

Headline Discoveries

April-June 2016 » Issue 2



MEGACITIES

Striving for Sustainability

Zika Virus Outbreak

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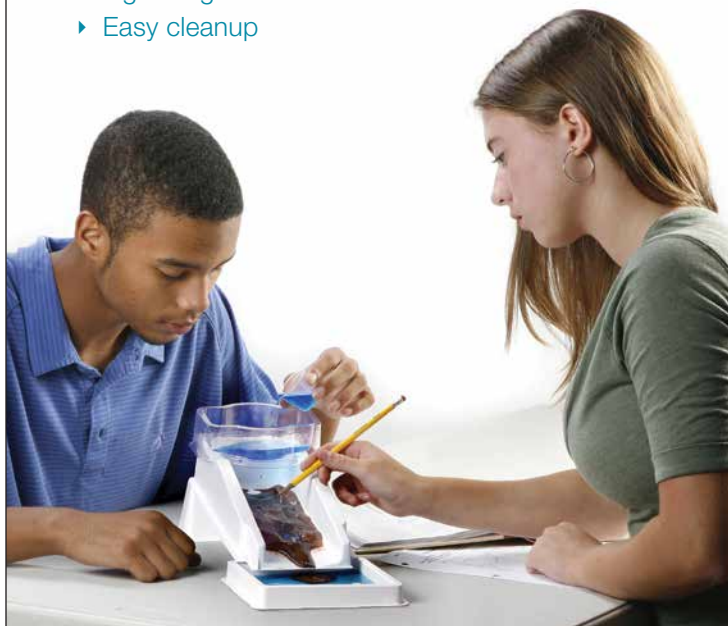
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ELECTRONIC WASTE: Better Options than the Dumpster **Pg. 25**

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MEGACITIES

Striving for Sustainability

By Kerry Connell

What is a City?

If you are like most people, you might say that a city is a big town with large buildings. Other components of a city are sidewalks, subways and streetlights—all inanimate objects. Cities, and the infrastructure that supports them, are not usually considered to be living things, but in many ways, they almost are. Cities expend energy, they use water and they produce waste. And if a city is a living thing, then a megacity is an even greater animal.

Megacities are metropolitan regions that incorporate a city (or two or more converging cities) and include a series of connected infrastructure systems. To be considered a megacity, the region's population must total at least ten million people. Most people who live in these megacities spend the majority of their time living and traveling within them, from suburban home to city office by commuter railway, car or other transport. City dwellers may enjoy the luxury of walking to work, while people in adjacent suburbs or small towns may never even enter the city center. But they all make up the human factor that megacities require to function. And humans, who consume, produce and transport energy, resources and waste, are what bring life to cities and megacities.

Globally, scientists have identified 27 megacities as of 2010. Tokyo (37,900,000 people), Jakarta (30,326,103 people), Seoul (26,100,000 people) and Delhi (25,703,000 people) are the biggest, but megacities exist all over the world. Rome is generally considered the first very large city; by the end of the first century B.C., its population was more than one million. By 1900, London counted more than five million people. In 1950, New York City became the first human population center to pass ten million—the threshold for today's megacity.

In 1800, just three percent of people lived in cities, but today, about 3.2 billion people, or nearly 50 percent, are city dwellers. The United Nations predicts that five billion people, or three in five, will live in cities by 2030. The number of megacities is expected to reach 37 by 2020. These regions generate 14.6 percent of our world's total GDP, but they also consume a disproportionate

percentage of resources. The rapid urbanization of modern megacities creates a strain on infrastructure that, if unabated, could easily lead to the failure of the very systems that brought the city about to begin with.

In addition to the many environmental challenges that such huge populations present, the limits that city conditions may place upon an individual's ability to experience happiness and security can be vast. Insufficient housing and transportation that simply cannot keep up with growth can lead to the development of slum conditions within and around large cities. Homelessness, crime and other social ills tend to increase with population and with concentration. Educational services, health care systems and sanitation services that do not keep pace with population growth can result in less than ideal conditions. But what about the purely environmental concerns that affect the life of the megacity organism and the world it inhabits? According to a study titled "Energy and material flows of megacities," published in *Proceedings of the National Academy of Sciences*, the megacities of today are home to only 6.7 percent of the world's population, but they are responsible for nine percent of the planet's electricity use, ten percent of its gasoline use and 13 percent of its solid waste generation.

[CLASSROOM QUESTIONS]

What steps can be taken to reduce the overall energy footprint in megacities? How is it different from smaller cities or more rural areas?

Would you rather live in a megacity, smaller city or a rural area? Why or why not?

[VOCABULARY]

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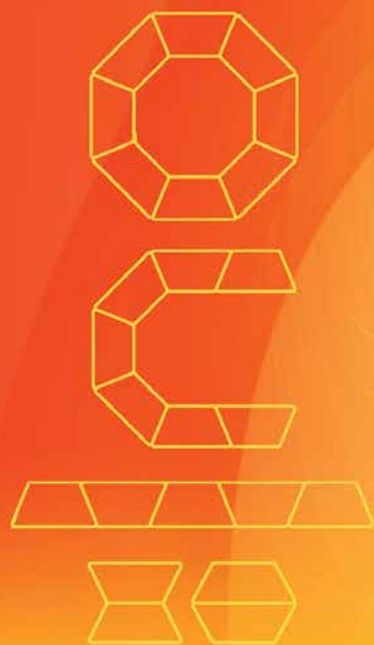
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Are You Faster than a T. Rex?

By Kerry Connell



Generations of kids have been fascinated by the gigantic size, fierce nature and presumed speed of the Tyrannosaurus Rex. But was this “king of the tyrant lizards” as quick as we imagined?

Simulated Dinosaur Speed

The speed of dinosaurs has been widely debated since the 19th century. In 2007, paleontologists William Sellers and Phillip Manning at the University of Manchester published results from GaitSym, their customized computer simulation that used fossils to recreate dinosaur anatomies. Using these models, Sellers and Manning approximated

the top speeds of five different carnivorous, bipedal dinosaurs — *Compsognathus*, *Velociraptor*, *Dilophosaurus*, *Allosaurus* and *T. Rex* — and found *T. Rex* to be the slowest of the pack, but still faster than the average human.

Clues to Prehistoric Speed

A newer study to be published in the June 2016 issue of *Cretaceous Research* helps to refine the hypothesized speed of *T. Rex* locomotion. Using sets of fossilized footprints found in rocks at an ancient shoreline in Wyoming, scientists were able to identify the dinosaur that made the tracks and estimate its size, gait and speed.

From the 18.5” wide imprints with three longer forward-facing toes and one shorter, thumb-like digit facing backwards, a team of paleontologists led by Scott Persons of the University of Alberta in Edmonton, Canada, determined that the footprints were made by a juvenile theropod. Based on the distance between the prints and the estimated height of the dinosaur’s hips, the scientist were able to calculate a walking speed of two to five miles per hour, or about a 12- to 21-minute mile.

This estimated speed was consistent though slower than the 6.8 miles per hour finding from another study — just under a nine-minute mile pace that many average runners could exceed. According to Eric Snively at

the University of Wisconsin, “If you were out walking a juvenile *T. Rex*, you’d be comfortable at a brisk walk. If you were walking an adult, you’d be jogging.”

[CLASSROOM QUESTIONS]

What are the top five fastest animals in the world today? Can the world’s fastest athletes outrun any of them?

What physical differences contribute to the faster animals’ speed?

[VOCABULARY]

THEROPOD GAIT BIPEDAL



Join the Bat Tour!

By Mary Rose Thomas-Glaser

Bats are the world’s only true flying mammal. They live in habitats ranging from wetlands to cities and represent over 25 percent of the world’s mammal population. Despite the popular belief that they’re dirty and dangerous, bats play a vital role in the ecosystem by controlling insects, pollinating plants and dispersing seeds. In one night, a single bat can consume up to 2,000 insects, finding their prey in the skies using echolocation.

Threats to Bat Populations

Throughout the world there are 950 identified species of bats, but according to some “chiropterologists” there may be over 1,200. They range in size from the teeny one-inch long bumblebee bat in Thailand to the rare giant golden-crowned flying fox megabat in the Philippines, which has a wingspan of up to 5.5 feet!

Bats are threatened by habitat loss, wind turbines and white-nose syndrome, a fungal disease that has killed millions of bats in the U.S. in recent years. The impact of these losses is exacerbated by one of the slowest animal reproductive rates — females give birth to only one pup a year. In the next 50 years, experts believe one in every five bat species is threatened with extinction.

