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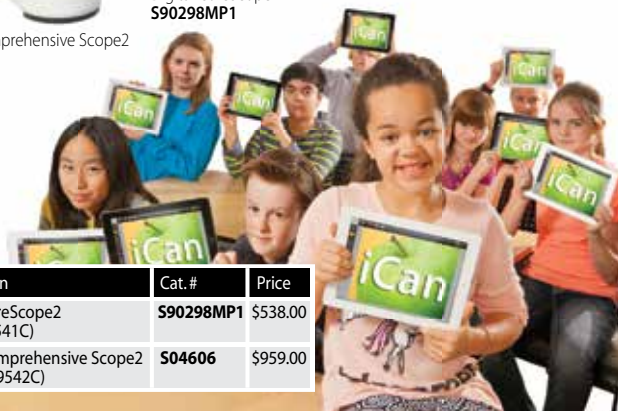
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ROBOTS in the Lab:

Automation Through the Ages

By Kerry Connell

From Gort to HAL, from Robby to Rosie, robots have long been a part of our popular culture. In our world, these old robots seem quaint and kitschy — they're nothing like our industrial and medical machines. Today, robots are technology unpersonified: efficient, practical tools that help us accomplish our goals. The many ways we routinely use robotics in the lab would boggle the minds of our very imaginative forebears.

Ancient Robots?

We tend to think of robots as a modern idea, but the engineers and artists of ancient civilizations all around the world were the first to build (or attempt to build, or at least describe) automated machines. Perhaps the first to succeed was Plato's friend Archytas, the founder of mathematical mechanics; his self-propelled artificial pigeon reportedly flew approximately 200 meters. A couple of hundred years later, around 270 B.C., Ctesibius (the father of pneumatics) created a water clock with animated figures.

Ancient mythologists, too, wrote of mechanical people. The Roman god Vulcan was said to have created robot servants. Jewish and Norse legends both include references to animated clay people. A third-century

Chinese text, the *Lie Zi*, includes the story of a mechanical engineer who presented the king with a mechanical man. And, of course, there's Leonardo daVinci to consider.

The First Modern Robots

The beginning of the twentieth century saw the birth of the first modern robots — practical devices like Westinghouse Electric's Televox and parlor tricks like Elektro, the seven-foot marvel of the 1939 World's Fair.

In 1954, George Devol invented Unimate, the first digitally operated, programmable robotic arm. Unimate transformed automobile manufacturing and kicked off the modern robotics industry. Nearly every industry uses robots now instead of humans for jobs that are too dangerous or for jobs that demand precision and accuracy beyond human ability. Naturally, laboratories have embraced robotics.

Lab-Bots

Laboratory robotics began with early applications in peptide and oligonucleotide synthesis. In 1983, Kary Mullis developed the polymerase chain reaction (PCR),

which uses a computer program to control temperature to accomplish DNA synthesis and generate copies. Organic chemistry processes also use automated synthesis.

In biological labs, robotic equipment can handle standardized microtiter plates, which scientists use to store samples that must be frozen or sealed to avoid degradation or contamination. The Society for Biomolecular Screening developed the microtiter plate standard, and labs everywhere use robotic liquid handlers or plate movers to prepare or move the plates. Standardization is key to the development of robotic technologies.

Some companies have developed technology that further automates biological handling. Andrew, by Andrew Alliance, is capable of interfacing with volumetric pipettes, effectively automating the handling processes and removing human error. Other instrumentation companies have developed plate readers that use optical or computer vision to detect specific changes in microtiter plates.

Med-Bots

Pharmaceutical companies like McKesson design robots that automate entire pharmacies to eliminate medication errors, and the daVinci Surgical Robot allows surgeons to perform minimally invasive surgery by controlling tiny instruments remotely and viewing their work on a magnified, three-dimensional display.

In the pharmaceutical lab, robotic arms have revolutionized sample preparation for processes like nuclear magnetic resonance and high-performance liquid chromatography-mass spectrometry (HPLC). The combination of nuclear magnetic resonance and x-ray crystallography allows for the automation of structural protein analysis. Robotics has also made it possible for scientists in

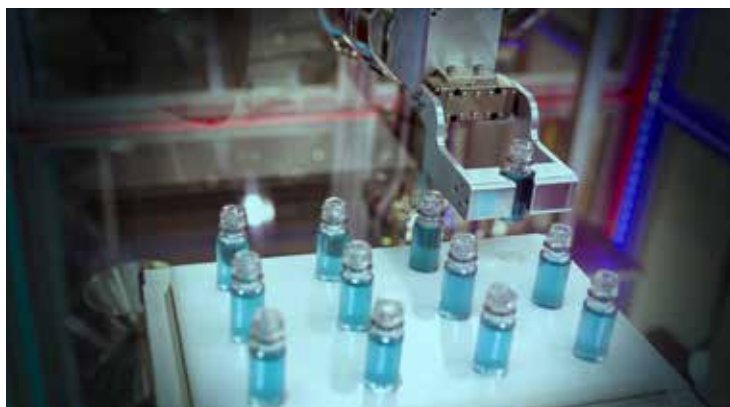
combinatorial chemistry pursuits to use very small quantities of reagents to make millions of compounds at once.

Pure-Bots

Robots also perform functions related to purification, such as the automation of simulated distillation (a type of gas chromatography) in the petroleum industry. Automation via microprocessors allows scientists to perform ion-exchange separation on a nanoliter scale very quickly.

But What About Humans?

As the science of robotics evolves, so too will our ability to apply automated technologies to laboratory tasks. In fact, a machine called the Robot Scientist (also known as Adam) is a prototype that is able to hypothesize and perform experiments independently. It also interprets its findings without human guidance. Does this mean that human scientists are on their way out? Not at all! Humans — not robots — are the ones with the imagination, passion, drive and insight to investigate challenges and discover answers that can change the lives of people worldwide. We have a stake in our research; robots do not. Besides, humans are the one who can flip the "off" switch.



[CLASSROOM DISCUSSION]

Discuss the advantages and disadvantages of using robotics in the laboratory.

What other applications and industries do you think could benefit from using robotics?

[VOCABULARY]

PERSONIFY

PEPTIDE SYNTHESIS

OLIGONUCLEOTIDE SYNTHESIS

PCR

SYNTHESIS



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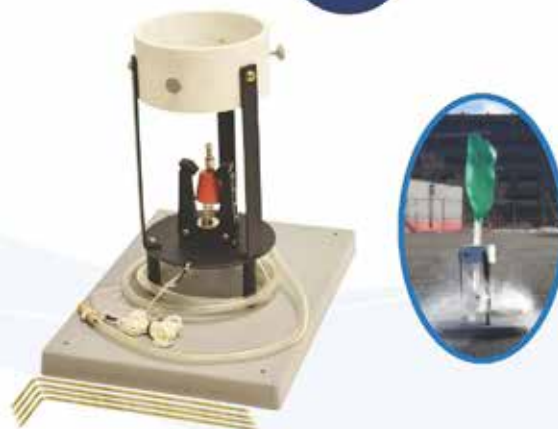
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Humans and Lizards in the Land of Dreams

By Mike Howie

Everyone, and everything, needs to sleep. Scientists aren't quite sure why we need sleep, but it's been proven time and again that nothing good happens when you don't get enough of it. Efforts in studying sleep haven't been entirely fruitless, though: It's clear that there are multiple stages of sleep, and now we're starting to learn that they might be more common between animals than previously understood.

