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OIL AND WATER DON'T MIX

By: Gwen Myslinski

Oil spills can occur day or night, on land or in water and in any type of weather. But understanding them, having a plan in place and moving quickly is the best strategy to avoid long-term damage to the environment, the wildlife and to human health.

OIL SPILL BEHAVIOR

The term "oil" is a general description to include a broad range of hydrocarbon substances or chemical compounds that are made from hydrogen and carbon. Hydrocarbons are often associated with crude oil and refined petroleum products, but they also include animal fats, vegetable oil and other non-petroleum oils.

After an oil spill occurs, the majority of oils spread horizontally into a smooth and slippery surface on top of the water called a "slick." The rate at which the oil will spread depends on many factors including the wave action, wind, water temperature (oil is more likely to spread in warmer temperatures) and currents, as well as the relative density and composition of the oil. These factors can also determine whether or not the oil slick will remain cohesive or break up.

If in the water for a long duration, many changes could occur to the oil. The slick could break down and become heavier than the water, which is also known as "weathering." In the first 12 hours, up to 50 percent of the lighter or more volatile substances within the oil could evaporate, leaving heavier components behind that can weather further or even sink. The oil could oxidize by being exposed to sunlight and wave action and turn into dense, sticky tar balls. Some of the oil might even emulsify into one of two emulsions. The first emulsion turns it into a thick mousse because water is trapped inside the oil; the second makes the oil sink and look like it has disappeared from the surface of the water.

WHAT AN IMPACT

Harmful effects often occur if an aquatic environment has long-term exposure to the oil after a spill. Plants and animals can be at risk for chronic long-term effects, though the impact can affect each very differently.

Coral reefs, for example, are an important nursery for shrimp, fish and other animals, and can be smothered by the oil. While beaches aren't home to many organisms on a full-time basis, if they aren't cleaned immediately, run-off can further contaminate nearby water sources as it can take several years for the oil to disperse naturally. Tidal flats, on the other hand, are rich with plant, animal and bird communities. They are broad, low-tide areas and, if they are affected with oil, can have severe effects on the ecology of the area.

Many people have seen photos of oil-soaked birds and mammals, but don't really understand the ramification that an oil spill has on them. When birds have oil-covered feathers they lose their ability to stay waterproof and insulated, and the weight of the sticky oil weighs them down and can prevent them from flying and even drown them. Mammals, such as otters, beavers, polar bears, manatees, seals, sea lions, walrus, whales, porpoises and dolphins can all be affected by the oil, but the damage is generally related to how important the blubber and fur are to staying warm. Therefore, otters, beavers, fur seals, polar bears and land mammals usually experience more harm because they need clean fur to remain warm.

Any oil that evaporates releases hydrocarbon vapors, and these toxic vapors can cause nerve and lung damage to any animal that has to surface the water to breath. Animals who ingest the oil can encounter bleeding in their digestive tract, as well as kidney, liver and reproductive damage. Not to mention that when small organisms, like plankton (also heavily impacted by oil spills), are eaten by other larger species this continues the cycle of contamination and its effects directly up the food chain.

TO PROTECT THEN SERVE

The Federal Drug Administration (FDA) works with other agencies like the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA) to ensure the food that humans eat is safe.

In early April 2010, Thermo Fisher Scientific opened its global Food Safety Response Center located in Dreieich, Germany to "help out laboratory customers around the world quickly mobilize during a food contamination crisis, using our depth of capabilities to develop methods that enable them to respond to potential threats," said Marc N. Casper, president and chief executive officer of the company. Then on July 8, the Response Center announced the development of two new analytical screening methods which will help to detect petroleum in oysters and fish. This helps organizations like the FDA and the EPA determine the safety of the food.

According to an article written by aolnews.com, related to the Gulf of Mexico oil spill, "The NOAA says the seafood is deemed safe if it doesn't increase a person's lifetime cancer rate by more than one additional case in a million people. Some states like Maine use a higher risk level, such as a lifetime cancer risk of no greater than one in 100,000 people."

CLEANUP AND RECOVERY

The techniques used to clean up an oil spill are challenging and depend on the oil's characteristics and the environment that's involved. Lighter oils often evaporate and break down very quickly and, therefore, tend not to deposit on shorelines and banks. Heavier oils, like crude oil, will form mousse, and will cling to rocks and sand or turn into tar balls which are very difficult to remove from rocks and sediments, making the cleanup much more crucial and much more difficult.

Physically removing the oil is a long and tedious process that involves many people and lots of equipment. Before cleaning begins, booms made of absorbent material are usually set up in the water along the banks to help contain the oil that is cleaned up. Cleanup crews can also try to remove the oil by skimming, filtering or using in situ combustion methods, which are controlled fires that reduce the oil's density in the water. On land, crews use low- or high-pressure washing and raking/bulldozing as a means to clean the oil or prevent it from escaping into sediments.

All of the oil that is cleaned up must be disposed of properly. Sometimes it can be recovered and reused, but other times it must be incinerated or placed in a landfill. Regardless of its disposal, the oil spill isn't considered to be over until all waste materials are disposed of properly.

COST AND PREVENTION

The cost of an oil spill is relative to both the quantitative and qualitative loss. Quantitatively speaking, costs incurred can include the oil lost, the repair or loss of machinery or facilities, payment for cleaning up the spill and the environment, penalties assessed by regulatory agencies, and legal and insurance fees. Qualitative losses are harder to assess, but can include losses of recreational enjoyment, loss of habitats and ecosystems, and any unknown wildlife and human health effects from exposure.

Preventing oil spills is a major priority, which is why the Oil Pollution Act of 1990 was enacted by Congress to strengthen oil spill prevention, planning, response and restoration efforts. The provisions of the Act go to the Oil Spill Liability Trust Fund, administered by the U.S. Coast Guard, which helps to pay for cleanup efforts after a spill.

Unfortunately, oil spills do occur, and prevention is the best strategy to avoiding potential damage to human health and the environment. If a spill does occur, the best course of action for containing and controlling it is to have a plan in place, and respond quickly in an organized fashion.

PROFILE
RANDY PAUSCH

By Dan Skantar

Randy Pausch (1960-2008) was an American computer scientist and professor who earned international fame for his "Last Lecture" about life and the pursuit of one's dreams.

The Baltimore native earned a BS in Computer Science from Brown University and a Ph.D. from Carnegie Mellon University and eventually joined the CMU faculty. With his enthusiasm and passion for learning and teaching, Dr. Pausch personified the Carnegie Mellon motto: My Heart is in the Work. Grateful to the mentors who had helped him in his career, Dr. Pausch encouraged his students to believe in themselves and to pursue their dreams.

Dr. Pausch's expertise included human computer interaction and entertainment technology. He was a lifelong learner who had learned from the best—a sabbatical with Walt Disney Co.'s theme park attraction designers, called imagineers, greatly influenced his work. Dr. Pausch founded CMU's Entertainment Technology Center (ETC), where an entire curriculum centers on high-tech storytelling through a fusion of engineering, design and technology. He also oversaw the development of Alice, a 3-D program that revolutionized computer science education through interactive storytelling. But Dr. Pausch's signature achievement did not involve a computer.

THE LAST LECTURE

At age 45, in the prime of his life, Dr. Pausch was diagnosed with pancreatic cancer, an incurable disease. With months to live, Dr. Pausch decided to tell his personal story in the form of a "last lecture." Conceived in part as a gift to his three young children, the lecture became much more. It began with a simple question: What would you tell the world if you knew it was your last chance to speak?

Dr. Pausch pondered his answer, and on September 18, 2007, he delivered The Last Lecture to an overflow crowd of students, colleagues and friends at CMU's Pittsburgh campus. With wit, thoughtfulness and openness, Dr. Pausch traced the course of his life, and the dreams he chased, like his unfulfilled wish to play professional football. ABC News called it "one of the most powerful accounts of hope, grace and optimism" ever covered by the network.

LESSONS AND LEGACY

Dr. Pausch's message was simple. Have fun in everything you do. Live life to its fullest. Seek your dreams. On defeating adversity, Dr. Pausch spoke of life's "brick walls", recalling how he had to wait before finally earning admittance to Brown. "Brick walls are not there to keep us out; they are there to give us a chance to show how badly we want something."

Less than a year after The Last Lecture, Dr. Pausch died at age 47. His research legacy lives on through Alice and the ETC. His personal legacy lives through the lives he has touched.

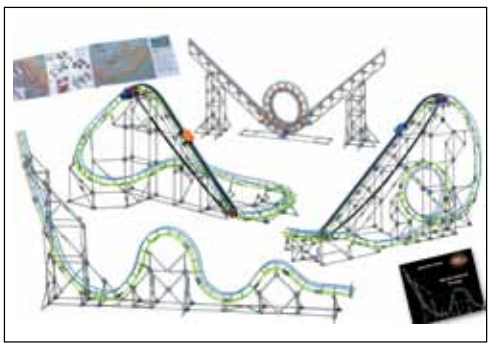
Among hundreds of tributes, the Carnegie Mellon community honored Dr. Pausch with a message painted on the school's iconic landmark, The Fence. In a twist on the CMU motto, it read: Thank you, Randy Pausch. Your work is in our hearts.

Read more about Randy Pausch in his book that he wrote with Jeffrey Zaslow (*The Last Lecture*, Hyperion, 2008). The book has been translated into 35 languages or see a video of *The Last Lecture* which is readily available on the Internet.

K'NEX CHALLENGE— CREATIVITY CONNECTS WITH FUN

By Joy Jones

Attention all master builders! The Allegheny Intermediate Unit (AIU), a division of the Pennsylvania Department of Education, will host a K'Nex competition, the first of its kind in the U.S., for students in grades four through eight this fall. Teams of up to four students will be challenged to design and build a K'Nex structure for the competition to be held on December 6, 2010 at the AIU facility in Homestead, PA, which is a borough of Pittsburgh.



The competition begins with a non-mandatory teacher workshop on October 14, at which design requirements including structure height, number, types of pieces, etc. will be announced. Teams can then embark on the process of designing their structure. Students are asked to bring to the competition a blueprint and a narrative outlining the design process used during creation of the structure. They will then be given a period of two hours in which to build it. Grades 4-5 will be judged together, as will grades 6-8, with awards given for first, second and third place. The AIU hopes that the competition will become a statewide event in upcoming years so that winners can advance to the next level of competition.

K'Nex is a toy construction system consisting of basic plastic rods and connectors, which, when arranged with such auxiliary pieces as wheels, gears, pulleys and bricks, can create a wide variety of 3-D objects and devices. The addition of a motor component allows the creation of such movable contraptions as roller coasters and robots.

ABOUT THE SCHOOL

The AIU is one of 29 Pennsylvania educational service agencies that assist pulic school districts and non-public schools. Intermediate units provide consulting, advisory and educational services to school districts, plus any ancillary services necessary to improve the state system of education. The AIU is the largest intermediate unit in the Commonwealth, serving more than 133,000 students, 9000 professional staff, and 42 school districts in the public school community. Students and teachers in more than 100 non-public schools also receive services.

