SEEKING SCIENCE

Strange States of Matter

Did you know that there are more states of matter beyond the three states of matter that most schools teach? 1

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Strange States of Matter

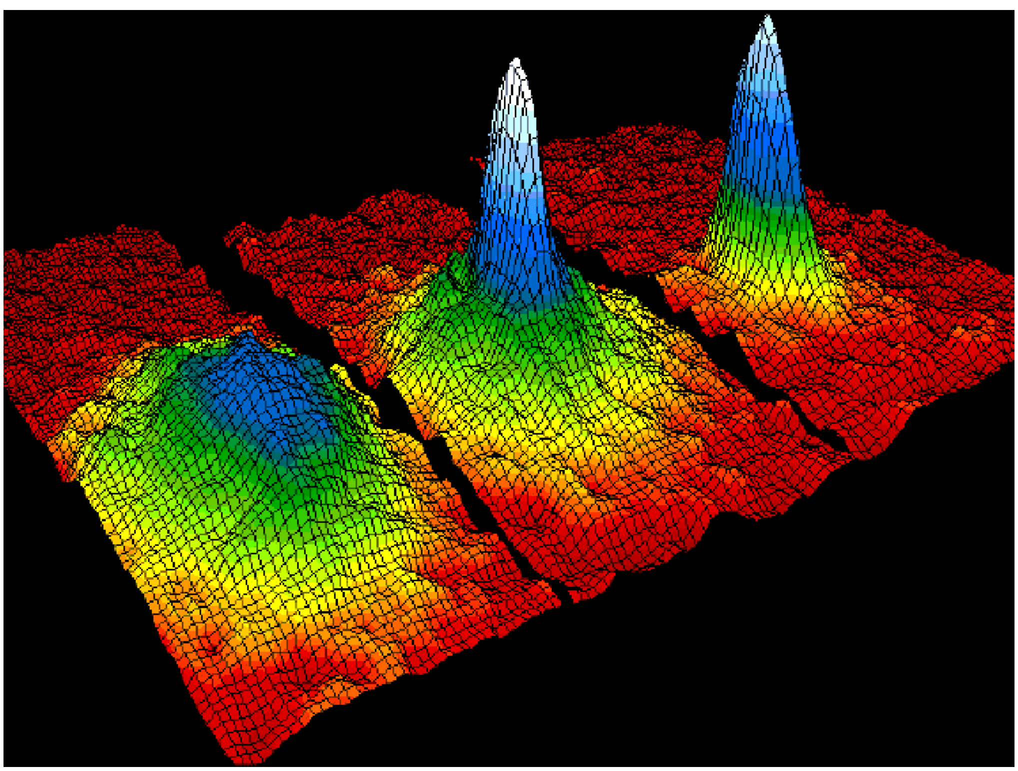
By Edward Huang

It is frequently taught in schools that there are only 3 states of matter: solids, liquids, and gas, each with their own fixed properties. However, this is untrue, and there are many, many states of matter that are not well-known but have very interesting properties.

One of the most well-known states of matter that is not part of the fundamental three is plasma, sometimes called the 4th state of matter. Plasma is similar to a gas in that it does not have a fixed volume or shape. In plasma, atoms ionize, which means they lose all of their electrons. As a result, a "sea of electrons" is formed, containing freely traveling electrons and the nuclei of the atoms they disconnected from. This sea of electrons gives plasma some very useful properties, including the abilities to conduct electricity and produce magnetic fields. Plasma is typically created by heating gases to a very high temperature or using electricity. Plasma can commonly be seen near lightning, in fluorescent or neon lights, and in stars.

A colloid is a type of material that has qualities of more than one state of matter. It is not a specific state of matter, but is instead a more general classification of materials. Colloids are mixtures of substances where insoluble particles are dispersed and suspended in a different medium. In some definitions of a colloid, both the dispersed phase and the dispersion medium can be solid, liquid, or gas (although gas-gas colloids do not exist). Some examples include jelly, gelatin, whipped cream, latex, and more. Many colloids do not have the properties of just one phase of matter, but usually have qualities of multiple, although this is more obvious in some examples than others.

A superfluid is a unique type of liquid with zero viscosity, which means it flows without friction. This can be seen in its ability to climb up the walls of a container and drip out from it. Superfluids are made by cooling liquids to extremely low temperatures, without converting them into a solid. This is commonly done with helium (H_2). One interesting property of superfluids is that they can flow without losing kinetic energy. This is famously demonstrated in an experiment, where liquid helium is placed in a rapidly spinning container, causing it to rotate with the container. Next, the liquid helium is cooled to a superfluid, still continuing to rotate. Because of its zero viscosity, the superfluid will keep rotating infinitely, even after the container stops spinning! Additionally, superfluids are studied due to the fact that they can create strange geometric shapes formed as a result of rotation, known as quantized vortices.



A Bose-Einstein Condensate, or BEC, is commonly referred to as the fifth state of matter. Formation of a BEC is done by cooling a gas of bosons, a specific type of particle, into near absolute-zero temperatures. As a result, these bosons condensate into a new state of matter. Properties of a BEC are very similar to those of a superfluid, although they are not the same exact thing (most BECs are superfluids and superfluids are not just BECs). BECs are mainly studied to further understand quantum physics and what happens at low temperatures.

Another state of matter is the time crystal. Time crystals involve parts that move in periodic cycles, without losing energy. As a result, entropy does not increase, which is a blatant and natural violation of the second law of thermodynamics. Time crystals are unique in that they are constantly changing, while being stable at the same time. This seemingly contradictory state can be explained by quantum physics. Time crystals are of great interest to scientists, since they have the potential to be used in quantum computers.

These few states are just the tip of the iceberg when it comes to phases of matter. There are a lot of states of matter, including supersolids, photonic matter, degenerate matter, Fermionic condensates, and many more. Scientists are constantly researching and studying these states of matter and proposing new ones, looking for uses in the real world. Perhaps these unique states of matter will play a role in the elusive quantum computer, which can potentially revolutionize society.

Species Interactions

By Eddie Zhang

Although seldom noticed, species, including humans, are constantly interacting with one another. Day-to-day examples of interactions would be a bird eating a seed, or two animals fighting for a mate. However, interactions such as these in the long term can have instrumental impacts on the different species involved.

First of all, why do these interactions take place? Species in a community live in the same general area, thus having access to the same resources. Since resources are limited, the separate species must compete to obtain them, resulting in the interactions that can be observed today. Some interactions may lead to growth of all species involved and some may lead to the local extinction of certain species. There are four main types of interactions, mutualism, commensalism, predation, and competition.

In the first two interactions, mutualism and commensalism, no species in a community are harmed. In mutualism (assuming only two species are involved), both species benefit. In other words, the actions of one species benefit the other, and vice versa. An example of this are symbiotic relationships in cells. In human cells, mitochondria provide ATP production and our cells provide protection. There are also non-symbiotic examples of mutualism, like the bees and the flowers. The bee feeds on the nectar of the flower, picking up its seeds in the process, and spreading them as it travels. In commensalism, one species benefits while the other neither gains nor loses. We can see this in tree frogs. They may use plants to camouflage and protect themselves from danger. In this case, the frog benefits while the plant doesn't.

In the other two interactions, predation and competition, some or all species in a community are harmed. Predation is the most recognizable type of interaction. In predation (assuming there are only two species involved), one species (the predator) hunts and eats the other species (the prey). We can see this in cats and mice, dolphins and fish, etc. In competition, different populations compete with one another for the supply of a limited resource. This often harms all species involved as competition can lead to violence. Furthermore, competing over resources results in fewer resources for all species. This interaction is the most common in the environment and can be seen all around us. It can even be seen in human civilizations, with nations disputing over natural resources.

When it comes to interactions, however, categorization goes far deeper than the ones mentioned. Yet, these four main categories produce the ecological effects that impact our lives. Despite not being the spotlight of attention, interactions among populations play a major role in shaping the world we live in now.