Stages of Sleep

Generally speaking, there are two patterns of brain activity in sleep. The first is slow-wave sleep, which has four stages in humans. During all of these stages there is little activity going on in the brain. The other pattern is known as REM, or rapid eye movement, sleep. This pattern is associated with dreaming in humans and was previously thought to occur only in mammals and birds. These two patterns cycle back and forth

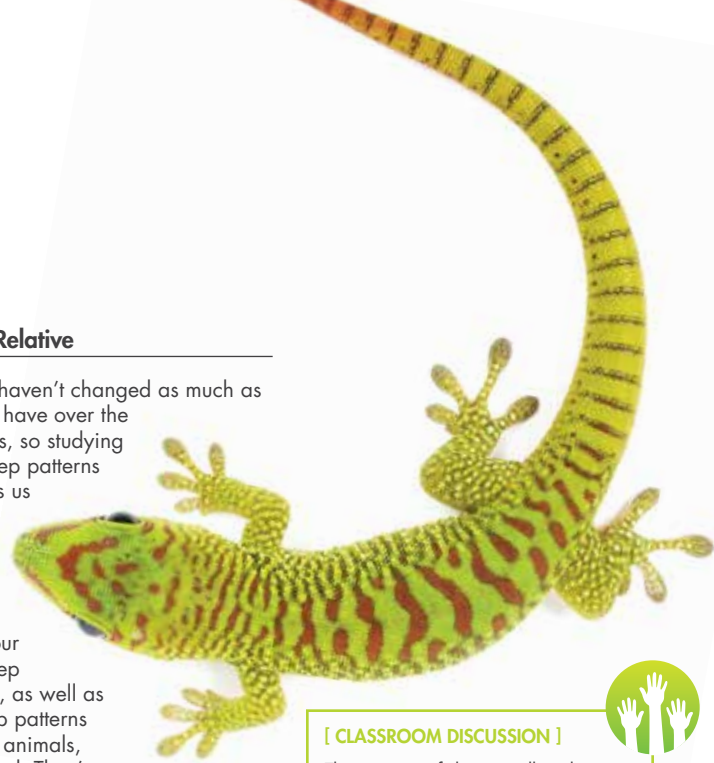
throughout the night, with each cycle lasting about 60 to 90 minutes each in humans.

Sleepy Lizards

While monitoring the brain activity of lizards, a team in Germany noticed that they have two patterns of brainwaves while asleep. The first is 4Hz, a low frequency similar to slow-wave sleep, and the second is at 20Hz, a higher frequency similar to REM sleep. These patterns occurred in a cycle similar to the one in humans but at a shorter interval, lasting only 60 to 90 seconds each. To back this up, the researchers used an infrared camera to record video of the lizards while they slept, which clearly shows the lizards' eyes twitching as they sleep. This doesn't necessarily mean that lizards and other reptiles dream just like humans do, but it does tell us that our sleep patterns are older than we thought they were.

It's All Relative

Lizards haven't changed as much as humans have over the centuries, so studying their sleep patterns provides us with a new way to study where our own sleep patterns, as well as the sleep patterns of other animals, originated. They've already helped us to discover that our sleep patterns are about 300 million years old, which is much older than we had once thought. While we're not quite there yet, it's exciting to learn that we're getting closer and closer to unlocking all of the secrets of sleep.



[CLASSROOM DISCUSSION]

The purpose of sleep is still unclear. Why do you think we need to sleep so often to stay healthy?

What could the brain be doing during REM sleep, and why are periods of REM sleep spread out?

[VOCABULARY]

SLOW-WAVE SLEEP

REM SLEEP

HERTZ



Robo-Mermaid Discovers Ancient Shipwreck

By Celeste Beley



(Image credit: Frederic Osada and Teddy Seguin/DRASSM)

Imagine finding treasure from a shipwreck, untouched for over 350 years, without even getting into the water. Seems impossible, right? But a new humanoid robot could allow for discoveries like this and more in the deepest depths of our planet's waters.

OceanOne, the humanoid robot developed by Oussama Khatib, enables humans to discover and explore parts of the ocean that have previously been unreachable, all while remaining dry aboard a nearby boat. A professor of computer science at Stanford University, Khatib initially developed OceanOne to study coral reefs in the Red Sea, a depth far greater than human divers can comfortably go. The prototype combines human-like vision, robotics, artificial intelligence and haptic feedback systems that work together to create a one-of-a-kind robot.

On its maiden voyage, OceanOne swam through the wreckage of La Lune, the flagship of King Louis XIV of France, which sank in the Mediterranean in 1664. This ship has remained untouched by humans for centuries, but OceanOne was able to explore the wreckage and recover from it a vase, fully intact, which it brought to the surface.

Anatomy of a Robo-Mermaid

The head of the approximately five-foot-long robot features stereoscopic vision — allowing the pilot to see exactly what OceanOne sees — as well as two fully articulated arms. At the ends of those arms are hands equipped with force sensors that relay haptic feedback to the pilot's controls, which allow the human to gauge whether the robot is holding

something light or something heavy. Besides shipwrecks, the robot can also handle delicate coral reef research and sensor placement.

While a pilot can control OceanOne, the robot is able to perform without human interaction. Sensors detect current and turbulence data that automatically adjust thrusters to keep the robot in place and activate quick-firing motors to keep the arms steady. Multiple sensors and cameras also give OceanOne a full perception of the surrounding environment while the robot runs data through algorithms to help it avoid collisions.

OceanOne was ultimately developed to perform tasks deemed impossible or too dangerous for humans, including deep-water mining, oil-rig maintenance and even dealing with underwater disaster situations. But

its combination of technology with human expertise makes it truly unique. "We connect the human to the robot in very intuitive and meaningful ways. The human can provide intuition and expertise and cognitive abilities to the robot," Khatib said. "The two bring together an amazing synergy. The human and robot can do things in areas too dangerous for a human, while the human is still there."

[CLASSROOM DISCUSSION]

Think of all the applications for a robot like OceanOne. What application do you think would have the biggest impact, and why?

[VOCABULARY]

HAPTIC FEEDBACK

TURBULENCE

STEREOSCOPIC





Gold Nanoparticles May Help Detect Kidney Disease

By Hamilton Waldron

In an effort to help urologists better understand the early stages of kidney disease, University of Texas at Dallas scientists are currently experimenting with some very innovative techniques.

Dr. Jie Zheng, associate professor of chemistry and biochemistry at UT Dallas, is using tiny gold nanoparticles combined with a technique called *in vivo* near-infrared fluorescence imaging to study early-stage kidney disease in a live animal model.

It is estimated that roughly 10 percent of adults in the U.S. may have chronic kidney disease. This is a scary reality, as kidney disease is often dubbed “the silent killer,” and usually worsens before anything can be done.

A Golden Solution

Noninvasive *in vivo* near-infrared fluorescence is inexpensive and used by many in laboratories. The way it works is pretty amazing.

First, a fluorescent organic dye is introduced into the subject, which is then exposed to an external source of invisible near-infrared light that can penetrate the skin. When the light reaches the dye, the dye displays a light of a different wavelength, which is then transmitted by a camera. This technique helps facilitate and inform eventual clinical investigations of disease in humans.

However, this technique has proven difficult for preclinical kidney disease studies because organic dyes don't produce an adequate contrast in the kidneys. But Zheng and his colleagues have since figured out a way for it to work, and the key is tiny gold nanoparticles less than six nanometers in size, which are just miniscule enough to clear completely out of the kidney through urination.

To take it a step further, Zheng has also discovered that the tendency of the nontoxic gold nanoparticles to remain in the body longer than

other fluorescent dyes can prove beneficial once it's time for surgery. As Zheng puts it, the problem with the current dye used by surgeons is that it dissipates faster, requiring surgeons to keep injecting dye into the patient. Zheng believes that in the future, the gold nanoparticles could help surgeons improve their accuracy in fluorescence-guided surgery.



[CLASSROOM DISCUSSION]

Discuss how long it will likely take for this technique to truly be implemented. Research what causes kidney disease, then discuss ways to prevent the disease.

[VOCABULARY]

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Diabetes Treatment Found in Stomach Cells

By Christina Phillis

Scientists have successfully engineered mini stomachs in mice. The purpose is not to allow these cheese-loving rodents to ingest more pizza, but instead to learn how to make the body produce more insulin.

That is the primary problem for people suffering from type 1 diabetes: insulin-producing beta cells are missing. Advancements have been made in engineering insulin cells in the lab; however the problem with these therapies is that the body continues to reject native and transplanted insulin cells. That's why the team of researchers at Harvard University was attempting to develop a method in which the body replenishes beta cells.

