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HEADLINE DISCOVERIES

INSIDE THIS ISSUE:

Price offers in this publication are good until December 31, 2010 unless otherwise stated.

GROWING, LIVING, TEACHING AND EATING GREEN

By Molly Quinn Philbin from EarthBox®

Farming employs only a tiny share of U.S. workers on a small number of large, specialized farms in rural areas. Consequently, many people don't know where their food comes from, how to grow it or how to eat healthy. Many more do not know how that food system affects the quality of life on our planet, or how other industries affect the food system.

INSTRUCTIONAL SCHOOL GARDEN MOVEMENT

The 1990s gave birth to an instructional school garden movement motivated by the need to teach students where their food comes from, to engage them in growing their own food, and to raise awareness about food systems and their affect on civilization and the environment. However, the time required to manage a garden and the numerous challenges inherent to gardening overwhelmed the efforts of many teachers. Mandated to achieve the stated goals of standardized testing, they could not justify the time and effort expended in the garden.

EarthBox Education set out to make it easier for teachers to incorporate sustainable, instructional school gardens into their curriculum. They developed a standards-based, cross-content curriculum and correlated garden guide that uses the controlled, hands-on environment of the EarthBox Container Garden System to teach the science behind plants, light, water, soil and nutrition and the development of horticultural, workplace and entrepreneurial skills. National Agriculture in the Classroom, the California Agriculture Foundation, the Southwestern Educational Development Laboratory and TERC evaluated and approved EarthBox Education as a quality educational resource.

The PreK-12th grade cross-content curricula, driven by guided inquiry, engages students with hands-on activities that address multiple learning styles in 45-minute procedures that complement most school day schedules. Scientific explanations summarize the concepts taught in each lesson while extensions support differentiated learning. Each lesson stands alone; a teacher can select a specific lesson plan to meet individual program needs, complete all lessons sequentially, or teach them in a sequence that best suits school requirements. The scientifically engineered container garden system gives teachers more time to teach, and students more time to learn. Its self-watering, gradient system eliminates weeding, hoeing and digging. It supplies crops with all the nutrients and water they need for the growing season, greatly reducing their susceptibility to pests and disease while producing high yields. Schools that have incorporated EarthBox "turnkey" Instructional School Gardens have met with success.

STUDENTS ENGAGE IN APPLIED SCIENCE

An afterschool program in Scranton, PA, implemented a large scale EarthBox Instructional School Garden for underserved, underperforming middle school students. Seth, a 7th grade student, became a member of the garden club. As a member, he shared many responsibilities, but his favorite job was pest management. Seth used the computer to research common pests, beneficial insects, plant disease and remediation. What he learned excited him so much that he presented his findings to the other members on the team. He explained that plants ask for help without speaking. They send off chemicals to invite beneficial insects to destroy harmful insects that are attacking them. The chemical released then reaches other plants that invite more "beneficials" by giving off the same chemical. The "beneficials" then establish themselves in the area to ward off harmful insects the following season. Seth presented his findings to a nationally televised garden show for youth. When he received a signed letter of support from the host of the show, he beamed with pride. By the end of the season, Seth could name 18 herbs and 21 healthy crops along with their nutritional and medicinal value. Seth will always remember his gardening experience and the wonder of plants, whose mysteries still elude us.

AGRICULTURE IN THE CLASSROOM

In 2006, the Florida Department of Agriculture named Ann Cruikshank the Middle School Ag teacher of the year for establishing a multi-season EarthBox Instructional School Garden indoors and out. The class studied science in the classroom and sustainable agriculture in the garden. They donated the produce they grew to the local food pantry. "I am a 6th grade science teacher. I have been using the EarthBoxes with my students for a number of years. The students have loved growing and harvesting the vegetables. I used the EarthBox curriculum to supplement my teaching. It's based on good science and is very teacher friendly. I highly recommend it to teachers."

EARTH DAY + EARTHBOXES AT SMART HOME

This past Earth Day (April 22, 2009), the Museum of Science and Industry in Chicago, Illinois brought in a group of 40 fifth-grade students from Bret Harte Elementary School to help upgrade an exhibit called "Smart Home: Green + Wired, Powered by ComEd." This modular three-story home is located literally in the Museum's backyard. It showcases the various ways that green living can easily be integrated into the typical household, and is touted as the city's " greenest home." Well, the kids from Harte Elementary helped make it greener, as they assisted master gardeners in planting 80+ EarthBoxes with vegetables, herbs and flowers. The EarthBoxes green the patio rooftop, as well as the garden on the ground. The plan is for the students to maintain the planters and care for the plants over the next few months.

CELEBRATE EARTH DAY'S 40TH ANNIVERSARY

Take the Fisher Science Education Earth Day Challenge and plant an EarthBox at your school on Earth Day and you could win $500.

April 22, 2010 marks the 40th anniversary of Earth Day. Since its origin in1970, Earth Day has become an annual event for people to celebrate the Earth and to make green changes in their homes, schools and businesses. Planting an EarthBox is the perfect way to celebrate Earth Day and bring science to life for your students. Gardening helps students develop a deeper understanding of natural systems and makes them better environmental stewards. Gardening projects also bring teachers, staff, students, parents and the community together in meaningful ways.

This Earth Day, plant an EarthBox with your students and cultivate their sense of community, nurture their self-esteem and foster their sense of curiosity. Best of all, tell us about it and you could win a $500 Fisher Science Education Gift Certificate for your school.

HOW DOES IT WORK?

1. **Plant an EarthBox at your school as part of your 2010 Earth Day festivities.**
2. **Tell us about it. Submit your EarthBox/ Earth Day story to fse.headline@thermofisher.com by May 30, 2010.**
3. **A winning story will be selected from the entries and will appear in the fall 2010 edition of Headline Discoveries. The school that submits the winning story will also receive a $500 Fisher Science Education Gift Certificate.**

PROFILE

GARRETT AUGUSTUS MORGAN, 1877 TO 1963

By Ed Schock

The morning of July 24, 1916 had been marked by disaster in the city of Cleveland, Ohio. Thirty-two gas company workers were trapped in a tunnel more than 200 feet below Lake Erie following an explosion that rocked the waterfront. A thick curtain of dust and poisonous gases separated the unconscious laborers from rescue workers at the mouth of the tunnel. Several men rushed into the breach, but then they too became trapped. As precious time drained away, onlookers could do little but wait. No one else dared pierce the dark veil of suffocating smoke and dust. A call went out for someone to find Garrett Augustus Morgan.

Born on March 4, 1877 as the son of former slaves, Morgan was a local businessman and self-educated inventor. He is credited with numerous inventions including a variety of hair care products and a crank-operated traffic safety signal. But it wasn't one of those creations that spurred onlookers into action on the day of the Lake Erie Crib Disaster.

Several years earlier in 1912, the inventor had developed and patented an apparatus which he called a "breathing device" or "safety hood." Understanding that smoke rises, Morgan had reasoned that the freshest air could be found near the ground. His safety hood incorporated a long hose that would trail behind the hood. A sponge-like material at the bottom of the hose filtered incoming air. Exhaled air escaped through a second hose.

Though Morgan's safety hood had won him a gold medal at the Second International Exposition of Safety and Sanitation in 1914, it translated into only meager financial success for his National Safety Device Company. Because of his race, Morgan found it necessary to have other people demonstrate his inventions in many parts of the country. Now, with so many lives hanging in the balance, the inventor and his breathing device would take center stage.

Garrett and his brother Frank quickly arrived on the scene and donned their safety hoods. Descending into the dark tunnel, the men disappeared for several tense minutes, and emerged with one of the injured workers. Over several trips, more than 20 lives were saved by the inventor's ingenuity and his courage.

Lauded by many as Cleveland's "Most Honored and Bravest Citizen," Garrett Morgan remained one of the city's leading citizens until his death in 1963.

AIRPORT SECURITY– USE OF WHOLE BODY IMAGING

By Brianne McCurley

To catch a flight, every traveler must go through the line for airport security and needs to go through certain rituals even before making it to the metal detector. Travelers must remove belts, jewelry or anything metal; they need to take off their shoes; and remove all liquids in containers, that have to be 3.4 ounces or less, from any carry-on luggage, and place them in the plastic bin. It can be very time-consuming, but in the near future, Whole Body Imaging scanners will replace the current metal detectors enabling passengers to walk through and avoid the excess wait-time.

The government has been searching for faster, more efficient ways of detecting weapons or explosives in travelers' carry-on luggage, shoes and bodies. Instead of just looking at a passenger's items, the government is now going to scan his/her body. Umar Farouk's attempted airplane attack on December 25, 2009 (he had explosives stored in his underwear) has prompted the United States Transportation Security Administration (TSA) to purchase 150 full-body scanners, at $150,000 each, and install them in airports nationwide by the end of 2010. They are designed to keep would-be terrorists from hiding weapons or explosives underneath their clothing. These machines should uncover what a physical pat-down would not. Items hidden in body cavities would be the only thing still undetectable by the scanners.

Passengers will walk through this X-ray-like machine and a black and white three-dimensional picture will appear, revealing almost everything–private body parts included. It can detect hidden items as small as a plastic button.

Initially, the scanners were only used as secondary screeners for travelers who were flagged by the metal detector, but now the TSA reports they will be used as the initial screening tool. In 2007, a Phoenix, Arizona airport was the first airport in the U.S. to begin using whole body imaging. Currently, there are 40 machines being used in 19 airports. Six airports are testing Whole Body Imaging scanners as their primary screening tool. The other 13 are allowing flagged passengers to choose between a full body pat-down or go through the whole body scanner. According to TSA reports, over 99 percent of passengers choose to have the whole body imaging scan. It's much faster and less invasive than a full body pat-down. Additionally, the Whole Body Imaging scan will detect any metal implants that passengers with joint replacements or other metallic devices inside their body have, as opposed to setting off the alarm from regular metal detectors.

HOW THE TECHNOLOGY WORKS

According to the TSA's Web site, two antennas simultaneously rotate around the body using Millimeter Wave Technology, which beams radio frequency energy over the body's surface at a high speed. The energy reflected from the body or other objects on the body is used to construct a three-dimensional image. The three-dimensional image, with facial features blurred for privacy, is displayed on a remote monitor for analysis. Backscatter Technology uses low level X-ray to create a two-sided image. The TSA is testing backscatter with an algorithm applied to the entire image to further protect passenger privacy.

TICKING AWAY TO THE DAY OF DOOM

By Sudarshan Balasubramanian
With contributions by Gwen Myslinski

We've all heard the adage, "time and tide waits for no one." But can there really be a day when time merges into the tide and there's nothing left? This day is what experts and scientists call doomsday, or simply, the end of the world.

Most of us believe as our biological clocks tick on, we are inching toward the end of time, or at least the end of our lives. But did you know there is an exclusive Clock, albeit symbolic, that reflects how close the world is to catastrophic destruction? The Bulletin of the Atomic Scientists' (BAS) board of directors, located at the University of Chicago, monitor this clock and advance or rewind its hands based on the state of the world.

This renowned group of scientists, including 19 Nobel laureates, makes adjustments to the Clock based on several factors. Originally, the Doomsday Clock represented the danger of nuclear threats; but since 2007, the factors have increased to include any new developments or discoveries that could inflict irrevocable harm, including climate-changing technologies or new developments in life sciences and nanotechnology.

When the Doomsday Clock was first unveiled during the Cold War in 1947, scientists moved its hands to show seven minutes to midnight. Between 1953 and 1960, the hands were further advanced to two minutes to midnight, when the U.S. and the Soviet Union were testing thermonuclear devices only nine months apart. Since the Clock's inception, this was the closest the hands have ever been to midnight. But after the U.S. and the Soviet Union signed the Strategic Arms Reduction Treaty in 1991, the hands ticked 17 minutes away, the farthest away from midnight, and stayed there until 1995. Since its creation, the clock has changed 19 times.

Currently, the Doomsday Clock has been rewound one minute and is now set at six minutes to midnight, which was updated on January 14, 2010. The BAS stated the movement in the Clock is because of "a more hopeful state of world affairs." The Bulletin went on to say, "We are poised to bend the arc of history toward a world free of nuclear weapons. For the first time since atomic bombs were dropped in 1945, leaders of nuclear weapons states are cooperating to vastly reduce their arsenals and secure all nuclear bomb-making material. And for the first time ever, industrialized and developing countries alike are pledging to limit climate-changing gas emissions that could render our planet nearly uninhabitable."

To get involved, or to learn how to inspire leaders to take action on how to overcome obstacles to nuclear security and climate protection, visit **www.TurnBackTheClock.org**.

THE STRANGE CASE OF PLUTO

By Herb Koller from Starry Night

From the dawn of recorded history our species has looked up at the sky and noted that of all the heavenly bodies, seven were different—they moved against the background of the stars.

The moon, Mercury, Venus, Mars, Jupiter and Saturn were found in the night skies and the sun in the daytime sky. The Earth, of course, was the center of creation and thus was not in the same category as stars and planets.

By the mid-16th century the special nature of the sun was grudgingly recognized and it was promoted to the center of the solar system. Earth was demoted from its exalted position and became just another planet. The moon, which orbited the Earth, became the first of a new breed of object—a satellite orbiting a planet. The solar system had now dropped to six planets and one satellite.

