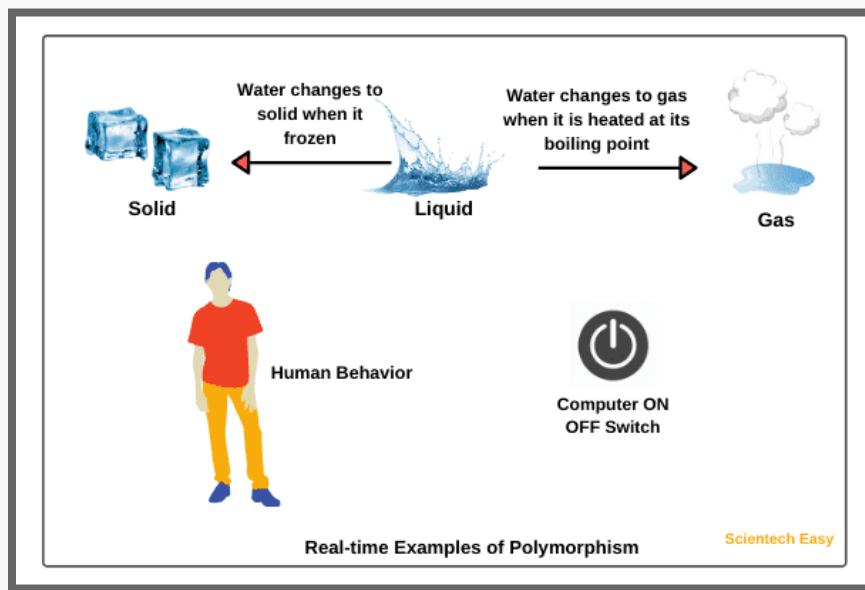


He explains that the surface texture suggests the occurrence of past eruptions, possibly a billion years ago. These eruptions would have oozed out water ice that was plastic rather than liquid and runny.

The Secret World of Polymorphisms

Ethan Chen

When using a program, you can often press a big red button to open a door, then press that same button somewhere else to launch a rocket or turn on a lamp. Have you ever wondered how pressing the same button can lead to dramatically different outcomes? Even if it always looks like the same red button, the code they execute is obviously not the same every time. In Object Oriented Programming, this is known as polymorphism: executing different code under the same interface.



In the case of the button that opens a door, it would likely be a DoorButton script that *implements* something like an “Interactable” interface. With the button that turns on a lamp, it would be a LampButton script that *also* implements the “Interactable” interface. The Interactable interface would be a special script that contains functions such as “Interact” or “Turn On” and “Turn Off”. The key is that interfaces do not have any code; there would never be a button that’s *just* an interface, because interfaces are not

executed. They are just a common set of functions and attributes that MUST be *implemented* into any other script that implements the interface.

When both our DoorButton and LampButton have implemented the Interactable interface, it is now possible to call ANY of the Interactable functions on them. For instance, the ‘Interact’ function on DoorButton may execute code that opens a door. On the LampButton, the ‘Interact’ function would instead execute completely different code that turns a lamp on and off.

The reason this is important is because of the bigger picture; if a user tries to use any object that implements the ‘Interactable’ interface, they can be *certain* that they can call ‘Interact’ on the object, regardless of what that actually does. The power of being able to dynamically change the code that is executed, despite calling the same function, is why interfaces and polymorphism as a whole is an incredibly useful tool for programmers when making larger and more complex user environments.

A Galactic Collision - Milkdromeda

Anna Dai

In about 4 billion years, astronomers have predicted that our galaxy, the Milky Way, and another galaxy, Andromeda, will crash together. These galaxies are 2.5 million light years apart and are hurtling at each other at a speed of 400 thousand kilometers per hour. After colliding the two galaxies will form a singular elliptical galaxy called Milkdromeda.

This scientific prediction was first established in the 1900s by astronomer Vesto Slipher who suggested that the Andromeda galaxy was headed in the direction of the Milky Way. Fast forward to 2012, the Hubble Telescope made it certain that the two galaxies were to collide over time. The Hubble Telescope measured and recorded data of stars in the Andromeda galaxy. From this, researchers were able to derive information that lead to a simple conclusion about the movement of Andromeda. It is certain that Andromeda is headed for the Milky Way.