According to the AIU, academic competitions such as the K'Nex Challenge encourage peer interactions and inter-district sharing. Not to mention they're just plain fun.

GET REGISTERED

To register a team for the competition (maximum of two teams per school), contact the Allegheny Intermediate Unit at 412.394.5818 before October 14, 2010. There is no entrance fee for the competition.

TRIVIA NOTE

An 8-foot model of the United States Capitol building consisting of 514,000 pieces is the biggest K'Nex model ever made.

THE SCIENCE OF 'SUPER FOUNTAINS'

By Nancy Thornton

Water can be hypnotic, especially when viewed as part of a stunning 'super' fountain. It can appear as a graceful dance with synchronized lighting and music, or as an unpredictable sequence of spurts and streams. It compels the passerby to pause and take notice. As with any form of dance, the production is the result of careful choreography which, in the case of a super fountain, includes complex technology systems.

DAZZLING DEVICES

The Bellagio hotel and casino has one of the most famous "super fountains" in this country, if not the world. Opening in 1998 at a cost of $40 million, it continues to serve as the most popular attraction along the infamous Las Vegas "strip." Over 1200 nozzles tightly control water flows at pressures up to 250 pounds per square inch, reaching heights of nearly 200 feet. Sophisticated valves deliver everything from a dribble to dazzling 20-story high explosive geysers.

As technology continues to develop, design firms integrate new features that re-define boundaries and deliver stunning effects. A corporate office, displacing "white noise," might employ a satin wall of water using a laminar flow fountain within a multi-story atrium. An urban park might feature a fountain powered by compressed air rather than pumps. Where suburban children dance through garden sprinklers, gleeful city-kids dart among random upward streams of water that shoot from the pavement.

COMPUTER-BASED CHOREOGRAPHERS

These fountains and their sequence of water gymnastics are the result of carefully designed computer programs and integrated electronic controls. Manually operated mechanical devices are too limiting. With blinding speed and accuracy, software applications control myriad effects. From opening and closing valves while governing water pressure, flow and direction, to synchronizing music, lights, fog and fire—these silent, off-stage directors deliver with consistent, awe-inspiring results.

Design firms, such as Cole-Parmer client Water Entertainment Technologies (WET), require demanding test labs with an array of analytical equipment and instruments such as spectrophotometers and gas chromatographs. Their development playground is a place where scientist, engineer and artist collaborate. The technology is complex—the results are mesmerizing.

In 2009, the record-setting fountain at the center of the Downtown Dubai project opened. At a cost of $218 million, this extraordinary attraction includes 6600 lights and 24 colored projectors, shoots water over500 feet into the air, and is accompanied by a full range of world music, from classical to contemporary.

STRONG STEM CRUCIAL FOR U.S. ADVANCEMENT

By Joy Jones

According to both the National Research Council and the National Science Foundation, the STEM (science, technology, engineering and mathematics) fields together represent the "core technological underpinnings of an advanced society." Many experts contend that the strength of the STEM workforce is a strong indicator of a nation's ability to sustain itself. And STEM-related careers are among those regarded as offering both the highest compensation and the greatest potential for job growth. So is it any wonder that the U.S. government is ramping up efforts to raise our nation's STEM savvy?

IN THE BEGINNING…

In his State of the Union Address in 2006, President George W. Bush introduced the American Competitive Initiative to address shortfalls in federal government support of educational development and progress at all academic levels in the STEM fields. Specifically, the initiative called for significant increases in federal funding for advanced research and development programs and an increase in U.S. higher education graduates within STEM disciplines.

That same year, the United States National Academies issued three recommendations to counter the declining state of STEM education in the U.S.:

- *Increase America's talent pool by improving K-12 science and mathematics education*
- *Strengthen the skills of teachers through additional training in science, math and technology*
- *Enlarge the pipeline of students prepared to enter college and graduate with STEM degrees*

In response, several organizations have introduced programs to advance STEM education, including NASA and the National Science Foundation (NSF), and a substantial lobby to raise awareness of STEM education issues has emerged in Washington, DC. The STEM Education coalition consists of advocates from over 1000 diverse groups representing all sectors of the technological workforce that support programs for teachers and students at agencies that offer STEM programs (e.g., NSF). Disappointingly, reports indicate that activity of the STEM Coalition seems to have slowed since September 2009.

WHAT THE FUTURE HOLDS

This past February, the House of Representatives heard expert testimony on undergraduate and graduate education that reinforced concerns about the decline of STEM education. Panel leaders suggested that "students start out interested, but the STEM programs are driving them away." An executive at Boeing, Rick Stephens, presented a bleak picture for the aerospace industry, which employs a major portion of the nation's STEM workforce, due to "an aging workforce and little domestic engineering talent to fill that void." He further asserts that today's youth have an unflattering view of STEM professionals as "nerdy and socially inept," which The Aerospace Industries Association is working with the Entertainment Industries Council (EIC) to correct.

However, the future holds promise. Now may be the best time to re-ignite the crusade for STEM education. The America COMPETES Act of 2007, whose initial focus was on K-12 but is now recognizing the deficit at the undergraduate/graduate levels to replace retiring baby boomers, is up for reauthorization. STEM supporters—take advantage of the momentum and let the STEM lobby and your government representatives hear your voice.

SHEDDING SOME LIGHT ON THE MATTER

By Gwen Myslinski and Gordon Bain

Science has become "cool" in the eyes of many middle- and high-school students, thanks to the surge in popularity of crime scene investigation television shows that feature it. Who knew that analyzing DNA samples, fingerprints or metal bullet fragments, which may help solve a case, could be determined by something as rudimentary as light?

In exploring the principles of light, students learn that when the sun passes through a prism it creates a "spectrum" of colors.

In science, this energy is part of an electromagnetic spectrum. An electromagnetic spectrum has several parts, some visible and some not. What the students see when using the spectrum is part of the visible spectrum—showing all of the colors seen in a rainbow. However, it's working with the non-visible parts, those that fall into the ultraviolet (UV) or infrared (IR) light spectrum, that are the most challenging for scientists doing various types of research.

SCIENTISTS SEE WHAT CAN'T BE SEEN?

The science of understanding how light works is called spectroscopy, and specifically understanding the IR and UV light, with the help of a spectrophotometer, is what helps scientists uncover the truth about what can't be seen with the eye alone.

HOW IT WORKS

A spectrophotometer determines the intensity of various wavelengths in a spectrum of light before and after passing through a liquid sample. From that measurement, the person performing the experiment can determine sample concentration, purity, color, light absorbing capacity and reflectivity, among other characteristics. These characteristics can relay a substantial amount of information and in some cases help to protect the population's overall health and safety with food and water quality control and ensuring the UV light protection of suntan lotions, sunglasses and fabrics is effective.

SPECTROPHOTOMETERS + STUDENTS

Introducing spectrophotometers in high school gives students to the opportunity to learn how to apply the principles of scientific research to real life issues in the fields of chemistry, biology, life science, material science and technology. It also shows them how each measurement they take can be converted to useful information about the samples and the environment around them (and answers their question: "How am I going to use this when I get out of school?"). Finally, it provides an understanding of one of the most principal laws of physics, Beer's Law, which explains the transmission of light using a formula.

NEW & IMPROVED

Spectrophotometers were first introduced in the late 1930s, and have constantly been revamped to provide improvements in the quality, resolution, wavelength accuracy and range throughout the years.

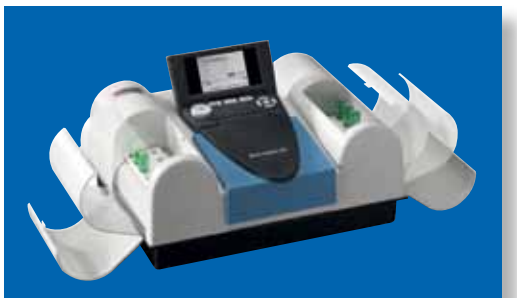
Recently, some models have been further redesigned to meet the needs of modern-day students by providing more student-friendly features, like a control setting that is intuitive to the video-game generation—as well as the familiar λ knob for setting wavelength, a color graphics screen, full spectrum scanning, and support for both square and round test-tube cuvettes as a standard feature.

INTERESTED?

Thermo Scientific is introducing a new spectrophotometer to market in early September, the SPECTRONIC 200.

The SPECTRONIC 200 is priced the same as SPECTRONIC 20D+, and there's special pricing available for the Fisher Science Education customers. There's even a trade-in deal that saves you money when you send in your old spectrophotometer to promote environmentally friendly practices.

For more information about the new SPECTRONIC 200, to learn about the special pricing or find out more about the trade-in offer, call your Fisher Scientific representative for all of the details.



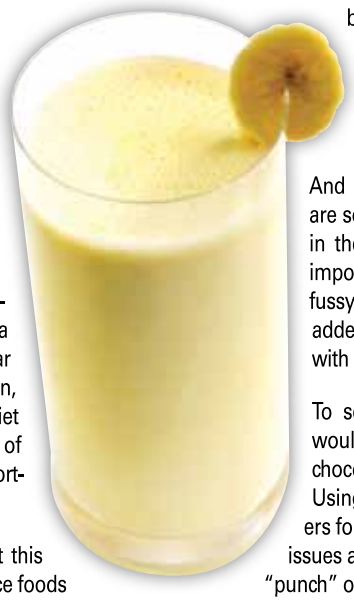
NEW FEATURES OF SPECTRONIC 200

- **Collects full sample spectrum**
- **Optical system offers room light immunity (run an experiment with the lid open)**
- **Screen tilts for easy readability**
- **Connects to a laser printer or a thermal receipt printer with a USB port**
- **Connect to a computer and run with optional Thermo Scientific piQue software**

WOULD A BANANA SMOOTHIE BY ANY OTHER NANO-NAME TASTE AS SWEET?

By Jason Akerman

In the underdeveloped nations of the world, the question of "what's for dinner tonight?" doesn't often revolve around whether or not to call the pizza joint down the street or cook up something in the microwave. For a large number of the Earth's population, basic resources like safe drinking water and nutritionally rich foods are at a premium. Tragically, poverty and disease go hand-in-hand in many of these places.



But recent advances in the growing field of nanotechnology have opened up potential avenues in the food industry that could help raise the health standards for many across the globe.

PEA GREEN TWINKIES

One of the biggest nutritional challenges facing poorer countries is a lack of iron and zinc. Iron in particular is critical in red blood cell production, and not getting enough iron in your diet can lead to anemia, literally, a "lack of blood," which can cause a wide assortment of health-related issues.

Up until now, the main way to fight this problem has been to fortify or enhance foods with iron. One problem, though, is that the body often does not absorb the added iron or nutrients well. Another issue is that the iron additives can make the food less than appetizing by affecting its natural taste, look or aroma. Pea green Twinkie, anyone?