First, scientists genetically engineered mice to express three genes that can convert other cell types into beta cells. Doing so allowed scientists to figure out which cells in the body would be the best at producing insulin. They found that the cells from the pylorus,

or the lower stomach region that connects to the small intestine, were the most responsive to high glucose levels in the blood and were able to produce insulin.

Next, they destroyed the pancreatic beta cells in one group of mice. This forced the mice to become completely dependent on the reprogrammed cells to produce insulin. The control group of mice, which did not have reprogrammed cells, died within eight weeks. The mice in the group with reprogrammed cells stayed alive for up to six months, which is how long they were tracked. The cells of these mice were able to maintain insulin production and regulate glucose levels. And with the help of stem cells, stomach tissue is able to replenish on a regular basis.

To test therapies for humans, scientists took stomach tissue from the mice and engineered it to express the same factors as the reprogrammed



beta cells. Next they grew the cells into a mini stomach and placed them within the mouse's abdomen. When pancreatic cells in the mice were destroyed, glucose levels remained normal in 5 of the 22 mice.

The results of this study further support individual patient therapy that involves collecting cells from a patient, reprogramming them into beta cells, and transplanting them as a way to treat diabetes.

[CLASSROOM DISCUSSION]

How can patients with diabetes benefit from the results of this study?

What other areas of research could benefit from the results of this study?

[VOCABULARY]

INSULIN

STEM CELLS

DIABETES

GLUCOSE



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Hippos Produce Their Own Sunscreen

By Kevin Ritchart

Because they are widely considered to be among the most violent and aggressive animals in the world, studying the hippopotamus — particularly in its natural habitat — is a challenge for scientists. For years, researchers have been curious about both the source of the reddish substance that appears on the skin of the hippo, and through testing it's now known what purpose it serves.

Despite the difficulty of getting close to these massive creatures in the wild, a Japanese team of scientists was able to collect samples of the hippo's secretions and subsequently test them to determine their makeup. The scientists separated the chemical compounds from the hippo's sweat using water and found them to be two highly unstable and highly acidic compounds. One was red in color and dubbed hipposudoric acid. The

other had an orange tint and was named norhipposudoric acid.

Built-in Protection

Despite being unstable on their own, when the two compounds combine in the presence of mucus and then dry on the hippo's skin, the resulting substance remains in place for hours at a time to protect the hippo from the sun. Further testing of the compounds revealed that hipposudoric acid also contains antibiotic properties. Even in low concentrations, the highly acidic compound — which is hundreds of times more powerful than vinegar — has shown the ability to control the growth of pathogenic bacteria.

This helps to explain why hippos remain largely free of infection despite the fact that they can inflict

deep wounds with their ivory tusks, which can grow as long as 20 inches. Before they battle over potential mates by butting heads or violently gashing each other with their tusks, hippos engage in a ritual called gaping in which they stand face to face and open their mouths to show their teeth. If the sight of the other's tusks doesn't cause one hippo to back down, a fight ensues.

Hippos are considered semiaquatic animals, as they spend up to 16 hours every day submerged in water and only venture onto land after nightfall to hunt for food. Staying in the water is effective at keeping the animals cool during the day, but it doesn't protect their skin from the sun's rays.

While some research has been conducted, there's still a great deal that's unknown about the hippo's

so-called built-in sunscreen. Scientists believe that the substances are synthesized from amino acids upon exposure to oxygen.

[DISCUSSION QUESTIONS]

If hippos didn't produce their own sunscreen, what are some other ways they could protect themselves from the sun?

For animals other than hippos, what kinds of things can they do to keep their skin from being damaged by the sun?

[VOCABULARY]

SEMIAQUATIC

HIPPOSUDORIC ACID

NORHIPPOSUDORIC ACID



Crater Drilling Makes an Impact

By Kevin Ritchart

Earlier this year, a drilling effort off the coast of Mexico helped to shed light on the extinction of the dinosaurs. Core samples taken from the Chicxulub crater, which was created when a giant asteroid struck the Earth 66 million years ago, are helping scientists to piece together the timeline for both extinction and the return of life to our planet.

Though scientists have drilled the massive crater before, the 2016 expedition is the first offshore effort as well as the first to explore the crater's peak ring, which is a circular ridge located inside the rim. Scientists are examining core samples taken from the Chicxulub crater's peak ring to determine if the crater itself was one of the first habitats for microbial life after the asteroid struck the Earth.

Samples taken from farther up in the peak ring have helped to identify the time period when life ceased to exist, and scientists are hopeful that computer modeling will aid them in learning more about the crater's formation.

Asteroid Aftermath

When the asteroid struck the Earth, the peak ring formed soon after, potentially within minutes. Following impact, granite bedrock from deep below the surface was forced upward — possibly as high as 10 kilometers into the air — before settling in a circular pattern around the crater. Following its formation, the peak ring was covered by a random assortment of rocks called breccia that came to the surface after impact. Then, just

hours later, tsunamis filled the crater with sediment.

In April, scientists drilled to a depth of 670 meters and brought up a section of rock that contained pieces of granite and various minerals, which indicated that the drill had reached the peak ring. Researchers are debating the depth at which they crossed from the Cretaceous period, which is the last age of the dinosaurs, and the Paleogene, which began 66 million years ago. The line between these two eras, known as the K-Pg boundary, is typically marked by the discovery of fossilized, small-shelled creatures called foraminifera. The foraminifera were found at a depth of 620 meters, but scientists are currently debating how to refer to the 50-meter section between the foraminifera and the peak ring.

Now that they've entered the peak ring, researchers will continue to drill — aiming to go as deep as 1500 meters — as they search for both ancient and modern DNA to further explore and hopefully add to our knowledge about the time following the asteroid's impact.

[DISCUSSION QUESTIONS]

What are some of the challenges of executing an offshore drilling operation?

As the researchers drill deeper into the Earth, what else do you think they'll learn about the Chicxulub crater?

[VOCABULARY]

PEAK RING

BRECCIA

FORAMINIFERA



The Science of Spicy Foods

By Dan Mahoney

Spicy foods are a staple of some cultures' culinary tastes. But what explains the appeal to some of a food that others consider painful? If you tend to dismiss the heat of a spicy food as more of a nuisance than a benefit, you may be surprised to know there's a lot going on in our bodies when we eat something spicy.

What Makes Spicy Food Spicy?

There are receptors in our bodies clustered around our mouth and skin that typically activate when exposed to atmospheric heat, generally over 109°F. But that's heat as measured by the thermometer, not our taste buds. So what is it about a "hot" pepper, whether it's no warmer than room temperature or even refrigerated, that sends us running for a glass of water after we take a bite?

The substance found in "hot" food that humans react to in this way is called capsaicin. Capsaicin triggers these

same receptors to induce a feeling of burning — a feeling that can affect the mouth, stomach, eyes and skin when in contact, extreme levels of which can even cause nausea or difficulty breathing.

How "Hot" Can These Foods Get?

The heat levels in food are measured in Scoville Heat Units (SHUs), which gauge our sensitivity to capsaicin. Developed in 1912 by Wilbur Scoville, this metric may not be as accurate as liquid chromatography methods, but it is still recognized today as the standard for spicy heat measurement.

Starting the scale at 0 SHU is a bell pepper. Other commonly known peppers include the banana pepper, scored at up to 900 SHU; the jalapeno, which can reach up to 10,000 SHU; and the habanero, measuring up to 350,000 SHU. There are actually varieties of peppers that

go all the way up to 2,200,000 SHU! Growers breed these extreme varieties by mixing strains of peppers to create specific traits like heat or sweetness.

Why Would We Eat Hot Foods?

Several studies have been conducted to evaluate the potential health benefits associated with eating spicy foods. One such study, published in August 2015 by the *Chinese Academy of Medical Sciences*, suggests that spicy food can extend life. Almost half a million people in China reported their intake of spicy foods for the study, the results of which showed that people who ate spicy foods six or seven times per week reduced their total risk of mortality by 14 percent compared to those who ate spicy foods no more than once per week. While people with cancer, heart disease and stroke were excluded from the study, it didn't take into consideration other dietary, environmental or health considerations.