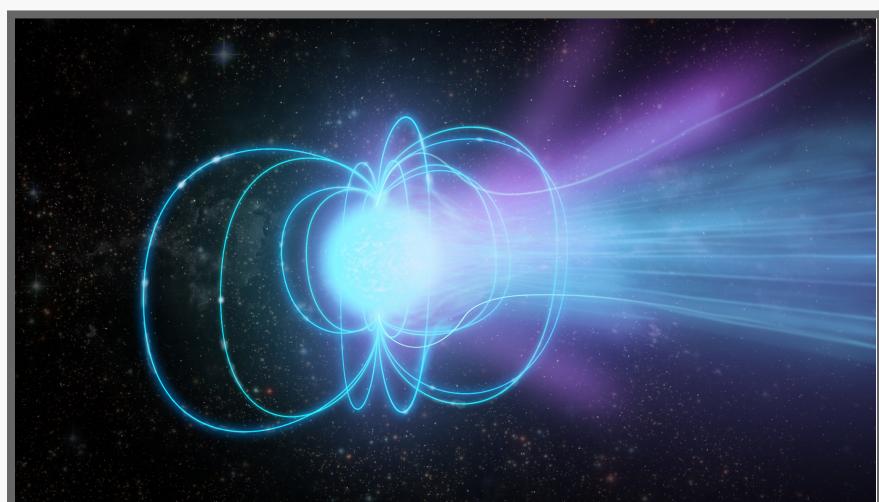
Both the Milky Way and Andromeda carry an SMBH, a supermassive black hole. It is also predicted that years after the collision of the two galaxies, both black holes will slowly emerge at the center of the new galaxy and clash! Simulations of this have been created and from it, researchers discover that the Sun might be ejected out of the galaxy into the black hole in either separate parts, or entirely.

Now, would the Earth survive this extreme collision? Some say that Earth will be completely destroyed in the process or not destroyed but inhabitable. Others say that Earth would survive but not entirely unaffected. Earth's surface is already predicted to be too hot for life to exist in about 1.1 billion years. It is very unlikely that humans will live during the time of Milkdromeda, making only one thing unclear about the collision, the fate of us.

Magnetars: The Strongest Magnetic Fields in the Universe

Arthur Liang

Magnetars are an exotic type of neutron star, made unique by their extremely strong magnetic fields. This magnetic field is about 1,000 times stronger than a normal neutron star and about 1 trillion times stronger than Earth. Magnetars are by far the most magnetic stars in the universe. If the distance to a magnetar is less than about 600 miles (1,000 km), the magnetic field will destroy your body, ripping the electrons out of your atoms and turning you into a cloud of individual atoms.



In addition to these super-strong magnetic fields, magnetars also emit enormous amounts of energy in the form of X-rays, and gamma ray bursts. They are associated with some of the most extreme events in the universe, their strangeness on par with that of black holes

Astrophysicists still don't know exactly how magnetars generate their powerful magnetic fields, but it may have something to do with the incredible density of neutron stars and their strange interiors. For a piece of neutron star matter the size of a sugar cube, on Earth it would weigh a billion tons or the weight of the average mountain.