Calling All Bat Detectives

To help track changes in bat populations around the globe, the Indicator Bats Program (iBats) is using volunteers to collect acoustic data on bats in their area using a free smartphone app. Once connected to an ultrasonic bat detector, recorded data can be uploaded directly into the iBats website to monitor population trends.

The Bat Detective World Tour uses citizen scientists to listen to bat call recordings to help identify different types of calls and sequences from various species. The goal of this classification process is to create an automatic program where researchers can access call information to help track bat populations.

The Bat Detective World Tour launched in Europe, traveled to sub-Saharan Africa and arrived in New York City on February 1, 2016.

[CLASSROOM DISCUSSION]

Why are wind turbines so lethal to bats and what can be done to protect bats from the dangers?

How does echolocation help bats find insect prey? What other animals use echolocation?

Visit www.batdetective.org (Classify tab) and listen to the social, searching and feeding “spectrograms.” How do the sounds differ?

[VOCABULARY]

CHIROPTEROLOGY ECHOLOICATIONS SPECTROGRAM HABITAT



Can Music Help People with Epilepsy?

By April Fischione



Do you ever catch yourself staring off into space? In some cases this is considered to be abnormal brain activity called an absence seizure. Epilepsy is a disorder of the brain that causes recurring seizures and affects approximately three million Americans and 65 million people worldwide.

The brain is the most complex organ in the human body and seizures can occur anywhere within it. Children typically experience seizures in the temporal and front lobes, while seizures in adults stem from the mesial part of the temporal lobe. There are over 40 different types of epilepsy, but the exact cause is unknown. Some of the most common causes of epilepsy are stroke, brain tumor, head injury, loss of oxygen to the brain, some

genetic disorders, some neurological diseases and brain infections.

Epileptic seizures occur from abnormal brain activity and affect multiple systems of the body. During a seizure, the circulatory and respiratory systems can be affected, causing shortness of breath and coughing. The muscular and digestive systems receive messages from the brain causing muscles to contract and relax. While the reproductive system is not affected directly by an epileptic seizure, it can result in high-risk pregnancies, hypertension, underweight babies and stillbirths.

Mozart, Beethoven, Bach, Coltrane

Even though there is currently no cure for epilepsy, it can be treated in several different ways. Depending on what is causing epileptic seizures, a

doctor will prescribe different forms of treatment. Among surgery, drugs, diet and vagus nerve stimulation, music is starting to be used as a form of treatment. Because music is processed in the auditory cortex – the same region where most seizures originate – it could prevent seizures.

The American Psychological Association performed an experiment among people with and without epilepsy using an electroencephalogram. In this experiment, the participant's brainwaves were recorded with 10 minutes of silence followed by a Mozart composition, 10 minutes of silence followed by music by Coltrane and then just 10 minutes of silence. The study demonstrated that there were higher levels of brainwave activity in the participants when they listened to music. The brainwave activity in the temporal lobe synchronized with the music at higher levels among those

participants with epilepsy compared to the participants without epilepsy.

The study's conclusion was that music is processed in the brain differently among epileptic patients and may be used as a novel intervention in accompaniment with traditional treatments to help treat patients with epilepsy.

[CLASSROOM DISCUSSION]

Identify the different structures of the brain and what the function is of each.

Research the different types of seizures. Are some more common than others? How do the types differ from one another?

Have some treatments for epilepsy been proven to be more effective than others?

[VOCABULARY]

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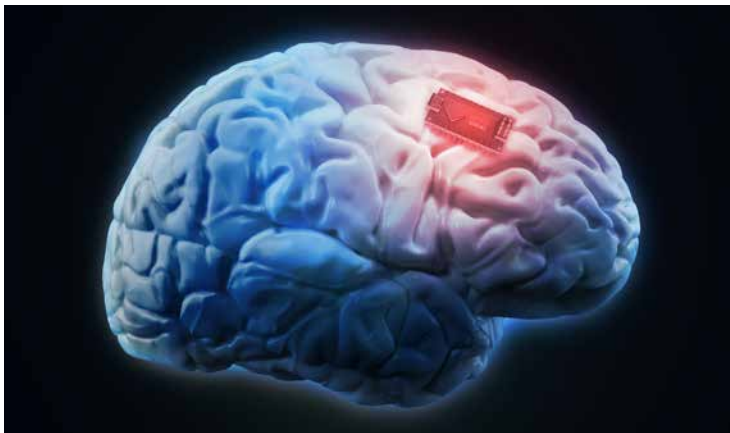
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The Future of Medical Implants

By Dan Mahoney



Humans have used medical implants for hundreds of years. While rudimentary dental implants might have been the foundation, current medical science is pushing the boundaries of implants every day.

What is an Implant?

An implant, as opposed to a biomedical transplant, is made from materials such as plastic, ceramic or metal and manufactured for a particular application. Many implants are meant to replace missing or damaged body parts like teeth, hips or knees. Others might be used to support body functions or deliver medicine to targeted areas of the body.

Risks of Implants

Implants are designed to improve or extend the life of a patient. But like all surgeries, placing an implant comes with risks. One common risk is infection, which can come from skin contamination during surgery. Human bodies can also reject an implant if the materials cause harmful reactions. Implants can and do fail over time, requiring a repair or replacement.

Making a Safer Implant

As science has progressed, researchers and engineers are capable of greater levels of precision than ever before. Specifically, advancements in bioresorbable implants have allowed patients to be treated in safer ways than ever.

John Rodgers, a professor at the University of Illinois at Urbana-Champaign, designed a tiny bioresorbable sensor that can be used to monitor health data. It's designed to completely dissolve when immersed in aqueous solutions, meaning that no secondary surgery is required to retrieve the implant. The materials

used in the sensor degrade at just nanometers a day, and by controlling the thickness of the materials, can ensure a uniform and appropriate lifetime of the implant. Rodgers and his colleagues have successfully tested their implant in monitoring brain temperature and pressure, which could be used in real-world applications like monitoring brain injury. Their results have been comparable to non-dissolving devices used today.

Since Rodgers was able to achieve consistent and precise readings in trials, he hopes to next move this technology into human use for similar applications, ultimately improving human health.

[CLASSROOM DISCUSSION]

How have implants been used in past procedures?

What are some potential use cases for using bioresorbable implants?

[VOCABULARY]

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The Mystery of the Sea Otter's Red Coat

By Danielle Ferrante



Sea otters are known for their unique social habits and undeniable charisma. They are also known for their exceptional grooming habits, spending almost half of their day making sure their fur is in perfect condition. It was this fact that made biologist Gena Bentall do a double take when she spotted a male sea otter's back covered in a red substance.

Her first thought was that it was either crude oil or some type of injury. Whenever an otter's fur becomes covered with a foreign substance it makes it difficult for them to stay warm. If this happens, the cold seawater could eventually give the otter hypothermia, so grooming their fur is an extremely important task.

Bentall rounded up a team of specialists to find out exactly what was covering the animal. It turns out the red coating was actually algae, which surprised Bentall and her team. Their otter's

grooming habits combined with the fact that algae usually grow on rocks puzzled the scientists and forced them to investigate further.

The algae are called *Acrochaetium secundatum* (AH-kro-KAY-ee-um Sek-um-DAH-tum) and are usually found in the North Atlantic region. The reason algae usually grows on stable surfaces like stones or coral is because it needs a strong surface that cannot be easily moved by the ocean's current or other marine animals.

So how can the algae survive on a sea otter that is constantly swimming, sliding and combing its fur?

It turns out the red algae only grows at the very end of the otter's longest hairs, allowing the otter to stay completely warm. This was reassuring news to Bentall and her team. The algae are just looking for a place to live where it can easily reach the nutrient-rich seawater.

While the otters aren't threatened by red algae, they still face other serious risks such as shark attacks, pollution and disease. Serious efforts have been made towards restoring the levels of sea otter populations, but they are still classified as an endangered species. As long as we continue to research all of the challenges and risks sea otters face, we can be sure they are protected and cared for properly.

[CLASSROOM DISCUSSION]

Most algae contain chloroplasts in their cells. What is the chloroplasts' main function?

What other survival risks do sea otters face? Pick one and describe a way to help combat this issue.

[VOCABULARY]

ALGAE HYPOTHERMIA

MARINE ANIMALS



Demystifying De-Extinction

By Christina Phillis



De-extinction, the process of bringing an extinct species back to life, sounds a little like *Frankenstein* or better yet a real-life version of *Jurassic Park*. But the comparisons stop there, as scientists are getting closer to making this a reality than ever before.