Volcano Experiment

By Cody Duan

Two common ingredients in cooking are vinegar and baking soda. These have other uses in science. One common way is to be used in an experiment, the volcano experiment, which consists of the chemical reaction between baking soda and vinegar.

The reaction of baking soda, a base, and vinegar, an acid, is an endothermic acid-base reaction. The chemical formula is NaHCO3 + HC2H3O2 → NaC2H3O2 + H2O + CO2. When baking soda and vinegar are mixed together, the vinegar's hydrogen ions mix with the baking soda's bicarbonate ions. This results in the two chemicals, carbonic acid, and sodium acetate. A second reaction, the decomposition reaction, occurs after the first reaction. The carbonic acid decomposes into water and carbon dioxide. Similar to a carbonated drink, the carbon dioxide rises to the top of the mixture and causes the formation of bubbles and foam.

The first step in the volcano experiment is to make the volcano with paper mâché. Take a mound of newspaper to create a base for the bottle or cup. Secure it onto a tray, and wrap newspaper to mold the volcano. Dip strips of newspaper into the paste, a mixture of water and flour, which has a consistency of glue, and place them onto the structure. Smooth out the newspaper strips by slowly massaging them. Let it dry for about 24 hours, and paint it. Once painted, add one cup of warm water to the cup/bottle, followed by a few drops of dishwashing detergent, and mix with baking soda. Then mix food coloring with white vinegar, and pour it into the volcano.

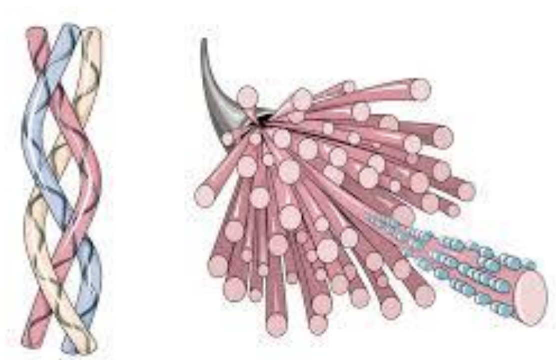
The volcano experiment is a “volcano eruption” with a paper mâché volcano, and vinegar inside. Baking soda is then added to the inside of the volcano with the vinegar, and the reaction occurs. Many, including schools, use this demonstration in the form of a chemistry experiment.

Osteogenesis Imperfecta

By Annabella Luo

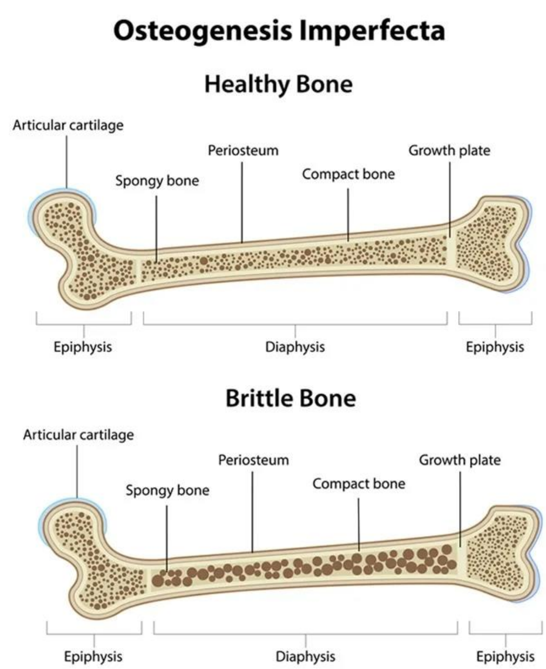
Osteogenesis imperfecta (OI) is an inherited genetic disorder that is present at birth. Also known as brittle bone disease, someone born with osteogenesis imperfecta may have soft bones that fracture easily and/or bones that aren't forming normally. Osteogenesis imperfecta affects males and females in equal numbers. It is estimated that 20,000 to 50,000 individuals in the United States have OI.

Symptoms of OI vary between types, which may include easily broken bones, bone deformities (like bowing of the legs), discoloration of the white of the eye (may be blue or gray in color), barrel-shaped chest, curved spine (scoliosis), triangular-shaped face, loose joints, muscle weakness, skin that easily bruises, hearing loss in early adulthood, soft discolored teeth. Since OI is a collagen-related disease, the arrangement and integrity of teeth (dentition), lung function, heart (cardiac) function, muscle strength, and ligament flexibility may be affected as well. The life expectancy between the types varies significantly. According to the American Society for Bone and Mineral Research, those with severe phenotypes have a mean life expectancy of 6.2 and those with milder phenotypes have a life expectancy of 63.5.



Historically, OI has been classified into four main types according to clinical features and severity. Over the past decade, many new genes have been identified in individuals who have brittle bones as a component of their disease. The classification has been expanded beyond types I through IV to include these new and rarer types of OI.

85-90% of the time, osteogenesis imperfecta (Type I to Type IV) is caused by a mutation in the COL1A1 gene or the COL1A2 gene. COL1A1 is located on chromosome 17, and COL1A2 is located on chromosome 7. Collagen is the major protein of bone and connective tissue including the skin, tendons, and sclera. The collagen protein is made up of three strands of proteins (two alpha 1 strands and one alpha 2 strand) that wind together in a helical fashion. These helical molecules then pack side by side to form characteristic bands that are linked together. This structure gives collagen enormous tensile strength. When a mutation occurs, the collagen that the mutated gene produces may be faulty or insufficient. In type I, the gene mutation results in a normal collagen protein, but only one-half of the normal amount is produced. Types II through IV are the result of mutations that affect the structure of the collagen protein. The precise location and type of mutation determines the severity of the resulting disease. The non-collagen types of OI (types V-XXI) are caused by mutations in genes that code for other proteins that play a pivotal role in the production of normal collagen. For example, in type XIX, the disorder is inherited in an X-linked recessive pattern.



The treatment of OI is directed toward the specific symptoms that are apparent in each individual. Treatment is aimed at preventing symptoms, maintaining individual mobility, and strengthening bone and muscle. Exercise and physical therapy programs have proven beneficial in strengthening muscles, increasing weight-bearing capacity, and reducing the tendency to fracture. Bisphosphonate therapy (intravenous infusions with either pamidronate or zoledronate) is commonly used to treat children with OI who have frequent fractures, spinal compression fractures, bone pain, and decreased bone density measured by DEXA scan. A surgical procedure in which metal rods are placed into the long bones of the upper and lower extremities (rodding) is used to treat some individuals with OI.

Although there are not yet reliable and optimized cell or gene therapies to treat OI, advances in gene-editing technology and gene therapy vectors bring with them the promise of gene-targeted interventions to provide an enduring or perhaps permanent cure for OI. The various gene-targeted approaches with the potential to treat or cure genetic disease can be grouped based on whether they modulate expression of harmful alleles (Oligonucleotide Therapies), utilize cell transplantation, or employ vectors for gene addition or repair. Each method has utility geared towards different mutations and has its limitations in application. There are still substantive obstacles that need to be overcome to treat genetic bone disorders using emerging gene technology. However, breakthroughs in AAV vectors and CRISPR/Cas9 gene editing are paving the way toward effective and accessible treatments for OI. It is expected that the rapid progress in Cas enzyme bioengineering and AAV vector design make it not unreasonable to anticipate human trials for OI gene therapy within 5 to 10 years.

COVID and Travel

By Aidan Hong

Amid the COVID-19 pandemic, people will continue to travel internationally. As they do, technology will have a huge impact on the traveler's experience in regards to safety and convenience. I was able to experience the impact of technology on my recent travels to Canada. It allowed for me to maximize on a contactless experience. At began with the check in process. Instead of the usual counter in-person experience, I utilize the airline app service to check in virtually. I was only required to drop off my luggage at the counter, saving me tons of time and increasing my safety by avoiding in-person contact. The experience continued during my flight to Canada. Instead of utilizing small built-in screens at the back of the seats headrest, we were able to utilize the in-flight service of the airline app. This allowed for a more customized entertainment experience utilizing the mobile device of your choice. I was able to enjoy the use of my tablet, taking advantage of my device's higher resolution but also once again, having a contactless experience.