In addition to this recent Chinese study, other evidence suggests spicy food can increase metabolism, speed up the feeling of being full, and possibly even decrease "bad" cholesterol to improve blood circulation. While such reports may associate health benefits with the consumption of spicy foods, that doesn't mean adding hot sauce will make a bacon cheeseburger "healthy!"

[DISCUSSION QUESTIONS]

Which cultures of the world are known for their spicy foods, and where are they?

What are some ways to neutralize the effects of spicy foods?

[VOCABULARY]

LIQUID CHROMATOGRAPHY

METABOLISM

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Wanted: Lifelong Learners

By Kelsey Doolittle

Ask a science teacher what skills they would like their students to have mastered by the time they graduate, and most won't mention organic chemistry or thermodynamics. Instead, their list will include abilities that are vital to today's workforce, such as problem solving and analytical thinking. They also take pride in seeing students develop the passion and curiosity to become lifelong learners. Creating a learning environment that cultivates these skills, however, is not an easy task.

Recently, two institutions of higher education teamed up to help teachers address this challenge. The Center of Excellence for Research, Teaching and Learning at Wake Forest School of Medicine (WFSM) and the Institute for Instructional Excellence at the University of Texas at Dallas (UTD) have developed a process for creating such an environment by combining the former's problem-based learning curriculum with the latter's project-based learning curriculum. The process includes four key components.

Establishing Standards of Authentic Instruction

The process begins by establishing fundamental standards of authentic instruction that can be unified across a system. Doing so provides consistency in every classroom so that higher-order thinking and substantive conversation become the norm. These

standards then become the bedrock on which a science, technology, engineering and mathematics (STEM) curriculum can be developed.

Providing Inquiry-Based Strategies and Resources

The next step is to provide ready-made problem- and project-based learning (PBL) cases that establish real-world connections to engage students and promote the use of appropriate STEM skills. Together, WFSM and UTD have authored 170 problem- and project-based cases that cover a variety of science topics for grades K-12. These cases provide authentic learning experiences while supporting a student's mastery of content.

Problem-based learning emphasizes the paths students take to arrive at their solutions, while project-based learning emphasizes the process and application of content through a complex product. But both types of PBL have the power to transform a student's learning environment by requiring them to think critically and learn collaboratively in order to solve a given problem.

In the problem-based learning case for high school biology called Project Site, students are placed in the role of a research assistant for an ornithologist at the Federal Wildlife Agency. The ornithologist has been asked to help in the development of

a new shopping center and needs the students' help to evaluate the possible effects of the new shopping center on area wildlife. By having autonomy in their course of research, students direct their own learning on the ecosystems and the ecological impact of the new shopping center. This ability to analyze a research topic, generate their own line of questioning and extract a hypothesis from their research is essential for a student to develop STEM skills.

Implementation Coaching

The third component of WFSM-UTD's process is implementation coaching, which helps teachers prepare for the challenges they may face when introducing a PBL program in their classrooms. It also includes a self-assessment mechanism that enables teachers to continuously improve their presentation methods and effectiveness.

Leadership Support

The final step is a leadership support piece that helps teachers to recognize their personality types and teaching styles, as well as those of peers and other personnel in a school or district, so they can fine-tune their instructional methods. This enables teachers to communicate a clear, consistent instructional message and support its successful implementation.

The WFSM-UTD process is being used throughout school districts in several states with positive results. By laying a firm foundation of authentic instruction, providing access to a large library of engaging, ready-to-use cases that connect the learning to real-life events, and providing coaching and leadership support, teachers are creating a transformative learning environment where STEM skills can flourish. Armed with these skills, students are able to enter the workforce ready to succeed and with a lifelong love of learning.

[CLASSROOM DISCUSSION]

What types of learning environments do you find engaging?

What STEM skills do you think are most important, and why?

[ACTIVITIES]

Download a sample PBL case from fisheredu.com/pbl to try out with your students.

[VOCABULARY]

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Talcum Powder and its Link to Cancer

By Christina Phillis



Talc, a common ingredient found in many household products such as body powders and cosmetics, has been subjected to renewed scrutiny as more people raise claims that it causes cancer. How could such a widely used product, in some cases lauded for its gentle touch, be able to cause such harm?

Made up mostly of the elements magnesium, silicon and oxygen, talc is a type of mineral. Talc is used to create talcum powder, which is generally used to absorb moisture and reduce friction. As a product for consumers it helps to keep skin dry and prevent rashes. For its ability to provide matte and opaque finishes it is used in many cosmetic products such as blush, face powder and eye shadow.

Does It Cause Cancer?

Most health organizations don't specifically state that talc poses any kind of definite danger to people. The

American Cancer Society (ACS) does not name talc as a known carcinogen, but it does acknowledge suggestions that have been made about talc as a possible causal agent in ovarian cancer if it comes in contact with the genital area. The International Agency for Research on Cancer characterizes use of products containing talc in the perineum region of the body as "possibly carcinogenic to humans."

The ACS also points out that it's important to know the distinction between talc in its natural form, which contains asbestos, and talc that is asbestos-free. The Centers for Disease Control and Prevention warn against certain methods of using talc in both forms. Inhalation of talc in any form should be avoided as it can have an effect on the lungs called talc pneumoconiosis. If it is inhaled, talc with asbestos is generally accepted as being able to cause cancer. Risks caused by breathing in the substance were the major concerns with talc in the 1960s, when the American Academy

of Pediatrics advised against its use as a baby powder. Products sold in the United States containing talc have been asbestos-free since the 1970s. The people most at risk of inhaling the asbestos in talc are people who have long-term exposure to the substance at work, such as talc miners.

Although a strong link between cancer and products containing talc has not been proven, certain forms of talc can be harmful while others warrant further study.

[DISCUSSION QUESTIONS]

What role does a company have in protecting consumers?

What should you do to ensure that the products you use don't contain carcinogens?

[VOCABULARY]

CARCINOGEN

TALC

ASBESTOS

PNEUMOCONIOSIS



Taste Isn't Just Tongue-Tied

By Kevin Ritchart



The concept that we eat first with our eyes is a commonly held tenet among members of the culinary community. But how a dish looks when it's served or how different smells waft through the air while a meal is being prepared are just small parts of the overall taste experience.

The tongue can recognize five different taste profiles — sweet, salty, sour, bitter and umami, a Japanese word that accounts for the taste of savory foods like meats and mushrooms. Umami, which means “delicious,” was added to the tongue’s taste profile in 2002. Each of these tastes corresponds to taste receptors on the tongue that send signals to the brain when a receptor is triggered. This is what allows us to identify different tastes.

Recent studies have shown that there are seven additional factors that can influence our sense of taste: Language, utensils, temperature, color, environment, expectations and memory have proven to change the way we experience food and drink.

Using descriptive language when speaking or writing about a dish has shown that it can change a person’s attitude about food. People tend to praise food more if it’s described in more detail. Though more research is needed on the subject, studies have shown that spoons made of copper or zinc can enhance the apparent saltiness of foods.

The Mental Aspects of Taste

Temperature also can change the way we perceive taste. Similarly, the color of our food — or the color of the plates it’s served on — can impact our feelings about the food. A recent study found that nearly half of the participants who drank soda from a blue glass found it to be a more satisfying experience, likely because they associate the color blue with the soda being cold.

Environment and expectations play a big part in how things taste to us. Eating at an expensive restaurant is likely to heighten a culinary experience prior to walking through

the door. A pricey meal carries with it the expectation of higher-quality ingredients, which, in turn, elevates our opinion of the food that’s served.

Our memories of particular types of food — and our most recent experiences tasting that type of food — also cause us to alter our opinions. In addition, studies have shown that people with certain diseases suffer from taste distortions, a condition known as dysgeusia. Mental stress and physical fatigue also have a negative effect on our ability to discern certain tastes.

[DISCUSSION QUESTIONS]

Is there a food that evokes a strong memory for you? Discuss what that is and why.