Can It Be Done?

One attempt starts with the last living Bucardo Goat in the world, Celia. After her death, a team of scientists

took nuclei from Celia's cells and injected them into goat eggs that had their DNA removed. Of the 57 surrogate mothers, only one goat successfully became pregnant with a clone of Celia. However, complications caused the baby clone to die after only 10 minutes of being brought back from extinction.

That was in 2003. Since then, scientists have been turning to new technologies to reconstruct DNA that once was. The next animal up for de-extinction is the Passenger Pigeon. Through Next Generation Sequencing scientists determined that the Band-Tailed Pigeon is its closest living relative. The fragments of available DNA for the Passenger Pigeon don't amount to much on their own, but using the Band-Tailed Pigeon's genome as a map, they hope to fill in some of the blanks using Multiplex Automated Genome Engineering.

Once the genome is completed, bringing the Passenger Pigeon back to life would require complex maneuvering. First, germ cells, generated by Rock Pigeon's stem cells

containing the completed genome, would need to be injected into Rock Pigeons. The first squabs to hatch after these birds mated would be normal Rock Pigeons, but they would carry eggs and sperm with altered DNA. After the first squabs mated, their offspring would carry traits of the Passenger Pigeon. Scientists could continue to inbreed these birds with other species until they were more and more like the Passenger Pigeon.

Should It Be Done?

Although technology and science seems to have caught up with fantasy, certain experts ask if this is nothing but a waste of time and resources. Some ask if we should instead be focusing our efforts on preserving endangered species. Another concern is the harm that introducing a genetically engineered organism, which may carry diseases or viruses, into the environment may cause for existing species.

Advocates for de-extinction argue that genomic engineering technologies currently under development for de-

extinction could help to preserve species that are endangered. Additionally, they believe that the biodiversity seen in nature can help lead to invention. It already has with pharmaceuticals that were derived from the natural compounds found in wild plant species.

As the debate continues, scientists are still making progress. In 2015, scientists were able to sequence the entire genome of a Woolly Mammoth, piquing our curiosity once again about this strange science. Bringing a species back to life may still be years away, but the science behind it continues to advance our ability to reconstruct lost genomes and manipulate stem cells.

[CLASSROOM DISCUSSION]

Discuss the pros and cons of bringing animals back from extinction.

Research other extinct species and pair them with closely related species.



Warming of the Ocean Depths?

By Mary Rose Thomas-Glaser



The depths of the oceans are in hot water according to Peter Glecker and fellow researchers. In a recent study, the scientific team analyzed ocean temperatures data from the past 150 years to determine the impact of heat uptake from the oceans' surface to the seabed. Using temperature records gathered from the 19th century, HMS Challenger expedition to today's ocean probes and Argo floats, they determined that roughly half of the heat uptake has occurred in the past 18 years.

Their findings, as published in *Nature Climate Change*, revealed that "nearly half of the industrial-era increases in global ocean heat content have occurred in recent decades, with over a third of the accumulated heat occurring below 700 meters and rising."

Meanwhile, scientists at the NASA Jet Propulsion Laboratory using a compilation of satellite and direct temperature data, determined that temperatures of ocean waters at depths below 1.2 miles have not warmed measurably from 2005 to 2013.

Whitewashing Coral

While potential long-term impacts of warming ocean depths are yet to be determined, warming water closer to the ocean's surface is one of the stressors that trigger "bleaching" of coral reefs. Other factors known to cause coral bleaching include runoff and pollution, overexposure to sunlight and extremely low tides.

When water temperatures fluctuate (either colder or warmer than normal), healthy coral polyps eject the symbiotic algae, or zooxanthellae, living in their tissue. These algae not only serve as the primary food source for the coral, but are responsible for

the bright array of colors found in reefs around the world. Without the algae, the coral turns white and appear to be bleached. While colorless, these corals are not dead and can survive bleaching, but are more susceptible to mortality.



[CLASSROOM DISCUSSION]

What impact could rising temperature changes have on ocean life? What about falling temperatures?

What is the Argo array and what is its purpose?

Are coral plants or animals? What benefit does the algae provide the coral?

[VOCABULARY]

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Zika Virus Outbreak

By Brianne McCurley



Are you primed and ready for a break from the winter weather? If you are looking to get away to a tropical destination, you might want to think twice about traveling to the Caribbean or South America. The recent outbreak of the Zika virus in 29 countries has travelers and world health officials on alert.

The *Aedes* species mosquito – found on all continents, except Antarctica, is responsible for transmission of Zika. This species of mosquito is responsible for many viruses including dengue, yellow fever, Zika and chikungunya. The most common symptoms of the Zika virus are fever, rash, joint pain and conjunctivitis (red eyes). The illness is typically mild and lasts several days to one week. Severe reactions requiring hospitalizations are uncommon and death is rare. According to CNN's Chief Medical Correspondent, Dr. Sanjay Gupta, "the vast majority of people, approximately 80%, who get this infection will experience little or no symptoms." People who have suppressed immune systems and other

infectious diseases may experience additional complications if infected with the Zika virus. At the time of publication, three deaths have been reported, but it is still undetermined if there is a direct link between the deaths and Zika.

Treatment

There is no vaccine or medications available to treat Zika infections. However, it can be treated with plenty of rest and drinking a lot of fluids. Pharmaceutical companies are scrambling to develop a vaccine, but trials could still be more than one year away, according to the Associated Press. The Department of Homeland Security is working closely with the U.S. Center for Disease Control and Prevention (CDC) to monitor the disease. They are working to educate people on the signs and symptoms, as well as monitoring infected travelers at the border and at detention facilities.

Birth Defect Concern

In Brazil, it was initially reported that the virus is associated with the birth defect microcephaly. Since November 2015, Brazil has reported

more than 4,000 suspected cases of microcephaly; however, the numbers may not in fact be microcephaly or linked to Zika. The country initially asked doctors to report all babies with a head circumference of 33 centimeters or less, but that is not a reliable factor. If that measurement was used according to United States growth charts, 10 percent of American newborns would fall into the suspected microcephaly category. That is obviously too high of a percentage. The CDC defines microcephaly as a birth defect where a baby's head is smaller than expected when compared to babies of the same sex and age. It can lead to developmental delays and impaired motor skills. This condition can also be caused by genetic factors and drug and alcohol use during pregnancy. However, knowledge of the link between Zika and microcephaly are still being researched.

A group of Argentine physicians have recently challenged the belief. They suspect that the Zika virus is not to blame for the rise in microcephaly cases, but that a toxic larvae, Monsanto Larvicide, injected into the water supply. The chemical Larvicide

was injected into Brazil's water supply in 2014 to halt the development of mosquito larvae in drinking water tanks. The chemical, pyriproxyfen, is manufactured by Sumimoto Chemical, a Japanese subsidiary of Monsanto. Thousands of children have been born with malformations from pregnant women living in these areas where pyriproxyfen was injected into the water supply.

At the time of publication, the Zika virus had spread to 29 countries since the current outbreak started. Zika is in the United States, but only from travelers returning from an infected area. It is likely that the spread of the disease will not be as devastating in the U.S. as it is in the Caribbean and South American countries because of the cooler climate. Mosquitoes need hot weather to reproduce. People should use caution when traveling to the affected countries. If you are traveling abroad for an upcoming vacation or business trip, it is recommended to use insect repellent with DEET, wear long-sleeve shirts and long pants, stay in air conditioned rooms and avoid areas with standing water, where mosquitos can breed.



Mosquito Facts:

1. Mosquitoes are the deadliest "animal" in the world.
2. They kill about 725,000 people every year. That's more than sharks, wolves, lions, crocodiles and snakes combined.
3. Malaria is the deadliest disease carried by mosquitoes, killing more than 400,000 people every year.
4. There are more than 3,000 species of mosquitoes.
5. They live on every continent, except Antarctica.
6. Some mosquitoes become immune to DEET after only three hours of exposure to the repellent.

Symptoms of Zika Virus

1. Fever
2. Rash
3. Joint Pain
4. Red Eyes (Conjunctivitis)

EDITOR'S NOTE:

The information contained in this article was current as of publish deadlines. Information on this outbreak is changing rapidly. Visit www.headlinesciencenow.com for the most up to date information.

[CLASSROOM DISCUSSION]

What other viruses are transmitted by mosquitoes?

Can you think of any other cases where chemicals were injected into the drinking water and caused health problems?