Our trip to Canada mainly consisted of snowboarding, and once again technology played a huge role on the mountains. One would never think technology and nature had anything in common. But utilizing the ski resort app, I was able to utilize tracking features. It allowed me to record my stats of my snowboarding activity, but more importantly I was able to track my family members in case if we were separated or got lost. Features that enhanced my activity and safety! Everywhere you go, we are surrounded by technology. As we continue to harness its potential, travel will become more convenient, contactless, and efficient.

A Chip With Optimizing Power

By Annabella Luo

Complex optimization problems — like calculating the most efficient delivery routes, optimally moving goods through supply chains, or routing passengers to destinations on-demand — can require power-draining computations that keep server farms running 24/7.

Based on a recent study led by Berkeley Sayeef Salahuddin, a professor of electrical engineering and computer sciences, it's possible to dramatically reduce both the energy and hardware requirements for these computations by using machine learning to map a powerful algorithm onto a single, programmable chip.

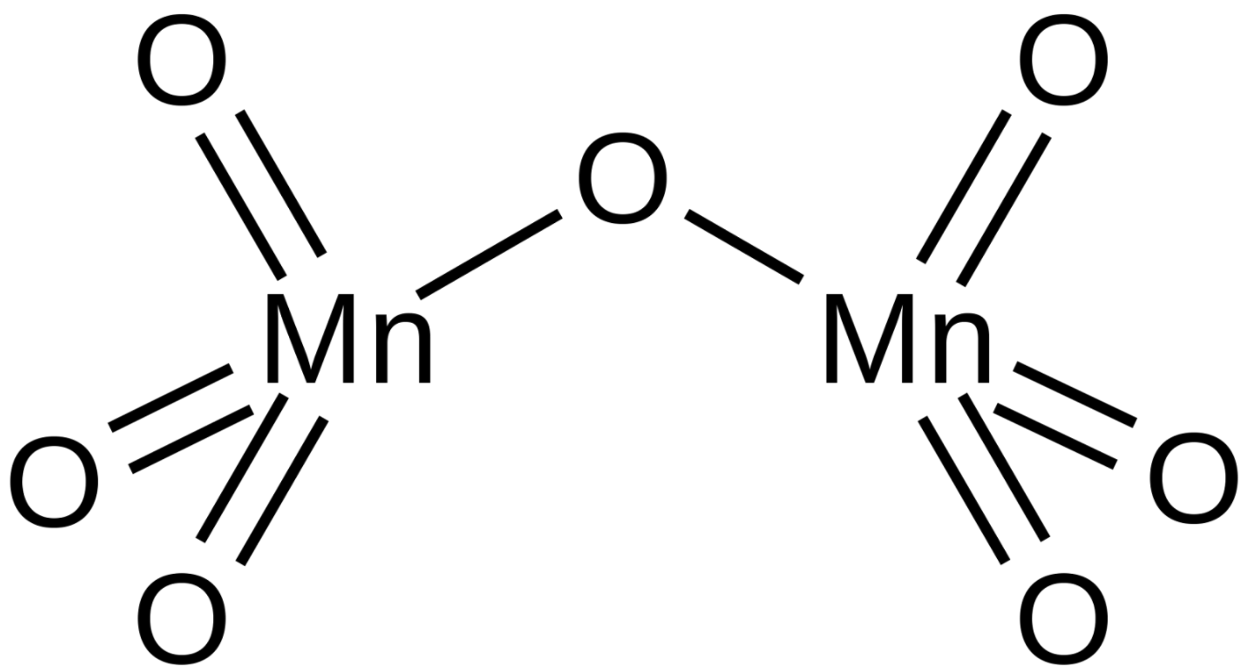
While algorithms for solving complex optimization problems do exist, Salahuddin and his team set out to build an algorithm that would require only minimal hardware — in this case, a single, programmable chip. In the study, researchers tested both the efficacy of this algorithm and its viability on hardware. The researchers put their chip to the test against a traditional processor on power-hungry tasks, like factoring 16-bit numbers. The chip beats the processor every time.

By combining machine learning with hardware design, the researchers hope to eventually develop a protocol that will enable small devices to quickly solve optimization problems. In the foreseeable future, a delivery person might be able to calculate the most efficient distribution route in just a few minutes using a cell phone or a smartwatch, which could help reduce our dependence on power-hungry server farms and, potentially, our carbon footprint.

Manganese Heptoxide

By Kenny Wu

Manganese heptoxide (Manganese VII oxide) is a highly reactive compound first found during the mid-1800s. This volatile liquid holds the potential to set nearly any organic material on fire and tends to explode upon contact with metals. This dangerous and unstable oxidizing agent applies the formula of Mn_2O_7. Due to Manganese heptoxide being a strong oxidizer, it will seek any opportunity to decompose, which may occur through interactions with objects or spontaneously.



Manganese heptoxide is formed by combining concentrated sulfuric acid and potassium permanganate, two relatively common compounds. Sulfuric Acid interacts with Potassium Permanganate to form Permanganic Acid when these two chemicals are combined. The Sulfuric Acid then dehydrates the Permanganic Acid, resulting in an anhydride variant. A new molecule would be generated by combining two Permanganic

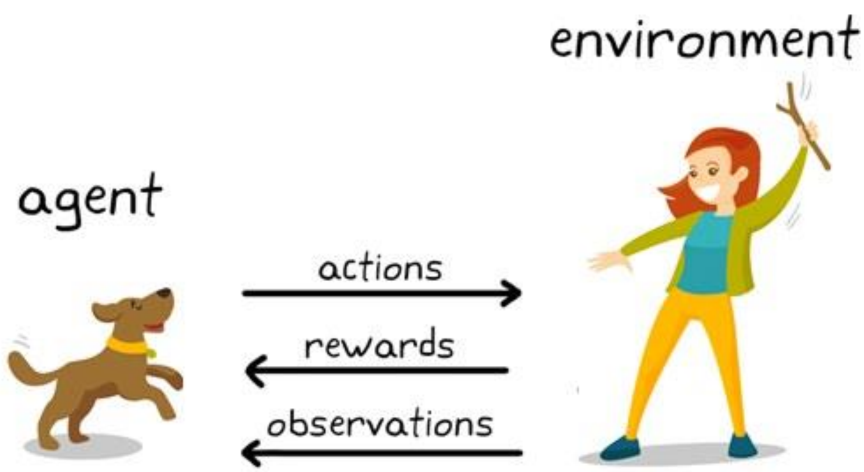
Acids. However, depending on how much potassium permanganate was added, a spontaneous breakdown can be rather simple to handle.

Regardless of how careful you are, playing with Manganese heptoxide is certainly unrecommended. When this liquid comes in contact with other objects, the reaction can be extinguished by adding water, which will kill any surviving Manganese heptoxide and revert it back to the pinkish Permanganic Acid. After a reaction, Manganese Dioxide can generate small, light particles that float around in the air, and it is critical not to breathe in any of these chemicals. Remember to always stay safe during experiments.