Swiss scientists, however, have recently developed a process that doesn't just, as in the past, simply create some iron additives like so much ground-up pepper, but instead results in nano-sized (incredibly small, on the level of a single atom or molecule) iron particles.

GOT NANO-MILK?

In order to produce these super small concentrations of iron and zinc, the researchers first had to add water, breaking down the iron or zinc to create a liquefied substance. The fluid was then exposed to extreme heat, causing the water to evaporate off. And voilá, instant clusters of nanoiron or nanozinc.

And because these nanoadditive clusters are so extremely small, they dissolve rapidly in the body with no problems. Even more importantly for the future of picky eaters and fussy kids everywhere, the food they are added to appears to go down pleasantly with no noticeable strange or unusual flavors.

To see how effective these new nutrients would be, the scientists mixed them into both chocolate milk and banana smoothie treats. Using rats that were anemic, the experimenters found the rats consumed the food with no issues and benefited from the added nutritional "punch" of the iron or zinc.

The true taste test, however, is yet to come, as humans have not yet tried out this nanonutritional menu. Some researchers are concerned there could be dangers as these are radically altered substances on a molecular level. But for now, the potential to help so many people on the planet lead healthier lives is a very exciting prospect indeed.

THE TRUTH BEHIND THE ILLUSIONS

By April Bailey

Mythbusters: MacGyver Myths, The Chronicles of Narnia, Star Trek. These popular movies and television show have something in common–but what is it?

Each relies heavily on some form of illusion to tell a story. No matter what medium is used, special effects of varying types are a big part of today's entertainment. Especially in the film industry, what looks to most people like cinematic magic is often entirely explainable, be it huge explosions, snowy sets, creepy makeup and the like.

On Mythbusters, the cast frequently employs various chemical reactions to figure out what's real and what's not. On their 100th episode, they tackled television's MacGyver by attempting to blow a hole in a wall with pure sodium metal dropped into water and they also tried to develop film using common kitchen liquids.

Snow can be created entirely artificially. Snow Business is an award-winning United Kingdom–based company that uses several methods to create the illusion of snowy sets via processes that are chemically dependent.

In sci-fi movies like Star Trek, actors are typically outfitted with extensively detailed life-like masks designed to dramatically transform their appearance. These masks are made of latex, which is derived from rubber that is harvested from trees. Because environmental conditions can affect its quality, it needs to undergo several chemical processes to ensure that the workability of the final latex material remains consistent.

The science behind this fun, intriguing and harmless type of deception is the topic addressed by this year's **National Chemistry Week**, scheduled to take place **October 17-23, 2010**.

A DEEPER LOOK BEHIND THE SCENES

Sponsored by the American Chemical Society (ACS), National Chemistry Week is a community-based outreach program that unites ACS local sections with schools, businesses and individuals to emphasize the importance of chemistry in everyday life. The focus has traditionally been toward elementary and secondary school students; however, colleges and universities do get involved, often providing programs for younger students.

Events are held on both national and local levels and are centered on ideas presented by ACS.

This year's theme "Behind the Scenes with Chemistry!" was chosen to help students learn that often what looks like magic or trickery is really a good example of chemistry in use. Events suggested by ACS include the following:

- Science Café (**www.sciencecafes.org**)–a live event allowing students to have face-to-face conversations with scientists to discuss the theme
- National Poster Content–"Where's the Chemistry?" ask students to think about and graphically represent common applications of chemistry that might otherwise be overlooked
- ChemMatters–An award-winning magazine produced for high school students that will devote the entire issue for October to the topic
- Celebrating Chemistry–Newspaper for elementary school students providing hands-on activities focused on this year's theme

HOW TO GET INVOLVED

More information, including resources for students, educators and volunteers to help plan events or find events, can be found at **http://www.acs.org/ncw**. To further help with planning, the Learning Center of the American Chemistry Council (**http://www.americanchemistry.com/learningcenter**) has a wide selection of resources.

SCHOOL LAB CONSTRUCTION

By Gwen Myslinski

Science is an ever-evolving field and new discoveries are constantly being made. Scientists need the right tools in place to help make these discoveries possible. The same is true as educators. You need the right equipment, whether it's books, pencils, desks or laboratory space, to properly demonstrate the curriculum you've laid out for your students.

If its time for your school's laboratory to go through a renovation, be reconfigured or if your school is building a new lab, here are a few tips that can help you get started and keep you on the right track throughout the entire process.

WAY BACK YONDER...

It used to be that many classroom labs were designed to hold as much bench space as possible. But that's changed with the growth of multi-use classrooms. Schools need to take advantage of the space that's available, therefore student workstations usually need to be adaptable to meet the constantly changing needs of teachers and students.

Something else to consider is the ever-increasing proliferation of computers in classroom laboratories, equipment storage and access.

GET TO THE BASICS

Designing school laboratories starts with simple questions like:

- What will the laboratory be used for: general science, biology, physics, chemistry, etc.?
- If there are specific curriculum requirements, will major pieces of equipment need to be placed in the lab; what are they; how much space will they take up; and what is there optimal location?
- Are there any safety installations that need to be included in the lab (i.e., face/eye washes, emergency showers, fire blankets, etc.); and where should they be located to conform to OSHA and other local standards?
- What are the preparation and storage room requirements?
- Will computers be incorporated and what will be needed to accommodate them?

1, 2, 3, GO

You don't have to go it alone in this process. Fisher Science Education has tools that can help you get started with a FREE lab planning Assistant CD-Rom that helps you plan and build your custom lab; view prices and total spend summaries for budget submissions; review, sort and save your finished lists and Excel® spreadsheets; and much more. They also can provide recommended equipment lists for all scientific disciplines and tips to help define your laboratory needs. These are easily downloadable from (**fisheredu.com**) or by contacting Fisher Science Education at **1-800-955-1177** or by e-mail at FSE.NewLab@fisheredu.com.

Fisher Science Education will be there throughout the process to help you outfit your lab, keep it stocked indefinitely and will provide ongoing support for problems, questions and more.

BOTTLES SQUEEZED FOR SPACE

By April Bailey

With all of the plastic that's used on a daily basis comes the need to have it recycled.

Most plastic bottles produced in the United States are made from Polyethylene Terephtalate (PET). In 2005, U.S. manufacturers produced 5.1 billion pounds of PET products, according to the National Association for PET Container Resources (NAPCOR). NAPCOR has estimated that if the current rate of production remains the same, then 40 billion pounds of PET waste will be added to landfills within a decade.

To help counteract this growth, some states offer financial incentives to consumers who bring in plastic bottles for recycling. In addition, companies are being encouraged to design bottles in ways that make them more efficient and cheaper to recycle. One of the most interesting ideas to come from this challenge is the collapsible plastic bottle.

BEGINNING OF THE COLLAPSE

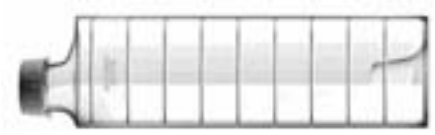
In 1985, a patent was filed for a collapsible plastic bottle. According to the patent description, the bottle would be constructed with walls that would look and behave like bellows, allowing them to be squeezed together and collapse upon themselves, thus reducing the overall size of the bottle by at least half.

The technology discussed in this patent has been used over the years; however, it has been limited to products geared mostly toward outdoor enthusiasts and athletes, and for corporate promotional giveaway items.

THE CHALLENGE BEGINS

One of the greatest impacts to the environment could be if major beverage manufacturers would incorporate some form of a collapsible bottle into their product lines.

For example, in early 2010, package designer Andrew Seunghyun Kim went public with a set of design concepts aimed at repackaging 20 oz. Coca-Cola®



"smaller footprint = smaller carbon footprint"

products. His design is based on the 1985 patent, but features a square package instead of a cylindrical design. Kim's design results in 66 percent less space being occupied than when the bottle is not collapsed.

While there are many advantages to this particular design, it is more unlikely that reengineering the bottle in a square shape will take off due to reasons that involve engineering problems, distribution challenges and production line changes that could be too costly.

However, other companies, like Plasto Solutions, are working on further developing the idea of collapsible beverage bottles. They are staying with a cylindrical bottle design to lessen the impact on manufacturing process changes for the end user. Their design uses a complex system of ribs instead of bellows and their plastic bottle folds by slightly twisting the bottle's body. This produces a flat circle of plastic that takes up only 10 percent of the original space.

BENEFITS OF COLLAPSE

The idea of impacting how much space is being occupied in landfills by plastic soda bottles is very appealing to those who are environmentally conscious. By reducing the amount of space that a bottle occupies, more can be placed in collection containers and thus provide a more cost-effective means of recycling.

ISLAND CRABS RUN MARATHON: NO TRAINING, NO PROBLEM

By: Gwen Myslinski

Training for a marathon is no easy task. It takes months of preparation, not to mention cross-training and weight lifting, to get one's mind and body adequately prepared to perform the strenuous and challenging activity of running 26.2 miles. Now imagine performing this athletic feat with practically no training at all. One crustacean species does just this, only this trek usually lasts five to seven days for a total of 3.1 miles. These 12 hour per day marathons, combined with the crab's shell measuring up to 6.5" wide, would be comparable to the average marathon runner running 13 marathons or 340.6 miles over the same time frame.

This event occurs on Christmas Island, which is located in the Indian Ocean, south of Indonesia. Once a year, during the beginning of the wet season (Christmas Island only has two seasons, wet and dry), usually sometime during the months of October and December, the Christmas Island Red Crabs, *Gecarcoidea natalis*, migrate from the rainforest to the ocean to mate and reproduce. The breeding activities are synched with the lunar cycles so that the low and high tides are as similar as they can be, making it easier for the females to lay their eggs.

AND THEY'RE OFF…

According to the Christmas Island Tourism Association, the long and arduous migration begins with the males who head out first so they can start to dig burrows in the ocean—think of these as the hotel room. Large males make it to the ocean first in approximately five to seven days, and soon females, who have already joined the migration, outnumber them. After mating, males return inland, much more quickly than the initial journey, reaching the plateau in approximately one to two days. Females, however, stay behind until they produce (which lasts three days), develop (12-13 days) and lay up to 100,000 eggs. (The time required to lay eggs depends on the moon–usually occurring in the last quarter–and can take five to six consecutive nights.) Once the eggs are released, they are hatched immediately, and many of the larvae are eaten by various ocean creatures. The larvae that do survive will live in the ocean for approximately one month, going through several larval stages before growing into juvenile crabs. Finally, the juvenile crabs emerge from the ocean and head inland to the plateau, usually taking nine days to complete this task.

'TIS THE SEASON…

Red Crabs live in the moist environment of the rainforest and dig burrows that have a single entrance tunnel that leads to a single chamber where the one crab will live alone until the breeding season, which is the only time they will interact with other crabs. For much of the dry season, the crabs will retreat and primarily stay in their burrow where it is humid and cover it loosely with leaves to maintain a high level of humidity.