[VOCABULARY]

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Cold Cuts and Cancer

By Mary Rose Thomas-Glaser

Meat offers a number of nutritional benefits to the human body. It contains high-quality proteins, iron, B vitamins and minerals, which is what the body uses to build and maintain muscles and bones and to make red blood cells. But are there health risks to eating meats as well? According to a recent report by the World Health Organization (WHO), the answer is yes when it comes to processed meats.

What's the Beef with Processed Meats?

Twenty-two experts from the International Agency for Research on Cancer, the WHO cancer organization, reviewed findings from over 800 studies and concluded that consuming two ounces of processed meats on a daily basis raises colorectal cancer risks by 18 percent. Two ounces of processed meat is equivalent to two strips of bacon or one jumbo hot dog.

So what does this increased risk mean? The average lifetime risk of developing colon cancer is five percent; daily consumption of two ounces or more of processed meat raises this average lifetime risk to 5.9 percent. Each year about 130,000 people in the United States are diagnosed with colon cancer and about half will die of their disease.

What are Processed Meats?

Unlike red meat which is sold fresh, processed meat is not fresh — it's preserved by curing, salting, smoking, fermenting or dehydrating. Processed meats include sausage, hot dogs, bacon, ham, lunch meats and beef jerky.

It's the preservation process when flavorings, sodium and chemical preservatives such as nitrates are added to slow bacterial growth and lengthen shelf life that creates health risks. In our bodies, nitrates bond to amino acids and are converted to nitrosamines, which are known carcinogens. Additional health risks can be created when meats are grilled at high-

temperature over a flame. Grilling can produce heterocyclic amines, which are suspected carcinogens.

The Bottom Line

Obviously a diet high in processed meats isn't good for your health, but eating a hot dog or bacon sandwich a few times a week likely isn't much cause for concern. Overall, the health hazards associated with eating processed meats are much lower than for other lifestyle risks linked to cancer — such as smoking.



[CLASSROOM DISCUSSION]

What are lifestyle risks associated with cancer?

What is cancer? How does it develop? What are treatment options?

What screening methods are available for colon and other cancers?

[VOCABULARY]

CARCINOGENS

NITRATES

COLORECTAL

AMINO ACID



The Science of Play

By Celeste Beley



Whether you are young or just young at heart, it's likely you have pretty vivid memories of your time on the playground. Research has shown that the amount of time allotted to play is diminishing, especially in schools. Recess time is being decreased, or even eliminated entirely, to allow for more classroom time. But here are 10 scientific reasons why you should play more.

1. Brain Development

Play helps kids learn how to regulate emotions and solve problems. It even affects the part of the brain that controls decision-making and thought analysis.

2. Social Skills

Play is more than learning how to interact and make friends. It helps kids understand things like fairness and following an established set of rules. Playing is the primary means for kids to develop peer interaction.

3. Physical Health

Kids should have 60 minutes per day of physical activity, but less than half actually do. Playing tag, riding a bike, shooting baskets in the school yard... it all adds up!

4. Academic Performance

Multiple studies confirm that when kids move more, they perform better in school, especially in math and reading.

5. Improved Focus

U.S. Government data shows that kids in public school who had at least one 15-minute recess per day were better behaved and less disruptive in class.

6. Stress Reduction

Play is exercise, and we know exercise reduces stress. Even a less-physical form of play, like video games, can reduce stress and improve mood.

7. More Restful Sleep

One study has proven that just 20 minutes of physical activity a day improved adults' sleep performance by 65%. This could be attributed to spending more time outdoors and away from artificial light, which shifts the cycle of sleep hormones.

8. Reduced Aggression

A theory abounds that play, which encourages socialization and provides happy moments, may help deter levels of aggression.

9. Fostering Creativity

Making rules, exploring new ideas and stories, and expressing imagination are all elements of play that help kids and adults build their creativity.

10. Happiness

Perhaps simplest of all, play is fun and enjoyable. Social and physical activity can reduce symptoms of depression, stabilize mood and decrease anxiety.

If just taking a break wasn't enough, now you have science to back you up. So get out there and play!

[CLASSROOM DISCUSSION]

Do you agree with this list? What would you add or remove?

Is there any upside to reducing or eliminating recess/playtime? What would be gained by doing so?



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Solving the Mystery of How Fireflies Glow

By Samba Lampich

The intermittent glow of fireflies at dusk usually signals the height of the summer season. To us, the twinkling bugs are magical, but there is a serious chemical reaction happening in their bodies.



How Do Fireflies Glow?

For decades, scientists have had a rough idea on how fireflies glow, but never the whole picture. Research shows that fireflies glow when a substrate called luciferin, an enzyme called luciferase and oxygen combine, producing a chemical reaction that causes their abdomens to light up. This production and emission of light is called bioluminescence. What remained unknown was what happened in the last step to cause the bioluminescence.

The Hidden Ingredient

Dr. Bruce Branchini, a chemist from Connecticut College, and his colleagues from Yale conducted a study that was able to confirm and further identify how the biochemistry in fireflies works. They replicated the fireflies' chemistry in the lab and revealed their findings in a report in the Journal of the American

Chemical Society. They found that a charged particle called superoxide ion was critical to the bioluminescent reaction.

Dr. Branchini used EPR (electron paramagnetic resonance) spectroscopy, which uses magnetic fields and microwaves. ERP was able to trap the fast bioluminescent reaction long enough to see what was happening. If the superoxide ion was actually present, it would react with another substance in such a way as to confirm its presence.

Superoxide ion is toxic to animals, but because the reaction in fireflies is contained and happens so fast (300 milliseconds from start to finish) it doesn't hurt the bug.

Implications of the Discovery

The findings that superoxide plays a key role in bioluminescence could lead to new biomedical procedures, including monitoring tumors by tagging them. Instead of using MRI or taking tissue samples to monitor a tumor, doctors could make it more visible by lighting it up, a procedure that would be much less invasive.

Why Do Fireflies Glow?

From the colorful plumage of a peacock to the fancy dancing of

guppies, all animals have evolved ways to attract a mate. Male fireflies use a flashy way to catch the eye of their mate by generating a glowing pattern at a particular wavelength. When a female of the same species identifies a pattern she is interested in, she responds by flashing back in a particular way.

But fireflies also glow to deter would-be predators. The same chemicals that make them glow, lucibufagins, taste terrible. So when the firefly glows, it's a way of reminding predators that they taste bad and wouldn't make a good meal.

A more sinister reason for the glow is to help the firefly become a predator. The female of some species lure males with deceptive flashes. When the unsuspecting male approaches her, she grabs him and eats him.

[CLASSROOM DISCUSSION]

What other living organism glow? Why do they glow?

What other applications are there for bioluminescence?

[VOCABULARY]

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How Spiders Make Sense of the World Around Them

By Kevin Ritchart

In comic books, it takes being bitten by a radioactive spider for a teenage photographer to develop his "Spidey Sense," but did you know that spiders can gather information about the world around them just by feeling the vibrations and sound waves that travel along their webs?

Researchers from several universities have been studying the way spider webs vibrate and how spiders use those vibrations to gain information

about what's happening around them. These super-sensitive arachnids use web vibrations to know when they've caught a meal, when a potential mate is approaching and even when their web might be in need of repair.

Scientists extracted golden silk from an orb weaver spider and tested it alongside other natural and man-made materials to measure how sound waves moved through each of the different kinds of fibers. Researchers also shot bullets at the fibers to gauge the responses to high-speed ballistic stimuli.

Setting the Tone

It turns out that spider silk is highly sensitive, and it can essentially be "tuned in" to various tones that allow spiders to listen to the world around them. Spiders use slit sensillae, which are small grooves on their legs that deform when exposed to even the slightest of vibrations, to decode the meaning of the movements around them. When an insect hits the web and gets caught, the spider employs its slit sensillae to interpret the web vibrations as the insect attempts to free itself. As a result, scientists now

believe that the size and shape of spider webs could be based on sonic sensitivity.

Engineers are currently exploring ways to use spider silk in the construction of things like lightweight sensors, bulletproof vests, cables and even artificial muscles.

[CLASSROOM DISCUSSION]



What other information could spiders learn about their environment from sensing web vibrations?

Can you think of more potential uses for spider silk?

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Drones to the Rescue

By Justin Kovach

In times of war, the ability to get injured soldiers from the battlefield safely back for medical treatment without risking another life is priceless.

Normally a soldier would call for medical evacuation for a wounded comrade, which usually takes place by a manned helicopter flight. The only problem with this type of evacuation is that it puts additional lives in danger, namely the pilots. But in our ever-increasing world of autonomous vehicles, this problem may soon disappear.