Are there foods that taste different to you based on where you are when you eat them?

[VOCABULARY]

UMAMI

DYSGEUSIA

Hungry to learn more about taste? See pages 10 and 21 for further reading.

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To Land a Brick

By Mike Howie

be controlled? This is where physics comes in: Because the blades are spinning in a circle, the inside of the blade is moving slower than the outside of the blade. This difference in speed means that the inside of the blade can continue to let air pass around it, which the pilot uses to keep the blades spinning, while the outside of the blade is moving fast enough to create lift. The pilot changes the pitch of the blades to adjust how much lift is being created, and in doing so can gently take the helicopter down for a landing. It's a process called autorotation.

So Dr. Tyson wasn't exactly right. And, in fact, because a helicopter lands vertically while a plane lands horizontally, it requires much less speed to get on the ground safely, and there's less risk of crashing into something. That means it's actually safer to land a helicopter without an engine than it is to land a plane without one.

**"An airplane whose engine fails is a glider.
A helicopter whose engine fails is a brick."**

Famous physicist Neil deGrasse Tyson tweeted that, and to an extent he's right. If the blades of a helicopter completely stop spinning while in flight, that helicopter is going straight down. But helicopter blades spin incredibly fast — in some cases faster than the speed of sound — so even if the engine dies while in flight, the blades will continue to spin, giving the pilot time to land safely.

How Helicopters Fly

To understand how a pilot can safely land a helicopter without an engine, you need to know a bit about the physics of what makes a helicopter stay in the air. Basically, the blades act like a giant fan that pushes air toward the ground with enough force to push the rest of the helicopter upwards. But the engine isn't the only way to make the blades spin. When the blades slow down, air begins to

move upward through them, making them spin in the same way wind can make a windmill spin. Pilots can use that air movement to keep the blades spinning by adjusting their pitch with a control called the collective.

Powerless Landing

With the engine off, the pilot is using some serious skills to keep the blades spinning — but how can the descent

[DISCUSSION QUESTIONS]

What variables determine how fast a helicopter's blades need to spin to get it in the air?

[VOCABULARY]

AUTOROTATION

COLLECTIVE



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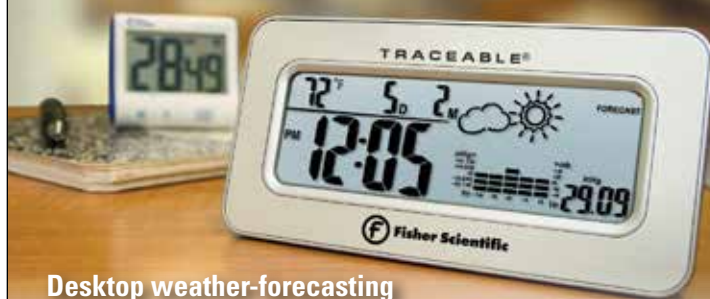
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Urine: the Next Renewable Energy Source

By Christina Phillis

Researchers have long been trying to come up with alternative, more sustainable energy sources. They've tried everything from electricity to vegetable oil, but one of the newest choices might be one of the strangest. Using a mini fuel cell, researchers at the University of Bath were able to generate electricity from urine.

The microbial fuel cell that was used to power this innovation is a device that relies on the natural biological processes of "electric" bacteria to turn organic matter into electricity. For the reaction to happen, urine must pass through the fuel cell. Then electricity generated by bacteria can be either stored or used directly to power electrical devices.

A Smaller Fuel Cell

In addition to developing a new source of energy, researchers set out to make a fuel cell that is smaller, more powerful and cheaper than

other devices. The fuel cell they developed, with the help of Queen Mary University of London and the Bristol Bioenergy Centre, is one inch square in size. They used ovalbumin, a protein found in egg white, and glucose as catalysts. This combination is much cheaper than the platinum used in other fuel cells and, more importantly, renewable.

To maximize the amount of power this tiny fuel cell could generate, scientists enlarged the cell's electrodes from 4mm to 8mm, which increased the power tenfold. Additionally, they stacked multiple units together, increasing the power further.

The fuel cell can generate 2 Watts per cubic meter of power, or just about enough energy to power a cell phone. Although this doesn't seem like much compared to other renewable sources, the technology is worthwhile because of its cost, inexhaustible supply and lack of harmful gases.

The team of researchers is currently working on improving the power output of the cell. By optimizing the design of the cell, they are optimistic that they can improve its performance. In the future, this device has the potential to generate electricity in remote areas for only about \$1.50 to \$3. "To have created technology that can potentially transform the lives of poor people who don't have access to, or cannot afford electricity, is an exciting prospect," Jon Chouler, lead researcher, told *Science Daily*.

[DISCUSSION QUESTIONS]

How can people living in rural areas use this new technology?

Brainstorm other potential sources of organic energy.

[VOCABULARY]

ORGANIC

FUEL CELL

MICROBIAL



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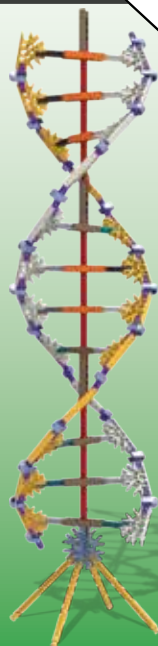
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Pennsylvania Students Compete in State STEM Design Challenge

By Danielle Ferrante



On May 13, 2016 elementary and middle school students from throughout Pennsylvania met at Harrisburg University of Science and Technology to participate in the third annual Pennsylvania State STEM Design Challenge. This year 184 students tested their engineering, design, critical thinking and teamwork skills in this challenging yet rewarding competition.

The annual challenge allows students in grades four through eight to brainstorm, develop and implement a solution to an engineering problem using K'NEX building materials. The problem is usually somewhat vague to encourage students to really use their imaginations and think of their solutions in more unique ways. This year students were tasked with building a structure that was at least one meter high and could withstand some load of weight. Each team was allowed to use only 1,400 K'NEX pieces and had just two hours to complete their build.

On the day of the competition students brought their blueprints, building materials and a ton of enthusiasm as volunteers from Thermo Fisher Scientific, the Allegheny Intermediate Unit (AIU3), AquaPhoenix Scientific and K'NEX Education evaluated the students throughout the two-hour build time. Teams were judged on their overall design and how well they

worked together, along with a written narrative and oral presentation that they had prepared. This year the students' creativity and design skills really took the spotlight, with judges seeing everything from school buildings and spaceships to hotels and even a pagoda!

As part of our mission to enable our customers to make the world healthier, cleaner and safer, we promote STEM education in classrooms all over the country, and the STEM Design Challenge accomplishes this in an interactive and engaging way. Christine Gray, a teacher at Octorara Intermediate School who has had teams place at the state competition over the past two years, told us, "It is because of this challenge that my students have a love for STEM." We are extremely proud to be champions of this cause and are grateful for everyone who participated in order to make this challenge possible!

PA STEM DESIGN CHALLENGE RESULTS

Grades 4-5

- 1st Place** Standing Stone Elementary
- 2nd Place** Ellwood City Area School District
- 3rd Place** Woodland Hills Academy
- HM** East Vincent Elementary
- HM** Indian Rock Elementary – York Suburban

Grades 6-8

- 1st Place** Lackawanna Trail School District
- 2nd Place** Octorara Intermediate School
- 3rd Place** St. Anne School – Bethlehem, PA
- HM** The Walden School – Media, PA
- HM** Southern Fulton School District

Inflatable Module Attached to Space Station

By Hamilton Waldron



Last month, NASA added an extra room to the side of the International Space Station. Now that the installation of the Bigelow Expandable Activity Module (BEAM) is complete, NASA will soon expand the room to its maximum size of 13 feet long and 10 feet in diameter, providing astronauts an extra 556 cubic feet of room to move around for the experiment's two-year duration.

Made of materials that help make it resistant to impact, these lightweight habitats could help save millions of dollars in launch costs and may also aid astronauts in protecting against radiation. In fact, BEAM will soon undergo a special test run intended to measure how it withstands the

temperature swings and high-radiation environment of space.

