

**Special Report:** *Classroom Discussion suggestions at the end of most articles.*

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# HEADLINE DISCOVERIES

Sept/Oct 2011; Issue 3

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FOOD DAY**

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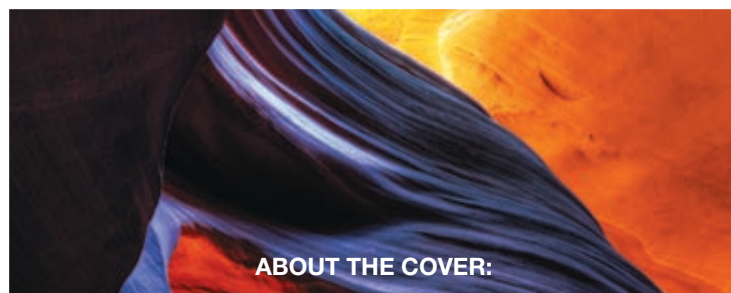


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Price offers in this publication are good until December 31, 2011, unless otherwise stated.



### ABOUT THE COVER:

A rock formation that contains the fifteen lanthanide elements. Learn more about how they are used in daily life on page 11.

## New STEM Professional Development Workshops from Fisher Science Education

**STEM Explorations for Teachers: Making Real-World Connections is a series of professional development workshops offered by Fisher Science Education.**

These workshops are designed to present teachers with strategies that will help them incorporate **STEM** learning techniques into their classrooms.

Workshop topics vary and are available for elementary, middle and high school teachers, cover multiple science content areas and incorporate the use of technology and engineering concepts.

Learn more at [www.fisheredu.com/STEM](http://www.fisheredu.com/STEM)

# FISHER SCIENCE EDUCATION PARTNERS WITH LEADING HANDS-ON SCIENCE MUSEUM TO PROVIDE STEM TRAINING FOR TEACHERS

By Jill Jones

Fisher Science Education (FSE) is committed to providing teachers with the most up-to-date information on STEM education. In support of this commitment, FSE is proud to announce a new partnership with Carnegie Science Center, a hands-on, interactive science museum in Pittsburgh, Pennsylvania.

This collaboration will provide teachers with current information and resources related to STEM education and programming, including *STEM Explorations for Teachers: Making Real-world Connections*.

Developed in collaboration with Carnegie Science Center's STEM education team, these professional development workshops are designed to present teachers with robust STEM-based learning techniques and content that are easily implemented in the classroom. Workshop topics vary; are available for elementary, middle and high school teachers; cover multiple science content areas; and incorporate the use of technology while introducing mathematical and engineering concepts.



For more information about these workshops and all of Fisher Science Education's STEM resources, go to [www.fisheredu.com/STEM](http://www.fisheredu.com/STEM).

Check out Fisher Science Education's dedicated STEM website and get the latest on:

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- Career Spotlight



Current career spotlight: Forensic Anthropology  
Check it out at [www.fisheredu.com/STEM](http://www.fisheredu.com/STEM)



# THE RISE OF VERTICAL FARMING

By Brianne McCurley



When cities need more space, they build upward. So why not use a similar idea for growing crops? This is the notion behind vertical farming – build gardens in high-rise buildings to save land and space. Nearly 80 percent of the world’s population will live in urban areas by the year 2050. According to the UN, over the next 40 years, the world’s population will grow to approximately 9.1 billion with food production needing to increase by 70 percent. It’s estimated that 109 hectares of land, roughly the size of Brazil, will be needed to grow that amount of food. By 2050 the world could run out of productive land and water, thus the rise of vertical farming.

The basic technology needed for the success of vertical farming already exists. Indoor farming environments can be tailored to meet the requirements to grow crops. Artificial lighting, temperature, airflow and nutrients can all be adjusted to create a suitable environment for growing food. Hydroponic technology allows practically any plant to grow in highly oxygenated, nutrient-rich water without the existence of soil. Small-scale vertical farm prototypes are in existence today and are being tested to determine the amount of energy savings and the reduction in land and water consumption.

Dr. Dickson Despommier, an American ecologist, wants to build a 30-story, city-block size building with transparent walls that would maximize sunlight and could potentially feed more than 50,000 people. “With about 160 of these buildings, you could feed all of New York,” he says. Despommier admits that a major drawback is that it would cost millions of dollars to build a vertical farm skyscraper and would probably make vertical farming too expensive.

The need for vertical farming will become more prevalent in the next few decades. With an increase in population and lack of available land to grow crops, a solution to the growing problem is needed.

## FALL PLANTING TIPS

- Mums or Chrysanthemums come in a variety of colors – orange, yellow, red, purple, bronze, lavender, burgundy, off-white and white – and are a great autumn flower to plant in your garden. Make sure to plant mums in full sun and well-drained soil.
- The trick to growing a spring flower garden is to plant bulbs in the fall before the first frost. Tulips, daffodils and hyacinths will survive the colder winter months and will bloom from April to June.

## CLASSROOM DISCUSSION

- How can we build our own mini vertical farm in the classroom?
- What plants can grow in a mini vertical farm?

# THE CASE OF THE VANISHING BEES

By Joe Giacobello

If you’ve noticed that there aren’t as many bees buzzing around your magnolias lately, or that you haven’t been “stung” during the family picnic in quite some time, it probably isn’t your imagination. The number of honey bees in the U.S. and abroad has been declining steadily for the past several years, and it’s all due to a mysterious syndrome called colony collapse disorder (CCD). This phenomenon, which has affected more than 30 percent of bee colonies in the U.S., could have a huge impact on the global agricultural market because so many plants (some 52 of the world’s 112 leading crops) rely on insect pollination.