While nestled in their burrows, the red crabs don't venture away very often. According to research by Ute Postel, Fiona Thompson, Gary Barker, Mark Viney and Steve Morris from the University of Bristol in the United Kingdom, these crabs received approximately 10 minutes of exercise a day, which is quite the opposite from the aerobic activity they endure at the beginning of the wet season. "During the dry season [Christmas Island] crabs are unable to sustain even moderate exercise with recourse to supplemental anaerobiosis. In contrast, the crabs migrating to the ocean showed no reliance on anaerobiosis and no evidence of metabolic acidosis," according to Agnieszka Adamczewska, and Steve Morris from the University of Sydney in Australia, and referenced by Postel, Thompson, Barker, Viney and Morris.

OVERNIGHT MUSCLE OVERHAUL

How do they get in shape for the 3.1 mile trek so quickly? To answer that question, a group of the researchers (Postel, Thompson, Barker, Viney and Morris) traveled to Christmas Island during the wet season and collected leg muscle samples from the crabs while they were migrating, and did so again in six months while the crabs were relatively dormant in the dry season. The researchers planned to look at the muscles at the molecular level, specifically the mRNA, so they could determine the difference between the gene transcription during both seasons.

"After many months [of] building a library from the mRNA molecules from both tissues and analyzing the expression levels of many genes, the team could see that there were dramatic differences between the migrating and inactive crabs' muscles," stated Kathryn Knight, the author of the summary for the researchers' published work in The Journal of Experimental Biology. She went on to say, "Not surprisingly the majority of the genes expressed in the muscles coded for muscle proteins, such as actin, which forms part of the muscle's contractile unit, and troponin and tropomyosin, which regulate muscular contraction. And, when the team took a closer look at the versions of genes that were expressed, they could see that the immobile dry season crabs' muscles were tuned to short anaerobic sprints while the muscles of crabs that migrated during the monsoon were aerobic, extremely resistant to fatigue and ideal for the crabs' arduous odyssey."

Specifically, the researchers determined that there were significant differences in the abundance of 14 gene transcripts between the two samples, and it is those differences that help the crabs' muscles essentially supercharge overnight and go from the dry season anaerobic physiology to the pumped-up, high-endurance aerobic version of the wet season.

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THE MYSTERY OF THE GALILEO THERMOMETER

By Valinda Huckabay

- ***Ever wonder what a Galileo thermometer is and how it works?***
- ***Ever wonder how Galileo came up with the idea for his invention?***
- ***Ever wonder how you're supposed to read one?***

WHAT IS A GALILEO THERMOMETER?

A Galileo (also known as Galilean) thermometer is one style of temperature-sensing device. These days, a Galilean thermometer typically looks like a tall, sealed glass cylinder containing clear liquid in which several small glass bulbs are floating.

Each glass bulb is filled with a slightly different amount of colored liquid, and each has a small metal tag stamped with a number hanging from the bottom of it. Some bulbs float near the top of the liquid, and others stay closer to the bottom.

As the temperature changes, these glass bulbs rise and sink, accurately indicating the temperature of the surrounding air.

WHEN WAS IT INVENTED?

Throughout time, mankind has depended on temperature in their surroundings for survival: metals melt at a certain temperature, rivers freeze at another. In order to have greater control over their world, people needed to be able to measure temperatures more accurately.

But the invention of such a device was relatively slow to develop. Even into the late 1500's, there was no way to accurately determine temperatures. In 1593, Galileo Galilei discovered that the density of liquids (how much they contract and expand) reacts predictably to changes in temperature.

Armed with this discovery, he invented a device that allowed temperature variations to be measured. This rudimentary device used the expansion and contraction of air in a bulb to move water up and down in an attached tube, indicating a range of temperature.

Because his device did not have a numerical temperature scale, it is not technically considered a thermometer. This early thermometer is more precisely called a thermoscope. The modern day version of this early thermoscope does not look much like its predecessor, although it does embody the same principles.

HOW DOES IT WORK?

Conventional thermometers—the kind with a bulb attached to a thin tube marked in increments—measure the temperature of their surroundings by the rise of liquid in a tube. A Galilean thermometer uses liquids to measure temperature too, but in a slightly different way than the traditional thermometers we're used to.

When the temperature of a liquid rises (gets hotter), the liquid expands, or increases in volume. When the temperature falls (gets cooler), the liquid contracts, or reduces its volume. Both of these reactions can be recorded and interpreted into an accurate temperature reading.

The principle of buoyancy determines whether objects float or sink in a liquid. If an object's weight is matched to the density of the liquid at a specific temperature, it will neither rise nor fall, which is called neutrally buoyant. If the temperature of the liquid changes, the density of the liquid changes too, and the objects floating in it either rise or sink accordingly.

The weight of each glass bulb in a Galilean thermometer has been carefully calibrated. It doesn't matter that they are made of glass or what kind of liquid they contain. The calibration is accomplished by adjusting the amount of liquid in the bulbs and the weight of the metal tag that hangs from them. When they weigh exactly the right amount, they will naturally gravitate to a position in the cylinder in which the temperature of the liquid surrounding them matches the number on their tag. In this way, the bulbs naturally arrange themselves to form a readable temperature scale.

Usually a gap forms between the top and the bottom bulbs. To get an accurate temperature reading, determine the number that falls between the two metal tags directly above and below the gap. If a bulb is free-floating in the gap, then its tag number is the current temperature reading.

WHY DO PEOPLE HAVE THEM INSTEAD OF CONVENTIONAL THERMOMETERS?

Today, most people own Galilean thermometers because they are fascinating and decorative, and not because they're the best way of telling temperature. Conventional thermometers still hold a very solid place in our lives.

In the end, though, the Galilean thermometer is still a unique and intriguing piece of science, beautifully and faithfully demonstrating the principles of:

- Buoyancy
- Temperature effects on fluids
- Density and floating objects

A QUICK HISTORY OF THERMOMETERS

Although ancient civilizations probably had ways of measuring temperature, the first reported invention of temperature-sensing technology didn't happen until the end of the sixteenth century.

1593 Italian scientist Galileo Galilei develops a device that measures temperature. Called a thermoscope, his device consisted of a bulb of air that, when heated, forced liquid (alcohol) into a column.

1611 Sanctorius Sanctorius, a colleague of Galileo's, added calibration to the thermoscope. Sanctorius marked the levels of liquid when it was cooled with melting snow, and heated with a candle. The space between these two points was then divided into 110 equal parts.

1632 Jean Rey, a French physician, invented the first liquid thermometer. It was a flask with a long slender neck, partially filled with water. As the temperature changed, the liquid level rose and fell in response.

1709 Daniel Gabriel Fahrenheit, a German physicist, invented the alcohol thermometer.

1714 Shortly after the alcohol thermometer, Fahrenheit invented the mercury thermometer.

1724 Fahrenheit developed the temperature scale for thermometers that still bear his name today.

1742 An astronomer, Anders Celsius, developed a different thermometer scale by assigning 0° to the boiling point of water, and 100° to the temperature of melting snow. Shortly thereafter, an inverted version of his scale (i.e., 0° for freezing and 100° for boiling) became widely used as the Centigrade scale.

1867 English physician, Sir Thomas Allbutt, invented the first medical thermometer used for taking body temperature. It responded quickly—results in about five minutes, as opposed to the 20 minutes of earlier devices.

ENERGY STAR– HOW IT BENEFITS THE EARTH

By Sandra D. Bledsoe

In a time where terms such as "climate change," "carbon footprint" and "low-carbon economy" are commonly heard on the nightly news, it is evident that a program which promotes the conservation and efficient use of energy is needed. Energy Star is that program. The Energy Star program protects the environment by providing cost-effective energy efficiency solutions to businesses, organizations and individuals.

First established in 1992 as a government program by the U.S. Environmental Protection Agency (EPA) for energy-efficient computers, the Energy Star program has grown to encompass more than 35 product categories for the home and workplace, new homes and superior energy management within organizations. The program has two main goals: 1) to reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy; and 2) to make it easy for consumers to identify and purchase energy-efficient products that offer savings on energy bills without sacrificing performance, features and comfort.

HOW PRODUCTS EARN THE ENERGY STAR RATING

The EPA has established energy efficiency requirements for products seeking the Energy Star rating based on the following set of key guiding principles:

- Product categories must contribute significant energy savings nationwide
- Qualified products must deliver adequate features and performance as well as increased energy efficiency
- If the qualified product is more expensive than a conventional, less-efficient counterpart, consumers must recover the additional cost in increased energy efficiency through utility bill savings within a reasonable period of time
- Energy efficiency can be achieved through broadly available, non-proprietary technologies offered by more than one manufacturer
- Product energy consumption and performance can be measured and verified with testing
- Labeling would effectively differentiate products and be visible for purchasers

Energy Star specifications differ with each item, but generally use 20 to 30 percent less energy than required by federal standards.

SMALL SAVINGS ADD UP

Twenty to 30 percent may not seem like much, but consider the following: if half of all U.S. households replaced a standard television with an Energy Star model, the change would be like shutting down a power plant. Using energy more efficiently avoids emissions from power plants, helps eliminate the need for new power plants and reduces energy bills. Americans, with the help of Energy Star, saved enough energy in 2009 alone to avoid greenhouse gas emissions equivalent to those that 30 million cars or fifty 300-megawatt (MW) power plants would have produced—all while saving nearly $17 billion on their utility bills.

ENERGY STAR GOES INTERNATIONAL

The Energy Star program has also been adopted by several countries around the world. In 2001, the EPA signed an international agreement with Natural Resource Canada, allowing it to implement an energy-efficiency labeling program modeled after Energy Star. This is in addition to existing Energy Star agreements with the European Union, Japan, Taiwan, Australia and New Zealand. As more countries adopt energy-efficiency programs, the environment will reap the benefits which result from the adoption of superior energy management practices.

EARTHBOX CHALLENGE WINNER

By Betsy Asheim-Dean, Principal at Bay Haven School of Basics Plus

The EarthBox® has taken center stage for the past four Earth Day celebrations at the Bay Haven School of Basics Plus, a K-5 public magnet school in Sarasota, Florida. From the first, when the inventor of the EarthBox, Blake Whisenant, a local tomato farmer from Ellenton, Florida, was invited to be the guest speaker; to this year, when this unique gardening box taught the student so much science and brought students, faculty, parents and the community together in surprising ways.

The 35 EarthBoxes at Bay Haven were first introduced by a group of parent volunteers who wanted all of the students to have a successful, hands-on experience growing organic vegetables. They hoped that students would see the nutritional and energy-saving benefits of growing and consuming locally grown food. This project was made possible through funding from the William G. Selby and Marie Selby Foundation and the Bank of America Client Foundation, sponsors of an Education Foundation of a Sarasota County grant.

