

HEADLINE DISCOVERIES

Sep/Oct 2013; Issue 3



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**HAND GESTURES MAY
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**ACTRESSES WHO HAVE HAD
STEM CAREERS**

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-Illustration by Michael Andrulonis

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BEAUTIFUL BRAINS

By Ritwika Bhattacharya

Hollywood is associated with glamour, style and beauty but not with STEM (Science, Technology, Engineering and Math). In TV or movie roles, scientists are often portrayed as geeky, nerdy or socially awkward.

But some glamorous actresses have strong backgrounds in STEM, impressive strong scientific credentials, awards, degrees, patents and theorems to their names.

STARS, STYLE AND STEM

Natalie Portman, Academy Award winner for the movie "Black Swan", is one of these actresses. When she was in high school she made it to the semi-finals of the Intel Science Talent Search, one of the most elite and demanding high school research competitions for young aspiring scientists. She maintained straight A's in school and earned a degree in psychology from Harvard.

Actress Hedy Lamarr, once regarded as the most beautiful woman in Hollywood, also pursued a serious scientific career. She invented and patented a torpedo-guidance technique that she called "Frequency Hopping," which prevented efforts to jam the signals of missiles that kept them on track. This technology has been adapted and extensively used in wireless communications.

Mayim Bialik, who plays the role of the frumpy and lovable Amy Farrah Fowler, the love interest of Sheldon Cooper on the sitcom "The Big Bang Theory", is a neurobiologist in real life too. Bialik has a PhD in Neuroscience from UCLA



Hedy Lamarr: Austro-American actress and mathematician, celebrated for her great beauty

and teaches science to home-schooled students. She also plays an active role in inspiring young girls to take up STEM-related studies and has been the face of HerWorld, an interactive workshop by DeVry University, educating teen girls about careers in STEM.

Bialik says, "The training and the knowledge and all of the things that come from learning about these subjects never leave you, no matter what you do. I view the world differently as a scientist now than I ever could have imagined I would".

CATCHING THE STEM BUG

Mae Jemison, a doctor, dancer and the first African American woman in space, once said, "The difference between science and the arts is not that they are different sides of the same coin, or even different parts of the same continuum, but rather, they are manifestations of the same thing. The arts and sciences are avatars of human creativity".

CLASSROOM DISCUSSION

- What other successful personalities have had STEM careers?
- How does STEM enhance performing arts?

SCHOOLS SHIFT FROM TEXTBOOKS TO TABLETS

By Samba Lampich

The days of hauling a heavy backpack filled with textbooks may soon be over. Tablets are quickly becoming popular among K-12 students and teachers, replacing textbooks and computers.

A GROWING TREND

A report from the new International Data Corporation (IDC) research shows that tablet shipments into the U.S. Education Sector expanded by 103% in 2012 and is expected to grow even more in 2013. This growth is driven by lower tablet costs and manufacturers, content creators and educators working together to create better delivery and quality of content in the classroom.

BENEFITS OF TABLETS

Most tablets today have a large memory, which can hold hundreds to thousands of textbooks, learning games and puzzles as well as software for homework. All this in a small device that is easy to carry around.

Tablets also offer an exciting, visually stimulating way to learn. With interactive tools and software, videos and audio files, tablets can bring the words in a textbook to life. Instead of trying to visualize an aerodynamic theory, students can watch video that explains how a plane flies. They can connect with

peers and teachers online and share ideas with other students around the world.

Tablets are also cost-effective, offering savings for schools. According to the Federal Communications Commission (FCC), the U.S. spends about \$7 billion per year on textbooks, many of which are seven to ten years out of date. In total, the FCC estimates the U.S. could save \$3 billion (assuming that a tablet would cost \$150, as schools buy them in bulk) as hardware gets cheaper and technology advances.

Electronic versions of textbooks are easier and quicker to update, which will save millions on printing costs and ensure information getting to students is up-to-date.

DO TABLETS IMPROVE LEARNING?

There is some evidence that in the long term, student readers are better able to remember what they read in printed books than what they read on an electronic screen. Kate Garland of the University of Leicester in England conducted a study in which psychology students were bombarded with questions on economics after reading digital and printed versions of text. Garland found that students reading the unfamiliar text in digital versions had to read it several times before gaining the same knowledge as



Chicago teacher Jennie Magiera was a tech skeptic, but has since successfully integrated technology into her classroom

print readers. She also found that students reading printed material understood it better.

Educators need to be aware that students may take longer to absorb material when reading on a digital device and should take this into consideration when creating lesson plans.

CLASSROOM DISCUSSION

- What are some challenges that would arise from exclusively using tablets?
- Would tablets work for every student population? Why or why not?

BOTTLENOSE DOLPHINS MAY ADDRESS LOVED ONES BY “NAME”

By Pattie Dobranski

Kathy S. Collier



Humans may not be the only species that can answer the proverbial question, “What’s in a name?”

A study published in a recent issue of *Proceedings of the Royal Society B*, a British biological research journal, examines how bottlenose dolphins may share the ability to call the “names” of family and friends through distinctive whistles, rather than words.

25 YEARS OF RESEARCH

While earlier research discovered bottlenose dolphins named themselves by emitting unique

whistles that announce their presence, this new study suggests they mimic the whistles of others to seemingly call them by name.

For this study, researchers from the University of St. Andrews Sea Mammal Research Unit in Scotland assembled 25 years worth of acoustic findings on both wild bottlenose dolphins and captive males, all living in Florida, to draw these conclusions. They also found there was no difference in the development of the name calling between the captive and wild dolphins.

ACROSS THE MILES

The dolphins used this name calling technique when trying to reunite with a friend or family member across the ocean, the study explained. Incredibly, the name calling whistles were detected as far as 12.4 miles away. Scientists noted the ability to travel this distance was affected by the depth of the water and the frequency of the dolphin’s specific whistle.

TERMS OF ENDEARMENT

The name calling was never used in aggressive encounters, the study said, and was only offered

to find loved ones. Further, dolphins even seem to apply inflection or an accent when calling others through mimicking the other dolphins’ self-proclaimed names. This seems to show the dolphins were calling others and not just announcing their own names. Even though this all adds up to quite a complex form of communication among bottlenose dolphins, scientists are not ready to call these dolphin exchanges “speaking.” Language currently remains a human-exclusive form of communication.