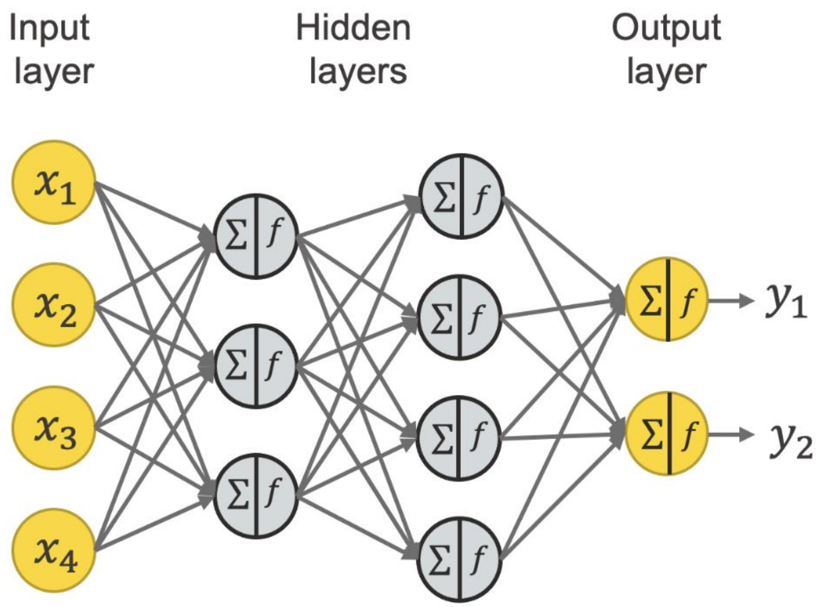
Rise of the Digital Brains

By Ethan Chen

Machine learning is the process of training a machine to achieve some functionality without a human specifically programming it to do so. Oftentimes, machine learning is used in place of explicitly writing the implementation because the implementation requires incredibly complex and fine-tuned calculations from an enormous number of inputs. Machine learning algorithms are used to guide the program toward a certain goal or behavior, such as through reinforcement training, supervised training, and unsupervised training.



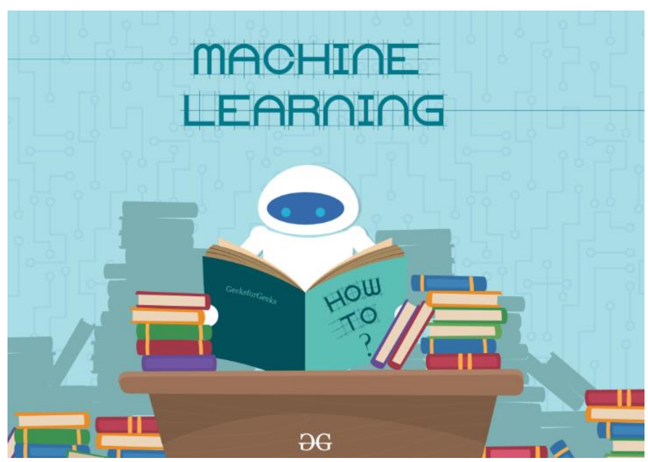
With reinforcement learning, a program is given an input, it returns an output, and then the output is graded based on how close it is to the desired behavior. This process of input, output, and grade is repeated, hundreds, thousands, or even millions of times. Throughout these trials, the program is being slightly tuned and changed by the training algorithm, optimizing for the highest grade possible. For instance, if a program is tasked to drive a racecar around a track in the shortest time possible, it would be given tons of inputs from its surroundings, such as the distance to nearby walls, its speed, and its direction. While driving around the track, the program would be taking these inputs and using them to calculate how to take the next turn or what speed to move at. After completing a lap, it would be graded based on how fast it did it, and then recalibrated by the training system to change how it responds to inputs. After passing a number of these trials, the program would eventually become fine-tuned to be proficient at driving a car around a track.



One of the most famous types of supervised learning are neural networks. Neural networks work by having a network of nodes which take input values and, depending on the weights and biases of the inputs, may or may not send an output to the node ahead of it. When mapped out, neural networks look similar to the complex structures and webs of neurons inside brains, which provides them with their namesake.

Much like reinforcement learning, neural networks rely on lots of input and lots of grading to adjust the sensitivity and connections between nodes, increasing their accuracy over time. However, a vital difference is the ability to directly influence the behavior of the program by changing the weights of certain inputs. For example, a neural network being trained to determine whether an AI agent should fight or flee would have inputs such as the difference in strength between the agent and the opponent, the distance to escape routes, and the presence of allies. These inputs won't necessarily have equal weight in determining the final decision, which means an agent going through fight-or-flight trials would eventually have their nodes arranged and weighted to optimize for the best decision or behavior for any situation it was trained for.

In contrast, unsupervised learning involves much larger sets of input data, but this data is now unlabeled, and the outputs are no longer graded. This method of training a program is most effective at finding differences and similarities between data sets, as opposed to specifically identifying certain data sets. For example, an unsupervised program would not be able to tell trains from buses, but would be able to list their differences (such as windows, tracks, shape) and characteristics (headlights, bumpers, wheels). When given enough input, these programs can eventually determine if it has received a brand new image that isn't similar to the data it was trained on, or determine if a new image is similar to existing images from the original data set. This is extremely helpful for grouping massive, unlabeled piles of data together, such as clustering similar news headlines on search engines, and finding faulty areas in equipment or anatomy.

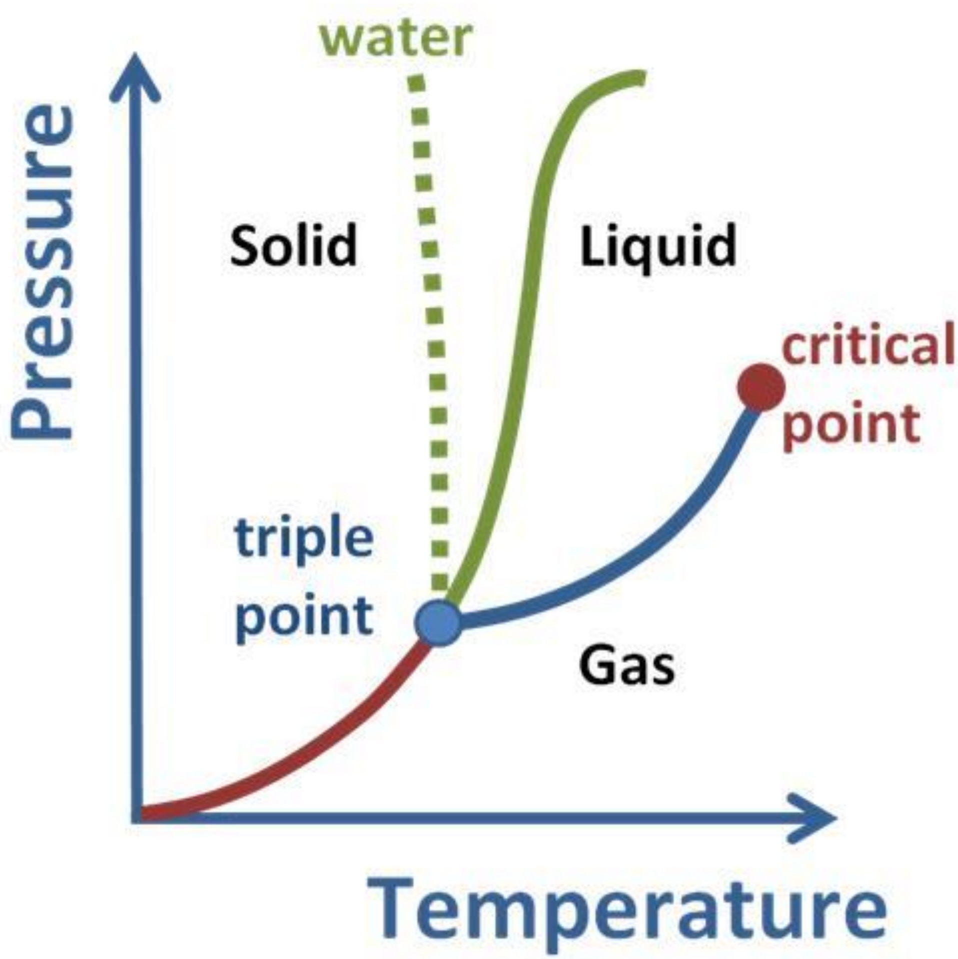


All in all, machine learning is an incredibly powerful tool that can be done through a variety of methods. Through reinforcement learning, programs can be slowly adjusted toward certain incentives, enabling them to eventually achieve some goal or behavior. With supervised neural networks, machines can literally have their brain rewired and molded to accomplish learning objectives and desired outcomes. At the same time, unsupervised machine learning allows for massive sets of data to be organized, allowing for easier accessibility by humans and other programs. While machine learning is a fairly recent innovation, it has grown exponentially in presence and power year over year, helping change the world through its ubiquity in our lives, whether it's recommending us YouTube videos, showing the latest relevant news, or autonomously driving our cars.