OUTTA THIS WORLD

As this campus-wide gardening initiative got underway, educator-astronaut, Barbara Morgan, in a live broadcast onboard the International Space Station captured the students' imaginations through her demonstration of the role of a lunar plant growth chamber (or 'SpaceBox' as the children named it) in growing cinnamon basil seeds in space. She invited the children around the country to join her in a NASA-sponsored "Lunar Plant Growth Chamber Design Challenge." The school acquired some of the basil seeds from NASA and the students joined in by conducting a scientific study of the growth rate of the cinnamon basil seeds exposed to space. They wrote up a report and shared their results with NASA. The students also drew comparisons between the design of the EarthBox and how it conceptually related to the design of the SpaceBox. From this study students could see that the EarthBox with its research-based, gradient gardening system was an innovative way to grow plants. The EarthBox not only provided opportunities to teach children about what plants need to grow, but the EarthBox illustrated scientific principles such as capillary action, diffusion, evaporation, condensation and heat absorption. The EarthBox also provided a conceptual basis for teaching children about the conservation of energy, water, soil and organic fertilizer. The plastic cover on the EarthBox kept the moisture in and the weeds out. By using organic soaps and lady bugs instead of harmful chemical pesticides, students were able to keep the aphids under control.

Thanks to donations of seedlings from a parent who owns a local organic farm, each Earth Day gave students another opportunity to celebrate the EarthBox with a salad-fest of delicious organic romaine lettuce, red leaf lettuce, cucumbers, radishes, broccoli and pole beans. During these salad-fests the school nurse even got into the spirit of things and presented nutritional lessons which emphasized the benefits of eating healthy, locally grown, organic vegetables.

From left to right, Amara Merritt and Bay Purcell check their organic romaine lettuce with the help of T. Ramsey, a Bay Haven parent volunteer.

LENDING A HELPING HAND

With all of the successes the students were having in growing organic vegetables, the faculty and parents decided to support ShelterBox USA, a non-profit, international disaster-relief program using the EarthBox. The mission of ShelterBox USA is to deliver humanitarian assistance and shelter to victims of natural disasters anywhere in the world. So for Earth Day the school invited several volunteers from ShelterBox USA to be guest speakers. They brought a ShelterBox to demonstrate its use, and students were amazed to see just what a one hundred and ten pound ShelterBox contained—a ten-person tent, a cooking stove, blankets, cookware, water purification equipment and other survival essentials for protection from the elements.

In celebration of Earth Day, the Bay Haven students unanimously agreed to sponsor the purchase of a ShelterBox by growing, harvesting, marketing and selling their EarthBox-grown produce at the school's Spring Festival. Thanks to the support of the friends, patrons, Parent Teacher Organization and staff of the Bay Haven community, students raised more than $300. That was enough money to help sponsor a ShelterBox. The students were given an identification number so that they could track the final destination of the Bay Haven ShelterBox.

A few months later, around the time of the earthquake in Haiti, ShelterBox USA informed the school that our ShelterBox had been sent to Sumatra, Indonesia to provide aid to survivors of a disastrous earthquake that claimed the lives of more than 1300 people.

This Earth Day project, "EarthBoxes to SpaceBoxes... to ShelterBoxes," continued to bring meaning into the lives of our young students as discussions continued in science and social studies classes as part of their interdisciplinary studies. It was empowering for many of the students to see that they could indeed make a difference in the global community.

THE ECO-FEST CONTINUES

On Earth Day 2010 we had much to celebrate. Again, the school, as well as a local "Eco-fest," committed to selling the EarthBox produce so that the students could sponsor another ShelterBox this year. The Earth Day 2010 guest speakers were representatives from the Florida Friendly Landscaping and County Extension Office. They demonstrated environmentally friendly composting techniques so that students could learn how to compost food waste from the school cafeteria and use that nutrient-rich soil for our EarthBoxes.

The new composting practices, together with the rain barrels, which provide water for the EarthBoxes, have taught students and teachers alike how to live a healthy, green lifestyle by practicing sustainable ways in which to leave a small environmental footprint.

The use of EarthBoxes at Bay Haven School of Basics Plus has certainly continued to bloom and grow over the years. With the enthusiastic support and dedicated teamwork of many parent volunteers, teachers, the principal, local high school science students, school and community resource staff, and generous grant sponsors, the Bay Haven students have begun to "think outside the box" by extending a helping hand to those in need around the world, and by defining their role in it as responsible stewards of our planet Earth.

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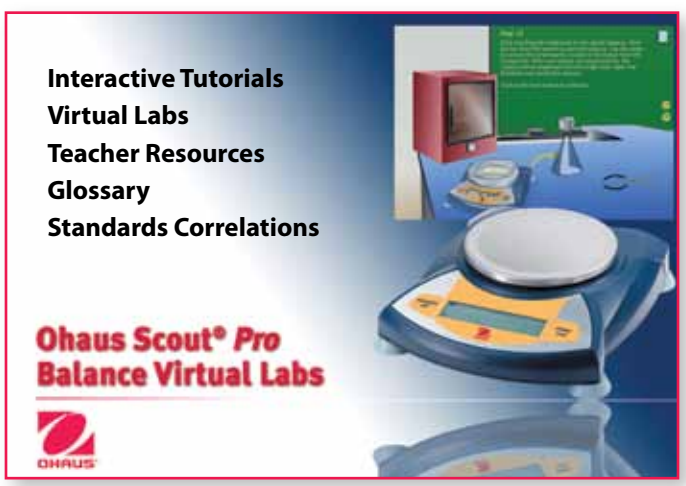

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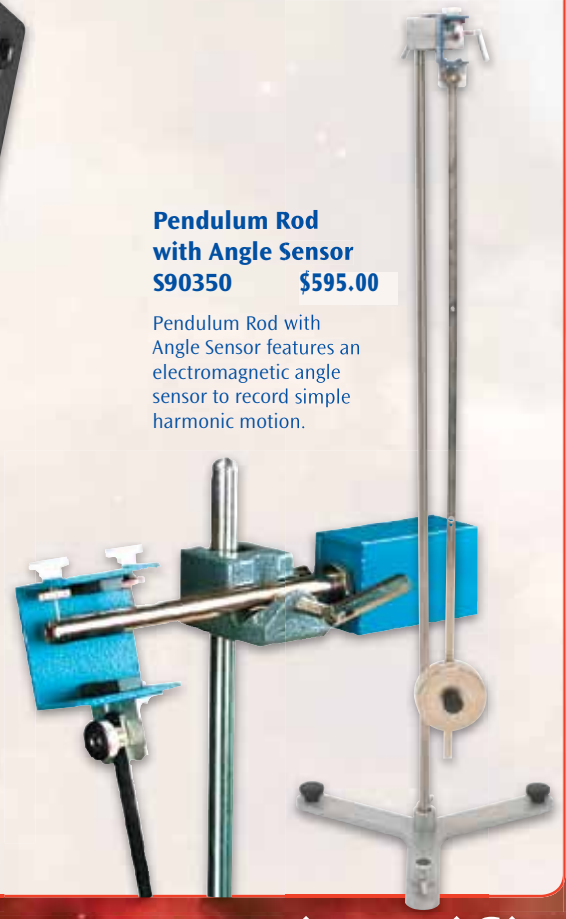

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MARCELLUS SHALE – ENERGY BOOM, ENVIRONMENTAL BUST…OR BOTH?

By Merry Morris

Oil-soaked ocean birds…fears of dependence on foreign oil…will we ever have a plentiful, domestic supply of high-quality, low-impact fuel? Some say the Marcellus Shale promises just that; others are not so sure.

THE MARCELLUS SHALE

Several eastern U.S. states are finding themselves in a classic predicament—the battle of resource extraction versus environmental protection. The source of the conflict is a geological formation that had once been written off as a large-scale energy producer. Ah, but times have changed.

The Marcellus Shale was deposited some 400 million years ago and underlies large parts of New York, Pennsylvania, West Virginia and Ohio, and smaller parts of Maryland, Kentucky, Tennessee and Virginia. It lies at varying distances below the surface and is present in varying thickness. It can be described as slightly radioactive, low density and rich in the organic matter that is associated with the creation of fossil fuels.

While other sources of fossil fuels have been tapped for many years, the Marcellus Shale gas was left largely untouched. The shale lies deep—commonly 5000 to 8000 feet below the Earth's surface—making it an expensive resource to access. To be economically viable, a high-rate, steady production of gas would be needed to offset drilling costs. But the gas in the Marcellus is present in tiny, poorly interconnect pores and in vertical fractures in the rock, as well as adsorbed onto mineral grains and organic particles. Removing it is expensive and slow, so wells in the formation were not superstars: they produced only modestly, over a relatively long period of time. These low yields could not economically support the development of wells that might cost one million dollars each to develop. Nonetheless, the magnitude of the gas reserves was considerable and its estimates kept growing—from 1.9 TCF (trillion cubic feet) in 2000 to recent estimates of 50TCF of "recoverable" gas—enough to keep people looking at its possibilities.

Photo: DelawareOnline.com/AllGreenToMe.com

WHY NOW?

In simple terms—economics and technology. With high energy prices, the Marcellus's economic equation changed. Even costly fuel is better than no fuel. Timely advances in drilling and extraction practices, horizontal (directional) drilling and hydraulic fracturing, made it feasible to open the Marcellus to widespread drilling. Horizontal wells—vertical wells that change direction to run along the gas-bearing strata—are expensive, but can nonetheless tap many more vertical fractures, drawing more of the precious gas into the well bore. Hydraulic fracturing uses the injection of a liquid or gas to create more passageways through the shale than nature provided. These practices support far greater yields, changing dramatically the profitability equation, but also require very high volumes of water to make the process work.

SO MORE GAS IS GOOD, RIGHT?

While many individuals and communities in potential gas-producing areas have been thrilled with the possibility of lucrative land leases and oil royalties, not everyone sees only gold at the end of that rainbow. Any type of resource extraction has the potential to cause environmental degradation and endanger public health, and the Marcellus Shale gas is no exception.

What in particular do those concerned over the Marcellus Shale natural gas drilling fear?

- Release of radioactive materials (associated with the decay of 238U) from drilling fluids and equipment
- Contamination of surface water and groundwater from hydraulic fracturing ("frac wastes"), especially in environmentally sensitive areas like river basins, watersheds, potential drinking water sources
- Gas (e.g., methane) infiltration into homes and other structures with the possibility of combustion
- Accidents: blowouts—explosive release of gases that can send waste streams spewing into the air, polluting air and water; burnouts—hitting a pocket of methane, causing explosion, fire and worker injury
- Magnified risks when drilling takes place in urban areas where thousands could be affected by a pollution event

SO WHAT TO DO?

This question plagues many individuals and representatives from neighborhoods, local governments and regulatory bodies, and there do not seem to be any easy answers. There are many calls for moratoriums—as well as outright prohibitions—on drilling in the Marcellus Shale until the environmental and public health questions are addressed. In many areas, though, drilling is proceeding under the watchful eyes of various regulatory agencies on state, watershed or river basin levels. It's their jobs to foresee potential drilling-related problems and find mechanisms to avoid or mitigate them. Through development of rules, regulations, best practices, permits and enforcement actions, these groups guide the actions of the companies extracting the Marcellus Shale's long-held gas reserves to preserve the quality of the air, surface water and groundwater resources, and ultimately the public health in drilling areas.