The Hero Named K-MAX

K-MAX is a power-lift helicopter manufactured by Kaman Aerospace that was converted to an unmanned cargo helicopter, successfully completing over 1,900 resupply operations in combat situations between 2011 and 2014. In March of 2015, K-MAX started doing casualty evacuation testing. Because of K-MAX's twin-rotor design that optimizes lift capabilities, it can fly in

weather that would normally ground manned flights. With less restrictive flight obstacles and no possibility of human life being lost by sending a rescue helicopter, it is no wonder the U.S. Military is interested in unmanned rescue drones. FAA (Federal Aviation Administration) regulations currently require a pilot for any flights involving humans, but those laws may change in the future when the technology of K-MAX and other such unmanned vehicles, like autonomous drones, start flying in our everyday airspace.

A Drone Cab from Your iPad

K-MAX isn't the only unmanned vehicle out there trying to safely fly humans around. A Chinese startup called Ehang recently unveiled a drone dubbed Ehang 184. Unlike the unmanned K-MAX, Ehang 184 is autonomous. It's a quadcopter capable of carrying a single passenger on a 23 minute flight at a speed of approximately 62 miles per hour. Using a tablet, the passenger can set the destination, takeoff and land while everything else is handled by the autonomous system in the



drone. EHang is hopeful that their air taxi can hit the markets in 2016, though it will be a little longer before they would arrive in the U.S.

[CLASSROOM DISCUSSION]

- What risks are involved in autonomous rescue vehicles and public transit?
- What problems will the human perspective have when it comes to accepting and regulating driverless sky taxis?
- Would you trust your life to a computer in the sky?
- What does the Federal Aviation Administration do?

[VOCABULARY]

AUTONOMOUS

QUADCOPTER

EXPEDITIOUSLY



Odds Predict 9TH Planet

By Robert Marshall

Dubbed Planet Nine, as of writing this article, evidence has yet to surface that disproves a newborn theory. Orbiting the sun, in a period that is suspected to take more than 10,000 years, Nine, following the current model, would meet the third and final planetary qualification making it much more than a dwarf: a mass of 10 Earths, easily clearing its path of debris. Despite potentially filling in Pluto's missing "planet" status, this unconfirmed solar system body would be significantly farther away – the reason astronomers have not been able to observe it directly, though now actively searching.

Follow the Orbits

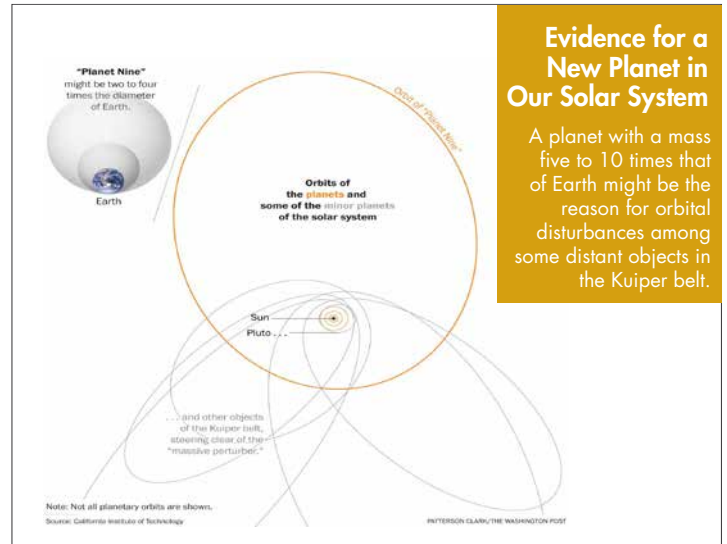
Planet Nine is predicted to exist by a California Institute of Technology two-person research team. Mike Brown, an observational astronomer, and Konstantin Batygin, an assistant professor at the California Institute of Technology, who together began their challenging investigation following the previous observational discoveries of more than a dozen icy Kuiper Belt objects all following similar odd orbital patterns. Considering

this was more than coincidence, the Caltech duo approached the pattern as if a missing mass could explain the anomaly. "It's almost like having six hands on a clock all moving at different rates, and when you happen to look up, they're all in exactly the same place," said Brown.

Mounting Evidence

Using an anti-aligned orbit during computer simulations, where a would-be ninth planet's closest approach to our Sun is opposite those approaches of six Kuiper objects, the outcome predicts stable orbital paths for all accounted objects. For now, the theory stands until new evidence may wipe the slate clean, forcing scientists to start over again. Then again, a possible observation with a detector could capture a photograph, or pixel, making this true planetary discovery one for the history books – the liking of which has not happened since ancient times.

Planet Nine, if in existence, would have a highly elliptical orbit spanning well beyond the path of Pluto.



California Institute of Technology; Washington Post

[CLASSROOM DISCUSSION] Strong scientific theories are based on strong evidence. What are other scientific theories with strong evidence that might be considered controversial?



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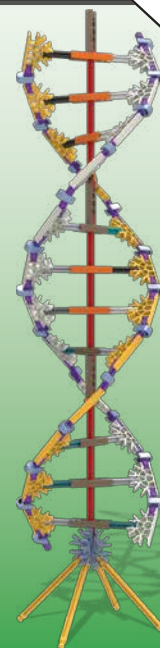
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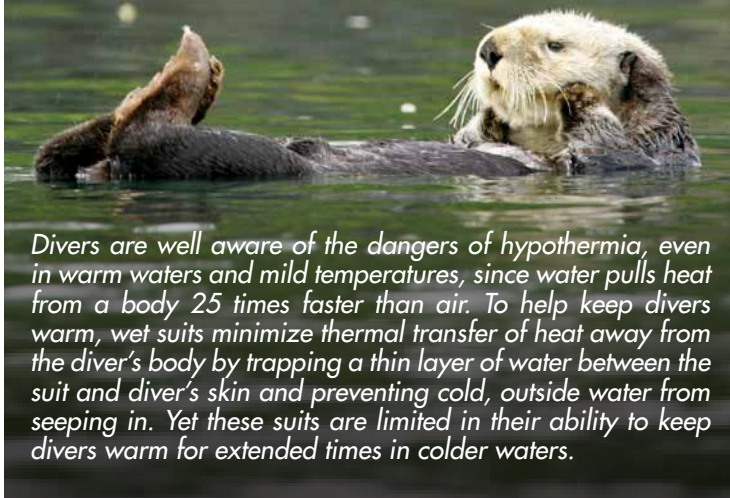
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Are Otter-Inspired Wet Suits on the Horizon?

By Mary Rose Thomas-Glaser



Divers are well aware of the dangers of hypothermia, even in warm waters and mild temperatures, since water pulls heat from a body 25 times faster than air. To help keep divers warm, wet suits minimize thermal transfer of heat away from the diver's body by trapping a thin layer of water between the suit and diver's skin and preventing cold, outside water from seeping in. Yet these suits are limited in their ability to keep divers warm for extended times in colder waters.

How Do Marine Animals Stay Warm?

Marine animals have physically adapted to their environment and can thrive in freezing waters. Whales, seals and porpoises maintain thick layers of insulating blubber. Other animals, like the sea otter, are insulated from the cold waters by fur.

Sea otters are born in the cold waters along the Pacific coasts of North America and Asia and spend most of their lives in the water, floating and even sleeping on their backs. And they maintain a constant toasty body temperature of 100°F without a layer of blubber.

What's So Special About Otter Fur?

The secret to their warmth lies in their super dense, water-repellent fur that traps air and prevents water from contacting their skin. In fact, otter fur is so dense that in just one square inch there are a million hairs. The average human head has about 100,000 to 150,000 hairs.

In addition, otter guard hairs have two key features. They are longer and coarser with an ovoid, rather than circular, cross section that allows them to flatten in the same direction when

wet. They also have minute, scale-like projections that lock hairs together to keep water out.

Using these features, researchers are exploring the water repellency of surfaces covered with rigid, squat projections. In a series of experiments, a team altered the length and spacing of projections and found that surfaces with longer, more densely packed protrusions trapped air best — just like otter fur. They plan to continue experiments to develop materials with surfaces that more closely mirror synthetic fur and explore potential practical applications — perhaps even wet suits made with artificial fur.

[CLASSROOM DISCUSSION]

What is biomimicry? What everyday products have been developed using biomimicry?

How does cold water pull heat from the human body?

[VOCABULARY]

BLUBBER

GUARD HAIR



Love otters? Read more about them on page 9.