Timeshares in Space?

Bigelow Aerospace, the manufacturer and owner of the 3,100 pound module, has previously tested two other prototypes, but BEAM is its first inflatable to host astronauts. Owned by real estate billionaire Robert Bigelow, the company is also working on modules that are up to 20 times larger than BEAM.

The company is also developing timeshare agreements that will allow commercial entities, research organizations and even some space tourists to lease the inflatable rooms.

Bigelow plans on making NASA the primary customer, since NASA is still working on establishing habitable living quarters for its planned three-year trips to and from Mars.

Speaking of trips to Mars, the biggest potential obstacle for BEAM is how it will fare during long stays in microgravity. It's for this reason that the BEAM includes a suite of sensors that will gather data about the habitat's time at the station. Astronauts on board the ISS are expected to enter the BEAM three to four times a year, at which time they'll be able to collect the info for NASA and Bigelow.

Once all the tests have been completed and the inflatable room

reaches the end of its two-year duration, the BEAM will be detached from the station and eventually burn up in the Earth's atmosphere.

[DISCUSSION QUESTIONS]

Discuss the pros and cons of a potential controlled habitat for "tourist trips" to space.

Research other prototypes that Bigelow Aerospace has previously tested.

[VOCABULARY]

BEAM

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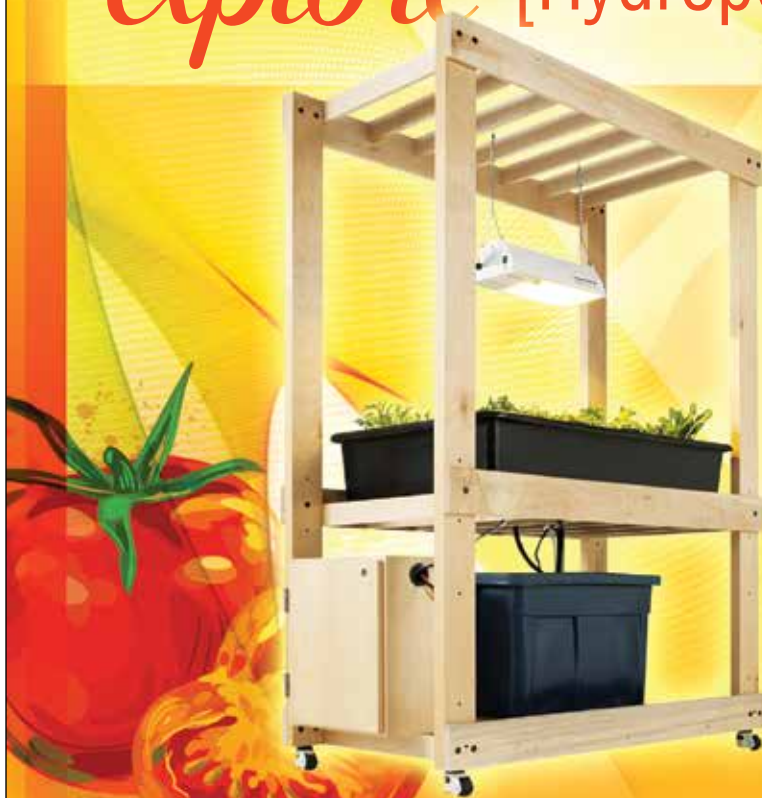


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First Successful Skin-to-Eye Stem Cell Transplant

By Hamilton Waldron



It's been reported that Japanese scientists have successfully completed the first skin-to-eye stem cell transplant in humans. In this instance, stem cells originating from a patient's skin were transplanted into her eye, which partially helped to restore her lost vision.

The patient was a 70-year-old woman suffering from age-related macular degeneration (AMD), which is the leading cause of vision impairment in older people. She first received the experimental treatment in 2014 as part of a pilot study. It's been almost two years, and scientists now have the results.

A small piece of skin from the patient's arm was modified and successfully reprogrammed into induced pluripotent stem cells (iPSC). These types of stem cells are capable of morphing into nearly any type of tissue within the body, making it possible for arm skin cells to be repurposed as retinal tissue.

Patient Tested, Patient Approved

While full vision has not yet been restored in any case, stem-cell treatments have increased in recent years. Researchers in the U.S. and China have also used stem cells to help improve the vision of infants with

cataracts. They did so by manipulating protein levels in stem cells.

In addition, a Maryland woman who had previously been blind for more than five years had some of her vision restored after her own bone marrow stem cells were injected into her eyes.

It's still early, but scientists speculate that pluripotent stem cells may also be used to successfully treat a range of other illnesses, including Parkinson's and Alzheimer's.

[DISCUSSION QUESTIONS]

Discuss what other types of illnesses stem cells could help treat in the future.

[VOCABULARY]

STEM CELL
PLURIPOTENT
TRANSPLANT
AGE-RELATED MACULAR DEGENERATION



The Home of Meaning

By Mike Howie

Words give meaning to the world around us. They allow us to comprehend the things we see and communicate the things we feel. Without words and their meanings, without all the complexity they describe so simply, we humans wouldn't be where we are today. So where does all that meaning live?

Mapping Words

Neuroscientists previously believed that some localized region of the left hemisphere of the brain was responsible for handling language. But according to Jack Gallant, a neuroscientist at the University of California, Berkeley, and his team, meaning and language are actually stored all over the outer layer of the brain.

This isn't to say that words are thrown haphazardly about wherever there's a bit of space. Instead, they're neatly grouped together according to their meaning. For example, words related to family — wife, aunt, brother — tend to be stored in a small area of the right temporoparietal junction, while words related to shape live in a small area of the left occipitotemporal cortex.

However, one word can live in more than one place. The word "top," for instance, lives in an area related to math, plus an area related to clothing, and an area related to buildings. None of this storage is random — groups of words are stored in areas of the brain that are related to similar functions. So words that describe things you see are stored near the visual cortex, which processes visual information from your eyes.

Watching While You Listen

Gallant and his team discovered all this by using a functional MRI scanner to monitor blood flow in the brains of volunteers while they listened to recordings of people telling personal, narrative stories to live audiences, which put the words in context for the listener. By comparing where blood flowed when a volunteer heard certain words, they were able to map meaning to parts of the brain.

With only seven participants in the study, the results aren't entirely conclusive. But it certainly looks like Gallant is on to something — the maps of all seven brains were remarkably similar. With a larger, more diverse group of people to study, researchers will begin to see what, if any, differences there are between people of different genders and backgrounds.

There's a lot more work to be done here. Beyond studying more people, the team has yet to study a language other than English. And who knows? One day, this research may help decode words that a person thinks, enabling ALS and non-verbal Autism patients to communicate in new ways.

Visit gallantlab.org/huth2016 to explore a map of where meaning lives in the brain.

[DISCUSSION QUESTIONS]

Do you think a larger, more diverse group of people will show a different map? Why or why not?

What other applications does this research have?

[VOCABULARY]

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Fueling Your Car with Seaweed?

By Lacey Cirinelli

The phrase "Good things come in small packages" certainly applies to algae. Over 20,000 types of algae, found in both fresh and salt water, collectively produce around 60 percent of the earth's oxygen. While some algae can grow up to 200 feet long, others are only the size of a single cell. This microscopic algae, known as microalgae, is high in fish oil and grows quickly with little maintenance, making it a potential biofuel.



Goodbye, petroleum! Hello, plants?

Currently, much of the world relies on fossil fuels like petroleum and coal for energy. Fossil fuels are the result of decomposing plant and animal matter trapped in the earth for millions of years. Although fossil fuels are an effective energy source, as a finite resource their availability is limited and their use gives off harmful greenhouse gases like carbon dioxide that contribute to global warming.

Alternatively, biofuels come from plants like corn, sugarcane and soybeans. But many biofuel crops

need time and acres of land to grow, and are harvested by equipment that runs off of fossil fuels.

Microalgae, on the other hand, can be grown in enclosed spaces with minimal equipment. And as an added benefit, most microalgae feed off of nitrogen and phosphorous (two common contaminants in waste water) and carbon dioxide, so they can help reduce pollution from other processes.