The Triple Point of Water

By Cathie Zhu

In thermodynamics, the triple point of any substance is referred to as the temperature and pressure in which the gas, liquid, and solid forms coexist in thermodynamic equilibrium. Thermodynamic equilibrium is an unquestionable concept in thermodynamics where there are no macroscopic flows of matter or energy within systems. The triple point is the temperature and pressure which the sublimation curve, fusion curve, and vaporization curve meet. It was used in order to define kelvin, thermodynamic temperature's base unit in SI.



Liquid water, solid ice, and water vapor can coexist in equilibrium at precisely 273.1600 K, 0.0100 degrees Celsius, or 32.0180 degrees Fahrenheit. At this point, it is possible to alter all of the substance to ice, water, or vapor by making relatively small changes in temperature and pressure. The system can still be brought to the triple point of water even if the total pressure is well above that of the triple point of water, as long as the partial pressure of the water vapor is 611.657 pascals.

The triple point of water corresponds to the minimum amount of pressure at which liquid water can exist. When pressure is below the triple point, solid ice that is heated at constant pressure is converted to water vapor. This process is described as sublimation. When the pressure is above the triple point, solid ice that is heated at constant pressure melts firstly into liquid water, then evaporates to form a vapor.

The triple point is also often the minimum temperature at which the liquid of a substance that can exist. However, in the case of water, this is not true. The melting point of ice decreases as a function of pressure, as shown in the phase diagram. Compression at constant temperature transforms water vapor first to a solid, then to a liquid at temperatures below the triple point. Due to the lower density of ice compared to that of liquid water, increasing pressure leads to a process called liquefaction.

A Glint of Realism: Holograms

Brian Wang

How do the holographic displays from movies such as The World Is Not Enough, Harry Potter, or Jurassic World, even work? For a long time, many believed that this was only imaginary. However, fiction soon became reality as technology continued to advance. Holographic displays are types of displays that create a virtual 3D image using light that is seeable without glasses. They can be easily manipulable, from showing pictures of a rotating globe to a human talking.

From a technical point of view, the screens we see in our everyday lives are 2D pixels that show color and intensity through simulation. The difference between these virtual objects and those in real life is that light reflects on objects from different angles. This effect creates a sense of "realism" for us, such that it also builds parallax motion and visual depth. The three key components of a hologram are a laser, display, and optics. Using the laser as a reference point, the hologram can intertwine its patterns and show this on the display. Just like how we perceive "realism", this display uses optics to direct light at different angles.

One such company that excels in this industry is called Looking Glass Factory. Shawn Frayne and Co-Founder Alex have always been bewildered by this idea of bringing holograms into real life. In some cases on some of the devices they offer, it first sends out one hundred million points, which are controlled through directionality, creating a realistic light simulation. To break some of these processes down, they take hundreds of images of an object. They combine them into a video but use each frame for a sense of perspective. According to Jesse Orrall at CNET, "These smaller desktop displays are aimed at developers, while the 8k immersive displays are aimed at specific industries, like medical imaging, holographic mapping, and scientific visualization."

As we continue to do more research, our knowledge of holograms will only grow more and more. Eventually, people will be able to live their childhood dreams in seconds.

Exploring the Deep Sea

By Arthur Liang

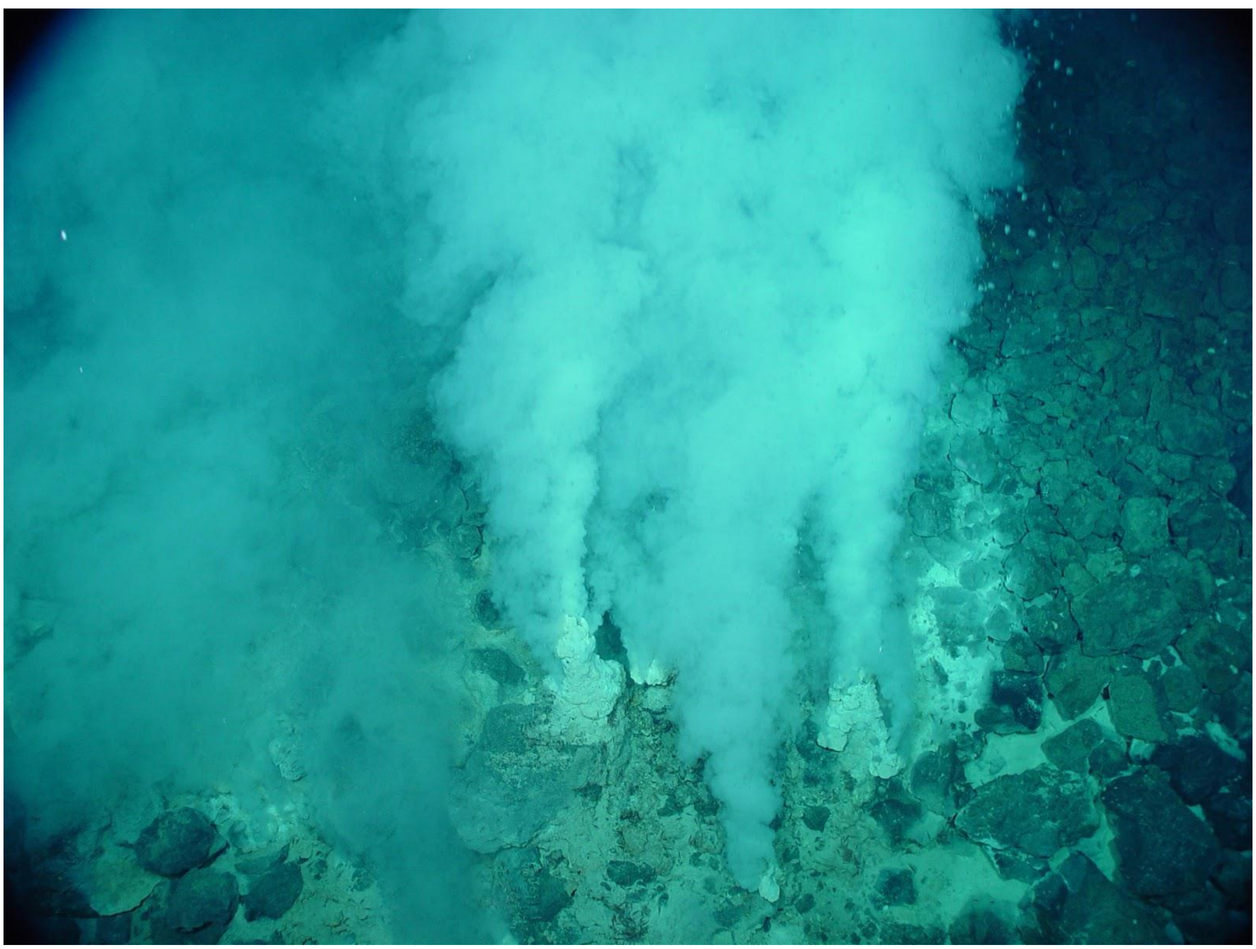
Wherever there is space to expand to on Earth, humans go there. Humans have conquered the tallest mountains and the coldest landscapes. Yet there is one place we have yet to reach, the deep sea. The temperatures, pressures, and lack of oxygen make this one of the most difficult places for humans to explore apart from space. However, it is
also the home of a diversity of species. Let's dive down and investigate this environment for ourselves.