The Salt Solution to Cleaner Power Generation

By Kevin Ritchart



Coal, oil and natural gas are used to produce more than 80 percent of the world's energy, but these methods of generating power have long been proven harmful to the environment. They produce greenhouse gases like carbon monoxide as they burn, which dirties the air.

In the past several years, efforts have been made to convert to cleaner, more environmentally friendly methods of power generation through the use of the sun, wind and water. While these methods of supplying power are better for the environment, setting up large-scale solar-, wind-, or water-based power plants is a costly and time-consuming process.

That's why nuclear engineers like Leslie Dewan of a Massachusetts-based company called Transatomic Power are searching for alternate modes of power generation that are

cleaner than nuclear energy, but also cheaper to produce than solar or wind power. Dewan's company is attempting to revive a power-generating technique using molten salt that was first attempted in the 1960s.

Eating Nuclear Waste

Along with serving a cleaner-burning alternative, the molten salt reactor can effectively "eat" nuclear waste. A light water nuclear reactor uses uranium pellets that are coated with metal in its power generation process.

Over time, radiation and the collision of atoms erodes the metal coating, slowing down the fission process and necessitating the disposal of the damaged pellets. Nuclear plants store these pellets, which still contain a great deal of nuclear energy, in large containers and submerge them in water. A molten salt power plant would be able to contain and reuse the uranium rather than having to discard it.

Instead of using uranium pellets like a traditional nuclear reactor, a molten salt reactor dissolves the uranium

in liquid salt, which is comprised of a lithium fluoride compound that's been heated to 600°C. The utilization of liquid fuel is safer in the event of a reactor failure, as the fuel can be drained into an underground tank instead of being released into the atmosphere as has been the case in nuclear disasters that occurred at Three-Mile Island (1979), Chernobyl (1986) and Fukushima (2011).

In the 1960s, the molten salt reactor was considered too costly to produce, but Dewan's team has come up with a smaller, more cost-efficient model that could change the way power is generated in the years to come. At this point, Transatomic Power has only run computer simulations of the molten salt reactor, but the company is planning to start building a prototype by 2020. Other U.S. companies, as well as firms in China and Japan, also are working on perfecting this technology.

[CLASSROOM DISCUSSION]

What are the advantages of molten salt reactors when compared to nuclear reactors?

What are some other ways to generate power that are more environmentally friendly?



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LaMotte

Physicists Synthesize Four New Elements

By Mary Rose Thomas-Glaser

Four of the heaviest elements ever discovered have been officially recognized by the International Union of Pure and Applied Chemistry to complete the seventh row of the periodic table. These yet to be named elements, 113, 115, 117 and 118, were created in a series of experiments conducted by nuclear physicists in the United States, Russia and Japan between 2002 and 2010.

Search for Stable, Super Heavy Isotopes

All elements are identified by their atomic number, or the number of protons in their nucleus. Only the elements below Uranium (92) are found naturally on Earth. All heavier elements, including the four newest, have been produced in nuclear reactors or with particle accelerators.

Elements lighter than Lead (82) are "stable" and will not decay or change. Conversely, heavier, "unstable" elements lose energy by releasing radiation and decay into less radioactive and more stable

elements. The time it takes for half of a radioactive element's atoms to decay is known as its half life.

Scientists have known that the nuclei of stable elements are held together more securely. The protons and neutrons in these elements are arranged in a series of shells that provide additional stability. In the 1960s, researchers discovered that the key to added stability of natural elements is the magic number of protons and neutrons.

Based on the stability of natural elements, researchers theorized that by maintaining the ideal proton-

neutron ratio it would confer extra stability to super heavy elements. Since then, physicists have sought to prove the theoretical "island of stability" for heavier elements with nuclei containing 184 neutrons and 114 protons.

In numerous experiments using particle accelerators, researchers fired beams of lighter nuclei onto films of heavy metal. In rare instances during this beam bombardment, a nucleus was hit head on. When such a collision happened, a compound nucleus was created and projected outward where a detector captured the timing of decay and energy of decay products.

The recent experiments produced the four newest super heavy elements. Only a few atoms of each new element were created, and none survived more than a few hundred milliseconds before radioactively decaying. Nonetheless, researchers

are one step closer to the elusive island of stability. While these elements lack any current practical application, they help researchers to better understand the forces that hold a nucleus together.



[CLASSROOM DISCUSSION]

What subatomic particles make up atoms? What are their individual properties?

When was the periodic table created and by whom?

What element was the first to be "scientifically" discovered?

[VOCABULARY]

PARTICLE ACCELERATOR

RADIOACTIVITY

ISOTOPES

Rise of the Bioplastics

By Lisa Jancarik

Roughly 330 million tons of plastic are produced annually, accounting for eight percent of the world's petroleum consumption, and up to 14 million tons entered the world's oceans in 2010. Plastic easily enters waterways as trash, and it has the added problem of fragmenting into smaller pieces that become impossible to collect. Plus, plastic tends to absorb other pollutants already present nearby. These bits of plastic enter the food chain when consumed by animals like birds and fish. The health impact on people who consume these animals is unclear.

Competing with the Dinosaurs

Despite growing public sensitivity to petroleum-based plastics in the environment, bioplastics haven't become entirely viable replacements for their conventional counterparts, which have had a 60-year head start on their plant-based competitors. Consequently, those plastics have a range of attractive properties and are inexpensive to produce. For bioplastics to be competitive, the price of a barrel of oil would need to almost triple.

New Bioplastics Developments

One type of bioplastic already in limited use is polylactic acid (PLA). Among other uses, PLA is one of the few materials suitable for 3D printing, and its biocompatibility makes it a good choice for medical products like absorbable sutures. To this point, PLA has not seen broader use because its

production is expensive compared to that of petroleum-based material. Plus, the intermediary steps of the current synthesis create waste and require the use of metals. At Belgian University KU Leuven, researchers may have found a way around these problems by using a zeolite – a porous mineral that catalyzes synthesis in a way that skips the intermediary steps and does not require metals. If success in the lab scales to the industrial level, then PLA synthesis will become more cost-effective and environmentally friendly.

While KU Leuven works toward improving PLA synthesis, another institute is focusing on degrading plastics for recycling. Researchers at North Dakota State University's Center for Sustainable Materials Science recently exposed a solution containing fructose-based plastic to 350nm-wavelength light. Three hours of light exposure degraded this simple plastic to its building blocks. The light

degradation approach suggests a faster, more environmentally friendly means to recycle and reuse polymer building blocks. In coming years, the group expects to examine how the process might work with plastics used in consumer goods, like cars and electronics.

Familiar Brands and Bioplastics

One iconic brand is already using bioplastics in its single-use products. Coca-Cola Company launched PlantBottle in 2009, and since that time, they have produced 35 million of these drink bottles. PlantBottle consists of polyethylene terephthalate (PET) and up to 30 percent bio-based material. PET is recyclable, but their latest bottle material, unveiled in summer of 2015, is entirely bio-based.

Where durability is the desired trait, the search for bioplastic alternatives

continues. Toymaker Lego announced in 2012 that it intended to find sustainable materials for its iconic bricks, currently made from ABS. The brand reputation for durability makes finding a replacement material tricky. There are other challenges, too. For example, brick colors need to match because play sets get mixed together. Plus, the Lego elements have to click together firmly, but pull apart with a child's arm strength. Within the plastics world, Lego's mission constitutes big news, as the company operates over 5,000 molds on more than 1,000 injection molding machines. In 2014, Lego produced over 60 million pieces for its building sets.

With major players like Lego and Coca-Cola looking at plastics alternatives, bioplastics are closing the gap on that 60-year head start held by their petroleum-based counterparts.

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How Does Changing Sea Ice Impact Mercury Levels in the Arctic?

By Mary Rose Thomas-Glaser



In recent years, the frequency of sea ice opening and closing in the Arctic Ocean has been escalating. The result of increased ice break activity is a shift from thick perennial ice masses to thinner seasonal ice sheets. Does this change in ice breaks and ice thickness affect concentrations of pollutants such as mercury in the air, water and on the ground? The answer, it seems, depends on the scientific study.

Increased Ice Breaks and Rising Mercury Levels

Based on findings from the 2012 NASA Bromine, Ozone and Mercury Experiment off the coast of Alaska, turbulence in the polar air above large cracks in the Arctic ice may be pulling atmospheric mercury down to the ground surface allowing it to enter the food chain. Project researchers believe that the temperature difference

between warmer seawater in the ice channels, or leads, and the layer of cold air up to 400 meters above the water causes a pumping reaction that draws down atmospheric mercury.