WHAT’S ON THE HORIZON?

The give and take between bottlenose dolphins continues to intrigue scientists. Right now, researchers are conducting audio experiments to gauge the reaction of wild dolphins to the recorded sound of their own whistle/name calling.

CLASSROOM DISCUSSION

- Do you think the bottlenose dolphin name calling whistles are a language?
- Why do you think this research is important to humans or other animals?

INVASION OF THE GIANT GOLDFISH

By Samba Lampich

The tranquil, quiet waters of Lake Tahoe, the country’s highest alpine lake, have been invaded by monster goldfish, weighing several pounds and measuring more than a foot long.

A group of researchers from the University of Nevada at Reno discovered and documented the oversized fish, and they say this household pet is an unwelcome visitor to the freshwater lake.

FROM HOME TO LAKE

Researchers say aquarium dumping is to blame for the invasion. Owners don’t think twice about emptying their aquariums into lakes, which may contain no fish but might have fertilized eggs.

The goldfish in Lake Tahoe grow faster and bigger than in a bowl or aquarium because they have a high-protein diet, which increases their weight, and they feed more often. They are also exposed to warm water, which hastens their growth. They have few predators, allowing them to grow larger and rapidly reproduce.

DISRUPTING THE ECOSYSTEM

The giant goldfish out-compete native species, such as trout, for food, leading to the decline of native fish. They also harm the lake clarity by rooting around the sediment for food and fueling algae growth with their waste, which interferes with food sources to disrupt the ecosystem’s food chain.

The California Department of Fish and Wildlife, Tahoe Regional Planning Agency and UNR partnered on a pilot project to remove warm-water fish species, such as large-mouth bass, from the Tahoe Keys during the summers of 2011 and 2012. Although only a small fraction removed in 2012 were goldfish, researchers found pregnant fish, which indicates that they are breeding quickly.

Efforts to eradicate these invasive species will continue through the summer of 2013.

CLASSROOM DISCUSSION

- What species of fish are goldfish and how were they domesticated?
- How and why are non-native species of animals and plants introduced into an ecosystem? Could there be any benefits?



Heather Segale, UC Davis



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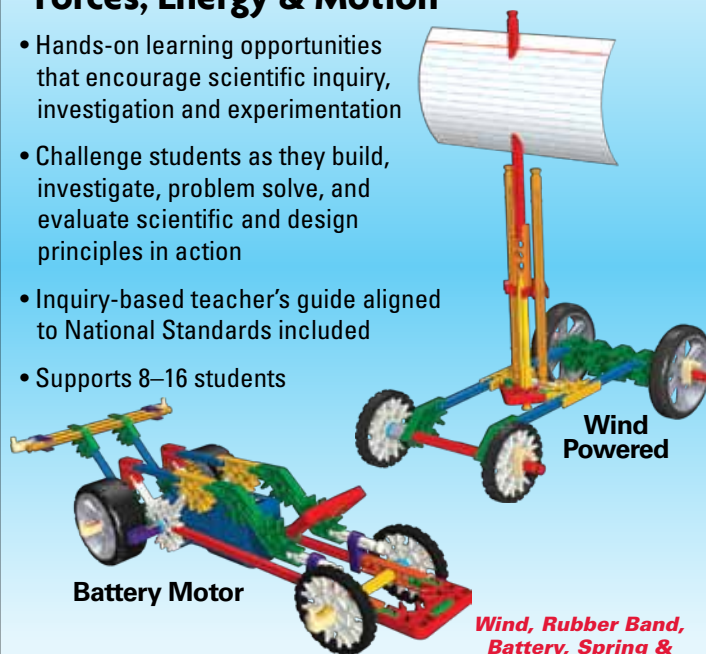
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MEN AND WOMEN REALLY DO SEE THINGS DIFFERENTLY

By Joe Giacobello

Latir Kelows via Wikimedia Commons



We've all noticed that men and women seem to think differently, but recent research suggests that they actually see things differently—particularly when it comes to colors. It seems that women are better at distinguishing among subtle color differences, while men have a greater sensitivity to fine detail and rapidly moving, distant objects.

MALE VS. FEMALE BRAIN

Scientists say that there are high concentrations of androgen—the male sex hormone receptors—in the visual cortex of the brain, which is responsible for processing images. Androgen is responsible for controlling development of neurons in the visual cortex during embryo formation. Men have 25 percent more neurons in this area than females. At the same time, however, linguistic research has shown that women tend to have a larger vocabulary than men for describing colors. So what does this all mean?

DETECTING SUBTLE COLOR DIFFERENCES

Israel Abramov and his research team at CUNY's Brooklyn College conducted a series of visual tests on men and women at both the high school and college levels. They tested and compared their color vision by projecting colors onto frosted glass or beaming them directly into the subjects' eyes. When asked to

describe colors displayed across the visual spectrum, the women were better able to distinguish among subtle differences in the middle of the color spectrum. They also detected tiny differences between yellows that looked the same to men. Additionally, the men required a slightly longer wavelength to experience the same hue as the women.

DEGREES OF CONTRAST

The subjects were also shown light and dark bars of different widths and degrees of contrast, flickering on a computer screen, an effect was similar viewing a car moving in the distance. The men were better able to see the bars, and their advantage increased as the bars became narrower and less distinct. They also had an easier time resolving more rapidly changing images that were closer together than the women.

EVOLUTIONARY ADAPTATION

A possible, but highly speculative explanation for why the sexes see differently is for evolutionary advantages. Back in the hunter-gatherer societies, the males needed to see predators or prey in the distance while women had to detect subtle color differences while scouring for edible plants.

CLASSROOM DISCUSSION

- How is our ability to distinguish colors important to our survival, ability to do our jobs or in everyday life?
- What differences have you observed, in the way that males and females think?

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LAB-GROWN KIDNEYS WORK IN RATS

By Ashley Peterson

Ott Laboratory, Massachusetts General Hospital Center for Regenerative Medicine



Previously decellularized rat kidney after reseeding with endothelial cells, to repopulate the organ's vascular system, and with neonatal kidney cells.