We inhabit the epipelagic or sunlight zone from the surface to around 200 meters deep. Here, sunlight can still penetrate the water, allowing photosynthesis to occur. This creates a life-filled ecosystem of coral reefs, algae, plankton, and sea plants that support many sea animals.

As we dive deeper, we reach the edge of the continental shelf, which leads to the continental slope. Sunlight slowly fades and becomes dimmer, resulting in plants becoming rarer and rarer as we go down. Until the 1000-meter point, we are in the mesopelagic, or twilight zone. Though dim, many fish and other organisms spend time down here during the day to hide from predators. At night, they go back up to the nutrient-rich surface waters. In the darkness, light becomes a powerful tool, and over 90% of species native to this environment have some kind of bioluminescence.

Organisms here survive off of marine snow that falls from above, mainly made of dead matter, fecal matter, and particles of shells, sand, and dust.

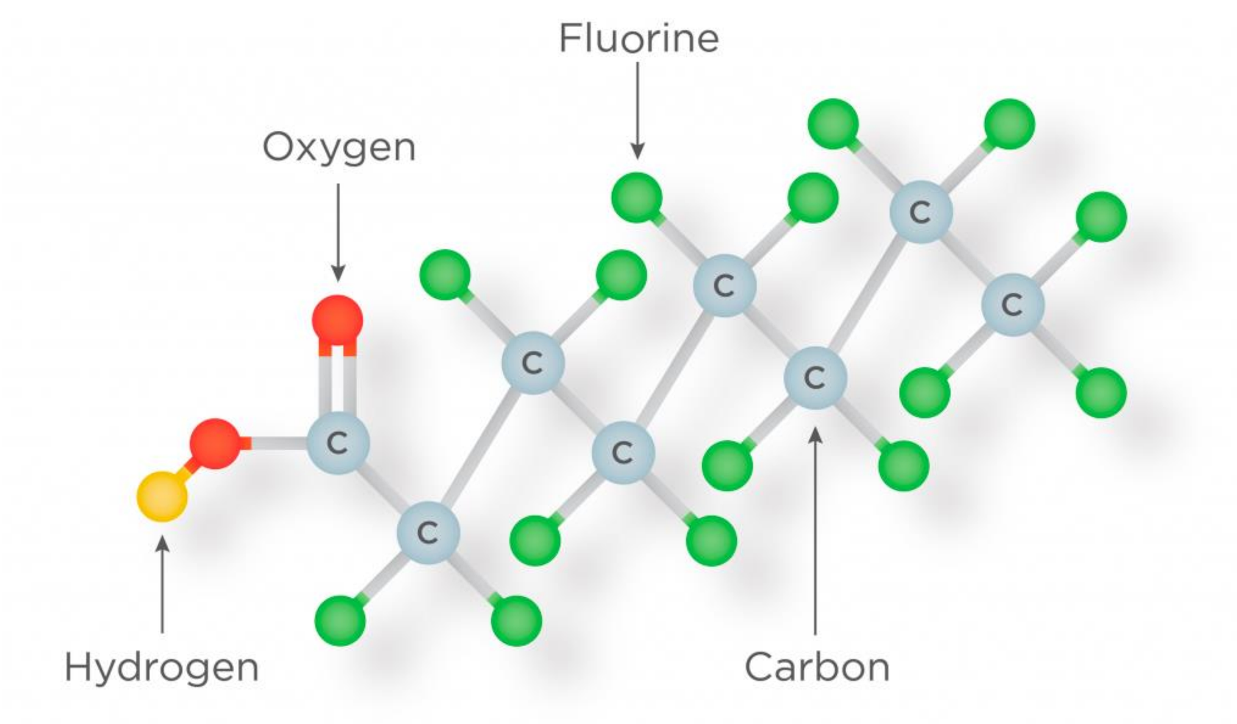
From 1000-meters to 4000-meters, we reach the midnight zone, a place of darkness. Down here, it is much harder to find food, and organisms evolved to be very energy efficient. Everything hovers motionless or moves almost in slow motion. At 4000 meters, we reach the ground again. Occasionally, we find black smokers or hydrothermal vents that spew minerals out from where magma heats up seawater. These minerals can be used, so around these vents, there are oases of life. At 6000 meters, we reach the Abyssal plain, and here is where the sea ends for most parts of the world, except for places like the Mariana Trench, which reaches 11000 meters deep.



Community Report 1: Breaking Down the Toughest PFAs

By Arthur Liang

Polyfluoroalkyl substances, or PFAs, are a group of chemicals that have been used in industrial and commercial processes since the mid-20th century. PFAs have found their way into the water cycle and now can be found in almost every water source. PFAs contain a bond between carbon and fluoride atoms, the strongest single bond known, making PFAs non-biodegradable and hard to filter out of water systems. When they end up in the tissues of organisms, they can cause problems and are currently associated with diseases like cancer, thyroid problems, and liver problems.



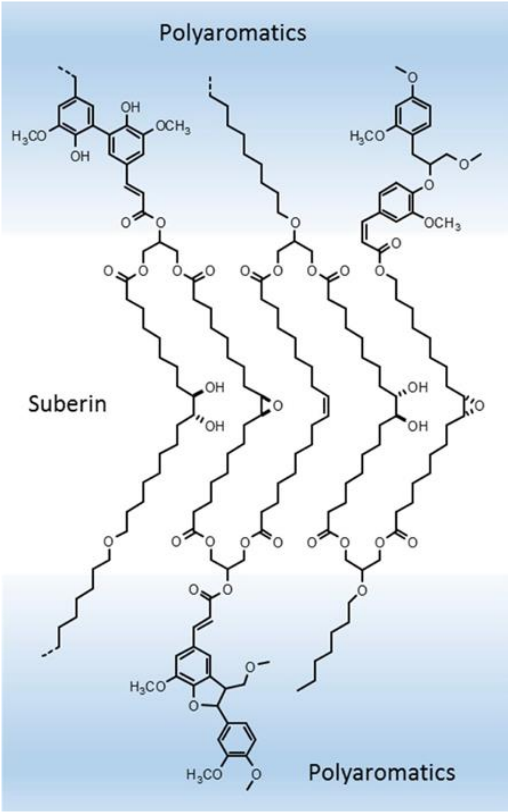
Engineers at UC Riverside have recently been the first to be able to break down a stubborn class of PFAs known as FCAs (fluorinated carboxylic acids). The breakdown was completed using anaerobic microbes. These microbes enter through a carbon double bond. Though breaking this double bond does not completely destroy the molecule, it breaks it down for other microorganisms to handle. Microbes capable of doing this are not rare, they can be commonly found in activated sludge (which are already used in wastewater treatment facilities). However currently, the work is not done because the FCA breaks down into other molecules which can also be harmful. Complete treatment requires breakdown of the parent molecule as well as degradation of the secondary molecules. Studies have found that certain sludge communities could completely break down a secondary molecule, implying that through cooperation of different microbe groups, deeper breakdown can be achieved.

Community Report 2: Protecting the World's Rice

By Arthur Liang

Rice is one of the world's most important crops, a major source of calories for 45% of humanity, so scientists are investigating the plant's technique for handling environmental stress. A team at UCR has observed what happens to rice under two stressful scenarios, either too much or too little water.

One important finding in this experiment was seeing a substance called suberin, produced by rice roots in response to stress. It protects the plant in floods as well as droughts. Suberin is a lipid that helps water go from the roots to the shoots, and helps oxygen go from the shoots to the roots. Suberin also cannot be broken down by microbes in the soil, so carbon that the plant stores in suberin will stay in the soil. This means suberin can also remove and store carbon from the atmosphere. Researchers were able to identify the gene that controls suberin production and can enhance its production by using gene editing or selective breeding.