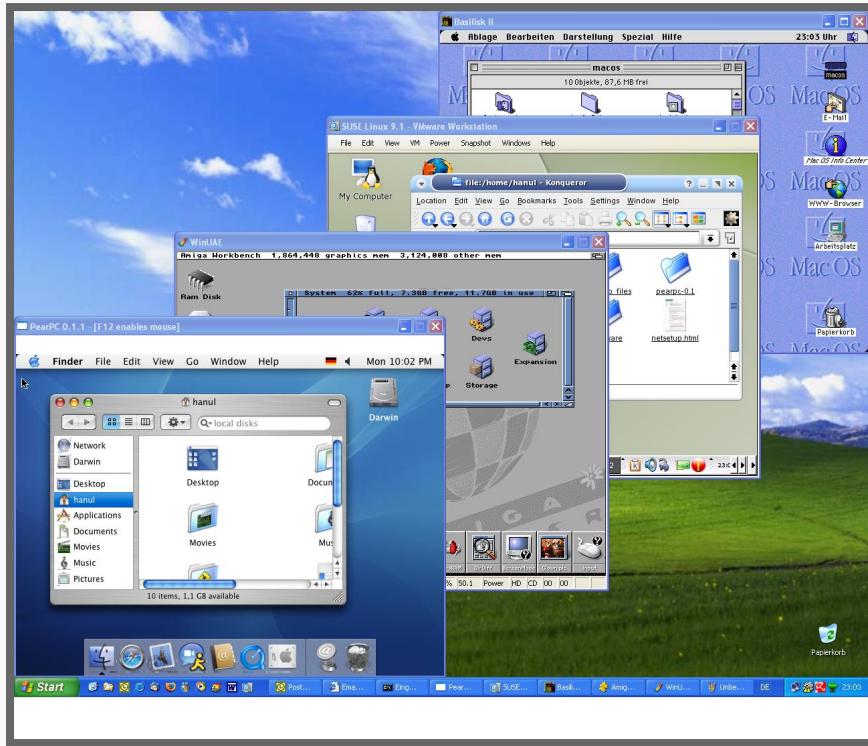
Some magnetars are also called pulsars. These are celestial beacons that sweep space with a powerful radio beam. The recent discovery of a magnetar that is also a pulsar has allowed astronomers to determine the exact distance to it for the first time.

Virtual Machine

Kenny Wu

Virtual machines, like VMware and Parallels are incredible software used for emulation of a different computer system in your computer. To put it in simple words, virtual machines allow the experience of running multiple operating systems at the same time. Virtual machines are often utilized by people who deal with computers that don't have access to the certain operating systems that they ought to use.

Along with the multi OS access, virtual machines are much appreciated for their security. Users could be heedless and infect their system, when this situation occurs, users can simply create a completely new machine and remove the infected machine.

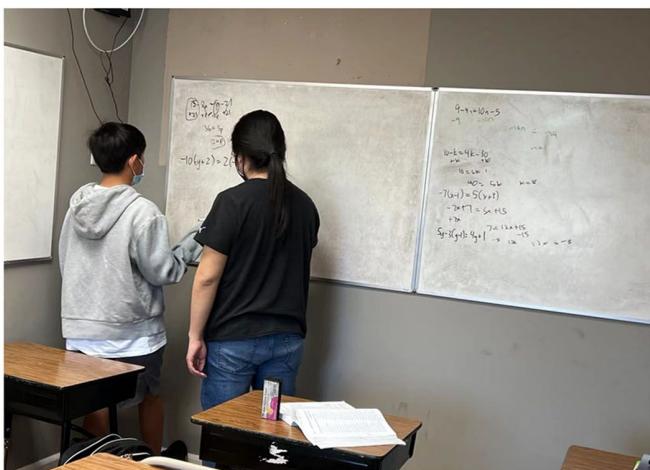


Therefore jobs related to cyber security can heavily abuse this special perk of a virtual machine.

Furthermore, having the right operating system you need regardless of what you have is quite the spotlight of a virtual machine. With cheap payments, you are able to experience the environment of Windows from Mac or any other operating system supported like linux. People may still question the need of switching operating systems, but they are actually different in various ways. For instance, linux is heavily used for cyber security for it being open source and for its highly compatibility with security tools. Mac OS being the best for casual works due to its user friendly design and Windows being the best for software compatibility.

All in all, virtual machines are promising and dependable computing tools that come in handy. Perhaps it's only competitor, bootcamp can attempt to replace virtual

machines, but even then, it is only compatible for mac to emulate the windows environment.



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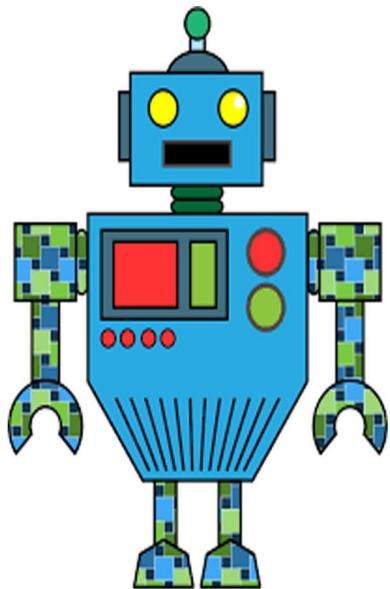
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