A team at Massachusetts General Hospital in Boston recently reached an important milestone in the field of regenerative medicine. For the first time, complete lab-grown kidneys have been successfully transplanted into rats, filtering and operating as natural kidneys would.

REGENERATING THE KIDNEYS

Dr. Harald C. Ott and his colleagues at Massachusetts General Hospital created bioengineered kidneys by using a decellularization technology Ott had previously developed. The team first stripped donor kidneys of their cells, leaving behind the underlying scaffold of connective tissues and blood vessels. They regenerated the kidneys by seeding or repopulating the decellularized organs with kidney and vessel cells from newborn rats. The kidneys produced urine but only about one-third as much as normal kidney transplants.

products from the blood and causes the body to retain excess water and waste products. Renal failure can be reversed by kidney transplants from well-matched donors. The problem is that there are currently not enough donated kidneys to meet the demand. An estimated 18,000 transplants are carried out each year, but 100,000 people remain on the waiting list to receive the surgery. Of those fortunate enough to receive the transplant surgery, approximately one in five experience organ rejection following the procedure.

According to Dr. Ott, "If this technology can be scaled to human-size grafts, patients suffering from renal failure, who are currently waiting for donor kidneys, could theoretically receive an organ grown on demand." Ideally the lab-grown kidneys would be grown from the patient's own cells so they would be less likely to be rejected by the recipient's immune system.

A PROMISING START

Ott and his team are now testing the approach with pig and human kidneys and improving the seeding process.

Though we are still a long way from being able to produce human-scale organs, bioengineered kidneys transplanted into rats filter blood and produce urine — an achievement that paves the way for growing replacement kidneys for humans.

THE SEARCH FOR A NEW ALTERNATIVE

The breakthrough marks an important step towards someday being able to grow human-scale organs virtually on demand.

Renal failure, which currently affects nearly one million people in the United States, is a medical condition in which the kidneys fail to adequately filter waste

CLASSROOM DISCUSSION

- What would be some of the next steps towards making artificial kidneys possible for humans?
- If you were a medical researcher working in a lab, what discovery or accomplishment would you make your primary mission?

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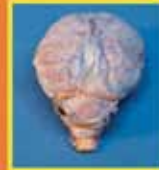
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MAGGOTS AS MEDICAL MICROSURGEONS?

By Cory Bickel

Patients with slow-healing wounds have been visiting their doctors for a strange kind of prescription lately — a crawly, squirmy dose of maggots.

TREATING WHILE THEY EAT

While this treatment may sound gross, maggots can be very helpful to these patients. The larvae of some species of flies will eat dead tissue in wounds and leave healthy tissue, helping it to grow and removing the food source for bacteria that cause infections. Doctors put the maggots into a pouch of gauze and place them on the wound. The maggots secrete fluids that digest unhealthy tissue and then absorb the nutrients. Maggots also help wounds to heal by secreting antibacterial compounds — proteins that stop inflammation that can damage tissue — and compounds that speed the body's healing abilities.

ANCIENT MEDICINE IN THE MODERN WORLD

Maggots have been used medicinally for thousands of years; by Mayan Indians, during the Renaissance and during the Civil War. They were a popular method of treating wounds and preventing infection until antibiotics, such as Penicillin, replaced them in the 1940's. Now, with more and more strains of antibiotic-resistant bacteria emerging, doctors are turning again to maggots to treat wounds. Maggots can stop infections of resistant bacteria, including flesh-eating bacteria such as *Staphylococcus aureus* that can't be treated by regular methods. In 2004, maggots, along with leeches, became the first animals to be approved by the Food and Drug Administration as "medical devices." Maggots are now grown for medical use in sterile environments that make them safe to put into open wounds.

This creepy kind of treatment may see a lot more use with diseases like



Bernd Baum, Biologic

Maggots grown and packaged in sterile BioBags

diabetes becoming more prevalent, where poor circulation can cause severe sores and wounds. With the increase in antibiotic resistant bacteria, more and more patients with wounds that are slow to heal and difficult to treat will need alternative treatments. Maggots provide a safe and simple method for helping these patients who may have few options left.

CLASSROOM DISCUSSION

- What kind of difficulties or challenges would arise when using medical maggots?
- What other "old-fashioned" treatments are still being used today?

BREATHING YOUR WAY TO BETTER HEALTH

By Mona Simpson



The "breathprint" of a student giving a sample

When you're feeling sick, it's unpleasant to visit the doctor and maybe get stuck with a needle...it's even worse waiting for days for a lab result to tell you that...you're sick! Well, imagine if you could visit your doctor and just blow into a tube. They immediately receive the results, called a "breathprint," and give a quick diagnosis. It sounds futuristic, but that future may be closer than you think.

Scientists had subjects breathe into a rubber tube that runs into a scientific instrument. They are able to match breathprints to the individuals who provided them.

FINGERPRINTS OF BREATH

A team of researchers discovered that when you breathe out, the molecules in your breath are unique to your body and your health. Breathprints are the

results of mass spectroscopy — the identification of chemical properties — of people's breath. Mass spectroscopy uses electric and magnetic fields to separate and measure the molecules in a given sample. The scientists tested participants' breath from different times of day and different days, and tried to see if they could reliably separate breathprints by the individual who provided them. They discovered that individuals' breathprints varied somewhat depending on the day and the time of day, but that each person has a core signature in the breathprint that remains unchanged. Therefore, they can capture breathprints and match the results to the individual breather, just like with fingerprints.

REAL-LIFE APPLICATIONS

Breathprints may have a large impact on medical testing: they're fast, easy, non-invasive and individual. They reflect the body's metabolism, which varies from person to person, and may help physicians give personalized treatment to their patients. Doctors could use the results to determine what medicine a person has been taking, or if they have biomarkers for cancer. The speed of results is also an important factor. Because results are delivered in real-time, this technology can be used to test athletes for performance-enhancing drugs quickly and easily.

So, in the future when you're feeling ill, maybe your doctor will order a breathprint test and you'll already know and understand the benefits of the test.

CLASSROOM DISCUSSION

- When else might it be convenient to identify in someone using breathprints?
- Name some specific instances in which getting a test quickly can make a difference.

RUBBER FROM DANDELIONS? TALK ABOUT FLOWER POWER

By Cory Bickel



Anyone who's gotten sticky hands from picking dandelions is familiar with the milky liquid they produce. This liquid is latex, a compound that can be processed to make rubber, and scientists are working to take this latex and turn it into tires.