Chances of success? Only time will tell if the Marcellus will prove to be energy boon or environmental bust.

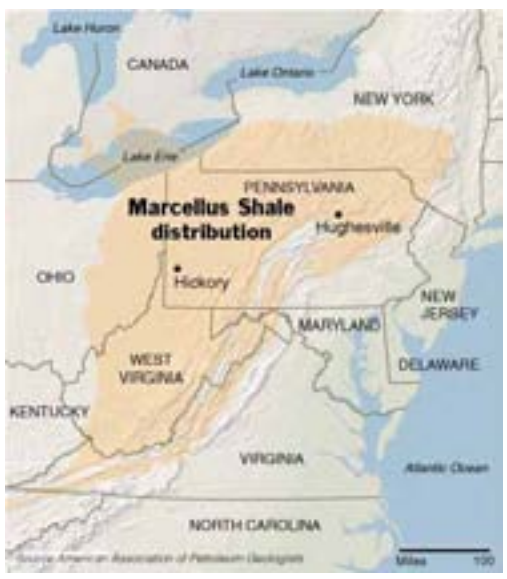


Photo: American Association of Petrolum Geologists

ENVIRONMENTAL CAREERS

If your students show interest in environmental careers, guide them toward the community relations liaison of your state environmental agency or local watershed or river basin commission. These agencies are a great place to learn about the science and challenges of environmental protection.

A RIVER RAN THROUGH IT

By Terri Sota

Scientists have new evidence that an ancient Amazon-like river system once spanned the continental United States. After comparing zircon (zirconium silicate) mineral samples from Michigan sandstone with samples taken from the Colorado Plateau and the northern Appalachians, scientists revealed that both were of a similar age. These findings, by University of Arizona geologist William R. Dickinson, are directional clues—indications of the course of the long-ago river connecting east to west.

The transcontinental river hypothesis has been proffered as an explanation for the origin of the Navajo Sandstone formations that scientists have long debated. Using radioisotope dating methods on the Utah zircon grains, Yale University geologists were able to determine when the zircon crystals were formed (between 1.2 billion and 950 million years ago) and when they cooled and eroded (500 to 250 million years ago). Scientists concluded that the Utah sand must have been remnants of rock eroded from the Appalachians, the only place in North America with zircons exhibiting a similar age distribution.

The latest finds come from a 20 kilogram hunk of Michigan sandstone, from which researchers extracted and analyzed zircons. Previous efforts to plot the course of the great river were limited by the rarity of rocks from the mid-Jurassic era in the Midwest and Great Plains; only the Michigan quarry offers access to stone samples of the proper age.

ZIRCON

This mineral, $ZrSiO_4$, belongs to the group of nesosilicates, which also includes topaz and garnet. Although less popular as a gemstone, zircon has been instrumental in the development of radiometric dating. Zircon contains trace amounts of both uranium and thorium and can be dated using several analytical techniques, including uranium-lead and helium dating. Its value rests in its survival strength; zircons can withstand severe geologic forces, including erosion, transport and even high-grade metamorphism. Each zircon sample possesses a rich record of Earth's history.

The similarity between the zircon samples from Michigan and Colorado is strong evidence that despite final destinations hundreds of miles apart, the minerals set out from the same place. Says Scott D. Samson at Syracuse University: "It's not as good as a barcode, but the match is really quite good."

ASHES, ASHES...

By April Bailey

Because of recent activity in Iceland, there have been many news reports done on volcano eruptions and the damages that can be caused by volcanic ash. So, just what is "volcanic ash?"

THE ASSUMPTION

It's not what most people may envision. Typically, when most people think about ash, they picture something light and fluffy—like ashes in the fireplace or barbecue. So, when they hear that a volcano has erupted and everything is covered in ash, the natural assumption is that it is relatively harmless and can be easily swept away. Not true.

THE BLAST AND ITS COMPONENTS

Volcanic eruptions occur when gases in magma, or molten rock, expand and escape into the air. They also occur when water that is superheated by magma abruptly flashes into steam, or when thermal contraction from chilling occurs after contacting water. Each scenario leads to eruptions that occur with explosive force, causing escaping gases to shatter surrounding rock layers of the Earth. When eruptions occur in areas covered by glaciers, the resulting plume can contain glass-rich deposits that were created when melted ice quickly chilled lava prior to its explosion.

Material expelled from the volcano at this point is called '"tephra." To better study components of a volcanic eruption, scientists have broken tephra into classifications based on size:

- Volcanic bombs or volcanic blocks: debris greater than 64mm in diameter (2.5")
- Lapilli: debris 2-64mm in diameter (.078 to 2.5")
- Ash: debris particles less than 2mm in diameter (.078")

PERSPECTIVE

While the size of a volcanic bomb doesn't seem so large, some perspective is needed. Take, for example, a storm producing hailstones of roughly the same size. They can cause excessive damage to car windshields and even slate roofs. To a person struck by a volcanic bomb, the impact would feel something like getting hit with a baseball thrown by a major league pitcher due to the high rate of propulsion.

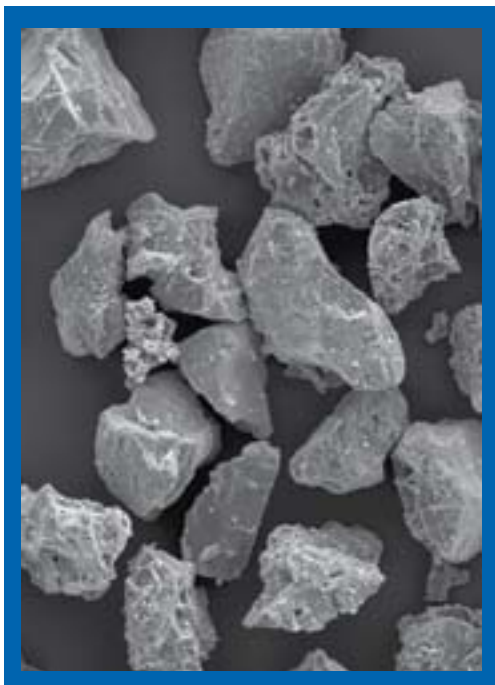
Volcanic bombs and lapilli do cause problems but, because they settle to the ground at a much quicker rate than ash, the extent of their damage is often not as far reaching. The tiny size of ash and its ability to readily travel everywhere means it can be a lot less apparent to ascertain the damages it can cause.

THE REALITY

Much has been written about the damage to people, animals, air, soil and water, but less so the damage and chaos that ash can cause to other things, especially those that are technologically and/or mechanically based. Following are just a few things that could be heavily impacted:

- Motors/Engines: internal combustion engines are prone to failure from volcanic ash due to the clogging of air filters; other parts can fail due to "sludge" forming between parts that need to move freely
- Paint Finishes: abrasive components of volcanic ash wear away finishes over time
- Electronics: items short-out due to dust particulates entering otherwise contained compartments; circuitry shorts-out
- Machinery: bearing, gears and any other moveable parts that are not well-sealed are subject to damage and/or failure
- Power Sources: highly charged ash particles produce frequent electrical discharges causing damage from short circuiting
- Telecommunications: dust particles either scatter or absorbs radio signals preventing connections from occurring (think satellite TV, WiFi, FM-Radio, etc.)
- Roadways and runways become impassible: little to no visibility if dry, reduced visibility and extra slippery if wet
- Air filtration and water filtration systems fail: due to combination of ash clogging filters and affecting moving parts of system
- Building's structural integrity fails: dry ash, 4" thick, weighs up to 200 pounds per square yard (twice as much when wet)

These examples show that volcanic ash is dramatically more devastating than it appears and has a great potential to leech its way into so many things that are important to the day-to-day operation of life for everyone in areas affected by volcanic eruptions.



GETTING TO THE BOTTOM OF IT

The words "tephra" and "pyroclast" both derive from Greek.

- **Tephra means "ash"**
- **Pyro means "fire"**
- **Klastos means "broken"**

Properties of Volcanic Ash:

- **Hard Substance, Minute in Size**
- **Cannot Be Dissolved**
- **Extremely Abrasive**
- **Corrosive**
- **Conducts Electricity When Wet**
- **Heavy**
- **Difficult to Clean Up**

EXTREME MEASURES SAVE LIVES

By Aprile Smith

For an emergency first responder or an ER doctor, administering toxic sewer gas, withholding oxygen or inducing hypothermia hardly seems the best way to treat trauma patients. However, recent research points to these methods as possible means to buy time for critical patients awaiting medical care. Potential applications include keeping patients alive to reach medical centers or allowing transplant organs a longer shelf-life outside the body.

SUSPENDED ANIMATION

Cell biologist Mark Roth runs a lab at the Fred Hutchison Cancer Research Center in Seattle, Washington. Roth and his colleagues study metabolic flexibility through suspended animation—they investigate how to decrease and temporarily cease body functions like respiration and heartbeat.

Suspended animation is not an unfamiliar subject; a simple example occurs in nature when bears hibernate. Deceleration of body functions in a trauma patient means cells, organs and systems do not breakdown as fast as they would under normal conditions.

SEWER GAS

Roth's lab purposely creates this state of slowed functioning. In February, his researchers released an experiment in which hydrogen sulfide was administered to lab animals. Hydrogen sulfide is deadly in chemical weapons. In small doses, it caused the mice to appeared dead temporarily; afterward, however, they returned to normal functioning. According to researchers, hydrogen sulfide bonds to places in the body usually filled by oxygen, slowing the metabolic functioning and acting as a dimmer switch to body systems.

OXYGEN DEPRIVATION

In June, Roth released another study using extreme oxygen deprivation to suspend animation in yeast and nematodes. This allowed the organisms to survive temperatures just above freezing for 24 hours. In this state of slower metabolic functioning, 66 percent of yeast and 97 percent of nematode embryos survived; they reanimated and lived to their normal life expectancy once conditions returned to normal. Oxygen deprivation halts biological processes before dangerous instabilities develop and slows the cells from dividing in an "error-prone" pattern that leads to death.

INDUCED HYPOTHERMIA

Both examples of suspended animation above parlay into possible real-world applications, with transplant organs and patient treatment. The Department of Defense is interested in suspended animation to aid soldiers in battle.

Injured in battle, a soldier losing blood can be dead in 20 minutes—it takes just three to four minutes of blood loss for cells in the brain to starting dying. Dr. Hasan Alam of the Massachusetts General Hospital is one researcher studying induced hypothermia to extend the length of time a bleeding soldier can wait for medical attention.

In animals, Alam and his team have successfully brought on hypothermic states; they cool the body, significantly decrease brain activity, and halt heartbeat by replacing blood with a fluid similar to that which is used in transplant patients. After the body is gradually brought back to normal temperature, the animals show no cognitive loss, acting the same as they were prior to the procedure.