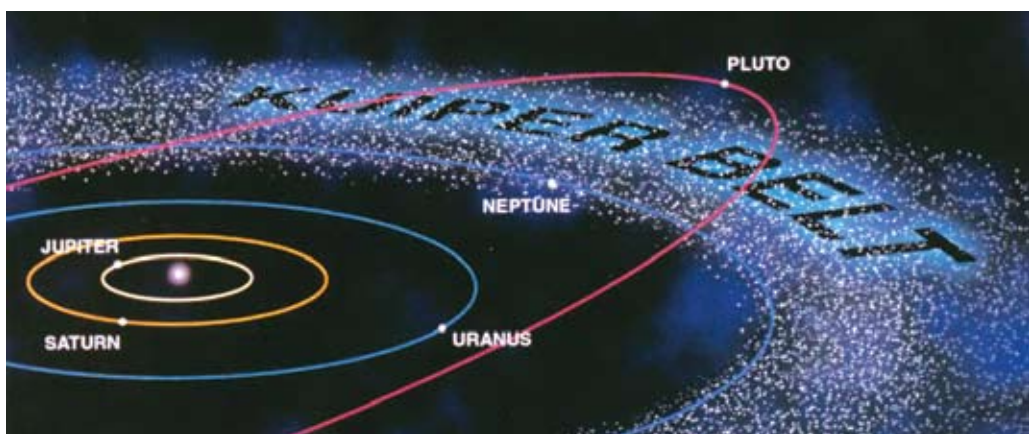
With the invention of the telescope and the passage of time, more objects orbiting the sun were discovered and, at one time, there were a total of 23 planets and numerous moons. But by the beginning of the 21st century this was whittled down to a more manageable nine planets and several satellites.

Pluto, the last planetary outpost, discovered in 1930, turned out to be a strange object. It was by far the smallest planet (smaller even than our moon), its eccentric orbit at times brought it closer to the sun than Neptune, and it strayed further from the ecliptic than any other planet.

But, as it turned out, Pluto wasn't the only "strange" object out there. During the last few years quite a number of objects with orbits as odd as Pluto's have been discovered beyond Neptune. Pluto is now recognized, not as an oddball planet, but as the first of a new group of objects called dwarf planets. Any dwarf planet beyond the orbit of Neptune is now dubbed with the special term "plutoid."

At present, there are four plutoids: Eris (which is actually larger than Pluto), Makemake, Haumea and of course, Pluto itself. They, along with thousands of similar bodies, inhabit a region of space called the Kuiper Belt.

With Starry Night, you can find the position of these KBOs at any time. However, make sure you have the latest update to Version 6 of Starry Night for all of these objects to show up.



SONIC BLACK HOLE TRAPS SOUND WAVES

By Aravind Telkar

Have you ever imagined the co-existence of black holes and humans, along with the other living species, on our Earth's surface? Researches at the Israel Institute of Technology (IIT) created an artificial black hole, something that could make our planet less noisy and yet not destroy it. These artificially created black holes trap sound waves and are called "sonic black holes." Scientists are trying to learn more about the actual black holes in our galaxy by using their "sonic cousins" as models.

WHAT ARE BLACK HOLES?

The general Theory of Relativity defines a black hole as a region of space from which nothing, including light, can escape. It's a result of the deformation of space time by a very compact mass, and it is characterized by immense gravitational attraction. The "point of no return" is marked around the undetectable surface of a black hole. The term "black" is appropriate because the area absorbs all the light that hits it, reflecting nothing.

According to Einstein's Theory of Relativity, as mass is added to a degenerate star, a sudden collapse takes place and the intense gravitational field of the star closes in on itself. Such a star then forms a "black hole" in the universe. A black hole is invisible, but can be observed through its gravitational field's interaction with other matter in the same area. For example, if astronomers detect a star in tight orbit around an invisible partner, presumably a binary star, it can be surmised that a black hole is obstructing the "missing" star.

SONIC BLACK HOLES

The theory of sonic black holes was first proposed by the Canadian physicist, William Unruh, in the 1980s. Since then, several scientists around the world have tried to create a sonic black hole; the Israeli team was the first to successfully achieve it, though the phenomenon is not long lasting. Scientists observed the sonic black hole for about eight milliseconds using lasers. They found that since their creation was a sonic black hole, and not a true black hole, light waves—traveling much faster than the sound waves—could still escape.

THE BLACK HOLE CONNECTION

Creating a sonic black hole will help scientists learn more about gravitational black holes because the concepts that describe sound waves are similar to the ones describing light propagation in a gravitational field. Such experiments will help to resolve the conflicts between general relativity and the quantum theory. For example, it could help determine if a real black hole would evaporate while emitting radiation generated in the quantum turmoil at its event horizon.

CALCIUM CAUSES PROBLEMS AT INTERNATIONAL SPACE STATION

By Kavitha Bhavi

Imagine a bottle of pure, potable water that has been obtained by recycling wastewater. Would you drink it or squirm at the thought of it? This is exactly the type of water that astronauts use for their daily needs during space expeditions.

It's commonly known that the Earth's natural life support system supplies the essential conditions for human life to go on, but for astronauts living in space, these basic necessities need to be provided by artificial means. Water is the second most crucial thing, after air, that astronauts require for survival in space.

Astronauts live and work in the International Space Station, a research facility situated in the orbit of the Earth. Here, astronauts conduct many science-related experiments. Availability of resources for daily life remains restricted in the ISS due to functional and situational conditions. An astronaut living in the ISS is provided with only 4.4 gallons of water for all daily activities, as compared to the average American who needs approximately 60 gallons a day.

Since water is not readily available in space, scientists and astronauts had to find other means to get it there. Originally, it was transported from Earth to the ISS. But because of the operational costs, this method could not be maintained; therefore a water reclamation unit was installed. The unit is capable of recycling a crew member's urine and wastewater into clean, drinking water. But for this to work, astronauts on the ISS need to recapture every possible drop of water, including those that evaporate from showers, shaving, brushing and hand-washing.

But turning urine into drinkable water isn't very easy in general, and certainly not in space. The water recovery system on the space station works in a similar fashion as a water treatment plant on Earth, which purifies wastewater in a three-step process. In the first step, a filter removes particles and debris such as skin cells, hair, etc. Then, this water is made to pass through multi-filtration beds which contain chemical substances that remove organic and inorganic impurities. Finally, the catalytic oxidation reactor removes volatile organic compounds and kills bacteria and viruses. Iodine is then added for microbial control, similar to how municipal authorities add chlorine to the water we drink, and then the resultant liquid is stored for use.

However, the $250 million water recycling system was not fail-safe. It stopped working due to clogs that developed in the system, and engineers resolving the issue found that calcium was the culprit. Further investigations showed that the high concentration of calcium came from the astronauts' urine. This discovery was alarming, and scientists are trying to figure out the exact cause for the discharge of high levels of calcium. Bone loss, a consequence of living in a zero-gravity environment, is one of the speculations that scientists are considering.

The weightless environment of space is known to induce several physiological changes in astronauts, primarily concerning bone mass and calcium levels. On Earth, the human body absorbs approximately 40 to 50 percent of the daily recommended 1000mg of calcium. But in space, the absorption levels drop to 20 to 25 percent. Vitamin D levels, which are known to help the body properly use calcium, decrease in zero gravity. Astronauts are not exposed to UV rays, the primary source of vitamin D, because of the heavy shielding in the spacecrafts.

ROBOTS—MEDICAL RESPONDERS OF THE FUTURE

By Hithaishi Bhaskar

The evolution of medicine and technology has made it possible to develop surgical instruments that are smaller, thus allowing procedures to be less invasive. Now, robots are more widely used in operating rooms for various procedures. It's become much easier for surgeons to reach many of the vital organs and other difficult areas within the body, and patients are able to experience shorter recovery times.

Advanced image processing systems of robotic surgery assist medical teams in tracing and executing surgical interventions. Medical research has made many advances in the development of different prototypical robots that feature image capturing functions, drug delivery and tiny forceps. These devices are known for their impeccable ergonomics and precision, along with smaller incisions resulting in decreased blood loss, less pain and rapid healing. Robotic surgery can be performed in three different ways: remotely, minimally invasive and unmanned.

Different surgeries require the use of a catheter to reach a part of the body that is not easily accessible. Approximately 40 percent of these surgeries fail because the catheter punctures the artery. To avoid this kind of damage, engineers at Monash University's Micro-Nanophysics Research Laboratory in Australia developed a microbot, measuring about a quarter of a millimeter wide, to fit on top of the catheter where surgeons can control the robot, and the catheter, with a remote control. Additionally, microbots can be used in patients to delivery medication to the site of an injury, carry cameras or guide wires.

There are many ways in which microbots can assist surgeons and physicians. Some have movable arms with interchangeable tools that can cut, drill, grasp or suture. Other devices are equipped with the power to remove blockages in veins, scrape out plaque in artery walls, pluck tissue samples for biopsy or crack kidney stones.

STAGES OF ROBOTIC SURGERY:

The surgeon instructs the robot with the right program in a three-step process called planning, registration and navigation. This determines the surgical pathway the robot will take.

- **Planning:** For the robot to move accurately, surgeons must map the patient's body thoroughly. The pre-operative phase builds 3D images of the patient's internal organs and anatomy, which in turn is changed to geometric model and guide during intra-operative situations.
- **Registration:** Surgeons are able to correlate the planning phase images on the patient's body and locate the corresponding points. Accuracy in matching is necessary for an error-free surgery.
- **Navigation:** Once the surgical team is ready, they activate the microbot and it makes corresponding movements with the previously programmed information. Throughout the surgery, sensors display the collected data on the computer monitor for the surgeons to analyze.

Robotic surgery is still relatively a young science and is often very expensive, which is why many hospitals have not adopted the technology yet. But certainly there will come a time in the near future when robots powered with artificial intelligence will positively locate anomalies in the human body, analyze them and operate to correct them.

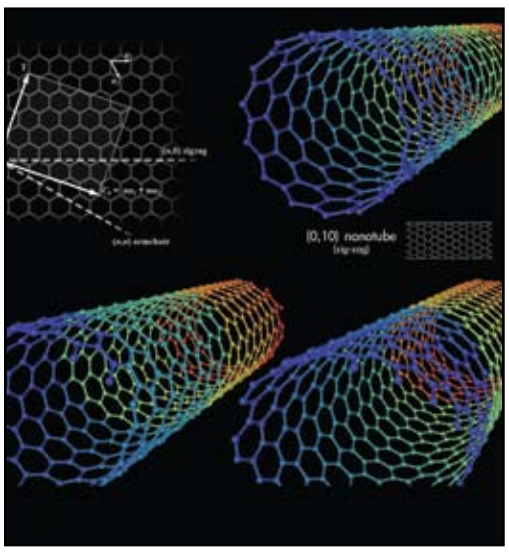
NANOTUBES + PAPER + INK = AN INSTANT BATTERY?

By Aravind Telkar

Paper, developed more than 2000 years ago, is widely used in everyday living. However, scientists have recently discovered that is can also be a platform for energy-storage devices by using nanotechnology.

The research, published in the Proceedings of the National Academy of Sciences, brings Stanford scientists closer to lightweight printable, and moldable, batteries that may one day be shaped into a variety of electronic devices like computers or cell phones.

Who would have thought that humble, ubiquitous paper when used in conjunction with carbon or silver nanomaterials, could result in conducting electricity? This technology is enabled by the pores that are formed by the tangled matrix of fibers in paper. These pores are not visible to the naked eye and are seen only when magnified to nano scale.



CONDUCTING ELECTRICITY

To understand how this works, we need to explore what really happens when we write. The vast porous surface area of paper helps normal ink to electrostatically stick; the same is true when a special type of ink, called the carbon nanotube ink, is applied to the paper. According to Yi Cui, the coauthor of the research, when the special ink adheres to the cellulose of the paper, the paper acts as a scaffold while the carbon nanotubes are able to conduct and store electricity because they act as electrodes with which the electrolytes in the solution react.

A battery is created by sandwiching a plain paper between two papers inked with carbon nanotubes. Then all the layers are submerged in an electrolyte solution. The paper is not only conductive, but it's flexible and bendable too. Even silver nanowires can be used for conducting electricity as a substitute for carbon nanotubes.

Initial calculations suggest that conductive paper coated with a kilogram of the carbon nanotubes could power a 40-watt bulb for an hour. And in a laboratory demonstration, Cui connected the paper battery to an LED light bulb, to prove that it would glow brightly.

New developments like this ensure that energy can be stored and utilized whenever required. Previously, cellulose was considered to be the backbone of conductive materials, but now it is the turn of the ordinary paper to act as a conductor of electricity. As this technology develops further, it could lead to a spurt in the paper making and printing industry.

NUCLEAR ENERGY- ENERGIZING THE FUTURE

By Shilpi Pradhan
With contributions by Gwen Myslinski

Man is surrounded by an ocean of energy; but only a fraction of it has been tapped for utilization in daily living. The largest source, the sun, is an unimaginably vast powerhouse that affects everything on Earth. For eternity, man has learned to harness this energy. With the progression of time, discoveries have proved that different forms of energy exist, including nuclear energy.