Dandelions produce latex in their roots, and biotech companies KeyGene and Kultevat are teaming up to make these small plants more productive in order to harvest large amounts of latex from them. Scientists at KeyGene found varieties of dandelions from Russia with mutations that cause helpful changes like larger roots and increased latex production, and are in the process of introducing these mutations into common dandelion varieties. Kultevat will take these improved varieties and get them growing in amounts large enough to support industrial-scale production of rubber.

The tire manufacturer ApolloVredestein developed prototype tires from dandelion latex. As soon as the biotech companies have enough plants pumping out latex, they can begin to manufacture tires, possibly in as soon as five years.



KEEPING UP WITH DEMAND

Most natural rubber comes from rubber trees, grown mainly in Southeast Asia. As more countries have become developed, the demand for rubber and its cost have risen drastically. Finding an alternative source, especially one as tough and easily cultivated as the dandelion, will enable rubber production to keep up with the growing demand. And because KeyGene's techniques use genes found naturally within dandelions, these plants aren't considered genetically modified, and can be grown in the European countries that currently ban GM crops.

While dandelions are often considered weeds and nuisances, the pesky plants already have nutritional and medicinal uses. Soon their fast growth and ability to grow seemingly anywhere will be put to another good use, and someday we may drive past weedy yards on our dandelion tires and smile.

CLASSROOM DISCUSSION

- What other products could be made from dandelion latex?
- What problems might the scientists have to overcome in developing the processes to make tires from dandelions?

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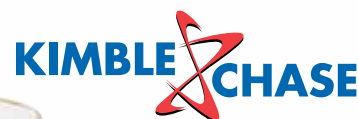


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WHAT I DID ON MY SUMMER VACATION

By Benjamin Preis



I jumped up with excitement as I read the description for a summer internship with Fisher Science Education, part of Thermo Fisher Scientific. It may seem like an unusual reaction to an internship, but from a long, daunting list of opportunities, I had found a position that sounded fun.

After a thorough interview process, I began my internship one week after finals. My fellow summer interns and I were greeted with great excitement as we were the first interns Thermo Fisher Scientific had seen in years. We met with our respective supervisors and mentors who would be guiding us through the summer. I was the only intern in Fisher Science Education, and I am positive I had the most fun of any intern.

My goal for the summer was to create YouTube videos explaining how Fisher Science Education products work. I combined my knowledge of science—I'm a physics major at Tufts University—with my experience in film production. My magnum opus was a series of four videos explaining the benefits and uses of an app called ChemAssist.

ChemAssist was created by the Fisher Science Education team to help chemistry teachers keep their chemical closets organized and safe; my job was to encourage teachers to use the app and help them understand how it works.

In addition to my project, I was completely integrated within my team. Team members brought me to meetings with other Thermo Fisher Scientific employees, and I had the opportunity to visit a high school and see how Fisher Science Education makes an impact. I was also able to meet executives within the company.

My time at Thermo Fisher Scientific was very rewarding. Not only did I have the opportunity to put my education and experience to work, I also learned a lot. The Fisher Science Education team provided me with an inside look at the workings of a Fortune 500 company, all while empowering me to affect change in classrooms around the world.

CLASSROOM DISCUSSION

- What skills have you learned in school that you could use at a job?
- How can you continue to learn, even when school is out for summer or winter break?



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SMART BRA AIMS TO DETECT BREAST CANCER EARLIER

By Samba Lampich

Breast cancer is the most common cancer among women in the United States and one of the leading causes of cancer deaths of among women of all races. Detecting it earlier and treating it sooner is key to saving thousands of lives every year.

First Warning Systems, a Reno, Nevada-based company, is hoping to make detection earlier and easier using their cancer-detecting bra, which is still in clinical trials.

BREAKTHROUGH TECHNOLOGY

The bra, which looks like an ordinary sports bra, is equipped with eight electrodes embedded in each cup that detect temperature changes in a woman's breast tissues during a 12-hour period. As tumors grow, they siphon off nutrients from blood vessels to feed their multiplying cells. The tumors induce new blood vessels to grow and this generates more heat than in the surrounding normal tissue.

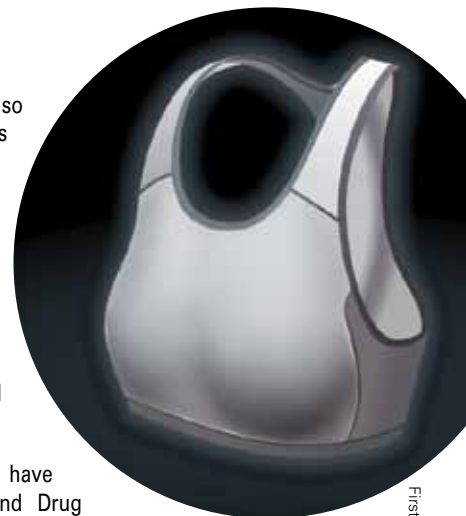
This data about the temperature changes is uploaded through a secure data link to First Warning's specialized software, which compares this information to the patterns of documented cancerous tissue. The data is analyzed and registered as "normal," "benign," "suspected for breast tissue abnormalities" or "probable for breast tissue abnormalities" classification. This report is sent to the patients' physician who will determine if a follow-up with tests and standard diagnostic procedures is required.

First Warning says they can then predict the presence of breast cancer with up to 90% accuracy. This is actually is a level of confidence that the system is getting its classification of breast tissue conditions accurate 90% of the time.

BEYOND TRADITIONAL DETECTION METHODS

The company says the bra is so sensitive it can detect breast tumors that are in the early stages of growth and cannot be detected by physical examinations of mammography. This early detection allows patients to start treatments earlier before the tumor gets a dangerous head start. It also is better at detecting tumors in dense breast tissue, which is often difficult with typical mammography.

First Warning Systems hopes to have its bra approved by the Food and Drug Administration and on the market by 2014. The bra will cost consumers around \$200 and will likely require a doctor's prescription.



First Warning Systems

CLASSROOM DISCUSSION

- What are the risk factors for breast cancer?
- What are some of the myths about breast cancer? Can men get breast cancer?