Slowing the body processes in a controlled and safe environment increases the amount of time emergency workers have to repair injury. Alam estimates a window of four to five minutes can jump to two or three hours.

Suspending animation using these methods could be just the beginning, giving doctors hours rather than minutes to work, which is a great start.

THE SEARCH FOR LIFE ON MARS

By: Joe Giacobello

The possibility of life on Mars has long been a subject of speculation and popular fascination, given the planet's proximity and many similarities to Earth. Aside from its polar ice caps, which were observed as early as the mid 17th century, Mars bears several other similarities to our planet. The length of a day on Mars is almost the same as a day on Earth, and the axial tilt of the planet is similar to Earth's. Further, Mars experiences seasons just as Earth does.

MARTIAN CANALS

In the late 19th century, astronomers observed a series of apparent Martian "canals," which led some to speculate that they could be the work of a long-gone civilization. This concept inspired H.G. Wells' fictional account, The War of the Worlds, which portrayed hostile Martian creatures invading our planet to escape the desolate conditions on Mars.

Eventually, spectroscopic analysis was performed on Mars' atmosphere and U.S. astronomer William Wallace Campbell demonstrated that neither water nor oxygen were present in the Martian atmosphere. Then, with the greatly improved telescopes of the early 1900s, astronomers conclusively put an end to the canal theory, determining that they were merely an optical illusion.

VIKING 1 MISSION

On July 20, 1976, the Viking 1 spacecraft touched down on Mars, with renewed hopes of finding some sign of life on the barren red planet. Tests were performed, and biologists concluded that the soil on Mars was sterile. They asserted that no life could possibly survive the ultraviolet radiation, extreme dryness and lethally oxidizing compounds present on the planet's surface. Similarly, the Phoenix mission of 2008 revealed that Mars soil contains perchlorate, and thus may not be as "life friendly" as earlier thought.

Indeed, if a life form does exist in such a desolate, hostile environment, it probably is not in the form of the green, "E.T.-type" creatures that you've seen in the movies. More likely, it exists as tiny microorganisms—tough little fighters that adapt and survive in the most cold, dry and inhospitable conditions.

CRYPTOENDOLITHS

In the mid-seventies, microbiologist Imre Friedmann observed super-resilient bacteria living in the Ross Desert of Antarctica, in mountain ranges so cold and dry they were thought to be devoid of life. The micro-organisms live, not in the soil, but in rock, surviving dark polar winters where they just barely survive, at degrees of 50 below. Friedmann called these creatures "cryptoendoliths" (crypto meaning hidden, and endolith meaning inside rocks).

These microbes, which seem to thrive in extreme environments, were found across the globe, living in harsh habitats such as deserts, mountains and the frozen poles. Friedmann wondered, if these microbes could colonize such miserable environments on Earth, where else beyond our planet might similar organisms exist? Friedmann's rock-bound organisms have provided valuable information and could one day hold the key in our continuing search for life on other planets.

THE MYSTERY CONTINUES

Today, it still remains an open question as to whether any form of life currently exists on Mars, or has existed in the past. While a multitude of theories have been proposed, no solid evidence has been discovered to date, and analytical results remain inconclusive. Several future missions are planned, which will continue the search for evidence of life on the planet. But for now, we can only theorize, and perhaps hope, that life indeed does exist somewhere on the beautiful red planet that we call Mars.

THE FIGHT AGAINST BUGS

By Robert Swartley, DMD

There are good bugs and bad bugs, which sounds like something you would learn in elementary school. Maybe you did. But in today's society in which germ hysteria runs rampant, we have to learn the lesson over again. As a teacher/dentist/scientist, my interest is the mouth. Most people don't realize that the oral cavity, or more commonly known as the mouth, is populated with more bugs than any other body cavity except one, which I won't describe further. Other than when you were sick with a sore throat or other malady, most of these bugs "hold the fort" stopping worse varieties from staking a claim.

SUPERBUGS

Today, the overuse of antibiotics and antibacterials such as hand washes and mouthwashes encourage the bad guys to take over. To be more exact, the bad guy's great, great, great, great, great, grandkids take over. Bugs multiply much faster than we do. We can kill off granddad, but the kids continue to charge our ramparts. Unfortunately, the kids are immune to whatever we are throwing at granddad. What most people don't understand is that our wonderful immune system, which guards against granddad, must experience his presence in order to learn how to fight him. Yes, even our immune cells must go through a learning process. If we wipe out the bad guys at the gate, before encountering our immune cells, there is no learning process on the part of our immune cells. Instead, it is the grandkids of the bad guys that learn how to breach our hope for antibiotic and antibacterial defenses.

MOUTHWASH

As a dentist, I never recommend a mouthwash that kills indiscriminately. Also, some mouthwashes have very high alcohol content levels, which is why I recommend Listerine® green over the original Listerine mouthwash to my patients. High alcohol content will unnecessarily dry the mouth's delicate tissues, and many people are already taking medications with this unwanted side effect. So why make things worse, especially when these tissues work most effectively at repelling the bacteria when they are wet?

A better alternative would be to cut out antibacterial mouthwashes altogether, and let the mouth do its own fighting. As a dentist, I recommend a fluoride mouthwash to my patients, to guard against attack by the bugs and bacteria that cause tooth decay. This is an area where our mouths could use some help. Actually, at the strengths used in mouthwash, fluoride does not kill bacteria. Instead, the fluoride strengthens the tooth structure, in effect, hardening our defenses and allowing the immune system to learn how to do its job and taking the advantage away from the superbugs that are hard to defend.

THE GOOD GUYS

It is interesting to note that the total number of our body's cells does not exceed the number of co-inhabiting bacterial cells. Scientists who have cracked the human genome are now looking at our bacterial genome. Good bugs assist many of the life-giving processes that occur in our bodies. Scientists are realizing that we need to replace the bugs that broad-spectrum pharmaceuticals are removing. Remember that a bug can be a good guy. Unfortunately, our antibiotics and antibacterials indiscriminately kill the good guys along with the bad guys.

SEVENTH GRADERS DISCOVER MYSTERIOUS CAVE ON MARS

By Sarah Macfarlane

Sixteen seventh-grade students participating in the Mars Student Imaging Program (MSIP) at the Mars Space Flight Facility at Arizona State University have discovered a mysterious cave on Mars while studying images taken by a NASA spacecraft. The students, all members of Dennis Mitchell's science class at Evergreen Middle School in Cottonwood, CA, discovered lava tubes with a Martian skylight—a single hole in the roof of a cave.

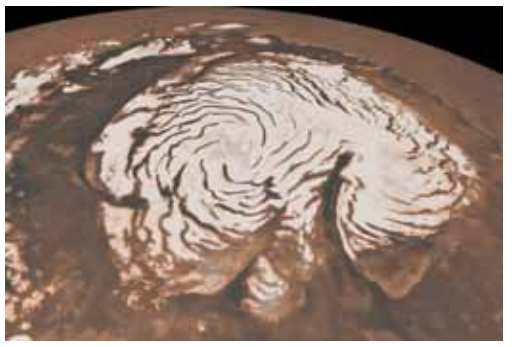
THE PROGRAM AND IMAGES

The program permits upper elementary and high school students to develop a geological question about Mars to answer through research. The students are then allowed to command a Mars-orbiting camera to take a picture that will help them answer their chosen question. Since the beginning of the MSIP program in 2004, over 50,000 students have participated.

The images were taken by the Mars Odyssey orbiter, which has been orbiting Mars since 2001 collecting and transmitting data and capturing images of the planet's surface. Glen Cushing, a U.S. Geological Survey scientist who ran a study in 2007 that found similar features on the planet's surface, estimated the pit to be approximately 620 by 520 feet (190 by 160 meters) wide and at least 380 feet (115 meters) deep.

THE QUESTION BEHIND THE DISCOVERY

"The students developed a research project focused on finding the most common locations of lava tubes on Mars," Mitchell said. "Do they occur most often near the summit of a volcano, on its flanks or the plains surrounding it?" The students chose to look closely at the area surrounding Pavonis Mons, a volcano nearly twice the height of Mt. Everest, near the equator of Mars. The hole exists on the slope of the volcano.



NASA/JPL-Caltech/MSSS

"This pit is certainly new to us," Cushing told the students. "And it is only the second one known to be associated with Pavonis Mons."

The tubes and caves are thought to be formed during volcanic activity when lava channels carved their way through rock, leaving behind "lava tubes" when the eruption was over. At some point, sections of the ceiling of the lava tubes collapsed, creating the skylight.

WHAT HAPPENS NEXT?

Following their discovery, the students submitted their site to be investigated further by the High Resolution Imaging Science Experiment (HiRISE) camera located on NASA's Mars Reconnaissance Orbiter. HiRISE may provide more detailed images, as the camera can take pictures of the surface at approximately 30 centimeters (12 inches) per pixel.

"The Mars Student Imaging Program is certainly one of the greatest educational programs ever developed," Mitchell said. "It gives the students a good understanding of the way research is conducted and how that research can be important for the scientific community. This has been a wonderful experience."

MINING DATA FROM STARDUST

By April Bailey

Abundantly found in the stardust that makes up the cosmos, space diamonds consist of carbon just like those found on Earth, but they differ in size and importance.

These gemstones, commonly called nanodiamonds, are roughly 25,000 times smaller than a grain of sand. Unlike regular diamonds that hold great monetary value the bigger they are, the tiny nanodiamonds have a different value—in the form of knowledge. With the adage of knowledge being power, some could argue that they are therefore worth much, much more by opening up new ways to learn about the universe.

Nanodiamonds, just like all objects in the universe, emit light over the entire electromagnetic spectrum and scientists believe that by studying the properties of this light, they can better understand the origins of the universe and learn more about how it has developed and changed over time.

HOW ARE THEY EVEN SEEN?

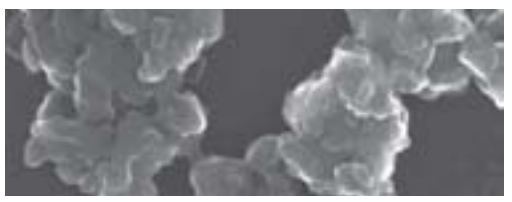
Given the right tools, technology and atmospheric conditions, this light could be seen by scientists on Earth. However, since the Earth's atmosphere tends to block out certain types of radiation, the best way to study nanodiamonds is by locating a telescope outside of the atmosphere.

Enter the Spitzer.

SUPER EYE IN THE SKY

The Spitzer Space Telescope, a super-sensitive instrument launched in 2003, is the fourth and final of NASA's Great Observatories, and is best known for having a high sensitivity to infrared radiation.

Spitzer was specifically designed to house a cryogenic telescope assembly since its detectors and telescope must be cooled to only about five degrees above absolute zero (-450 degrees Fahrenheit, or -268 degrees Celsius).