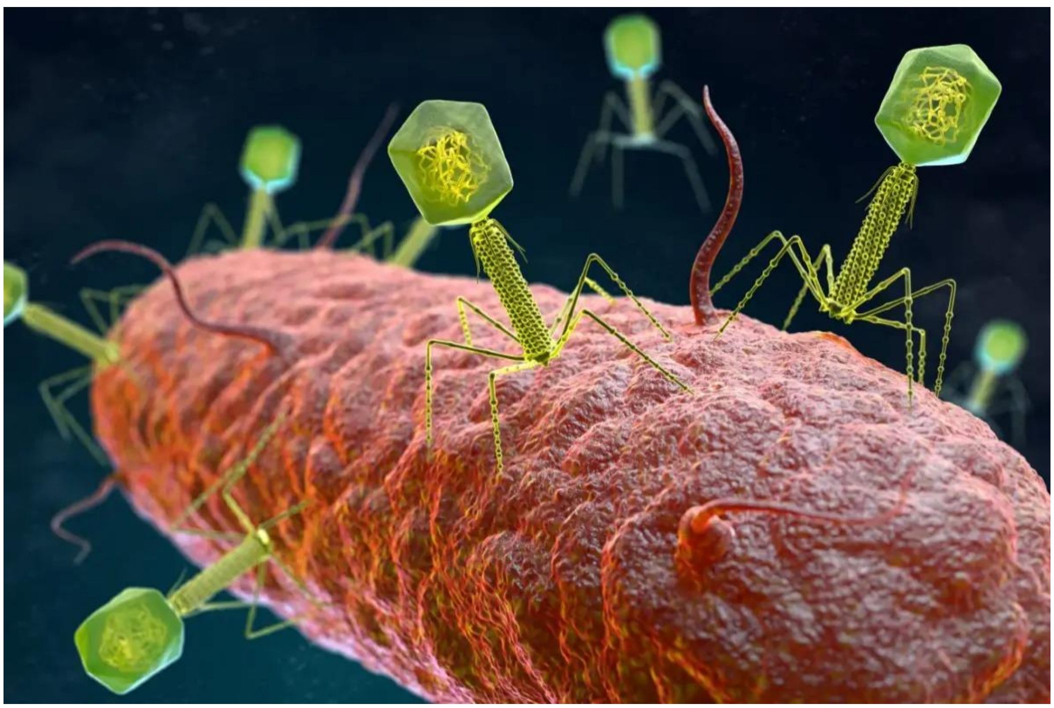


The research team plans to modify these stress responses to make rice more resilient and tolerant to both wet and dry conditions. They hope that new genetic technology can save this plant before it is too late.

Phage Therapy to Kill Bacteria

By Annabella Luo

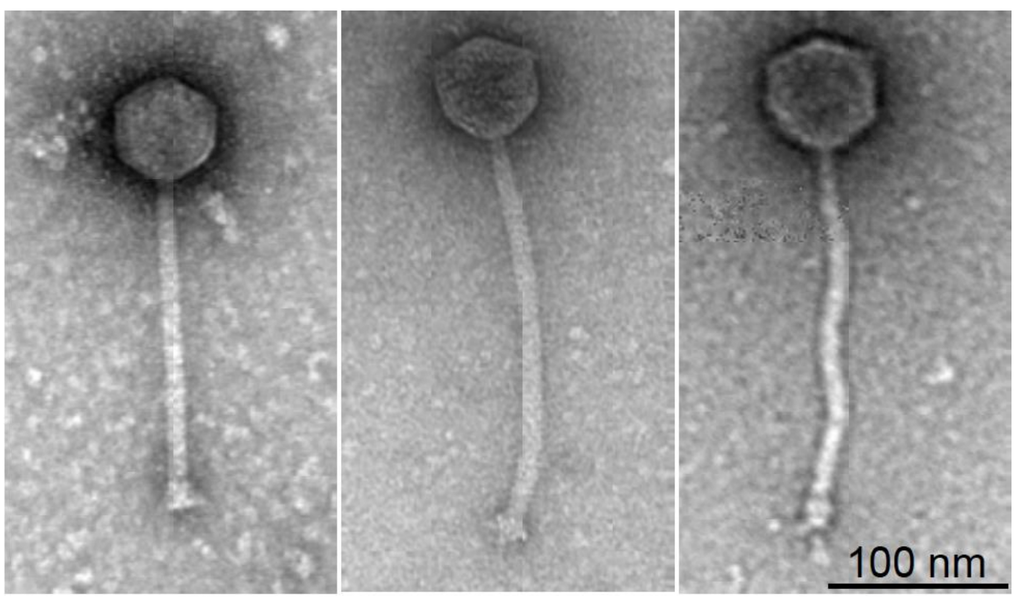
Bacterial infections are becoming increasingly difficult to treat due to antibiotic resistance built up by bacteria as they evolve and adapt to medication. UCLA biomolecular engineers and their colleagues are developing an alternative therapy to treat wound infections using phages — viruses that infect bacteria — to kill bacteria resistant to antibiotics.



Since the introduction of penicillin, the first group of antibiotics, to treat bacterial infections in the 1940s, antibiotics have saved millions of lives. They interfere with bacteria's ability to properly reproduce, stifling their vital functions or wrecking their physical structure. However, infections have been increasingly difficult to treat with the rise of antibiotic-resistant strains of bacteria.

Phages are common in nature and are essentially viruses that infect bacteria instead of other organisms. They latch onto the host bacteria's cell wall, then inject genetic material for replication, killing or at least slowing the growth of the bacteria. The potential of using phages for treatment of wound infections has been considered for more than 100 years. But a few concerns previously held back further research. These include inconsistent effectiveness, safety concerns, the potential for phages to transfer antibiotic-resistant genes into the host bacteria, as well as other potential evolutionary effects on bacteria that could render them more difficult to suppress.

To work around those challenges, the UCLA researchers combined phages with nanoscale rods of gold. These nanoparticle-phage combinations first attach themselves to the cell walls of host bacteria. Using near-infrared light, the researchers then heat up the gold rods and rupture the bacteria on the wound, killing them within 15 minutes. The phages are also destroyed in the process, eliminating the potential transfer of undesired genetic material.

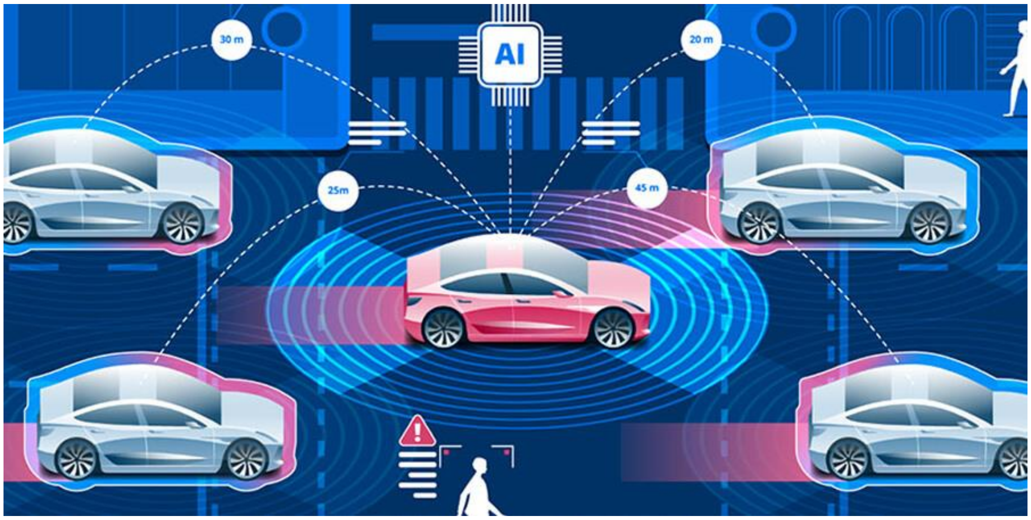


The research team led by Dr. Irene Chen, who is an associate professor of chemical and biomolecular engineering at the UCLA Samueli School of Engineering. showed that the technique, demonstrated under in vitro conditions, also works in mice and is well tolerated. A study detailing the new finding is published in the American Chemical Society journal ACS Nano. The therapy is currently in preclinical stages.