DUNG BEETLES REACH FOR THE STARS

By Shubhangi Chouhan

Key-Africa via Wikimedia Commons



They may be tiny and always down in dirt, but they also keep their eyes on the stars.

Dung beetles are a species dependent on feces for their nutrition and breeding. They shape piles of dung in small balls, use their hind legs to roll them away from competitors and bury them underground to feed their young.

The beetles roll the dung balls using their hind legs and, if they don't roll in a straight line, they risk circling back to their competitors. How they manage to maintain a straight course on a moonless night — without any set landmarks — is the subject of a new study.

THE STRAIGHT AND NARROW PATH

The dung beetles are known to follow a linear path using visual cues from celestial bodies such as the sun, the moon or the pattern of polarized light that creates a compass around them.

The beetles don't need to roll perfectly in-line with the Milky Way, although they use its natural light as a reference. Vision scientist Marie Dacke and her colleagues at Lund University in Sweden studied this behavioral pattern by tracking a group of African dung beetles.

The beetles and their dung balls were put in the middle of sandy area surrounded by a meter-high wall and no landmark on the ground. An overhead camera recorded their movements. Although the tiny compound eyes are too weak to distinguish individual planets or stars, when the moon and the stars were clearly visible, the path they made was almost straight. Even on a moonless night they efficiently used the light-to-dark gradient of the Milky Way to roll dung in straight paths. But with an overcast sky, the insects rolled the dung aimlessly.

When masking blinders were used on these beetles, they were still able to orient themselves using the Milky Way, proving that they are the first species of their kind to find their way around using a visual compass system rather than landmarks.

OTHER NOCTURNAL NAVIGATORS

Scientists theorize that frogs, spiders and other nocturnal critters also use the stars, the Milky Way and polarized moonlight for orientation but they have yet to conduct studies to prove it.

CLASSROOM DISCUSSION

- Do you know of any more species with such special navigation/orientation abilities?
- How might light pollution affect dung beetles and the role they play in sustaining the ecosystem?

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BEES AND FLOWERS COMMUNICATE USING ELECTRIC FIELDS

By Samba Lampich



Flowers use their colors, size, shape and smell to attract pollinators. But scientists say they may also be giving off an electric vibe to maximize their attraction to bees. Researchers Daniel Robert, Dominic Clarke and Heather Whitney from the University of Bristol have shown that flowers use electric fields to attract bumblebees.

were wired to create a small electric field and the other half were not. The wired flowers held sugar water and the unwired ones held quinine, a substance bees find unpleasant.

When bumblebees were released into the fake flower patch when no flower had an electric charge, the researchers found that the bees visited the flowers randomly. They landed on the sugary flowers as often as on the quinine filled ones. But when a small electric charge was released into the sugar-filled flowers, the bees learned to visit them with 81% accuracy. When the charge was removed, the bees went back to randomly visiting flowers.

THE POWER OF ATTRACTION

The science community has long known that flowers growing in the ground have a natural negative charge when flying through the air. Bees, on the other hand, are positively charged. This is because the friction between tiny air particles and the bees cause them to lose electrons leaving them with a positive charge.

What remained unknown was whether the electricity between the bees and flowers was mutually beneficial. Did bees notice the electric fields and use it to choose flowers?

To find out, the scientists set up an experiment by building a small arena full of fake purple flowers consisting of a stalk and small dish at the top. Half the flowers

NATURE'S BILLBOARDS

Roberts and his fellow researchers studied real petunias and measured the electric field around the flower before and after a bee visited it. They found that a flower's electric field increased in charge as a bee approached and the boost remained for about 100 seconds after the bee had gathered nectar and left.

Roberts believes that this lingering charge helped to inform other bees that the plant had no more nectar and that they should find another flower. This way, the bees are not wasting their efforts and the flowers can replenish their supply in peace.

CLASSROOM DISCUSSION

- How can noise and air pollution affect pollination? Consider the effect on the pollinators themselves.
- How does the use of pesticides affect fruit and vegetable farmers?

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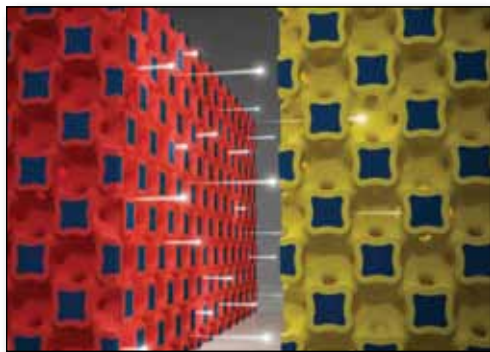


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MIGHTY POWER IN A MICROBATTERY

By Samba Lampich

The Beckman Institute for Advanced Science and Technology



The graphic illustrates a high-power battery technology from the University of Illinois. Ions flow between three-dimensional micro-electrodes in a lithium-ion battery.

Most smart phone and tablet users have had a quick moment of panic when their devices alert them that their battery is almost dead. They dread being tethered to an outlet while it charges.

But now, in this fast-paced, tech-driven world, researchers have built new batteries that charge instantly and hold hours of juice.

develop a matching anode. The two were then assembled in a 3D microstructure to make a complete new battery with superior performance.

SOLVING EXISTING BATTERY PROBLEMS

The problem with existing batteries is that they can release energy very quickly but store only a small amount, or they can store a large amount of energy but release it very slowly. Capacitors express their power very quickly but don't store a lot and Li-Ion batteries hold a large amount of energy but take a long time to charge. These new microbatteries offer the best of both; holding much energy and expressing the charge quickly. Ideally, a cell phone could be fully charged in one second.

POTENTIAL USES OF MICROBATTERIES

With their ability to charge quickly and hold a lot of power, these microbatteries could be used in medical devices and laser sensors where their electronics are small but their batteries are large.

"Now we can think outside of the box," said James Pikul, a graduate student who worked on the project. "It's a new enabling technology. It's not a progressive improvement over previous technologies; it breaks the normal paradigms of energy sources. It's allowing us to do different, new things."

Researchers at the University of Illinois at Urbana-Champaign developed a small, dense battery that can charge 1000 times faster than normal batteries and release a lot of power. Professor William King who headed the researchers says the microbattery is so powerful the power storage device in a cell phone could be used to jumpstart a car battery. The group is working to make the batteries small enough to fit inside a "credit card-thin" device.