When light from nearby stars hits the molecules that make up the nanodiamonds, energy is absorbed from infrared radiation and then excites the bonds in the molecules to a higher state of vibration. This causes the bonds to either bend, twist or stretch, resulting in distinctive wavelengths of infrared light being produced.

Spitzer's super-sensitive infrared spectrometer then breaks that light into its component parts. Data collected is shown as an infrared spectrum, with the resulting image indicating wavelength patterns helping to identify what elements and molecules the object is made of, thus uniquely identifying the nanodiamonds based on their "infrared fingerprint."

Considered a technological marvel, Spitzer includes many innovative features never used on previous space missions, yet the telescope's fully functioning lifespan is limited. Its cooling system has been exhausted, allowing some components to overheat and not function. Still operable are the two shortest wavelength modules of the IRAC camera that will continue to be used, allowing further data discovery based on nanodiamond composition, but to a more limited degree.

NANODIAMOND DATA PROSPECTING

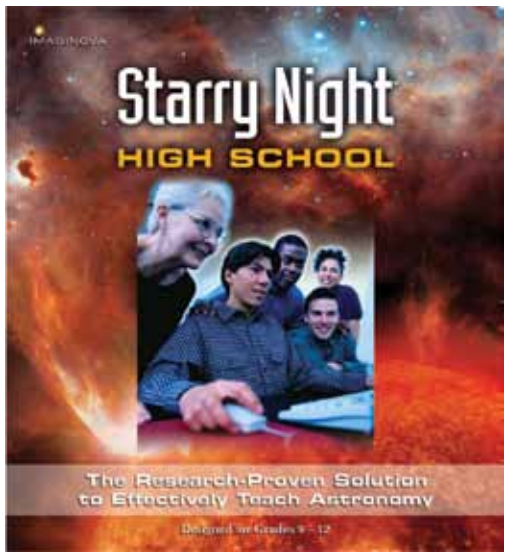
Recently astrochemists have focused their efforts on Elias 1, the Orion Bar, the CS region of HD 44179 and the Red Rectangle nebula where the unique infrared emission from nanodiamonds has helped identify the chemical form of interstellar matter. This provided new knowledge about the physical properties of celestial objects and their interactions over time and is helping scientists to better understand the universe.

Available from Fisher Science Education #S96656A

STARRY NIGHT: Offering the Night's Sky Any Time of Day

SOFTWARE REVIEW

By Joy Jones



If you can't take the class to the planetarium, you can bring the planetarium to the class. Starry Night® Education, a planetarium software package for Windows Vista®, Windows XP®, and Mac® OS X, provides a clear, realistic view of the night sky. Initially developed by Sienna Software, Starry Night is now owned and developed by Simulation Curriculum Corp., a Minneapolis-based publisher of educational curriculum and software.

The recently released 6th edition of this award-winning astronomy education package offers:

- Detailed lesson plans, teaching models and user-friendly assessment tools
- Classroom activities that incorporate key conceptual background and discussion questions
- Instruction fully correlated to state and national standards—a complete resource to meet space science curriculum requirements

Written for teachers by teachers, Starry Night Education software is SmartBoard compliant, and comes in four different editions: Elementary School; Middle School; High School; and Higher Education. Users of previous versions are eligible for discounted upgrades.

To view processing requirements for or learn more about Starry Night Education, please visit **http://www.starrynighteducation.com**.

PRODUCT REVIEW

NEULOG™ NEURON LOGGER SENSORS

By April Bailey

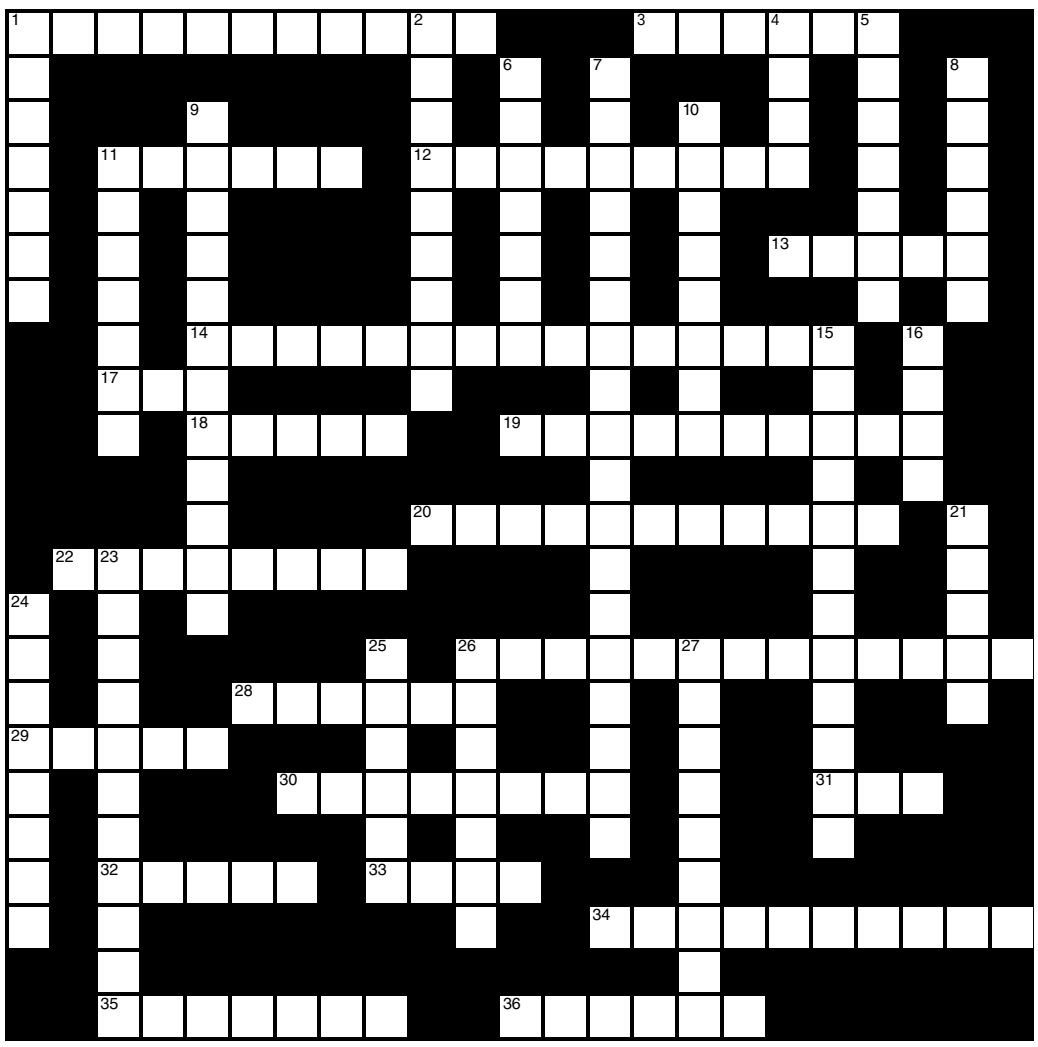
Datalogging typically requires three independent steps: data capture, digitizing of data and data storage. Other products simply capture data and require the additional purchase of an interface/datalogger. NeuLog Neuron Logger Sensors provide all three phases in each individual sensor. Unlike other sensors, NeuLog sensors are equipped with integrated computer chips that not only record data, but make it a complete system for the collection and analysis of physical data.

FEATURES OF THE NEULOG NEURON LOGGER SENSORS THAT MAKE THIS PRODUCT A WISE ADDITION TO ANY CLASSROOM

- Simple, versatile and economical state-of-the-art data acquisition
- Offers both wired and wireless functionality for easy operation and data collection
- Plug-and-play system of components can be chained together to provide support for diverse sampling conditions
- Some sensors measure more than one thing (e.g.: free and dissolved oxygen levels; decibels and sound waves)
- Equipment never becomes obsolete; updates can be easily downloaded
- Sensors are programmable (e.g.: range, units, duration, etc.)
- Results can be saved and reported in multiple formats (Microsoft Excel®, Word®, and PowerPoint®, as well as Adobe PDF®, etc.)

(*) Updated Mobile Display Unit features a larger screen with better graphics.

CROSSWORD PUZZLE



ACROSS

1. Causes an explosion when dropped in water. (p. 5)
3. Lack of blood. (p. 5)
11. Which company employs a major portion of the STEM workforce? (p. 3)
12. The _____ Shale is an important new source of natural gas. (p. 14)
13. What university did Mr. Pausch have to wait to attend? (p. 2)
14. Microscopic creatures living in rocks are known as what? (p. 19)
17. Christmas Island has two seasons, dry and _____. (p. 8)
18. What is the name of the 3-D program Randy Pausch helped to develop? (p. 2)
19. Who developed the first temperature scale for modern-day thermometers? (p. 10)
20. Volcanic ash conducts _____ when wet. (p. 17)
22. The fountains at the ____ are among the most popular attractions in Las Vegas. (p. 3)
26. What sort of emissions does the Energy Star Program help reduce? (p. 11)
28. What is the name of the camera located on NASA's Mars Reconnaissance Orbiter (abbr.)? (p. 21)
29. Many school labs were designed to hold as much ____ space as possible. (p. 7)
30. In which month will the K'Nex Challenge be held? (p. 2)
31. Plastic bottles are made from (abbr.) _____? (p. 8)
32. What spanned the continental U.S. in the Ancient times? (p. 15)
33. Super small. (p. 5)
34. What's the name of the non-profit organization Bay Haven School of Basics Plus sponsored? (p. 11)
35. Who invented the first temperature-sensing device? (p. 10)
36. This country signed an agreement with the EPA in 2001 to implement an energy efficiency labeling program (p. 11)

DOWN

1. _____ Space Telescope (p. 21)
2. Suspended _____ (p. 18)
4. The red planet? (p. 19)
5. Many regular mouthwashes have high levels of what? (p. 21)
6. Students discovered lava tubes with a _____ skylight? (p. 21)
7. _____ can help investigators and scientists control food and water quality, and ensure UV light protection is effective, among many other applications. (p. 4)
8. Mars mission of the mid 1970s. (p. 19)
9. Nebula where nanodiamonds are found. (p. 21)
10. A good mouthwash alternative contains this main ingredient. (p. 21)
11. Bottle can be collapsed by means of this design. (p. 8)
15. What is the science of understanding how light works? (p. 4)
16. Why do Christmas Island crabs migrate to the ocean every year? To _____. (p. 8)
21. City that features the world's largest, choreographed fountain system. (p. 3)
23. STEM stands for Science, Technology, _____ and Mathematics. (p. 3)
24. Oxidizing the oil can cause the oil to turn into dense, sticky_____? (p. 1)
25. What mineral belongs to the group of nesosilicates? (p. 15)
26. In what country did Thermo Fisher Scientific open its new Food Safety Response Center? (p. 1)
27. Where will the K'Nex Challenge be held? (p. 2)

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