Once a futuristic and fancied technology, nuclear energy is now the second largest source of electricity in the U.S., after coal. Today, over 100 nuclear power plants provide approximately 20 percent of the nation's generated electricity. By splitting one atom (fission) of uranium, this "clean" form of energy can produce 10 million times more energy than combusting an atom of fossil fuel.

FACTS ABOUT NUCLEAR ENERGY

1. **Increasing Energy Demand:** The world will need greatly increased energy supply in the next 20 years, especially electricity generated from "clean" sources, and nuclear energy is available and able to meet these demands.
2. **Environment:** Unlike other forms of alternative energy, nuclear energy releases no carbon dioxide, sulphur or mercury emissions into the atmosphere.
3. **Economics:** Other forms of generated electricity, like natural gas and coal, are more exposed to price fluctuation than nuclear energy because uranium fuel accounts for only a small portion of production costs. This price fluctuation accounts for 80-90 percent of production costs, increasing costs to consumers.
4. **Safety:** Since 1957, several regulations and safety measures have been put into place to avoid potentially deadly accidents. During this time, no one in the U.S. has died or been injured because of operations at a commercial nuclear power plant. Additionally, a survey conducted by the Nuclear Regulatory Commission (NRC) determined that reactor cores in the U.S. have multiple enclosures that block the escape of radioactive materials, thus preventing accidents like Chernobyl.
5. **Waste:** According to the Department of Energy's Office of Nuclear Energy, nuclear power plants do produce either low-level or high level waste.
   - Low-level waste is slightly contaminated and can decay relatively quickly. This waste is placed in shallow burial sites that are regulated.
   - High-levels of waste that come from a nuclear power plant are usually in the form of spent fuel, and it is stored in pools of purified water at the reactor site that have been proven to be safe.

   However, long-term storage of the waste is difficult, and is a topic that is widely debated throughout society.
6. **Weapons/Terrorism:** A nuclear reactor can be used to make bombs from the plutonium derived from uranium fission. And the plants themselves could be targets for terrorist attacks. However, plants in the U.S. have safety measures in place specifically designed to prevent any thefts or attacks.

MOVING FORWARD

Government officials acknowledge that the U.S. needs to address the challenge of decreasing the carbon footprint, and providing alternate sources of energy for electricity. Nuclear energy is just one of many possibilities that can provide a clean and versatile energy form for the future.

GENETICS VS. ENVIRONMENT

THE BEST WAY TO TEACH JOHNNY TO READ

By Brianne McCurley

A recent study has shown for the first time the extent to which environment plays a crucial role in developing reading skills in children. A child may have poor skills upon entering school, perhaps related to his individual genetic makeup; however, with the proper environment and instruction, his subsequent reading skills can be much improved.

While genetics is the initial factor in reading development, it appears that environment is just as important as children grow older. In this study, environmental factors consisted of everything children experience around them—parental care, neighborhood, diet and nutrition, time being read to as well as instruction in schools.

The study published in the Journal of Child Psychology and Psychiatry consisted of 314 twins from Ohio (135 identical twins and 179 same-sex fraternal twins). The Western Reserve Reading Project studied twins beginning in kindergarten or first grade who were then assessed in their homes annually for the next two years.

The study measured word and letter identification, sound awareness, vocabulary and the speed at which children could name a series of letters. While genetics was a major factor in the overall development of learning skills, the nature of the task dictated the relative importance of environmental influences. For example, in speed tests, the predominant factor (three-quarters) was genetic, while for word and letter identification, environment was responsible for two-thirds of test results.

Beyond the home, the environment at school was also considered extremely important and should provide conditions that avail students of opportunity, time and a variety of materials to allow different ways of learning. Positive parent-teacher relationships and interactions are vital—how a teacher manages the classroom and emphasizes sociality and cooperation among children is also central to a child's learning development.

TIPS FOR A SUCCESSFUL READING ENVIRONMENT

- **Make reading materials available—create a special place for books in the child's room**
- **Be a reading role model—take your child to the library and let them see you reading often**
- **Read aloud to children—let them choose the book**
- **Encourage personal libraries—give your children books or magazine subscriptions as gifts**
- **Limit television, computers and video games—these can be distractions to reading and homework**

HARNESSING HYDROGEN FOR INFINITE ENERGY

By Sandra D. Bledsoe

We are living in an era in which concern about exhausting the world supply of fossil fuels is at an all-time high. The demand for energy is growing and the raw materials for the fossil fuel economy are diminishing. Oil, coal and natural gas supplies are not replenished as they are consumed. Consequently, scientists have begun the search for an energy source that offers an alternative to our nearly total reliance on oil as a transportation fuel, and hydrogen is a leading contender.

USING HYDROGEN AS FUEL

Due to the concern about climate change and the recent surge in gasoline prices, the idea of utilizing hydrogen as a fuel source has begun to grow in popularity. The advantages of hydrogen over fossil fuels are obvious: the use of hydrogen greatly reduces pollution. And unlike coal or oil, as the most abundant element in the universe, supplies of hydrogen are virtually infinite. When hydrogen is combined with oxygen in a fuel cell, energy in the form of electricity is produced. This electricity can be used to power vehicles, as a heat source and for many other uses, and the only byproducts are water and heat. No greenhouse gases or other particulates are produced by the use of hydrogen fuel cells.

Auto companies are working on building cars and trucks that use fuel cells. In a fuel cell vehicle, an electrochemical device converts hydrogen (stored on board) and oxygen from the air into electricity, to drive an electric motor and power the vehicle. Currently, there are estimated to be 200–300 hydrogen-fueled vehicles in the U.S. A few of these vehicles burn the hydrogen directly, producing almost no pollution.

Hydrogen may be the key to sustainable transportation because it can be produced in virtually unlimited quantities from renewable resources and because its use is nearly pollution-free. In fact, the National Aeronautics and Space Administration (NASA) has used liquid hydrogen since the 1970s to propel rockets and now space shuttles into orbit. Hydrogen fuel cells power the shuttle's electrical systems, producing a clean byproduct, pure water, which the crew drinks.

However, there are disadvantages which prevent hydrogen from being used as a widespread fuel source. First and foremost, implementing the technology on a large scale remains prohibitively expensive ($3000 - $5000 per kilowatt hour). Unfortunately, the present cost of fuel cells means that the expense of operating hydrogen-powered vehicles greatly exceeds that of conventional vehicles. Additionally, hydrogen is highly explosive, which presents a flammability hazard, and the manufacture of fuel cells causes oxygen depletion. For these reasons, large hydrogen plants probably won't be built for a while. In the meantime, hydrogen fuel cells are being used in some places on a small scale as a source of emergency power, from hospitals to wilderness locations.

THE FUTURE OF HYDROGEN

Some experts think that hydrogen will form the basic energy infrastructure that will power future societies, replacing today's natural gas, oil, coal and electricity infrastructures. They see a new "hydrogen economy" to replace our current "fossil fuel-based economy," although that vision probably won't happen until far in the future.

THERMO FISHER SCIENTIFIC AND THE UNIVERSITY OF PITTSBURGH

TEACH MIDDLE SCHOOL STUDENTS SCIENCE

By Aaron Craig

Do you remember waking up on Saturday mornings wondering what "Bill Nye, the Science Guy" would teach us next? In the early 1990s "Bill Nye, the Science Guy" was regarded as one of the most innovative and inspiring educational programs on public television. The show typically included an experiment, comedy bits and a music video for a parody of a popular song, with new lyrics to fit the topic of the day. Great program, but what would it be like to see where the show was made or even get your hands "dirty" by conducting science experiments of your own?

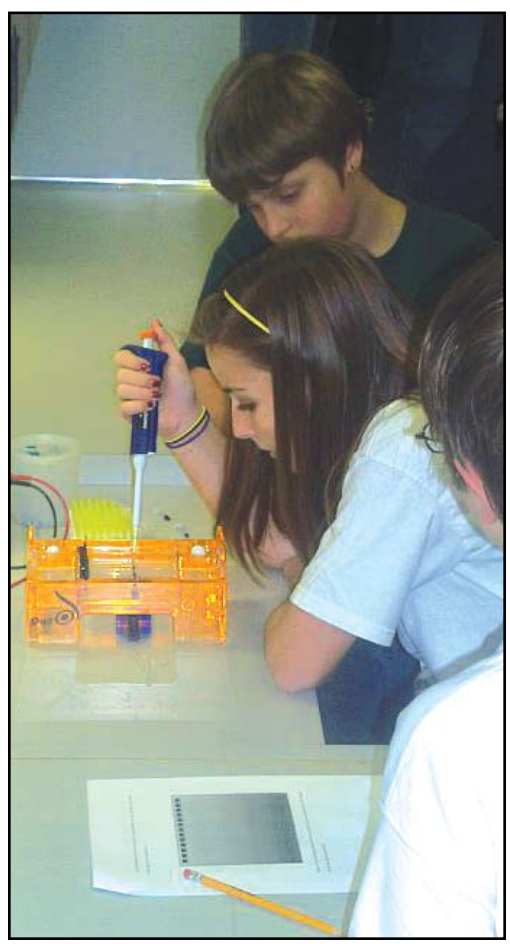
Fortunately, some of Pittsburgh's middle school students were given that chance–no, not to be on the set of "Bill Nye, the Science Guy," as that program ceased taping more than a decade ago. However, 55 students from St. Maurice Catholic School, in Pittsburgh, PA got to perform lab experiments of their own and were given backstage access to "Science Mission 101," a television program produced through a partnership by WQED-TV and the University of Pittsburgh. The show has recently been accepted for national distribution by American Public Television.

These middle-school students were given a tour of the WQED-TV station, a preview of "Science Mission 101" and participated in lab activities in the University of Pittsburgh's mobile lab unit, which was a featured attraction of the visit. Several representatives from Thermo Fisher Scientific, including Bob Forte, Senior Vice President, Business Development, and Fisher Scientific Senior Sales Representative, Mary Ann Prignon, were instrumental in helping Pitt retrofit a tractor trailer into a mobile lab that is now used to conduct science education outreach to local schools. This tractor trailer was also used as the back drop of the pilot show for "Science Mission 101."

The goal of the mobile lab is to bring the world-class research of the University to the middle and high schools of the Pittsburgh region by inviting students and teachers to roll up their sleeves and work one-on-one with "real" scientists doing "real" science.

One student who was learning how to use micropipets in the mobile lab said, "Wow, this makes me feel so 'science-y'."

Prior to the student's arrival, Thermo Fisher Scientific employees stuffed Fisher Scientific reusable, eco-friendly gift bags, which were given to each student. The bags, included a Fisher Science Education newsletter, mini Fisher Scientific Nerf footballs, Fisher Science Education pens, Fisher Scientific plastic cups, Fisher Scientific dry erase boards with markers and Fisher Scientific key chains. The teachers each received the same items plus a Fisher Scientific periodic table mug. In addition, Thermo Fisher Scientific donated three Fisher Science Education microscopes to the St. Maurice's science department.



ABOUT "SCIENCE MISSION 101"

In the search for America's next generation of scientists, WQED-TV is producing the educational, competitive, science-based reality program, "Science Mission 101."

In the pilot episode, host Mike Lee challenges Team Awesome and Team Dominate to investigate whether amoebae, like those found in our digestive systems, prefer to eat specific types of bacteria, and if that preference relates to the fact that only certain bacteria make people sick. The students expose an amoeba to different strains of the bacterium Salmonella—which is found in raw or undercooked food—to determine if it prefers to eat one strain over the other. Students perform their work in laboratories within Pitt's Department of Biological Sciences and on the Pitt Mobile Science Lab.

Team Awesome includes team leader Olivia Lannone, 14, of South Park High School; Jason Chen, 16, of North Allegheny High School; and Aliya Taylor, 16, of Riverview High School. Team Dominate is led by Dominic Stokes, 16, of Valley High School, who is joined by Pietra Bruni, 16, of Seton La Salle High School, and Guthrie Gintzler, 16, of Taylor Allderdice High School.

The teams present their findings to judges from Pitt's Department of Biological Sciences and are evaluated based on cooperation, creativity, interpretation of experimental data, presentation and scientific thought. The judges are Alison Slinskey Legg, Ph.D., Mobile Science Lab Director and Director of Outreach Programs for the Department of Biological Sciences; Graham F. Hatfull, Ph.D., Eberly Family Professor and HHMI Professor and Chair of the department; and Kristen Butela, a graduate student in the lab and Pitt biological sciences professor Jeffrey Lawrence.

PITTSBURGH TO HOST WORLD ENVIRONMENT DAY

By Aprile Smith

The United Nations Environmental Programme (UNEP) named Pittsburgh the North American host of this summer's 37th World Environment Day (WED). Established in 1972 to spur environmental awareness and action, every year UNEP names a World Environment Day host in each of its six global regions: North America; Latin America and the Caribbean; Africa; Asia and the Pacific; West Asia; and Europe.

"The City of Pittsburgh is honored to be chosen as World Environment Day host city for 2010," said Mayor Luke Ravenstahl. "Through the Mayor's Office of Sustainable Development and Energy Efficiency, Pittsburgh demonstrates its ongoing commitment to our environment." The city's traded in its old industry image and gone green, transforming itself from steel producer to environmentally conscientious region with substantial riverside development and green buildings. Pittsburgh's commitment to sustainability and a green economy dovetails nicely with the 2010 theme of World Environment Day, "Biodiversity—Ecosystems and the Green Economy." The city possesses several key components of a green economy movement: work force, raw materials and access to the education, innovation and research displayed by notable institutions of higher learning such as Carnegie Mellon University and the University of Pittsburgh.