Warmer Air, Decreased Ice and Declining Mercury Levels

A first-of-its-kind study by the U.S. National Science Foundation and China Scholarship Council compared

the impact of environmental variables such as temperature, sea ice extent and wind speed in two regions, using computer modeling to simulate recorded levels of mercury in air and water from 2000 to 2009. The findings, published in the August 2015 *Geophysical Research Letters*, suggested that warmer springtime temperatures and decreased Arctic ice levels, Arctic reduced mercury deposits from the atmosphere to the ocean.

Since more water is open to contact with the air from summer through fall, mercury is transferred from the water to the atmosphere. The end result, according to study scientists, is less mercury in the Arctic ocean than 10 years ago, an annual decline of about 0.67 percent for the 10-year period. "Because climate scenarios suggest that climate warming in future decades will increase surface air temperatures and decrease sea ice extent, we think it might drive

substantial declines in Arctic Ocean mercury in the future," said Long Chen, doctoral candidate at Peking University and lead study author.

In reviewing the study, Associate Professor Steve Brooks at the University of Tennessee Space Institute stated, "The reduction in ocean mercury predicted by the model should be seen as good news. It means that there is less mercury in the ocean that can wind up in the food chain."

[CLASSROOM DISCUSSION]

How do pollutants in the food chain affect humans?

What are sources of mercury in the environment?

[VOCABULARY]

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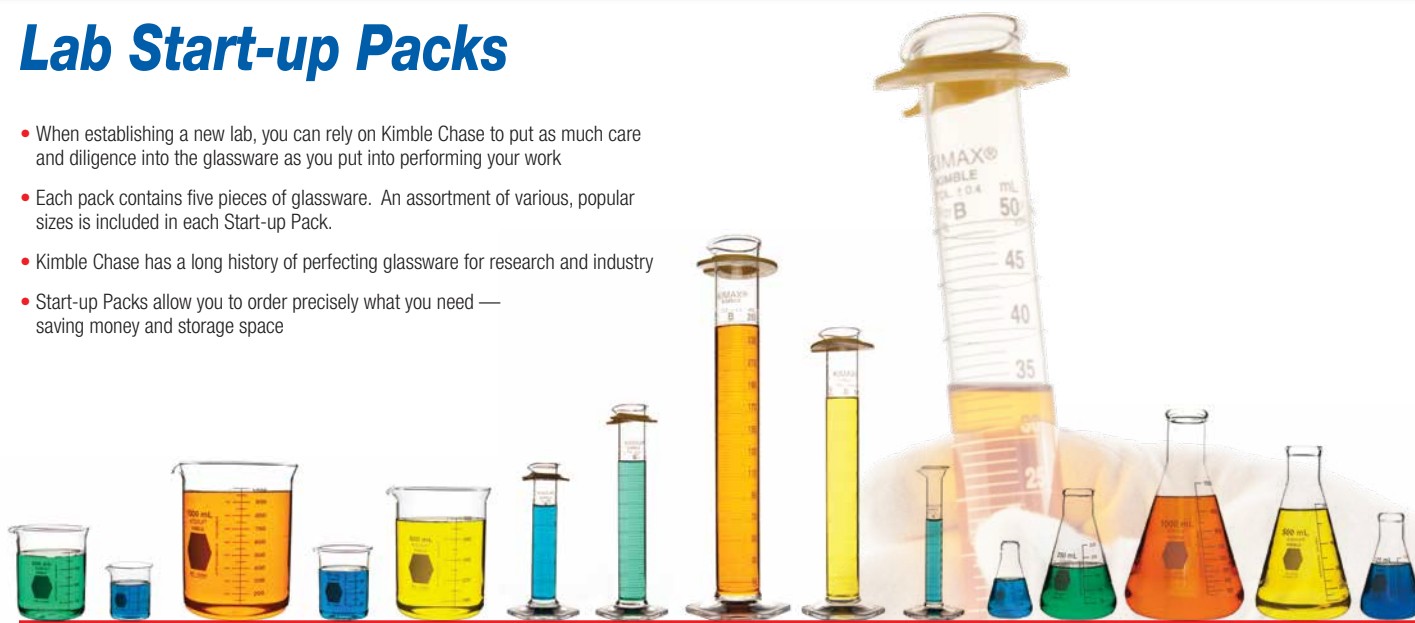
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Five Fascinating Natural Wonders

By Mary Rose Thomas-Glaser



The Earth is an amazing planet filled with incredible natural phenomena from mountain top to ocean bottom. Here's a peek at five astounding marvels from around the globe.

Blood Falls, Antarctica

Blood Falls creates an eerie image as crimson water stains the snowy face of Taylor glacier. The source of this

aqueous mystery is the super salty, iron-rich anaerobic water trapped 400 meters below the glacier that feeds a lake atop it. As water spills from the lake, iron in the water rusts creating the "blood" trail as it flows down the glacier.

Surtsey, Iceland

This one-square mile volcanic island appeared off the Icelandic coast, following a series of underwater

volcanic eruptions from 1963 to 1967. Since its birth, the island has been protected, and no one is permitted to go ashore. The island serves as a pristine natural laboratory for scientists to observe the plant and animal colonization process.

Moeraki Boulders, New Zealand

Koekohe Beach provides a chance for visitors to view prehistoric geological wonders, formed up to 65 million years ago. Huge spherical boulders measuring up to 12 feet in circumference formed on ancient sea floors by gradual precipitation of calcite in mudstone — created much like a pearl. Eventually the mudstone was raised from the seabed into cliffs, and over the millennia wind, rain and waves exposed the boulders encased in the mudstone, a weathering process that continues today.

Pamukkale, Turkey

Over thousands of years, mineral-rich waters from natural hot springs on a cliff overlooking the ancient Roman city of Hierapolis (modern day Pamukkale) have flowed over travertine terraces on the hillside. The water deposited calcium carbonate to create a strikingly beautiful landscape of ghostly waterfalls known as the "cotton castle." Millions visit these naturally heated basins to enjoy

the therapeutic benefits of the 96° mineral springs.

Eternal Flame Falls, Orchard Park, New York

In a chamber tucked behind a small waterfall in New York's Shale Creek Preserve at Chestnut Ridge Park burns the "eternal flame." Rumored to have been lit hundreds of years ago by Native Americans, the flame is fueled by a macro seep that spews methane gas from the shale below. This seep also features the world's highest concentrations of ethane and propane.

[CLASSROOM DISCUSSION]

- What causes iron rust?
- Are there any active underwater volcanoes today and where are they located?
- What health benefits are associated with mineral-rich waters in natural springs?
- What other unique geologic formations are formed by calcium carbonate deposits?
- How is methane gas formed underground?

[VOCABULARY]

- ANAEROBIC
- MACRO SEEPS
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ELECTRONIC WASTE:

Better Options than the Dumpster

By Lisa Jancarik



Discarded old cell phones, laptops and other electronics have created enough of a problem to have their own specific terms now: WEEE (waste electrical and electronic equipment) or “e-waste”. According to a report released by Countering WEEE Illegal Trade (CWIT), only about 35 percent of the European Union’s used, but functional, electronics discarded in 2012 made it to official collection and recycling systems. The rest were either exported, recycled under noncompliant conditions (often linked to other organized crimes) or just tossed in dumpsters.

The U.S. is in no position to gloat over its track record with e-waste, either. Nonprofit firm Silicon Valley Toxics Coalition reports that 70 percent of the heavy metals in American landfills come from e-waste of value, releasing lead and other contaminants into the environment in the process. “If they can pull the metals out by bashing and burning, that’s what they do,” said Barbara Kyle, executive director of Electronic TakeBack Coalition. “These are people working for a few dollars a day and don’t get health safety.”

Urban Mining

Electronics too obsolete to be repurposed may still have their components recycled. Recyclers will very often charge a nominal fee to accept e-waste, but some do it for free. These organizations may harvest parts like circuit boards for reuse or resale. John Sherigan, chairman and CEO of Electronic Recyclers International, describes the process of reclaiming batteries and power supplies from the e-waste in landfills as “urban mining.” However, he offers a much broader definition of the term: “Urban mining goes way beyond electronics,” he said. “It’s everything that goes into a landfill that can be taken out.”

The U.S. Environmental Protection Agency reports that Americans simply trash two million tons of e-waste annually, six times the amount they recycle. Upgrading your phone? The agency estimates that only 11 percent of discarded smartphones make it to recycling facilities annually.