Microalgae also grow rapidly and can be converted from a single cell to biofuel in a matter of hours. To do so, microalgae is grown in

tanks of water, exposed to sun light, and harvested hours later. Once harvested, microalgae are crushed to release their oils. The oil is then mixed with a catalyst and alcohol to create biodiesel and a glycerol byproduct.

With their ability to simultaneously clean wastewater with fewer chemicals, produce oxygen while reducing greenhouse gasses, and possibly create renewable biofuel, microalgae are proving that they are small yet mighty. And they just might be key to a brighter, more environmentally friendly and sustainable energy future.

[DISCUSSION QUESTIONS]

What other crops are used for biofuels around the world?

What are other types of alternative energy?

What are the pros and cons of microalgae over other alternative energy sources or other biofuel crops?

[VOCABULARY]

FOSSIL FUEL

BIOFUEL

WASTEWATER





Mood-Regulating Chemicals Help You Taste Sour Foods

By April Fischione

Does your mouth water when you grab a handful of Sour Patch Kids™, or do you cringe when you taste a kiwi or a lemon? If you answered yes to either of these questions, you can thank serotonin, which gives you the ability to taste sour foods. But what exactly is serotonin?

Serotonin is a neurotransmitter that is responsible for sending chemical messages between nerve cells. While serotonin is manufactured in the brain and performs its primary functions there, it also travels throughout the body and can be found elsewhere, especially in the digestive tract. By helping to relay messages from one area of the brain to another and because of its large map, serotonin influences a range of psychological and bodily functions.

There are approximately 40 million brain cells in the human body and it is believed that most of those cells that are related to our moods, appetite, sleep, memory and learning, temperature regulation and social behavior are

somehow influenced by serotonin. But if serotonin is responsible for psychological and bodily functions, how does it also allow us to taste sour foods?

Serotonin — We'll Never Be Sour on You

When you take a bite of sour food, the acid in it triggers a response in the taste receptor cells found on your taste buds. Chemicals are then released and relay this message back to your brain. If the food tastes sour to you, and possibly even makes you cringe, you can chalk it up to the mood-regulating neurotransmitter serotonin.

This was the finding of a group of researchers whose study was published in the *Journal of Neuroscience*. The group performed an experiment using a green-glowing protein that fit into serotonin receptors to test where the glowing proteins congregated. The researchers discovered that high concentrations of these glowing

proteins were found on the tongue, pointing indisputably to serotonin as the neurotransmitter whose signals to the brain tell us that a particular food tastes sour.

It's strange to think that something so small can be responsible for so much, but serotonin plays a huge role in the human body and for multiple reasons we wouldn't be able to live without it.

[DISCUSSION QUESTIONS]

Identify which parts of the tongue are responsible for tasting sweet, salty, sour and bitter foods.

How does serotonin play a role in your everyday life?

[VOCABULARY]

SEROTONIN

NEUROTRANSMITTER

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Hungry to learn more about taste? See pages 10 and 13 for further reading.

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Carbon Emissions Threaten Arctic

By Kevin Ritchart

While it's easy to see the immediate impact of wildfires on people and places, the long-term impact on the environment may not always be clear.

Within the next 100 years, the soot that's produced from the burning of fossil fuels and plants during wildfires — also known as black carbon — will not only continue to cause respiratory diseases and greenhouse warming, it will also accelerate the melting of Arctic ice.

Scientists estimate that rising temperatures and changing weather patterns will alter the location and the intensity of where wildfires are likely to burn, based on recent simulations. By the year 2090, wildfire seasons in several regions could last anywhere from one to three months longer than they do now. In regions that border the

Arctic, soot emissions from wildfires could double, which would counteract the predicted soot-emission reductions from human activities during that time frame.

Predicting future emissions levels can be problematic because of variations in both weather and vegetation. Scientists put together three simulations in an attempt to predict soot-emission levels in the Arctic. The first simulation dealt with changes in vegetation. The second was a wildfire predictor. The results of the first two simulations were plugged into a climate simulator that produced the long-term findings for the Arctic region.

Reversing the Trend

If we don't take steps to cut carbon emissions, overall soot emissions

from wildfires will likely remain at approximately the same level, but the location will change. As wildfire season gets longer toward the end of the century, it's estimated that wildfire soot emissions will increase by as much as 49 percent. In the tropics, emissions will decrease by 37 percent thanks to a number of factors, including changing land usage, fewer human-caused emissions and urbanization.

If wildfires shift northward, the Arctic will face further peril from falling soot that is expected to darken the ice and snow and accelerate the melting process. New simulations indicate that 53 percent more soot will settle in the Arctic by the end of the century, even if humans are somehow able to cut their own emissions in half.

While the simulations and the resulting statistics carry with them a potentially devastating environmental impact, scientists warn that they are just speculation at this point. There are too many factors at play to be able to accurately predict exactly what the melt rate of the Arctic will be 100 years from now.

[DISCUSSION QUESTIONS]

What can we do to reduce our personal carbon emissions?

What are some ways to prevent wildfires from occurring?

[VOCABULARY]

URBANIZATION

CARBON EMISSIONS



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Modern Dams Thwart Ancient Instincts

By Mike Howie

In the fall, salmon follow their instincts out of the ocean and upriver to their breeding grounds, a safe place for their eggs to hatch and their babies to mature. Historically, very little could stop them from getting there. They would jump over small waterfalls, avoid hungry bears, and evade the hooks of fishermen while chasing the inescapable need to reproduce. But no salmon can jump over a dam.

River Blocks

Humans build dams for any number of reasons. Some help prevent floods, some collect water for irrigation, and others generate electricity. All of them, however, get in the way of migrating fish. When the salmon run into a dam before they reach their breeding

grounds, they don't know what to do. They pool at the bottom and swim around, stuck between human creations and natural instincts.

On the other side of the dam, another story is unfolding. Sediment that the river would normally carry to the ocean becomes trapped behind the dam, just like the salmon. In an unimpeded river that sediment would become a sandy beach, but behind a dam it's just mud.

Breaking Barriers

Luckily for sand and salmon, a few environmental restoration projects are showing just how disruptive dams can be. When the Elwha and Glines Canyon dams were removed from the

Elwha River in Washington State's Olympic National Park, salmon and other migrating fish responded quickly, making their way to breeding grounds they hadn't visited for over a hundred years.

That part was to be expected, but the sand is what excited the scientists who studied the project. They estimated that millions of tons of sediment had piled up behind the dams, and once they came down that sediment was free to flow toward the ocean and accumulate in the river delta. About 2.5 million cubic yards of sediment settled in the river delta in the first two years after the dams were gone, followed by another 1.5 million cubic yards over the next few years.

After a decade or so the river will return to its normal patterns, with about 300,000 cubic yards of sediment flowing down the river each year. Sand will go to the beach, salmon will lay their eggs, and nature will be in control once again.

[DISCUSSION QUESTIONS]

What negative effects could result from the removal of a dam?

Research the causes and effects of beach erosion, then discuss solutions for improving and managing it.

[VOCABULARY]

RIVER DELTA

SPAWN

SEDIMENT



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A Century of Preserving Our National Treasures

By Christina Phillis



This year marks the 100th anniversary of the National Park Service (NPS), and special events are taking place across the country — or, as the song says, “From the redwood forest, to the gulf stream waters.” With more than 400 NPS sites spanning 84 million acres, ranging from battlefields and monuments to parks, seashores and rivers, you truly can choose your own adventure. There are also a variety of centennial programs throughout the year designed to help you get involved and help keep the NPS around for another 100 years.

History

Yellowstone was the first when Congress named it a national park on March 1, 1872. As more and more national parks were established, the need grew for one unified governing agency to oversee them all. On August 25, 1916, Woodrow Wilson signed the Organic Act, which established the National Park Service as a new federal bureau in the Department of the Interior. Its mission was simple: to preserve and protect the then 35 national parks and monuments and those yet to be established so they would be left “...unimpaired for the enjoyment of future generations.”