Pittsburgh's increased development of outdoor recreational activities, as well as artistic and cultural amenities, were also what drew WED organizers. A group comprised of UNEP, Allegheny County, the City of Pittsburgh and Sustainable Pittsburgh are coordinating events to "bridge the gap" between the 40th annual Earth Day on April 22 and World Environment Day on June 5; outdoor and arts activities are both featured prominently in the six weeks of Earth-friendly, environmentally focused events.

In addition to these events, independently organized activities will promote and support the sustainable development of the region. Even before Pittsburgh was named North America's host, several planned environmental events had been scheduled and now "anchor" the six-week time period between Earth Day and WED:

- **Global Pittsburgh's International Bridge Awards (April 21):** A business-focused organization promoting Pittsburgh internationally and offers services to support international residents in the region. Its International Bridge Awards Celebration will highlight strengths in Energy and Environmental Revitalization.
- **Pedal Pittsburgh (May 9):** Organized by the Community Design Center of Pittsburgh, more than 2000 cyclists ride several courses through the city but end in the same location. The routes for this annual event range from six to 60 miles and include various notable Pittsburgh landmarks.
- **The 10th Annual Venture Outdoors Festival (May 22):** Venture Outdoors works to increase outdoor recreational activity in the Pittsburgh area. A signature event of Great Outdoors Week (May 14 to 23), the free festival features regional opportunities for kayaking, biking, dragon boating, rock climbing, fishing, etc.
- **Rachel Carson Legacy Event (May 27):** The 2010 Rachel Carson Legacy Awards and Symposium on Biodiversity in May will also celebrate WED.
- **Three Rivers Arts Festival (June 4 to 13):** The multidisciplinary visual and performing art showcase celebrates its 50th year this summer. The festival returns to scenic Point State Park this year.

BIOCHAR— THE OTHER BLACK SOIL

By Somdatta Basu

With global warming capturing the human consciousness like never before, the burning question is what if it gets worse sooner than expected? In the past few years, global warming has led to an increase in the Earth's mean surface temperature. This has led to polar ice caps melting, floods, natural calamities, shifts in the seasons, various species extinctions, crop destruction by the sudden change in temperatures and new diseases being triggered. As the scientific and nonscientific communities worldwide are trying to grapple with this issue, the answer may lie in a material called biochar.

Biochar is a byproduct of charcoal that is produced by burning wood products slowly at low heat levels. It is produced through pyrolysis or gasification, that heats biomass in the absence (or under reduction) of air. Pyrolysis is a unique alternative energy source because it produces heat and power by burning of wood products and any kind of organic material, such as peanut shells, pine chips and even poultry litter, in air-tight conditions. This process results in a finely grained, highly porous charcoal that helps soil retain nutrients and water.

Biochar production is not something new, it has been used thousands of years ago by the Pre-Columbian Amazonian natives. Its current production is modeled after their process; these indigenous people created islands of rich, fertile soil called terra preta (or dark earth). Anthropologists speculate that cooking fires and kitchen middens, along with deliberately placing the charcoal in the soil increased its fertility and carbon content. Even after thousands of years, these terra preta soils continue to have significant carbon, and remain highly nutrient-enriched without any need to add fertilizers. Brazilian markets have even dug up the carbon-rich soil and sold it as potting soil to locals.

Valuable byproducts are obtained during the process of biochar formation. Some of the gases emitted during the process can be converted to electricity, while others can be condensed and converted to gasoline. In addition, there are also some pharmaceutical applications for these byproducts.

COMBATING GLOBAL WARMING

Carbon levels are increasing steadily at an alarming rate since the 1980s, according to the National Oceanic and Atmospheric Administration (NOAA). Since 2000, it's common to find a yearly increase of 2 parts per million (ppm) of carbon dioxide, while in the 1980s the carbon dioxide increased by 1.5ppm per year.

Biochar causes particular interest in the wake of climate changes due to the emissions of carbon dioxide and other greenhouse gases. A study by James Hansens, a scientist associated with NASA, states that worldwide use of biochar could cut carbon dioxide levels by 8ppm within 50 years.

Sustainable biochar can be used to help combat global warming by retaining carbon in soil and by displacing fossil fuel use. Research shows that the stability of biochar in soil greatly exceeds that of uncharred organic matter. Additionally, since biochar retains nitrogen, emissions of nitrous oxide (a potent greenhouse gas) could be reduced. Turning agricultural waste into biochar also reduces methane (another potent greenhouse gas) generated by the natural decomposition of the waste.

GREEN GAZETTE

By Aprile Smith

SOLAR POWERED CHARGERS TO HIT MARKET SOON

Forget your charger again? You may not need one. To solar charge your cell phone, simply place it in a convenient carrying case. The latest solar power technology uses dye-sensitized cells, which are manufactured with low-cost materials and require no elaborate apparatus. Scientists have been tweaking the technology for the last several years, and new consumer products lined with the thin film solar cells are slated to hit the market this spring.

The cells will be used for charging phones, e-book readers and other devices; they will be used to line backpacks and sports bags so owners just plug their device into the bag for charging. Smaller cases are estimated to cost around $99.

Several companies, including Sony, have been developing the technology for commercial use. With a few sports bags already available, other plans for the cells include prolonging the battery life of wireless sensors, keyboards, and similar type items.

Though use of the cells is limited in extremely cold or hot temperatures, the technology has proven quite efficient at solar conversion. According to manufacturers, the recharger fuels in six to eight hours in sunlight, but takes more time indoors.

HOLE IN OZONE HEALS; GLOBAL WARMING SPREADS

The South Pole is one place the sun will be shining bright enough to fuel the thin film solar cells for those chargers. Just when the ozone layer has begun to show signs of improvement, a report suggests the hole helped to produce cloud formations, which in turn blocked sun rays. A paper appearing in the publication Geophysical Research Letters indicates that the hole was actually slowing the effects of global warming over the area it exists.

When the hole in the ozone layer was discovered in the mid1980s, chlorofluorocarbons (CFCs) were the cited cause. Found in refrigerants and aerosols, CFCs were largely phased out, leading to some ozone recovery. However, the new study suggests, the hole over Antarctica caused high-speed winds; these winds fed sea salt into the atmosphere and formed moist clouds, some showing an increase in cloud droplet concentration by as much as 46 percent.

The extra-moist clouds were also extra-bright, shielding the area from greenhouse gas emissions and reflecting the sun's rays, resulting in a cooling effect. According to Ken Carslaw, University of Leeds professor and co-author of the report, this could "accelerate warming" in the Southern Hemisphere.

Other scientists, however, claim the hole's recovery may not have as great of an impact as expected. While the ozone mends, rising greenhouse emissions and increased temperatures would cause high-speed winds over time and result in similar moist, protective clouds.

FEWER AMERICANS CONCERNED WITH GLOBAL WARMING

If the decreasing hole in the ozone layer does indeed aid global warming, a new poll released this year suggests that fewer Americans will care. According to the poll, concern in regard to global warming has decreased 13 percent since October 2008.

Only 57 percent of Americans believe global warming is true, down from 72 percent in the original poll. In addition, 47 percent think global warming is caused by humans, which is 10 percent less than those who thought so just 14 months earlier.

The poll was funded by the Yale Project on Climate Change and the George Mason University Center for Climate Change Communication.

Increased disagreement among scientists may be affecting public opinion. Anthony Leiserowitz, director of the Yale Project on Climate Change, offers that unemployment, dissatisfaction with politicians and the healthcare debate have diverted attention from global warming concerns.

MORE AMERICANS OPT FOR CAR-SHARING SERVICES

General economic issues—perhaps some even stemming from the unemployment, politics and healthcare—are believed to be the cause behind the rise in car-sharing in North America. Market research analysts at Frost and Sullivan (F&S) report car-sharing in America rose 117 percent from 2007 to 2009.

A person pays a yearly fee to belong to a car-sharing service; cars can be rented by the hour. Pick up and drop off times are scheduled. Many times, the service company even takes care of gas, oil and other maintenance. These services are convenient for those who don't drive a great deal or who may need a larger vehicle once in a while.

Though F&S cites the economy as the major reason for the marked increase, the environmental benefits of the service can't be denied. Fewer vehicles on the road emit less pollution. Some services even have electric vehicles available for an even larger environmental plug.

An estimated 4.4 million Americans will be part of a car-share by 2016.

DECODING TABBY

By Dan Skantar

New research suggests that clues to the cause of certain skin diseases might be found in the fur of a cat.

Sound strange? Cat owners know that a feline fusses over its coat like few other animals do. A cat's nose-to-tail bath is a fastidious ritual.

Recently, a global team of scientists took a deeper interest in Tabby's fur—specifically, its pattern markings. They discovered clues that could some day unlock secrets to the causes of human skin disorders, such as skin cancer. Their findings were published in the January 2010 issue of the journal Genetics.

According to Eduardo Eizirik, a researcher from the Pontifical Catholic University of Rio Grande do Sul, Brazil, "We hope that the study opens up the possibility of directly investigating the genes involved in pattern formation (i.e., the establishment of stripes, spots and other markings) on the skin of mammals, including their structure, function and regulation."

CAMMO COATS

Scientists believe that a cat's coloring disguises it from potential prey. Amid tall grasses, a tiger's tawny body and dark stripes render the animal virtually invisible. Likewise, a leopard's dark spots help it melt into jungle shadows. Even a domestic tabby can "disappear" into backyard foliage.

But while scientists understand what the coat markings do, the genetic origins of these patterns had been an unsolved riddle, at least before now. With great diversity of its fur patterns, *Felis domesticus* was the ideal subject for study.

HERDING CAT GENES

The geneticists crossbred cats with various coat patterns and tracked the pattern inheritance among the offspring. They linked genetic samples from

the kittens to various molecular markers and found that specific markers were inherited by a kitten each time a given coat pattern appeared. The researchers eventually identified at least three different genes responsible for the presence of different stripes, spots and other markings on the cats. Using the statistical method of linkage mapping, they then located two of the genes—a discovery that establishes a foundation for future research.

IMPLICATIONS

Understanding the inheritance pattern in cats' coats will help scientists determine if such standardized patterns apply to other mammals, such as humans.

Mark Johnston, Editor-in-Chief of Genetics, sees hope behind this genetic breakthrough. "This study in cats may ultimately help us better understand the genetics behind hair and skin color in other mammals. In turn, this understanding could lead to new therapeutic strategies to correct skin problems in people."

EYE COLOR EXPLAINED

By Sarah MacFarlane

The iris of the human eye is perhaps the most complex tissue structure on the outside of the body. Recently, the science community has been greatly interested in its color, and the debate over the genetics and physical characteristics that determine eye color has been revitalized by new findings.

THE BASIS OF EYE COLOR

The iris is made up of connective tissue and muscle around the pupil that controls the amount of light that enters the eye. The contractions and dilations of the iris affect the size of the pupil, which in conjunction with the light source, can change the appearance of an individual's eye color. There are two major layers that make up the iris: the anterior iridial stroma (AIS) and the iris pigment epithelium (IPE), the former having the greatest influence on eye color. The IPE consists of cuboidal pigmented cells that are tightly fused together, but it does not have a major influence on eye color unless it lacks melanin entirely, as in the case of individuals with albinism. The AIS is made up of loosely arranged connective tissue, fibroblasts and melanocytes, which originate from the same place as dermal melanocytes. The melanocyte cells store melanin in their cytoplasm within a specialized organelle called the melanosome. Lighter eye color is associated with melanocytes that contain low numbers of melanosomes, which in turn contain less pigment. Darker eye color is thus associated with high numbers of melanosomes containing larger amounts of pigment. Interestingly, different colored irises contain similar amounts of melanocytes. When light hits the eye and passes through the layers of a relatively melanin-free iris, the tiny protein particles within the iris scatter short blue wavelengths to the surface, causing the eyes to appear blue. In addition, the type of pigment plays a role in eye color. For example, darker eyes have a higher ratio of eumelanin:pheomelanin, whereas lighter eyes showed greater levels of pheomelanin.

CAN EYES CHANGE COLOR?

In European populations, most children are born with unpigmented eyes, which is why many newborns have blue eyes. Throughout the infant's development, melanocytes produce melanin slowly until approximately six years of age when the iris reaches its final color. However, since melanocytes continuously produce pigment throughout life, it is possible for eye color to change to be either lighter or darker.

GENETICS AND EYE COLOR

The genetics of eye color have been the subject of debate since the beginning of quantitative gene studies. For decades, the Mendelian dominant-recessive model has been used to explain the genetic inheritance of eye color, but this model is too simple. In reality, eye color is inherited as a polygenic, not monogenic, trait. For example, two blue-eyed parents can have a child with brown eyes, a phenomenon that cannot be explained using Mendel's model. Recent genetic research shows that 74 percent of the variance of human eye color is determined by one interval on chromosome 15 that holds the OCA2 gene. However, other genes most likely play a role in determining eye color. The ASIP gene has been linked to brown eye color, and a screen of candidate genes showed the single nucleotide polymorphisms (SNPs) within pigmentation-related genes were identified to have a significant impact on iris color, most of these occurring in the OCA2 gene. Further research linked blue eye color to the neighboring HERC2 gene.