Rise of Autonomous Cars

By Nick Li

Autonomous cars combine a variety of sensors to perceive their surroundings, such as radar, computer vision, Lidar, sonar, GPS, odometry, and inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage.



Autonomous vehicles are frequently believed of in terms of their use for people, but they can have even as more influence on technical drive at this supplies business. For hundreds, logistics companies have made profits on increasingly narrow profit margins. Now businesses like Amazon are using autonomy—inside and outside the warehouse— to their benefit.

Some of America could recall this attractive driverless automobile that Google got revealed in 2014 which took the peak rate of 25mph. Instant ahead to 2017 and we see some carmakers have already brandished their autonomous car technology and many of them aim to roll out production vehicles with driverless capabilities by 2020. Automakers such as Ford, General Motors, Baidu, Google, Tesla, Lyft, etc. Plan to have some form of the autonomous vehicle (car) ready for commercial use within the next five years.

Goldman Sachs predicts that by 2030 driverless cars are estimated to contribute to 60% of U.S. auto sales.

With this growth of field like self-driving automobiles and droning, it's evident that we've participated the phase of quickly producing independent steering. New organizations exist unusually honest in their intended environments, and the robots being developed by companies like Boston Dynamics prove that autonomous navigation can be adept even in unpredictable terrain. The problem is that these systems are extremely dependent on GPS or other external location systems.

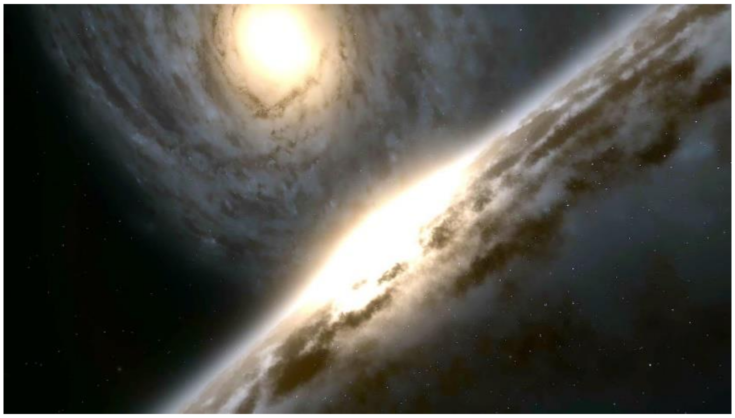
Beyond the Milky Way

Anna Dai

It is clearly known that our home is located on Earth and, even broader, the Milky Way. Where is the Milky Way? It's located in a small group of galaxies called the Local Group. But what is beyond this little group? Only five percent of the universe has been discovered and ninety-five remaining. And what could possibly be in this remaining ninety-five percent? Extragalactic objects or extraterrestrial life? So many questions need to be answered and the only way is to risk an adventure beyond.

The nearest galaxy to the Milky Way is the Andromeda Galaxy, and as of now, no one has traveled to another galaxy. Traveling between galaxies, called intergalactic travel, is past the capabilities of the present but is not entirely impossible. Going beyond the Milky Way is unthinkable, however, going beyond the Solar System is not.

Astronomers in the 1990s discovered the first few planets outside of the Solar System. More than 4,000 exoplanets within the Milky Way have been confirmed. Unexpectedly, astronomers located a possible "extragalactic exoplanet." According to NBC News, the Hubble Space Telescope and the Chandra X-ray Observatory composed an image of a planet detected outside the Milky Way. Scientists think that it consists of a black hole or a neutron star.



Scientists believe that there are at least 100 billion more galaxies in the universe, and out of all of these galaxies, there must be some sign of life. It's hard to think that Earth is the only place where living things thrive in. A good percent of exoplanets, planets that orbit a star outside the Solar System, are habitable. This means they have a similar structure to Earth. The possibility of life existing on these planets is healthy. However, exoplanets have been observed by the strongest telescopes, and still, no signs of life were found.

Information about the mysteries outside of the Milky Way is unreachable. On the other hand, astronomical objects within the Milky Way are already discovered. Some of these objects, exoplanets, are similar to Earth, which leads to a chance of life inhabiting them. Besides that, an extragalactic exoplanet has recently been discovered. There is still so much more that space is hiding and needs to be revealed.

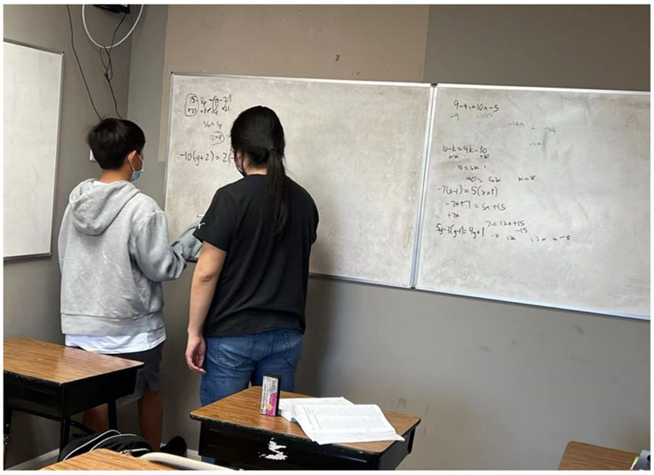
Vex Robotics Spin Up

By Stephen Hung

The new VEX Robotics Competition season for middle school, high school, and college students has begun with the release of the game called Spin Up. Students will design a robot that must be able to perform a variety of tasks efficiently with an alliance against another alliance. VEX Robotics builds discipline in the area of engineering for young adults. Not only are students required to design a competitive robot, but detailed documentation in an engineering notebook and a strong judge's interview is also needed.

Games are played on a 12′ by 12′ square field with 4 robots consisting of 2 robots from a random blue alliance and 2 robots from a random red alliance. A 15-second autonomous period where the robot can only operate by preprogrammed steps is available before the drivers are allowed to control the robot for 1 minute and 45 seconds to score the most points possible. Driver and programming skills are also available for teams to see how many points they can score individually.

In VEX Spin Up, there are 60 foam disks on the field, 4 rollers, and 2 high nets in the corners of the field. Robots must be able to pick up disks and score them in the high nets and each disk scored in the high goal is worth 5 points. Underneath the high nets is the opposing team's low goal, and disks landed in there add 1 point to their score. Robots also must be able to spin the rollers located on the edge of the field, and the color that is facing upward on the roller at the end of the match determines which alliance owns that roller. Each roller is worth 10 points. Furthermore, at the end of the match, each tile that the robot is covering adds 3 points to the alliance's total score. This game will be very challenging for both experienced and new teams, and it will be quite interesting to see what designs will appear at competitions.



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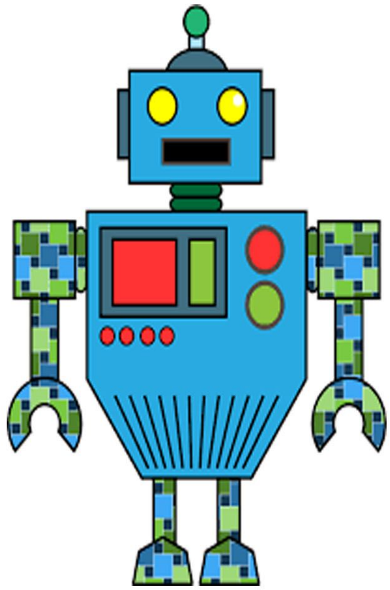

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