Commemorations

To commemorate the 100th anniversary of the NPS, the U.S. Mint struck and

issued three gold coins. The surcharges from these coins must be paid to the National Park Foundation to help fund projects that preserve and protect its resources.

The gold coins are clad with images of two instrumental conservationists: Theodore Roosevelt and John Muir. Muir helped to establish Yosemite National Park and published many books on conservation and natural wonders, including “Our National Parks.” And during his time as president, Roosevelt created the United States Forest Service and established 150 national forests, 51 federal bird reserves, 4 national game preserves, 5 national parks, and 18 national monuments.

Centennial Programs

Starting with the 2015-2016 school year, fourth graders and their families were given free access to hundreds of parks, lands, and waters through the Every Kid in a Park Program. Students and fourth-grade educators, on behalf of their students, can print out a paper pass for free access by visiting www.everykidinapark.gov. The site also offers advice for planning your trip, including finding places to visit, as well as overnight accommodations, and a packing list.

As a way to inspire more people to connect to America’s parks, the NPS

also kicked off the Find Your Park Movement. You can join it by visiting www.findyourpark.com, where you can locate parks near you and share your story. You can also get involved on social media by using [#findyourpark](https://twitter.com/findyourpark).

Looking to the Future

Although the NPS has much to celebrate this year, there are still challenges that lie ahead. David Barna, the public affairs chief for the NPS, told National Geographic, “One of the greatest challenges we face is in making the National Park Service relevant to all Americans.” The NPS is addressing this challenge with its Urban Agenda Program, which asks parks and cities to rethink how to connect with Urban America. People living in these areas don’t always have the means to visit one of the many awe-inspiring parks, so the NPS hopes to offer populations in these areas access to nature through the development of innovative, new spaces.

The NPS is responding to not only the changing American culture, but also our changing planet. Roosevelt was prescient when he said, “...the time has come to inquire seriously what will happen when our forests are gone, when the coal, the iron, the oil, and the gas are exhausted, when the soils have still further

impoverished and washed into the streams, polluting the rivers, denuding the fields and obstructing navigation.” We now know that climate change has the power to alter the ecology of many parks. Extended droughts, fire seasons, low-flow rivers, and rising air and water temperatures can cause certain species of animals and plants to either adapt or die. Barna notes that peer-reviewed science will be instrumental in dealing with climate change.

The NPS is optimistic that much of its future success will come from the 22,000 people it employs as well as the 221,000 volunteers who donate their time and money every year. And what a glorious green 100th year it’s shaping up to be for America’s treasured national parks!

[CLASSROOM DISCUSSION]

Go to www.findyourpark.com and find a park that you would like to visit.

How can science be used to deal with climate change?

[VOCABULARY]

CONSERVATION

UNIMPAIRED

PRESERVE

CENTENNIAL

URBAN

ECOLOGY



Addicted to Cell Phones

By Celeste Beley

Most of us can't imagine being separated from our mobile devices. For older generations, that may be easier to imagine since mobile devices haven't been around that long. But to teens who have grown up constantly connected to the internet and each other via cell phones, iPads and other devices, that's a harsh reality they may not be prepared to face.

A new poll by Common Sense Media found that 50 percent of teens believe that they are addicted to their mobile devices. The poll interviewed 1,240 children, ages 12 to 18, and their parents. Of those parents, a larger number, 59 percent, thought their teens were addicted to their phones.

What is technology addiction?

But how many teens are really addicted? It's hard to say. Technology addiction is a rather new phenomenon but is defined by addiction.com as "a serious problem involving the inability to control use of various kinds of technology, in particular the Internet, smartphones, tablets and social networking sites." In 2011, a

review of 18 different research studies thought that true internet addiction might affect up to 26 percent of teens. Regardless of your definition of addiction, 66 percent of parents and 52 percent of teenagers agree that they spend far too much time on their phones.

The good news is that most students are aware of their potential overuse of devices, and more than a third of them stated that they try to cut down the amount of time they spend on their devices. Meanwhile, parents are navigating new strategies on how to limit use as well as how and when their children are connected.

But even adults admit to feeling addicted to their mobile devices. In the poll, 27 percent of parents felt they were addicted and 28 percent of children believe their parents are addicted.

Digital Detox

An expert recommends that to curb the addiction, we must resist endless hours of surfing the internet and set

limits on our use of mobile devices. Another recommendation is to limit posting on social media to three to five times per week. And if you can handle it, that same expert also recommends that when you feel the need to check your device, go for a walk or exercise instead — something that can provide the same unpredictability and stimulation as reading Facebook or Twitter.

Survey Stats:

- 78% of students and 69% of parents said they checked their phone hourly
- 72% of students and 48% of parents said they feel the need to respond immediately to texts and social network posts
- 36% of parents said they argued with their child daily over device use
- 77% of parents feel children are distracted and inattentive when they are together
- 56% of parents admit to checking their phones while driving



[DISCUSSION QUESTIONS]

Do you feel addicted to your devices? Would you take any steps to curb your use?
What are some health risks associated with overuse of technology?

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The best way to work toward becoming a vet is to take biology and chemistry in high school and then major in chemistry, biological science or a related field in college. Many

colleges offer pre-veterinary courses, which may prove helpful in gaining acceptance to one of the 28 graduate schools of veterinary medicine in the country that confer doctorate degrees. But even after earning your doctorate in veterinary medicine, you must also pass federal and state licensing exams before you can practice as a vet.

The U.S. Bureau of Labor Statistics expects the number of veterinary positions to grow by 36 percent between 2010 and 2020, with the average vet earning \$82,040 per year.

Discoverer of Buckyball Dies

By Hamilton Waldron

The term “buckyball” and the name “Harry Kroto” may not be household names, but the importance and accomplishments of both live on. A recipient of the 1996 Nobel Prize in Chemistry, Harry Kroto, whose team is credited with discovering the spherical, soccer ball-like structure of carbon atoms nicknamed the buckyball, died April 30, 2015 near Lewes, England. He was 76.

The discovery by Kroto’s team of the spherical carbon molecule and its related class of molecules, the fullerenes, significantly advanced scientific understanding by opening new avenues for research across multiple areas of study.

Dr. Kroto specialized in spectroscopy, a field of science in which the spectrum of light from an object, such as a star, is researched to help identify its chemical composition. Partnered

with two American chemists, Kroto worked tirelessly at Rice University in Houston. From there, the three would later receive the 1996 Nobel Prize in Chemistry for their discovery.

The discovery by Kroto’s team of the spherical carbon molecule and its related class of molecules, fullerenes, has significantly advanced scientific discovery by sparking new lines of inquiry across multiple areas of study. The resulting research has led to numerous developments, from more effective treatments for AIDS and multiple sclerosis to new designs for bulletproof vests.

Hard Work Pays Off

During their time at the Rice University lab, Kroto and his team spent intense periods of days conducting experiments that contributed to the discovery of this carbon molecule —

which, unlike graphite or diamonds, was at that time the only known form of the substance.

The molecule in question that the three were able to focus on contained 60 carbon atoms and was highly stable. Once it was assembled into a model, the molecule was something to behold. It resembled the geodesic dome invented by R. Buckminster Fuller, which is prominently featured at Walt Disney World’s Epcot Center in Kissimmee, Florida.

As a tribute to Fuller, the scientists decided to name the molecule buckminsterfullerene, which later led to its earning the nickname “buckyball.”

While the buckyball now enjoys a storied history, its discovery essentially introduced the entire field of nanotechnology.

Chief among Harry Kroto’s contributions to the science world is a rather simple one. As someone who was most passionate about motivating children to learn about science, Kroto recognized the importance of encouraging students’ interest in science for generations to come. Without intrigue, discoveries are more difficult — but thanks to Kroto, there are masses of inspired youths primed to keep discovering.

[CLASSROOM DISCUSSION]

Discuss how Kroto’s discovery helped spark research in nanotechnology. Research how the buckyball contributed to improved AIDS treatments.

[VOCABULARY]

BUCKYBALL

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