Eye color is caused by the chemical and physical makeup of the iris. Eye color remains stable in the majority of individuals after childhood, but a genetic basis for changing eye color may soon be identified. Genetic research into the cause of eye color is ongoing and will most likely continue to turn up new complex explanations of why the iris exists in its multitude of colors.

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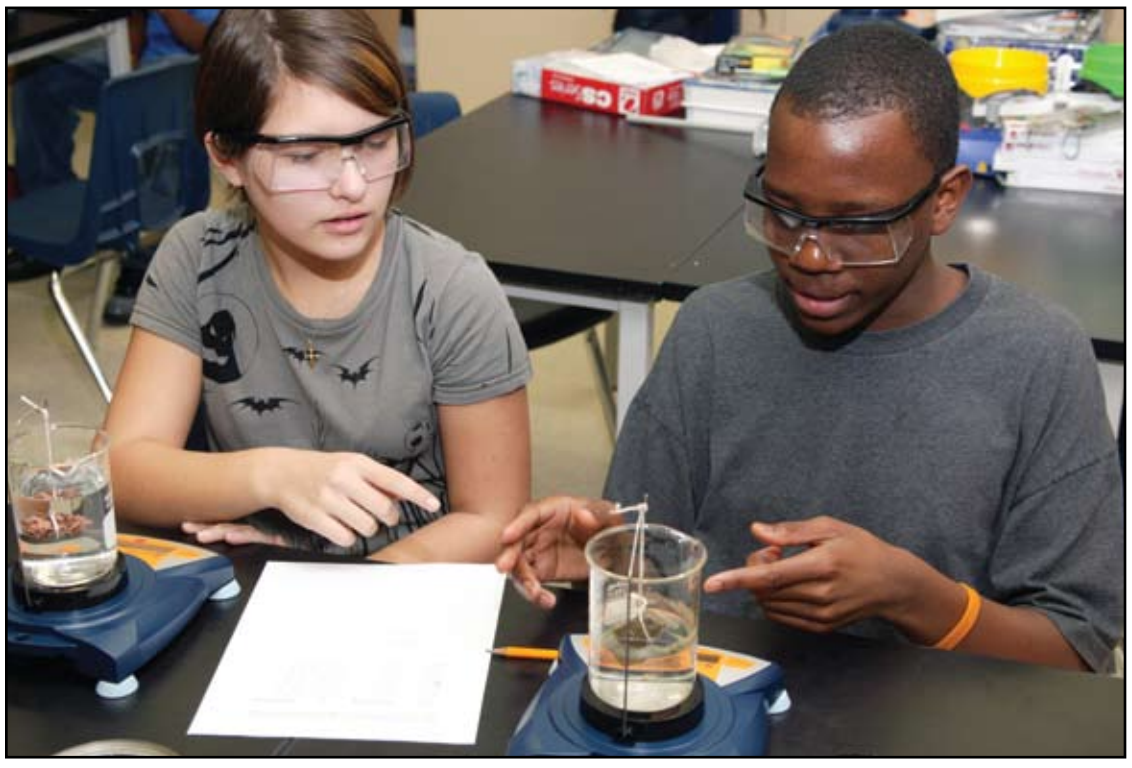

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FRIENDLY PETS THAT COULD BE THREATS!

By Joe Giacobello

As a child, I was terribly allergic to fur-bearing animals. So, while the other kids were playing with their dogs or cats, I generally leaned toward the more aquatic or exotic pets, such as turtles, frogs, or even creepy crawlies like tarantulas. The way I saw it, they were ideal companions. They didn't bark when the mailman arrived each day, jump on Mom's new couch, beg for food at the dinner table or require walking at all hours. But what I didn't realize is that some of these fun little creatures can actually pose a real health risk, if you're not careful.

AFRICAN DWARF FROGS

Recently, a Salmonella outbreak in the United States was linked to the African dwarf frog, a common pet that is typically kept in home aquariums. By the end of December 2009, there were 85 cases of the infection spanning 31 states, and according to the U.S. Centers for Disease Control and Prevention (CDC), the outbreak is still ongoing. It is the first known Salmonella outbreak caused by contact with frogs.

According to CDC epidemiologist Shauna Mettee, most of the infections occurred in children. She points out that "half of the cases were less than five [years of age] and almost 80 percent of all cases were less than 10 years old." The first signs of the outbreak were discovered in Utah, where five children contracted Salmonella. Soon after, cases emerged in several other states, including Ohio, Colorado, New Mexico and California. New cases are still being discovered.

African dwarf frogs, which measure approximately 1 to 1½ inches long, became popular as pets in the 1960s. Easily available for purchase at pet stores, fairs, toy stores and even small convenience stores, these playful frogs are kept in aquariums with other fish. However, as with all reptiles, frogs carry the Salmonella bacteria. It is passed on to humans not only by touching the reptile itself, but through contact with the water in the aquarium. Mettee explains, "Anything the frog comes into contact with is contaminated with Salmonella." So, even after changing the aquarium water, some Salmonella is still present–in the water, the gravel or other surfaces within the tank.

Take a few simple precautions to avoid infection. First, after contact with the frog, their water or their habitat, thoroughly wash hands with soap and water. Secondly, do not clean their aquarium where food is prepared, such as in the kitchen sink or on the kitchen counter. If the bathtub is used, scrub it afterwards with bleach and water. And finally, do not keep the aquarium in a young child's bedroom.

TURTLES

In September 2007, two North Carolina teens swam in their backyard pool with two pet turtles. Unexpectedly, both girls were stricken with vomiting, bloody diarrhea, fever and stomach cramps. They both contracted Salmonella from the infected turtles, and one experienced kidney failure and was hospitalized for eight days. Soon, other cases turned up with other North Carolina children—some involving direct contact, such as kissing the turtles or putting them in their mouths. Other cases involved more indirect contact, in which kids played with the turtles at school and brought the germs home to their family members.

Quickly spreading coast to coast, the outbreak stretched to 34 states, sickening 107 people. One third of all patients, many of which were children, had to be hospitalized. Fortunately, no one died in the outbreak. According to researchers, it was the largest nationwide Salmonella outbreak caused by contact with turtles.

The concept was nothing new. In 1975, the U.S. Food and Drug Administration banned the sale of small turtles (with shells less than four inches long) because of the high risk of Salmonella. Unfortunately, they continued to be sold illegally. According to the American Veterinary Medical Association, the number of pet turtles in the U.S. increased notably from 950,000 in 1996 to nearly two million in 2006. A popular favorite, turtles have long been purchased from pet shops, flea markets, street vendors and even online.

Salmonella in turtles is easily transmitted as the bacteria in their feces often ends up on their shells and body, and then spreads to people who handle them. The federal ban targeted only smaller turtles because of reports that young children were putting the tiny reptiles in their mouths.

Recent efforts by turtle farmers to overturn the ban have failed. Zoological medicine professor Mark Mitchell is currently leading research that is aimed at raising Salmonella-free turtles. Initial efforts, which involved cleansing turtle eggs with antibiotics, were unsuccessful, as it led to strains of antibiotic-resistant bacteria.

Infection can be avoided with some simple, but often overlooked, precautions: thorough hand washing, keeping turtles away from food preparation areas, avoiding contact with or ingestion of turtle water, and making sure that children keep turtles away from their mouths.

TARANTULAS

It has recently been reaffirmed that even allegedly "safe" tarantulas can cause significant harm to the health and functioning of a handler's eyes. A 29-year-old man in Leeds, England recently developed a highly swollen and red eye, with initial signs pointing to a typical conjunctivitis caused by a microbe. When standard antibiotic therapy brought no improvement, doctors at St. James University Hospital looked closer at the eye, and discovered a number of tiny, barbed hairs stuck at various depths within the cornea. Some had migrated into the eye's interior, causing inflammation.

When they mentioned these protrusions to the patient, he recalled that he had been cleaning out his tarantula terrarium, and, at one point, the spider became irritated and released a "mist of hairs" that hit his eyes and face. After unsuccessfully attempting to remove the hairs with micro-forceps, the doctors prescribed topical steroids. After eight months, the man still suffered mild inflammation that required special steroidal eye drops. He now wears eye protection before interacting with his eight-legged friend.

Tarantulas have long been a popular pet because of their docility and apparently harmless, non-venomous nature. Recent evidence suggests these animals can cause a good deal of harm, described as "devastating ocular inflammation" that can bring about serious side effects, including cataracts.

As a precaution, anyone planning on handling tarantulas should wear protective gloves and goggles to avoid the possibility of coming into contact with transferring hairs or being sprayed with a shower of barbed hairs from a panicked spider.

Creatures like frogs, turtles and spiders may seem like perfectly harmless pets, but without taking the proper safety measures, they can pose a real health threat to both adults and children alike.

WHIFF OF CHILDHOOD MEMORIES

By Daisy Rani Devi

The memories of a human adult are mostly visual and emotional in nature. In newborns, however, the effect of the sense of smell is more profound than any of the other senses. As early as the first week of birth, new memories are registered in the baby's mind with each whiff he or she takes.

The highly developed sense of smell that newborns have, work to form an irrevocable bond between mother and child, particularly during breast-feeding. Each time a newborn smells something, and associates it with an object, the brain will retain that special status.

A team led by physiologist Benoist Schaal of the European Center of Taste Sciences in Dijon, France, has substantiated this by demonstrating that newborn babies who inhale a specific odor during breast-feeding favored the same odor over others a year or later. This preference is exhibited even if the babies smelled it for just eight days.

ASSOCIATIVE MEMORY PROOF

As stated by the researchers, human infants recognize and recall smells associated with breast-feeding. Scientists were of the opinion that the strongest odor memories are formed during the first week after birth. The researchers reported that odor memories, acquired during breast-feeding, have the ability to influence behavior until at least early childhood.

Biopsychologist Julie Mennella of the Monell Chemical Senses Center in Philadelphia acknowledges these new findings are an addition to a growing scientific consensus, demonstrate the significance of odors for mother-baby bonding, and for forming memories throughout infancy. Mennella remarks that the mother's diet helps determine the odor and flavor preferences in babies. This was proposed in a recent study in which babies were found to favor odors and flavors experienced prenatally in the amniotic fluid because of the mother's diet.

LEARNING TO RECOGNIZE SMELL

Schaal's team wanted to explore the relationship between smells and memories of newborns. As a part of the study, they offered a balm to the nursing mothers of newborns in a French maternity ward.

Of the 37 moms who volunteered to participate in this study, 20 used the chamomile blend. Each nursing session was followed by application of the balm, and the affected areas were covered with a pad to retain the chamomile odor. Beginning anywhere from the day of delivery to the fourth day, women smeared the fragrant balm for eight to 120 consecutive nursing days.

At the age of seven months, the children of the participating mothers were given three teething rings. The rings, with a chamomile scent, a violet scent or no scent, were handed to the children one at a time randomly. The researchers observed that babies, whose mothers had used the chamomile balm, spent considerably more time mouthing and holding the chamomile scented ring in comparison to the other rings.

The same pattern was observed when the babies were 21 months old. Toddlers who experienced chamomile smell during breast-feeding displayed some reaction when a chamomile-soaked cotton swab was placed under their noses. The others showed signs of repulsion from Chamomile smell, such as nose wrinkling. Babies who had previous chamomile encounters chose to play with chamomile-scented toys over violet-scented or unscented toys. They usually preferred to drink from a chamomile-scented bottle rather than a violet-scented bottle. Their peers, on the other hand, displayed no sensitivity to the scent-associated inclinations.

SLEEP DEPRIVATION CAN CAUSE SERIOUS SIDE-EFFECTS IN TEENS

By Terri Sota

Students falling asleep in first period chemistry? This has little to do with the instructor and everything to do with sleep deprivation. Much to the chagrin of parents and teachers, internal clocks are reset in puberty, reprogramming the sleep-wake cycle. Most teens have trouble falling asleep at night and rousing early for school. And, while snoozing in lab may not be great cause for concern, there are many more serious side-effects—depression and suicidal thoughts, as well as traffic accidents and drug-abuse.

Forty years ago, a study by researchers at Stanford University demonstrated that more, not less, sleep was required as children grew into adolescence. Teenagers limited to six hours of sleep per night exhibited the same severity of sleepiness as narcoleptics who require medication and several naps to treat their disease.

According to Dr. Mary Carskadon at Brown University, teenagers require nine-and-a-quarter hours of sleep, yet most report getting fewer than seven. While their bodies and minds are undergoing tremendous physical, intellectual growth, 75 percent of 13 to 18 year-olds are going to bed at 11 p.m. or later—on school nights. Add early morning class times, and the result is sleep deficits of two to three hours per night. It is little wonder that 40 percent of all teens report feeling "too sleepy" most of the time.

Most high schools, for a variety of reasons, begin school before their students can focus. Morning routines and commutation times require wake-ups in the wee-hours. In a study examining the effect of earlier start times on students transitioning from junior high to high school, Dr. Carskadon observed that "none of the students made an optimal adjustment to the new schedule; none was sleeping even eight-and-a-quarter hours on school nights."