HOW DID THEY DO IT

According to the researchers, the secret to creating the microbattery was miniaturizing the anode and cathode. King and his group used materials science and engineering professor Paul Braun's method of miniaturizing the cathode to

CLASSROOM DISCUSSION

- What other devices would benefit from these microbatteries?
- How would this kind of battery affect other sources of energy, such as solar?

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NASA SPACECRAFTS PREPARE TO STUDY COMET FLYING BY MARS

By Robert Marshall, Educator, Carnegie Science Center



After the discovery of comet C/2013 A1 by the 20" telescope of the Sliding Spring Observatory earlier this January, scientists are predicting its close encounter with the red planet on October 19, 2014. Each observation since its discovery has led to better orbital trajectories, helping to determine the time, velocity and distance at which it will pass.

RED PLANET SAFE FROM IMPACT

Original mathematical calculations gave Mars a 1 in 2,000 chance of impact. Those odds were high. Though such an impact would only exhibit one-third the amount of energy as the theorized dinosaur extinction event on Earth 65 million years

ago, such an event would change Mars, a planet with merely one-tenth the mass of Earth. Scientists would then have a chance to study a global climate-changing event, in real-time, right here in our own solar system. But today, odds of impact have been reduced to 1 in 120,000.

MARTIAN ENCOUNTER

Regardless, the comet is expected to pass within approximately 186,000 miles of Mars, making this event unprecedented for the network of Martian spacecraft, giving scientists a look at another world from another world. Odyssey and MRO (Mars Reconnaissance Orbiter) currently orbit the planet, taking images of the rusty oxidized surface. Adjusting their pitch so that their instrumentation can be directed out toward space could provide a solution. But engineers are not even sure if this is possible. Additionally, C/2013 A1 will be buzzing by quickly at 125,000 mph, presenting an additional challenge for capturing images.

However, these satellites don't offer the only chance for close observation. From the surface, Opportunity or MSL (Mars Science Laboratory) could look up and photograph the comet's nighttime glow. These wheeling spacecraft are almost on opposite sides of the planet from one another, meaning the rotation of Mars during the comet's pass will determine which rovers — maybe both — get a peak.

CLASSROOM DISCUSSION

- Where do comets originate?
- What other retired spacecraft missions have been sent to Mars? What about planned future spacecraft?

THE GREEN GENIE IN A BOTTLE

By Mona Simpson

Tired of recycling? No problem — now you just toss all those plastic soda bottles right into your backyard. And the best thing about it is that you'll be applauded, not scolded.

We can all agree that plastic bottles make everyday life more convenient. Unfortunately, they also can damage the environment. But now there's a way they can improve it.

A BEAUTIFUL SECOND ACT

Architect Marcelo Rosenbaum is featured on Brazilian home design television show *Home Sweet Home*. He developed an amazing way to upcycle soda bottles into an attractive vertical garden. Upcycling is the practice of taking waste materials and improving their usefulness and value to make an item that is better than the original.

Rosenbaum brought his unique and creative designs to the home of the Rodriguez family: a mother and her two daughters who are already on the organic fast track by growing some herbs and vegetables in upcycled containers. He transformed their outside living space with a vertical garden made from upcycled bottles and twine. He took hundreds of clean, used plastic soda bottles and cut out a section in each to create a planter. He then strung the bottles up horizontally on a sunny wall that runs along a pathway by the family home. The design was so attractive and practical that Rosenbaum received many requests for the plans, which are now available for free (in Portuguese) on his design firm's website.

Vertical gardening is a concept that has existed for thousands of years. There are records of ancient Egyptians using vertical gardens as early as 3000 B.C. The concept has taken on new life and garnered renewed interest recently

with increased environmental awareness and the adoption of green building practices.

SMALL SPACE, BIG BENEFITS

There are several benefits of vertical gardening:

- Gardeners can grow many plants in a small space
- Diseases and pests can't reach the plants as easily
- The structures to which vertical gardens are attached are cooler because of the shade provided by the garden
- Plastic bottles are lightweight, making the garden a lighter load on the wall to which it is attached
- Materials, such as recycled bottles, are inexpensive



Marcelo Rosenbaum's Upcycled Vertical Garden



Close-up of the upcycled bottle

Marcelo Rosenbaum

CLASSROOM DISCUSSION

- How else can you upcycle plastic bottles?
- What other materials would work well for upcycling into a vertical garden?

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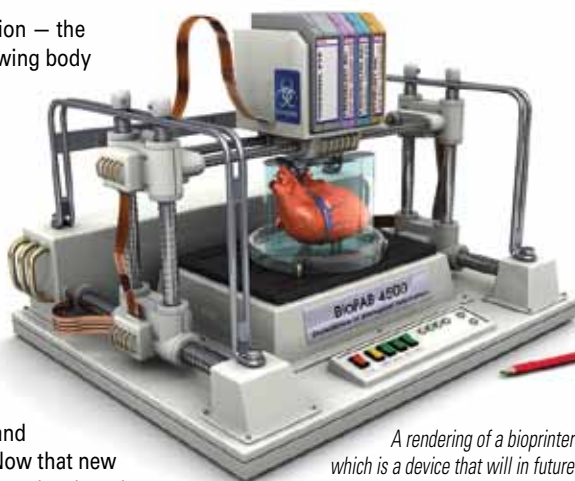
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GROWING NEW ORGANS

By Brian Marks

Tissue regeneration — the practice of regrowing body parts — is a multidisciplinary field involving biology and engineering that is likely to revolutionize the health and quality of life for millions of people worldwide by restoring tissue and organ function. Now that new methods have been developed, there is potential that this technology could be used to test new drugs or to grow organs and human tissue.



A rendering of a bioprinter which is a device that will in future 3D print replacement human organs

Using a 3D printer and injections of living cells, scientists have taken the first step toward growing customized new ears for children born with microtia (malformed external ear) or people who lose one to accident or disease. Also, researchers have printed living embryonic stem cells using a printer capable of printing droplets of cells gently enough to keep the cells alive and maintain their ability to differentiate into multiple cell types.