Shipping E-Waste Overseas

Shipping e-waste overseas is mostly legal in the United States, so much of the first world’s electronic waste is simply sent elsewhere. The nations on the receiving end – most often China, Vietnam, Ghana and Nigeria – have few, if any, regulations of their own. According to the Electronics TakeBack Coalition,

which promotes responsible electronics recycling, crude and unsafe methods are used to extract any materials. For companies like ERI, discarded electronics offer a rich source of metals like platinum and iridium. China accounts for 97 percent of the rare earth metals market, but U.S. landfills offer a potential domestic source for these same elements.

ERI’s success depends in part on regulations at the state level. For example, California charges a fee for new electronic devices to support e-recycling efforts. The fees subsidize recyclers and collectors who bring electronics to recycling plants. Other states shift the burden of recycling efforts to manufacturers, encouraging design of easily recycled products or use of recycled materials.

Donations

Donated mobile services occupy a special niche for repurposing. Working cell phones collected by domestic violence programs and shelters offer people who need those services a lifeline. For example, Verizon’s Hopeline is a free service accepting donations of working mobile devices to distribute to people who need them.

In the U.S., consumers can often donate their outdated, but functional, equipment to organizations like Goodwill or the Salvation Army. Some charities like iLoveSchools.com and the National Cristina Foundation find homes for this sort of equipment in schools and nonprofit organizations, like food banks.

Future: Doing Something Smarter With Smartphones

According to Darren Beck, blogger and member of Sprint’s Corporate Social Responsibility Practice, reuse is the key to managing unwanted phones in the future. Even older models can process data and communicate via Wi-Fi or Bluetooth. These devices contain accelerometers, GPS systems, touch screens, gyroscopes and cameras; all components potentially reusable elsewhere. Beck describes Sprint’s Smartphone Encore Challenge as a contest for U.S. college students to develop an innovative device using older smartphones or their components.

[CLASSROOM DISCUSSION]

Have you ever disposed of an electronic device? What did you do and why did you make that choice? Would you do it again or would you do it differently now?



Five Weird Facts About Earth

By Celeste Beley



1. The Eiffel Tower is taller in the summer.

Because of thermal expansion, the Eiffel Tower in Paris is 5.9 inches taller during the summer months. Thermal expansion occurs when a substance or object is heated and its particles move about more, therefore expanding their size. While the phenomenon mostly occurs in gases, it also can happen in liquids and solid objects. It's because of this that tall structures, such as the Eiffel Tower, are built with expansion joints to avoid any damage when thermal expansion does occur.

2. The Amazon Rainforest produces (and consumes) nearly 20 percent of the Earth's oxygen.

More than seven billion humans survive on planet Earth, and that takes a lot of oxygen. The Amazon Rainforest in South America produces up to 20 percent of the total oxygen needs for our planet, but because of the decomposition of organic plant and animal matter, the rainforest actually consumes about as much oxygen as it produces. Because of this, scientists refer to the rainforest's cycle of production and consumption as "oxygen turnover."

3. Hawaii moves nearly 3 feet closer to Alaska each year.

Hawaii sits on The Pacific Plate, a tectonic plate moving closer to the mainland each year. Because tectonic plates are always moving due to currents created by rising and sinking rocks, the island state is slowly moving with it.

4. If you removed the empty space between atoms, the entire human race would fit inside a sugar cube.

No, really. There are seven billion people in the human race, and without the space between atoms in our bodies, we'd all be significantly smaller. Human atoms are made of a tiny nucleus surrounded by electrons – about 99.99 percent of which is just empty space.

5. In 2.3 billion years, Earth will be too hot for life to exist and the sun will engulf the planet.

Scientists predict that the sun will get hotter and brighter as time progresses, which eventually will cause our oceans to evaporate completely. The result will be a desert landscape similar to that of Mars. A few billion years after the oceans evaporate, the sun will engulf Earth and life on the planet will be impossible.



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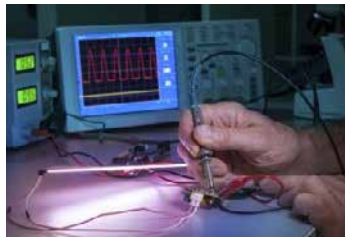
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To pursue a career as an Automotive Service Technician, a student should begin taking courses on automotive repair, electronics and mathematics. Beyond high school, many Service Technicians pursue an associate degree at a vocational school. There are also many opportunities for on-the-job training. After two years of experience, an Automotive Service Technician may take an exam to receive a certificate from The National Institute for Automotive Service Excellence in one of eight areas within Automotive Services. This certificate demonstrates proficiency in this area of work, and will often result in higher compensation for the Automotive Service Technician.

Students who want to pursue this career certainly have jobs available to them. According to the Bureau of Labor Statistics, it is expected that the United States economy will add 124,800 jobs for Automotive Service Technicians from 2010-2020. The median pay for an Automotive Service Technician is \$35,790, above the national median pay for all jobs.

Centuries of Women in Science

By Lisa Jancarik

Ada Lovelace Day occurs on October 13th each year as a day for the scientific community to welcome and encourage women and girls to enter the sciences. Lovelace was born to poet Lord Byron, and known as a lifelong friend to inventor Charles Babbage. She worked closely with Babbage on his mechanical analytical engine, a precursor to computers. The first algorithm for the machine, which she developed, is today considered the first computer program.

While math and science were unusual occupations for women in centuries past, Lovelace was not unique. Several women advanced astronomy, chemistry, physics and biology over a period of centuries.

Women Scientists of the 20th Century

Some of the 20th century's most notable scientific contributions were made by women. While some had a smooth path, others struggled for opportunity and recognition.

In biology, Rosalind Franklin ranks among these women. Using X-ray crystallography, she imaged DNA and had nearly figured out its structure when a colleague showed her images to

James Watson. When Watson quickly figured out that the molecule was a double helix and published the finding with Francis Crick, he and Crick were awarded the 1962 Nobel Prize. By then, Franklin had died of ovarian cancer. Another X-ray crystallographer, Dorothy Hodgkin, also mastered X-ray crystallography and determined the 3-D structures of penicillin, vitamin B12 and insulin.

Women did eventually gain Nobel recognition. In the 1970s and 1980s, geneticist Barbara McClintock first described "jumping genes," which have since been found in a range of organisms, including maize and even insects and humans. McClintock earned a Lasker prize in 1981 and a Nobel Prize in 1983 after years of not being taken seriously.

Emilie Du Chatelet

(1706 – 1749)
Math and Physics



A courtier and a paramour of philosopher Voltaire, this broadly educated woman's French translation

of Isaac Newton's Principia is still used today. In her childhood, Du Chatelet is thought to have been permitted to study Latin and geometry with her brother. Later, she began serious study of Descartes' analytical geometry and published her first book, Foundations in Physics, in 1740.

Caroline Herschel

(1750 – 1848)
Astronomy



Herschel was the first British woman to receive payment for her scientific efforts, as she was the assistant to the king's personal astronomer (her brother, who discovered the planet Uranus). She was also the first British woman to have her work published by the British Royal Society. In her own work, she discovered eight comets plus stars and nebulae.

Mary Somerville

(1780 – 1872)
Math, Physics, Astronomy



Although her father disapproved of her pursuit of mathematics, Somerville found support for her efforts in her adult life. Eventually, she moved from Edinburgh to London, where she hosted her own intellectual circle including famous astronomer John Herschel and inventor Charles Babbage. She wrote on a number of scientific topics and studied magnetism. Her best known work; however, was the English translation of Pierre-Simon Laplace's The Mechanism of the Heavens, which became a

textbook for much of the next century despite her personal dissatisfaction with the finished work.

Mary Anning

(1799 – 1847)
Paleontology



Young dinosaur fans may have heard of Anning as the first person to recover an ichthyosaurus ("fish lizard") when she was 11 years old. Her older brother put her up to excavating it, although he had misidentified it. In fact, she had a long career as a fossil hunter. Her fossils of ichthyosaurus, pleisiosaurs, pteryodactyls and other specimens helped construct our knowledge of the Jurassic period. Although she had little formal education, she taught herself the anatomy, geology and paleontology she needed to know to be taken seriously by contemporaries.

Maria Mitchell

(1818 – 1889)
Astronomy



Unlike Somerville, Mitchell enjoyed her father's support, and he taught her to use a sextant and reflecting telescope. By age 17, she was already teaching science and math to girls at a school she started. When she discovered a comet in 1847, she earned recognition in the American astronomical community. She would go on to become the first female astronomy professor in the U.S., working at Vassar College. Her work there largely focused on the Sun.

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