While academic performance is important, there are life and death issues at stake. In January, CBS News announced more frightening findings: tired teens are more likely to struggle with depression and have thoughts of suicide. Columbia Medical School researchers found that students with bedtimes of midnight or later were more likely to have suicidal thoughts than those with imposed bedtimes of 10 p.m. or earlier. Those who slept five hours or less were 71 percent more likely to report depression and 40 percent more apt to think of suicide. Lack of sleep hinders the ability to cope with stress, impairs decision-making and results in poor impulse control, including the use of drugs and alcohol. The good news: earlier bedtimes can help protect adolescents from such tendencies.

What can teenagers do to help themselves? Although difficult, work to achieve a better balance between academic and extracurricular commitments. Experts suggest establishing a relaxing bedtime routine: have a light snack before bed and retire the same time each night. Adopt an eight-hour lights-out policy. Avoid sleep products, caffeine late in the day, and naps longer than 30 minutes. Reserve the sheets for sleeping only. In the morning, let the sunshine in, turn lights on and open the blinds upon waking. On weekends, do not deviate more than an hour or two from weekday sleep schedules.

Parents need to work with teens to establish a healthy wake-sleep routine. Experts recommend encouraging teenagers to experiment with earlier bedtimes so they can see for themselves how beneficial even an hour more of shut-eye can be. Researcher James Gangwisch, Ph.D. says, "We all must put higher priority on sleeping. We feel like we can just eat into our sleep time, but we pay for it in many different ways."

RAISE KIDS—LOWER BLOOD PRESSURE?

By Angela Rydeski

Anyone can develop hypertension, more commonly referred to as high blood pressure, but certain risk factors like heredity, obesity, age and sensitivity to sodium can significantly increase the chances of a person becoming hypertensive. Simple lifestyle changes like regular exercise and a balanced diet can help keep hypertension under control, but just recently that lifestyle list opened up to a new and unlikely factor —parenting.

Albeit biologically or socially driven, a new study from Brigham Young University (BYU) reports that the act of parenting can be accurately associated with having and maintaining lower blood pressure.

The study involved 198 adults (99 parents vs. 99 nonparents) monitored by concealed, portable blood pressure monitors for a period of 24 hours. The monitors were programmed to take consistent blood pressure measurements at random intervals throughout a 24-hour time period. A statistical analysis preceding the tests allowed researchers to account for factors like age, body mass, gender, exercise, employment, smoking and other factors known to influence hypertension results. With everyone on a statistically even playing field, parents clocked-in at an astounding four-and-a-half points lower than nonparents in the systolic (top) number, which is the amount of pressure that blood exerts on vessels while the heart is beating. Parents also reported three points lower than nonparents in the diastolic (bottom) number, which is the measure of blood pressure while the heart is relaxed.

Lead researcher and BYU Psychology Professor Julianne Holt-Lunstad noted that even though the point difference varied significantly between each subject group, the experiment's intention was never to encourage making hasty life decisions based on the reported information alone.

"This doesn't mean the more kids you have, the better your blood pressure," Holt-Lunstad said. "The findings are simply tied to parenthood, no matter the number of children or employment status."

The results were considerably more pronounced among women participants, with motherhood weighing in at an impressive 12-point difference in the systolic pressure and a seven-point difference in the diastolic pressure. Test results were surprisingy unaffected by the number of children or developmental stage of parenting. Parents of teens and toddlers alike were all toting lower blood pressure.

Professor Holt-Lunstad accredits test results to a parent's natural ability to derive a sense of meaning from their respective family unit. She explains that though caring for children has its "daily hassles," the sense of gratification and purpose parenting produces, outweighs the way the body processes and translates that stress.

These findings have been reported in the peer-reviewed journal Annals of Behavioral Medicine.

WAYS TO HELP CONTROL HYPERTENSION

- **EXERCISE:** Extra pounds put an extra burden on the heart. Just 20 minutes of walking a day can significantly reduce the risk of heart disease and lower blood pressure.
- **HEALTHY DIET:** Reduce the amount of sodium by avoiding adding salt to food at the table and in cooking. Limit daily intake to 2400mg or less.
- **ALCOHOL INTAKE:** Alcohol increases blood pressure. Set limits of no more than one drink a day for women and two drinks a day for men.
- **SMOKING:** Quitting will help improve overall heart health, decrease the risk of heart attack as well as reduce the risk of having a stroke.

THOUGHTS ABOUT BRAINS

By Alida Cataldo

Without doubt, the human brain is a fascinating and complex organ that is the controlling center of the nervous system. Scientists have been studying it for centuries, and every new discovery is a "eureka" moment that gives us a better understanding of how our brains work. Still, there's much to be discovered, and many believe that we use only a fraction of the full capacity of our gray matter.

SPEED THINKING

How long does it take us to form a thought? Nerves operate at different speeds and travel different distances, so the speed of thought varies. In 1850, German physiologist Hermann von Helmholtz discovered that it took one one-tenth of a second for a signal to travel from a frog's leg muscle to its brain. He also found that people reacted more quickly to a shock at the base of the spine than to one in the toe.

More recently, Johns Hopkins scientists found that it takes humans about 300 milliseconds to recognize a picture and another 250 to 450 milliseconds to fully comprehend it. Comprehension was faster when the picture was something familiar. They came up with a speed of thought ranging between 550 and 750 milliseconds.

Speed thinking is critical to our ability to react to a sight, sound, touch, odor or taste. Tim Gollisch of the Max Planck Institute of Neurobiology in Germany discovered that "speed boosters" in the nerve cells in our eyes allow the nerves to send signals to our brains before the entire picture is received. And the thicker and more insulated the nerve, the faster its signals reach the brain. In 1854, physicist William Thomson demonstrated that the wider telegraph wires sent signals faster and farther. The same can be said of our nerves. Myelin insulation is important to speed, too. Signals can travel up to 180mph from heavily myelinated neurons in the spine to the brain.

But neurons lacking myelin move at only 0.5mph.

Determining the speed of cognitive functions such as language processing can help scientists address comprehension and word loss associated with strokes, dementia and Alzheimer's disease. Although "speed thinkers" are apt to score higher on intelligence tests, scientists aren't convinced that faster responses always equal higher intelligence.

BRAIN FARTS

Yes, there really are such things. Science has proven it, but refers to them as "maladaptive brain activity changes" that cause us to make dumb mistakes when doing mundane things.

You've probably experienced them. Maybe you're driving home from work—the usual route—and miss your exit; or abruptly "awake," surprised at where you are but don't remember getting there. "Brains love to pick up regularities, patterns, rules," says Vince Calhoun, an expert in MRI analysis at the University of New Mexico. "As you generate an expectation, you become less attentive."

Research indicates that brain farts are innate types of cognitive mistakes. The default mode of the brain is inward thinking. When processing a repetitive task such as the drive home, the brain goes on autopilot so that the default mode network (DMN) can concentrate on what to make for dinner or work to be done tomorrow. When the DMN and the autopilot collide (and they will), a brain fart—and human error—occur. Immediately after, the stress hormone cortisol surges as the brain hits its panic button. Depending on the magnitude of the brain fart and result of the error, it may take us a little while to settle down.

MALE VS. FEMALE BRAINS

All of us learn differently, and some differences are based on gender. The brain of a newborn boy is 12-20 percent larger than that of a girl. But the size of the brain is relative to the child's body weight, so there's no real difference between boy brains and girl brains. In male adults, the brain weighs approximately 11-12 percent more than that of a woman. But men's heads are also 2 percent larger than women's.

A recent study indicates that, depending on gender, different parts of the brain are used to process language. In girls' brains, the language areas were used more to decide if spoken or written words rhymed, while boys applied more of the areas that receive the input to make that determination.

READING OUR MINDS

It's not science fiction anymore. In February of this year, researchers announced that they could receive answers to questions in the form of brain waves from patients in a vegetative state. What's even more remarkable is that such subjects maintain a level of consciousness that enables them to respond to auditory stimuli.

The study of 54 patients in the United Kingdom and in Belgium involved magnetic resonance imaging (MRI). Five of those patients were able to control their brain activity to respond to questions, even though they were unable to communicate in any other way.

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CHEMISTRY OF COOKING

THE SCIENCE-SAVVY COOK

By Nancy Thornton

As spring dissolves the cold dark days of winter, thoughts turn to backyard grilling and outdoor gatherings. Anxious for a cause to celebrate, Cinco de Mayo presents a timely excuse to clean the grill and dust off the deck for a party. With a menu of popular favorites, it's hard to go wrong—until faced with discolored guacamole made from unripe avocado accompanied by tough, flavorless steak fajitas. Not to worry—the fiesta can go on, because the science-savvy cook is armed with special insights guaranteed to deliver a flavorful feast.

RIPENING ON A SCHEDULE

To accommodate delivery to distant grocery store displays, many fruits are harvested and shipped green because they can ripen after being picked. As they ripen, these 'climacteric' fruits naturally produce dramatically increased levels of ethylene. To accelerate the process requires artificial manipulation. In the case of bananas, they are picked green and gassed with ethylene after shipment. Covering fruit has a similar effect, and creates a perfect solution for the home cook and his unripe avocado. Placing the avocado in a paper bag with an apple or banana increases levels of ethylene and carbon dioxide gases and accelerates the ripening process. An overnight stay can have transforming powers.

BROWNING PREVENTION

Experienced party planners prepare things in advance so they can enjoy the gathering with their friends. Having created the perfectly ripe avocado, our excited chef launches into the guacamole preparation but, without taking special care, the end result quickly discolors and becomes unappetizing.

'Enzymatic browning,' is caused by a reaction between an enzyme (polyphenol oxidase or tyrosinase) contained within the fruit, with oxygen and iron-containing phenols, that are also in the fruit. The oxidation reaction forms a sort of rust on the surface. Several techniques are available to slow or prevent this process. For the sake of a perfect guacamole, the trick is to lower the pH level through introduction of acid, such as lime juice. Cutting and mashing the avocado in advance and abandoning it while preparing the other ingredients can prove risky. A squeeze of lime juice can provide a little anti-browning insurance.

ACID TENDERIZES

The typical steak fajita uses relatively tough, budget-friendly cuts of meat that, with a little advance attention, can yield tender and flavorful results.

Tenderizing meat requires breaking down muscle and connective proteins in meats. Acids, such as citrus juices, pineapple, buttermilk and wine tenderize by denaturing or unwinding protein strings. Using an acid-based marinade before cooking is the science-savvy chef's secret weapon. Adding oil to the marinade helps it penetrate deeper and faster and, with some well chosen seasonings, the flavor is also enhanced.

BROWNING ENHANCEMENT

A well-marinated steak applied to a hot grill is sure to generate a highly desired browning effect that further enhances its flavor. Known as the "Maillard reaction," it occurs when denatured proteins on the surface of the meat recombine with the sugars that are present, changing the color and creating flavor. The reaction occurs most readily at around 300°F to 500°F. When the time comes to place that well-marinated skirt steak on the grill, a little heat goes a long way toward maximizing flavor.

THE GENDER BIAS OF CAFFEINE

By Prathima Ramachandra

Doesn't the mention of coffee refresh your mind? If there can be one single drink that enjoys the equal acceptability all around the world, coffee would probably win. But have you ever thought about what makes coffee appealing, so much so that many people are tempted to go for it cup after cup? Well, if you guessed caffeine, you're right. Caffeine, when added to water along with milk, is responsible for that intense bitter taste that so many crave. This brew not only tastes amazing, but also boosts energy levels with a feel of heightened alertness. According to the U.S. Department of Agriculture, a single teaspoon of instant coffee (1.8 grams in weight) contains 57mg of caffeine, regardless of the amount of water, milk or cream added.

CAFFEINE CHEMISTRY

It's well known that college (and now, high school) students often use caffeinated beverages to stay awake while studying for exams, and drivers use it to push through to their destinations. Without the cuppa de rigueur, most people find it difficult to get themselves going. While medically, caffeine is known as trimethylxanthine, it is also known by other chemical names like coffeine, theine, mateine, guaranine or methyltheobromine. It is naturally available from several plants, including coffee beans, guarana, yerba maté, cacao beans and tea. Caffeine is known to act as a natural insecticide since it paralyzes and kills insects that attempt to feed on the plants. It is a little known fact that the leaves of the tea plant contain more caffeine, around 5 percent, compared to the 1-2 percent in coffee beans.

SHORT-TERM AND LONG-TERM EFFECTS

In humans, caffeine has been proven to stimulate the central nervous system, heart rate and respiration; it also has mood-altering properties and acts as a mild diuretic. Due to its stimulating nature, caffeine

is definitely habit-forming, if not addictive...but unlike nicotine, caffeine is a lot more sociably acceptable. Nonetheless, it is not without any ill-effects on human health. It is known to cause contraction of muscles, increased heart rate, slowdown of blood flow to the stomach, and constriction of blood vessels on the skin. Caffeinated beverages are known to cause obesity in kids, and too many sweetened caffeinated drinks can lead to dental cavities. Too much caffeine can result in caffeine intoxication, characterized by nervousness, excitement, increased urination, insomnia, increased heart rates and sometimes hallucinations.

EFFECTS OF CAFFEINE ON MEN AND WOMEN

Although the effects of caffeine are legendary, they are perceived to have a stronger effect on boys than on girls. A study published in Behavioral Pharmacology observed the effects of caffeinated beverages in children between the ages 12 and 17.