ADDITIONAL TISSUE ENGINEERING METHODS

In addition to 3D printing, scientists have studied manipulating faint electrical currents in the skin that appear to regulate tissue regeneration. By inhibiting such a current after amputating a salamander's leg, scientists are able to shut down the process of regrowth. In light of this research, scientists are testing electrical fields on human tissue, hoping to enable regeneration where it doesn't normally occur. Also, a cell-based approach is being attempted to transform cells back to progenitor cells that are similar to stem cells in that they can differentiate into a specific type of cell. It's possible that these cells could be pushed to multiply and differentiate into cells needed to grow new human organs or tissue.

3D PRINTING

Biotechnology firms have studied 3D printing technology as a possible solution to tissue regeneration. In tissue engineering applications, organs and body parts are built using inkjet computer-aided printers. Natural materials are printed one layer at a time until a particular 3D form is achieved. In the near future, you may be able to inject living cells into a printer and spray out 3D tissue to develop into human organs or tissue.

CLASSROOM DISCUSSION

- How could stem cell research help tissue regeneration?
- What other problems can we potentially solve by combining biology and engineering?

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SOLDIERS COULD COMMUNICATE THROUGH THEIR UNIFORMS

By Samba Lampich



Massachusetts Institute of Technology (MIT) is not a leader in fashion, but some of its scientists are turning soldiers' fatigues into quite a statement. In a joint venture, the U.S. Army and MIT are working to weave microscopic fiber-optic-like gold threads into uniforms that would enable soldiers to detect light, heat and sound.

FIBERS ARE DEVICES

The fibers are an entirely new communication device, although they are currently not yet able to carry out that function. Unlike other devices, they do not have any transistors, circuitry or processors. "These are new kinds of fibers that are themselves devices," says John Joannopoulos, the director of the Institute for Soldier Nanotechnologies. The fibers are about a millimeter in diameter, which is too thick to sew into a uniform, and Joannopoulos wants to scale down to 100 microns. The team plans to test and refine the concept and design in the next 10 years.

FROM THE LAB TO THE BATTLEFIELD

The technology would have several applications that could save lives and make communication easier and faster.

The fibers could be used to identify friendly soldiers at night, in the distance or on smoky and rapidly changing battlefields. They could shine lasers on other

soldiers' uniforms and, if they were wearing the same uniform, the fibers would sense it and send a signal back.

These uniforms would also be helpful to medics who could identify a soldier's wounds by examining heat patterns from the fibers on the uniform.

"Your uniform would transmit that information. You wouldn't be talking, it would transmit information: who you are, what time you went down, where the wounds are, what is the estimated severity of the wound, et cetera," Joannopoulos says. "The idea with these fibers is that eventually, we'd like to enable full-body sensing for the soldier."

IRONING OUT THE KINKS

The concept and design also pose some challenges. The fibers can only transmit data within a 75m distance and they function only when in the line of sight of the other uniforms with fibers. If there's an obstacle, such as a tree or structure, the communication is compromised.

The fibers may eventually supplement other communications methods, such as radio and phone, providing options for soldiers facing the unpredictability of the battlefield.

CLASSROOM DISCUSSION

- In what other fields/professions would such fibers be useful?
- What would be the benefits of having a non-verbal form of communication?



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A BILLBOARD THAT MAKES DRINKABLE WATER OUT OF THIN AIR

By Ashley Peterson

A new billboard in Lima, Peru is attracting a great deal of attention and bringing a message of hope to an area that has long faced serious water challenges. The University of Engineering and Technology of Peru (UTEC) and an ad agency called Mayo DraftFCB and created the structure to serve as a resource for residents and also to inspire would-be engineers to apply to the university.

A TOWN IN DANGER OF RUNNING DRY

Lima, Peru's capital, is the fifth largest city in the Americas and is home to 1.2 million people. It's located in a type of climate known as a coastal desert where the annual rainfall is less than an inch. As a result, many residents have to get their water from polluted wells or expensive unregulated private-company water trucks.

Despite the city's almost non-existent precipitation, the region experiences humidity levels of up to 98%. This led UTEC researchers to try and find a way to convert the humid air to water.

UTEC and Mayo Draft FCB designed and launched the first-ever billboard able to harvest and purify the moisture-rich air into potable drinking water.

SENDING A POWERFUL MESSAGE AND SOLVING A SERIOUS PROBLEM

The billboard reads, "A billboard that produces drinking water from air" and since its installation, the structure has produced almost 25 gallons of water a day.

The billboard uses a reverse osmosis filtration system to convert the air moisture into liquid. The air goes through an air filter, condenser and carbon filter before



Draftcb / UTEC

ultimately collecting into 20-liter storage tanks. Locals can access the water through a faucet at the bottom of the billboard.

The billboard has not only become a local attraction, but has also quickly become an indispensable part of life in the neighboring villages. The concept might spread to other troubled spots around the world as the UN and other international leaders have recently called for greater solutions to the global water crisis.

In addition to addressing a serious environmental issue, the marketing campaign aims to inspire potential students by illustrating how engineers and scientists work to solve social needs on a daily basis through technology and innovation.

CLASSROOM DISCUSSION

- How has climate change affected water sources in coastal desert areas such as Lima?
- How does lack of access to clean water hinder the social, economic and healthy growth of societies?

BALD EAGLES RETURN TO PENNSYLVANIA

By Samba Lampich



After more than 250 years of absence, the bald eagle has returned to nest along Pittsburgh's three rivers. The majestic bird of prey was nearly extinct but thanks to an aggressive protection program, their numbers are on the rise.

INDUSTRIALIZATION AS A CULPRIT

Booming industrialization in the 19th century led to large-scale deforestation and destruction of mature trees that were home to the bald eagles. Pollution from growing industries and use of the pesticide DDT destroyed rivers and the fish that were the main source of food for the birds. All these factors — a lack of nesting trees, decline of food and the use of DDT — lead the near-extinction of the birds.

LONG FLIGHT FROM HOME

By the 1980s, there were just three pairs of eagles' nests in the northwest region of Pennsylvania. In June of 1983, the Pennsylvania Game Commission launched the Bald Eagle Restoration Project. A group of Game Commission employees, travelled to Laronge, Saskatchewan to capture young bald eagles and bring them back to Pennsylvania. They would take seven such trips. At that time, the Saskatchewan province had a stable bald eagle population.

A BRIGHTER FUTURE

According to the Pennsylvania Game Commission, by 1999, 42 active nests produced 47 eaglets and by 2010 they had produced at least 293. By 2012, there were more than 200 bald eagle nesting locations in Pennsylvania. Efforts to clean up Pennsylvania's rivers have been successful and there are pairs of nesting bald eagles along each of Allegheny County's three rivers; the Monongahela, Allegheny and Ohio.

The bald eagle remains threatened in Pennsylvania and continues to be protected under state and federal laws.

BALD EAGLE FACTS

- Bald eagles build the largest nests of any North American bird and can be found nowhere else in the world
- A pair of bald eagles generally mate for life
- The bald eagle wingspan ranges from five and a half to eight feet
- An eagle may weigh eight to 12 pounds and the females are about 25% larger
- Both male and female will sit on the nest to protect the eggs and young, and will take turns foraging for food

CLASSROOM DISCUSSION

- What are some etiquette rules that should be followed when observing endangered species like the bald eagle?
- How have some of the federal and local laws helped with the restoration of endangered species? Think about the Clean Water Act and others.

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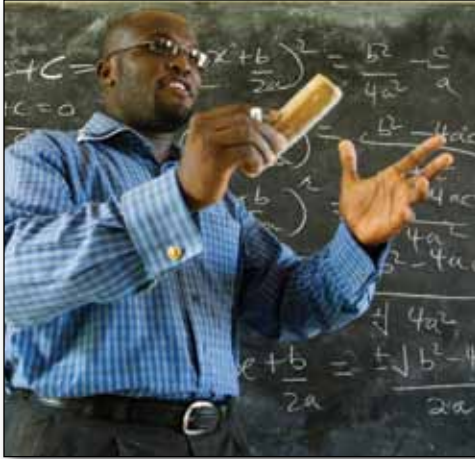


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HAND GESTURES IMPROVE MATH LEARNING

By Samba Lampich



Grasping mathematical concepts isn't easy for most students, but a new study reveals that by using hand gestures, teachers can boost math learning. The study, published in the journal *Child Development*, provides some of the strongest evidence yet that gesturing boosts ability to understand, apply and remember math.

The study, conducted by Fenn and Ryan Duffy of Michigan State University and Susan Cook of the University of Iowa, tested 184 second-, third- and fourth-graders on their ability to solve mathematical

equivalence (i.e., $4+5+7=_{+}7$) which is crucial in learning algebra.

Half the students were shown videos of instructors waving their hands under each side of the equation to explain that they should be equal and the other half watched speech-only videos of instructors explaining the same concept.

The students were given a test immediately afterward, and those who watched the gesture videos performed better than those who watched the speech-only video. A second test given 24 hours later showed the students who observed the gestures showed improvements and the speech-only group did not.

MAKING MATH MEMORABLE

According to Fenn and Cook, gestures help students understand the fundamental concept of the equation problem, regardless of the numbers. The students are able to solve new problems with new numbers by applying the mathematical concept to the new numbers.

The visual hand gestures often illustrate or reinforce a concept that cannot be easily explained by speech alone; for example, using both hands to demonstrate

balance when teaching equations where both sides should be equal.

But it's not just the teacher's gestures that seem to boost math learning. A 2007 study by Cook reported that third-graders who were asked to gesture while learning algebra were nearly three times more likely to remember what they had learned than the students who didn't gesture.

MASTERING MATH EARLIER IN THE U.S.

Fenn says that teaching math using gestures would be beneficial to U.S. students who lag behind other Western countries in math. It would help them master equivalence problems in early grades.

"So if we can help them grasp this foundational knowledge earlier, it will help them as they learn algebra and higher levels of mathematics."

CLASSROOM DISCUSSION

- How can gestures help students learn other subjects like geography, chemistry or grammar?
- What is the purpose of gesturing, other than communication? Consider that blind people and people talking on the phone gesture.

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FREE STEM IPAD APPS

By Robert Marshall, Educator, Carnegie Science Center

Schools' demand for high-tech handheld devices is at an all-time high. First-generation iPads are significantly less expensive than traditional laptops. And with more and more of these smart devices appearing in classrooms, the customer-dedicated team at Fisher Science Education took a leap in creating a tool that is revolutionizing the way educators interact with their chemical suppliers.

ChemAssist is a free Apple mobile application that anyone can download and use to track inventory and conveniently restock their Fisher Science Education chemicals. And along the way, teachers and students will learn the industry's best chemical storage practices using a standardized color coding.

The iPad can be used for just about every

subject in the school. As I lead STEM workshops for teachers across the country, I'm often asked, "What educational apps are available for the iPad?"

MUST HAVE FREE IPAD APPS

The following is my list free iPad apps with brief descriptions, available in the app store.



3D Sun

View real solar images and data captured from NASA heliophysics spacecraft

NOVA Elements

Make sure to build atoms with the correct number of subatomic particles

Earth-Now

Visualize continents, oceans and their dynamic properties in action

Exoplanet

3D Milky Way database of confirmed extra solar planets

ISS Live!

Manipulate a 3D model and follow the astronauts' daily schedule

Khan Academy

One-stop shop for economics, history, mathematics and science videos

Mars Globe

See a detailed labeled map of the red surface, including rover landing sites

NASA

Explore NASA missions, news, videos, launch information and countdown clocks

National Geographic Today

Stunning photographs, videos, quizzes and articles in a hands-on National Geographic portal

Particle Zoo

If you have ever been confused about Quantum, have a double look here

Simple Physics

Design engineering solutions for a series of projects while staying under budget

SkyWeek

Learn what celestial objects and special events are visible in tonight's sky

CLASSROOM DISCUSSION

- How could you integrate any of these apps into something you're learning right now?
- What is Citizen Science? Can you find other Citizen Science apps available on the iPad?

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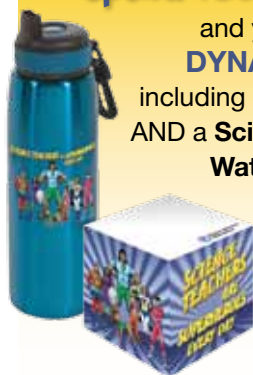
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