Jennifer Temple, a neurobiologist at the University of Buffalo, expected caffeinated drinks to work more strongly on those who routinely consumed the most caffeine, regardless of sex. Instead, the results revealed a relationship between gender and the desire for caffeinated soda. It remains to be determined, though, as to why caffeine has a stronger effect on boys. Temple speculates it's because of the circulating hormones and their effects on the metabolism of caffeine.

A study was conducted where participants underwent a baseline test to determine if they could taste caffeine in the study drinks. In order to familiarize them with study drinks, the participants were given a week's supply of test soda, randomized to be caffeinated or noncaffeinated. They were instructed to drink a 32-ounce bottle every day for seven days, but no other soda or caffeinated products. In the second week, they were given a week's supply of the opposite drink. In the next part of the study, participants were equipped with two computers, one on which they played a computer game to earn caffeinated drinks and on the other, noncaffeinated drinks, although the drinks' caffeine status was not made known. The longer they played, the more difficult the game was designed to become. Surprisingly, the difference in the reinforcing potential of caffeine was noted to be between males and females and not, as expected, between high and low consumers.

Another study headed by researchers from the University of Barcelona, showed that caffeine has a greater effect on men than women and that these effects start just ten minutes after consumption. Volunteers were asked to consume either a classic espresso (100mg of caffeine) or a decaffeinated espresso (5mg of caffeine). Researchers looked for changes in alertness over the ensuing minutes or hours and observed that 45 minutes was the maximum time needed for caffeine concentration to reach the blood, but levels reach half this concentration within a few minutes. This effect was perceived to be greater in men as compared to women.

Dr. Euan Paul of the British Coffee Association said, "This new scientific study demonstrates interesting differences in the positive effects that caffeine may have on alertness between men and women, an area that has not been heavily researched in previous scientific investigations. We welcome further research to investigate with greater certainty any differences in the stimulant effects of caffeine that may be experienced between gender groups."

One thing is clear–despite the recent findings, most doctors continue to recommend moderation with regard to the intake of caffeine. While these studies give hope to those who are hooked on their morning cup of coffee, there is still a long way to go to determine the long-term effects of caffeine use.

ALLIGATORS RESPIRE LIKE BIRDS—AN EVOLUTIONARY LINK

By Anju Nidhin Ryan

Evolution has always been a subject of interest—one reason being its tendency to show us unexpected relationships. In a January, 2010 Science article, scientists discovered that alligators breathe like birds.

A study conducted by Colleen Farmer and Kent Sanders, from the University of Utah, looks at a possible link between birds and alligators where it was found that both birds and alligators use a single airflow channel for respiration.

MODE OF BREATHING

Cul-de-sacs or Loops for Airflow: The airflow in the lungs of humans and other mammals is like the tides. As we inhale, the air moves through several tiers of progressively smaller, branching airways (called bronchi), until they reach the smallest chambers—cul-de-sacs—called the alveoli. Here, oxygen enters the blood, and carbon dioxide moves from the blood into the lungs.

Birds, on the other hand, breathe through their lungs where the air flows in a single direction within a series of tubes. When birds inhale, air is stored briefly in the air sacs before passing into the lungs at the next inhalation. It then exits the lungs through the windpipe. This allows the lungs to extract up to two-and-a-half times more oxygen than a mammal. This lung design in modern birds improves their oxygen usage as birds fly at altitudes where the percentage of oxygen is relatively low.

A structural similarity in the way birds' and alligators' bronchi branch through the lungs caught Farmer's attention. In this study, she revealed that alligators also use this one-way inhale/exhale, suggesting that they have an evolutionary link. "The aerodynamic valves in the lungs aid in the unidirectional flow where air is inhaled through the trachea, or windpipe, then flows into two primry bronchi, or airways, each of which enters one of the alligator's lungs. The bronchi branch into narrower airways, the first of which is bypassed by the incoming air because that branch makes a hairpin turn that acts as an aerodynamic valve; instead, the air flows into other bronchi, and down into even smaller airways where gases get exchanged with the blood," explained Farmer.

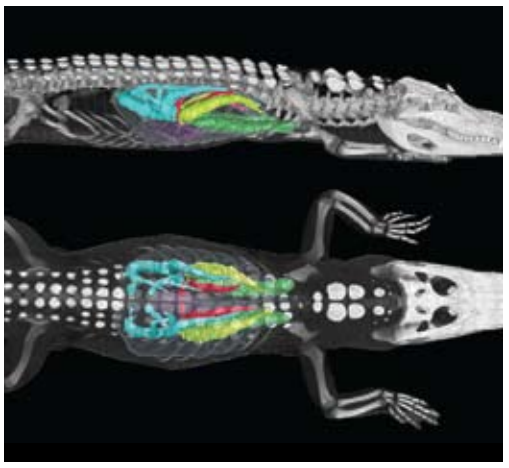
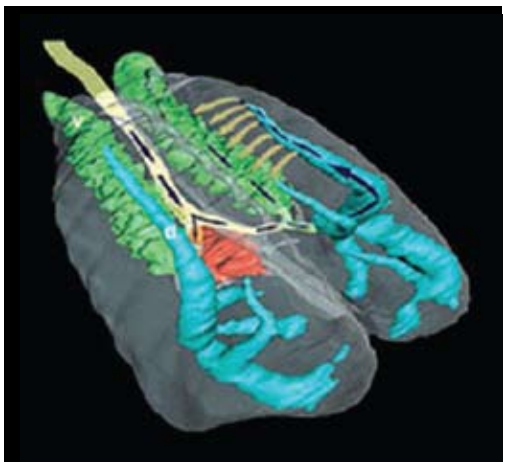


Image of CT scan of American alligator courtesy of C. G. Farmer



En route through an alligator's lungs (shown on CT scan), air skips the first bronchial branch (green) and flows through the second (blue), then moves through smaller parabronchi (light brown arrows) into the first branch and out of the body.

The study further explains that the alligators and birds have evolved from archosaurs. Approximately 246 million years ago, these archosaurs evolved into two types: the Earth-bound ones like crocodiles and alligators, and the avian ones like pterosaurs, dinosaurs and birds. This new discovery could explain why archosaurs came to dominate over the group of mammal-like reptiles called synapsids, whose descendents are the modern mammals. After the mass extinction, the recovering ecosystem was warm and dry, with oxygen levels in the air as low as 12 percent (in comparison to today's 21 percent). Even with less oxygen in the air, many archosaurs, such as pterosaurs, could sustain vigorous exercise. "Lung design may have played a key role in this capacity because the lung is the first step in the cascade of oxygen from the atmosphere to the animal's tissues, where it is used to burn fuel for energy," Farmer said.

THREE LINES OF EVIDENCE

Farmer conducted the study, funded by the National Science Foundation, along with Kent Sanders, an associate professor of radiology at the University of Utah School of Medicine. CT scans of a 4-foot-long, 24-pound alligator were performed in order to study the breathing patterns.

Farmer and her colleagues performed three experiments to test this new idea and to observe if air indeed flowed only one way in alligators:

- They performed surgery on six anesthetized alligators and inserted flowmeters, called thermistors, which measure the direction and speed of airflow into their lungs. As the air entered each lung, Farmer noticed that the primary bronchi each split into two branches and surprisingly, air passed through the first branch in each lung in the same direction irrespective of whether the animal was inhaling or exhaling.
- They also pumped air in and out of lungs removed from four dead alligators and monitored the flow.
- Lastly, using lungs from another dead alligator, they pushed and pulled water through the lungs with tiny fluorescent beads. They recorded this entire event and made movies to show the direction of flow.

All of these experiments demonstrated that air flowed through the lungs in just a single direction. Many scientists did not believe that alligators would have this one-way flow of air as they lack the air sacs, unlike birds, which were thought to be necessary to create a unidirectional flow. Farmer proved this idea wrong. "They cannot argue with this data," she said. "I have three lines of evidence. If they don't believe it, they need to get an alligator and make their own measurements."

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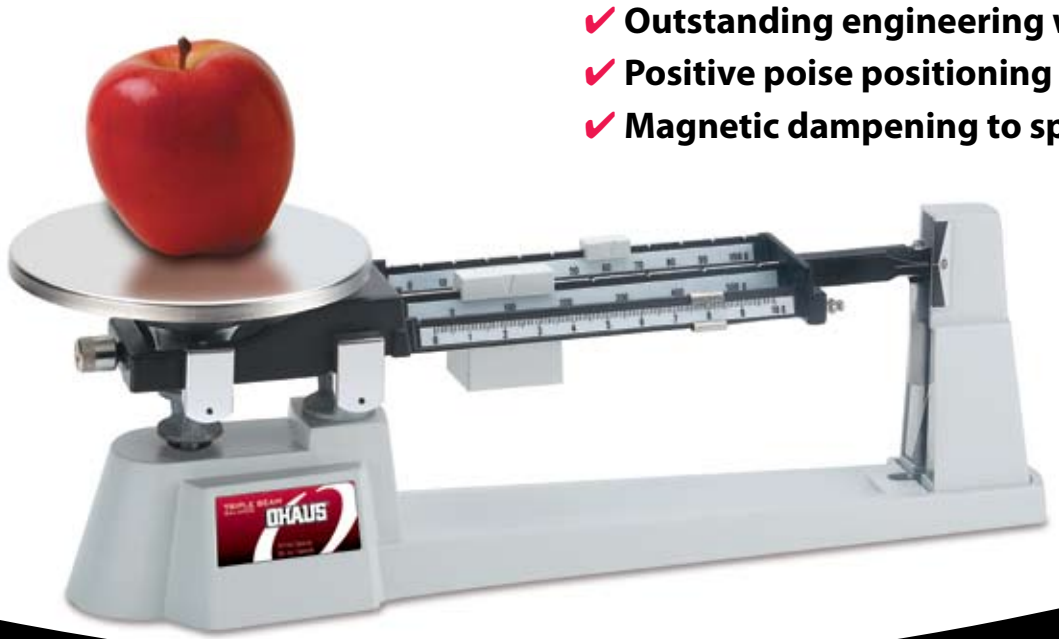

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HARMFUL ALGAE BLOOMS

By Brianne McCurley

Green algae blooms in Lake Erie are viewable from space. Every summer the toxic green algae force some Lake Erie beaches to close and restrict swimming in the lake. Although the algae have not caused any human deaths, they are toxic to humans, fish, pets and other animals.

Eutrophication is a natural process that occurs in an aging lake or pond as that body of water gradually builds up its concentration of plant nutrients. Cultural or artificial eutrophication occurs as an ecosystem responds to human activities that fertilize water bodies with nitrogen and phosphorus, often speeding up plant growth and choking the lake of all animal life. Excessive amounts of nutrients, including phosphorus and nitrogen, cause these algae to grow out of control. Nutrient pollution is mainly responsible for algal blooms, some of which can cause dead zones in Lake Erie and other coastal areas. This is a widespread issue worldwide, yet gets the least attention. More than 90 percent of the rivers in the continental U.S. exceed nutrient water-quality standards, according to the United States Environmental Protection Agency.

In the 1960-70s, high amounts of nutrients were evident in lakes and streams. To resolve the issue, phosphate dishwashing and laundry detergents were banned and sewage treatment was upgraded to reduce wastewater, nitrogen and phosphorus discharges to inland waters. The laws passed in the '70s on phosphorus-containing laundry detergents are credited with playing a major role in cleaning up the Great Lakes. By the 1980s, human activities such as fertilizer runoff from farm fields or suburban lawns doubled, then tripled, the transport of nitrogen and phosphorus from land to streams, lakes and oceans. Eutrophication has emerged as one of the key factors in degradation of coastal ecosystems.

Many American homeowners use fertilizers to make sure they have green, healthy lawns, and can easily add too much phosphorus to the lawn. Most soils already

have sufficient amounts of phosphorus to maintain the healthy lawns. Rain water carries off much of the excess phosphorus to the nearest stream, river or lake where it stimulates algae blooms. While there are many other factors that add to the production of algae blooms, such as the combustion of fossil fuels by local power plants, large industries and automobiles, the fertilizer used on lawns and gardens seems to be an easy fix. Local municipalities are starting to pass laws that forbid the use of fertilizers containing phosphorus. Both farmers and landowners need to be responsible, and avoid using these types of fertilizers.

Students and teachers can help the cause by finding a local lake, river or stream to conduct tests on the water quality, and report their findings to the local health department or department of natural resources. Test pH, nitrates, phosphates, turbidity, velocity and the dissolved oxygen of the water using dataloggers for subsequent analysis. Students can also look for macro invertebrates as an indicator of water quality. Conducting studies on water sampling will create awareness for students, but also for their local municipality.

A SLUG THAT'S A PLANIMAL?

By Jason Akerman

The *Elysia chlorotica*, a green, leafy-looking sea slug, inhabits the marshy waterways along the eastern U.S. and Canadian seaboard. This fascinating and unique super slug rarely has to worry about feeling "sluggish" when it runs out of food because it has both animal and plant characteristics. When food is absent, the slug acts like a plant, producing chlorophyll to get energy from sunlight.

YOU ARE WHAT YOU EAT

For *Elysia chlorotica*, truer words were never spoken. When hungry, this sea slug's favorite take-out meal is the algae *Vaucheria litorea*, which it consumes much like a Slurpee®. Using its finely toothed, ribbon-like radula, the sea slug breaks open the algae's cellular "packaging" and sucks out the "guts" of the algae like it's using a straw.

But the really strange part is that instead of simply eating and digesting the algae for dinner, our sea slug "steals" the algae's genes and chloroplasts and absorbs them into its own cells. Chloroplasts are organelles, or organ-like structures, in plant cells that allow plants to perform photosynthesis, the process whereby plants absorb sunlight and convert it into energy.

STEALING SOME "GREEN"

What has surprised scientists like Sidney K. Pierce, who has studied the sea slug for many years, is that the slug steals so many important plant parts from the algae, that it is then able to make chlorophyll all by itself. Chlorophyll is what makes plants have their green color and it is vital for photosynthesis. The slug basically takes for itself the plant's solar power ability so that it too can go without food and live off of sunlight. Using radioactive tracers, Pierce and other scientists found out that the sea slugs were indeed making the chlorophyll on their own and it was not just a case of algae chlorophyll leftovers.

Further, it turns out that not only do the slugs never have to eat again after such an algae super-sized meal, but they can pass their plant genetic loot down to their offspring, even though they have never eaten algae before.

A FUTURE DNA SLUG-OUT?

So what does all this mean? Why care about this animal…plant…thing? Isn't it just a slug after all?

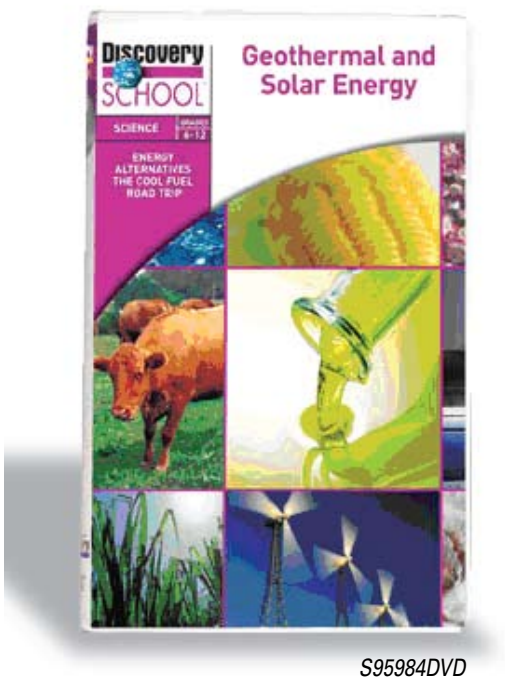
Well, for starters, it's pretty amazing, and nothing like this creature has ever been found that can do what it does. It also opens up a whole new area of further research because no one fully understands how the slug is able to take over the algae's genetic material and use it for itself. If nature already has such an example of one creature mixing up its DNA with another, what does that mean for the future? Will we one day be able to mix up genes from different animals or create new animal hybrids? For now, all that is certain is that *Elysia chlorotica* is one fascinating slug.

Available from Fisher Science Education #S95984DVD

DISCOVERY EDUCATION ENERGY ALTERNATIVES: The CoolFuel Road Trip Geothermal and Solar Energy DVD

DVD REVIEW

By Merry Morris



S95984DVD

A team of four enthusiastic Australians and their dog, Sparky, take you on a "no-gas" trip from California to Arizona in one leg of the 16,000-mile "CoolFuel" trip across the U.S. In other excursions, the crew and Sparky travel to other states showing how additional alternative fuels like garbage, water and food can be used instead of gas. This particular jaunt, however, takes the crew through some of the sunniest parts of the country, highlighting how solar and geothermal energies power electric vehicles.

This adventure begins with Marty, Master Mechanic, and his canine companion tucked into a tiny, three-wheeled Corbin Sparrow car/motorcycle. As they continue through the challenging desert and foothill terrains, they trade the Sparrow for a succession of equally interesting vehicles: electric motor bike, solar canoe, photovoltaic cruiser and scooter. One highlight of the trip is an off-road race between a Ferrari and limited production tZero sports car, in which—you guessed it—the tZero leaves the Ferrari in the dust.

The team does run into trouble along the way—charges run down—and help arrives by way of a number of gas-free rescuers.

The "CoolFuel Road Trip" will entertain students in grades 6-12 and illustrate that with ingenuity and engineering/mechanical skills, gasless travel is not such a far-fetched goal after all.

BOOK REVIEW

SWIFT OPTICAL LAB MANUAL: LEARNING BIOLOGY WITH A DIGITAL MICROSCOPE

By Merry Morris

Available from Fisher Science Education #S01392

"Nature composes some of her loveliest poems for the microscope and the telescope."

—Theodore Roszak

Biology students can learn more about "nature's loveliest microscopic poems" when they are able to learn microscope skills through interesting and engaging activities. High school teachers can provide their students with exciting, "hi-tech" activities when they offer digital microscopes and guide students in their use with an accompanying manual written to open up the diversity of the microscopic world and concurrently support measurement and data collection skills. Teachers can find just such a teaching aid in the Swift Optical Lab Manual.

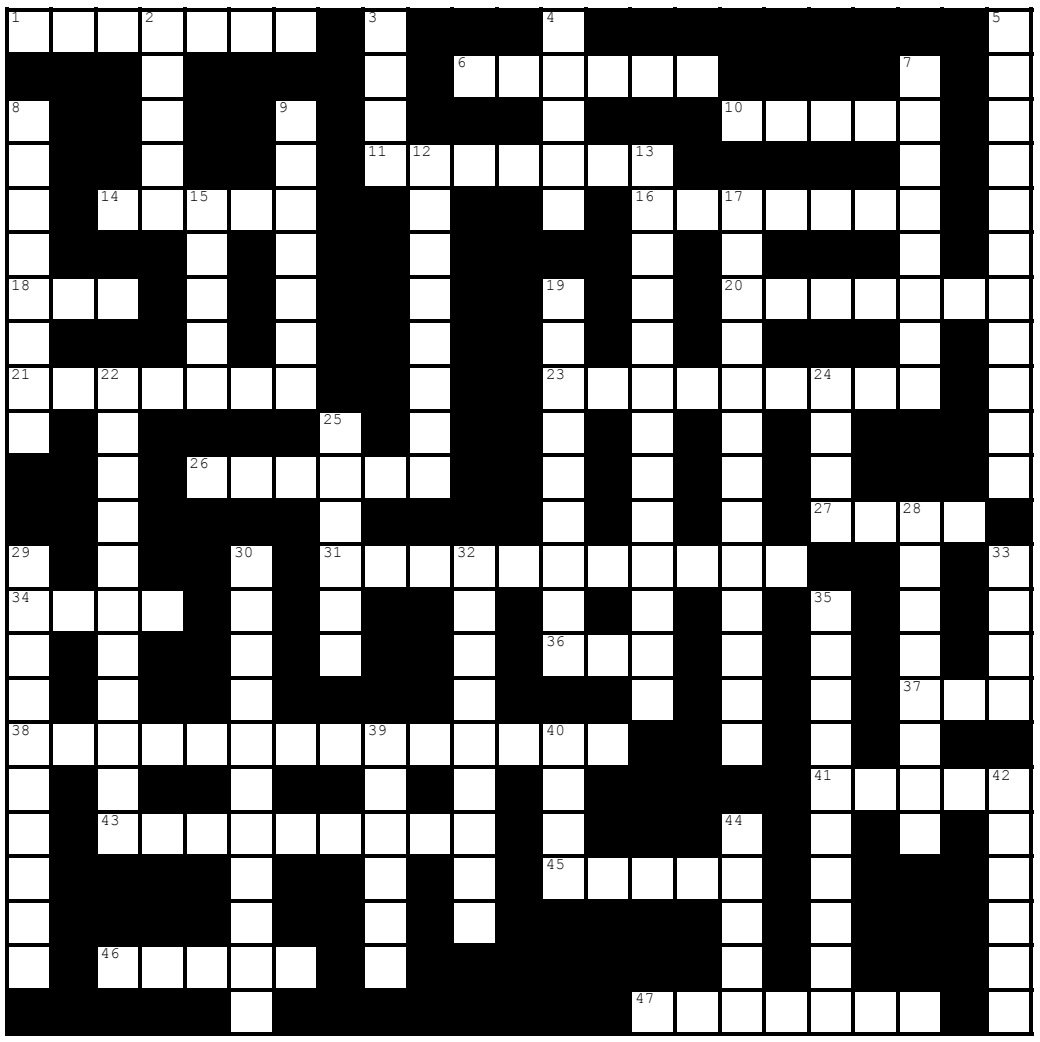
The Swift Manual comprises four units covering an introduction to the digital microscope and calibration, structure and function of cells, structure and function of biological processes, and behavior. Each activity within these broad areas is represented by preparatory information for the teacher and a student activity sheet.

The teachers' materials provide basic information on the lesson, but also include applicable standards and pertinent chapters of major biology texts. The textbook-matching feature provides the teacher with information that would be difficult and time consuming to collect on his/her own. (There is a cross-reference of these textbooks' chapters against the manual's activities at the end of the manual. Additionally, there is a section that presents the biology/life science standards [national and selected states] matched to specific manual activities.)

The student activity sheets are clear and succinct, and they allow students to practice the calibration and measure skills learned in the introductory activities. The functions of the digital microscope are presented, as well as those of the standard microscope, giving the student the opportunity to view specimens traditionally as well as onscreen and projected.

Activities include, but are not limited to the following topics: Prokaryotic and Eukaryotic Cells, Cell Specialization, Not All Movement is Life, Mitosis, Changes in Salinity, Daphnia Heart Rate and Temperature, Hydra Feeding and Reactions to Light.

CROSSWORD PUZZLE



ACROSS

1. Upcoming science series on public television: Science _____ 101. (Page 7)
6. Molecular_____ (Page 11)
10. A food that *Elysia chlorotica*, the photosynthetic sea slug, commonly eats is _____. (Page 22)
11. People who don't wish to own their own car can take advantage of a car-_____ service. (Page 9)
14. The ASIP gene has been linked to_____ eye color? (Page 11)
16. ___ mapping (Page 11)
18. The leaf of this plant contains more caffeine than a coffee bean. (Page 19)
20. What do scientists think is clogging the astronauts' water reclamation unit? (Page 4)
21. What can be created when nanotube, paper and ink are combined? (Page 5)
23. What are loops for airflow in a respiratory system called? [three words] (Page 20)
26. This material insulates nerves. (Page 16)
27. A mother's _____ helps determine the odor and flavor preferences in babies. (Page 15)
31. Factor in child's reading skills development is the _____. (Page 6)
34. If a tarantula panics, what body element does it spray for protection? (Page 14)
36. An unimaginably vast powerhouse which affects everything on Earth. (Page 6)
37. A researcher connected a paper battery to an _____ light bulb to prove that it would light up. (Page 5)
38. The process whereby plants absorb sunlight and convert it into energy is _____. (Page 22)
41. Artificially created black holes called _____ black holes, trap sound waves. (Page 4)
43. Mammal-like animals are called _____. (Page 20)
45. The sense of _____ is stronger than any other senses in newborns. (Page 15)
46. What is the second most crucial necessity to astronauts while in space? (Page 4)
47. _____ is a byproduct of charcoal produced by burning wood products slowly at low heat levels. (Page 9)

DOWN

2. In the future, _____ power may be used to charge cell phones. (Page 9)
3. Object of this genetic study. (Page 6)
4. The controlling center of the nervous system is the _____. (Page 16)
5. Students from St. Maurice Catholic School performed _____ in a University of Pittsburgh mobile lab. (Page 7)
7. _____ is the initial factor in reading development. (Page 6)
8. The carbon _____ ink is a special type of ink that can be used to conduct and store energy. (Page 5)
9. Which month did the most recent change in the Doomsday Clock occur? (Page 3)
12. Fuel cells in cars and trucks can use _____ and oxygen to create electricity. (Page 6)
13. Sustainable biochar can be used to help combat _____ by holding carbon in soil and by displacing fossil fuel use. [two words] (Page 9)
15. An _____ hole can be found over Antarctica. (Page 19)
17. The second largest source of electricity in the USA after coal: _____ [two words] (Page 6)
19. What are tiny robots that aid in medical procedures called? (Page 5)
22. Flowmeters used to measure direction and speed of airflow in lungs are called _____. (Page 20)
24. Agent that helps denature protein strings. (Page 18)
25. What do 40 percent of students report feeling most of the time? (Page 15)
28. Gas that can serve as ripening agent for fruits. (Page 18)
29. Fertilizers with _____ are a factor in the creation of algae blooms in lakes, streams and rivers. (Page 22)
30. What is the name of the body scan technology that creates a two-dimensional image? (Page 2)
32. Caffeine intoxication is characterized by _____ heart rates. (Page 19)
33. Garrett Morgan"s "safety _____" was based on the idea that the freshest air at a fire scene could be found near the ground. (Page 2)
35. Where is the North American 2010 World Environment Day going to be held? (Page 8)
39. What is the maximum number of minutes teens should nap? (Page 15)
40. What part of the human eye is the most complex tissue structure on the outside of the body? (Page 11)
42. Rachel _____, a founder of the modern environmental movement, was born in this year's WED host city. (Page 8)
44. What planet was discovered in 1930, and has recently been changed to dwarf planet? (Page 3)