## COLONY COLLAPSE DISORDER

From 1972 to 2006, a significant reduction in the number of feral honey bees occurred in the U.S. At the same time, beekeepers were reporting a gradual decline in the number of colonies they maintained. By late 2006, the rate of disappearance had increased to alarming proportions, and the term “colony collapse disorder” emerged as the newest “buzz word” to describe the sudden, dramatic rash of disappearances. By February 2007, commercial beekeepers in several states reported losing 30 to 90 percent of their bee colonies. The decline continues.

## POSSIBLE CAUSES

The cause of CCD has not yet been conclusively determined. While several



theories have been suggested, from parasites to cell phone radiation, many researchers believe that it may be due to a variety of things in combination like pesticide exposure, blood-feeding parasites, bee viruses, fungi and decreased plant diversity causing poor nutrition for the bees. “It’s a complex interaction of several different factors that are causing bees to die, resulting in quick colony decline,” said Jeff Pettis, entomologist and chief researcher at the U.S. Department of Agriculture’s Bee Research Lab in Beltsville, Maryland.

## ECONOMIC IMPLICATIONS

With the human population increasing rapidly, there is concern that the bee decline may result in a global economic crisis involving limited crops and ever-rising food prices. In 2009, a study by economists estimated the value of insect pollination, mainly by bees, at about \$212 billion. Researchers are hopeful that someday we may determine the cause of CCD, and ultimately save the busy, buzzing insects that

are so crucial to the agricultural market, here and abroad.

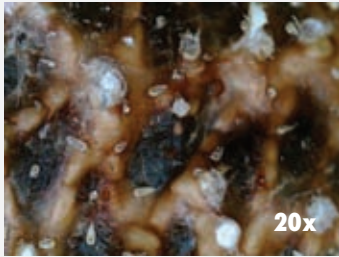
## CLASSROOM DISCUSSION

- Imagine if all of the bees in the world were to suddenly disappear tomorrow. Discuss the ways in which this would affect the world as we know it.
- Study the characteristics and behaviors of bees. List five ways in which you feel that bees are similar to people.

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# COMING SOON TO YOUR GROCERY STORE: CULTURED MEAT?

By Joy Jones



"If you looked at my stomach then, you saw my spine. I was already dead." These are the words of Willem van Eelen, 87, a prisoner of Japanese concentration camps in World War II whose experiences triggered a lifelong obsession with food, nutrition and survival. Today, he is championing an effort to "grow" meat in the lab, which would eliminate the need to raise or slaughter animals.

With a population that has tripled since World War II and the effects of global warming, in vitro meat production may be an idea whose day has come. According to Hanna Tuomisto, a Ph.D. candidate at the University of Oxford, meat grown in the lab involves "approximately 35 to 60 percent lower energy use, 80 to 95 percent lower greenhouse gas emissions and 98 percent lower land use compared to conventionally produced meat products in Europe." Not to mention lower shipping costs, since meat could be "grown" at local production sites.

After facing years of disappointment, van Eelen, who calls himself "the godfather of in vitro meat," finally persuaded Dutch officials in 2005 to pledge financial support for in vitro meat research in the Netherlands. Van Eelen forged ahead, leading a team that was eventually able to grow thin strips of muscle

tissue, but nothing that tasted like "a T-bone steak that came from a Petri dish" (Incidentally, an American beat him to the punch by "growing" a fish fillet using skeletal muscle from a goldfish.) Critics say van Eelen underestimated the scale of the challenge.

## A MULTI-STEP PROCESS

Technicians first isolate embryonic or adult stem cells from the animal, which are placed in bioreactors to grow using a plant-based culture. The stem cells divide and redive until technicians instruct them to differentiate into muscle cells (rather than other types of cells, e.g., skin). Finally, the muscle cells are "bulked up," much like animals build strength by exercising.

In addition to process challenges (e.g., ensuring that cell differentiates into muscle cells), there are financial challenges to overcome, including the high cost of the culture media used to grow the meat. And another big hurdle — consumer resistance to in vitro food.

Regarding the latter challenge, van Eelen supporters assert: With another outbreak of mad cow disease or bird flu, cultured meat may suddenly look a whole lot more appetizing.

## CLASSROOM DISCUSSION

- What might be some other advantages of growing meat in the lab instead of obtaining it from animals?
- What industries/occupations might benefit from having "grown" meat available?  
*Hint: space industry; armed forces, etc.*

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# FORENSICS GONE WILD

By Joy Jones

**Could this be the title of the next blockbuster TV crime show?** Entirely possible, but you might be surprised to find that the crime victims are animals. In fact, illegal trafficking of wild animals or wild animal parts has become a billion-dollar industry -- one that scientists in the field of wildlife forensic genetics are working to eradicate.

On the cutting edge of this burgeoning field is the Conservation Genetics Lab, located at the University of Arizona. Their mission is to conserve and protect wild animals around the world. In addition to collaborating with state and federal wildlife management agencies to solve cases of wildlife crime, they also help to identify and remedy cases of animal inbreeding that result when populations become fragmented and isolated due to urbanization and other causes of habitat loss. The resulting loss of genetic diversity can lead to disease susceptibility and reduced reproductive fitness, and ultimately, endangerment of the population.

## DNA TELLS THE TALE

Researchers extract DNA from hair, bones and/or carcasses of dead specimens, or from blood samples or cheek swabs from living animals. According to Ashwin Naidu, a Ph.D. candidate at the Lab, "every species has a unique DNA sequence known as a DNA bar code, and every individual has a unique genetic fingerprint." DNA bar codes and fingerprints from the animal samples are compared with a genetic database of species and populations that previously have been studied. If the DNA shows that inbreeding has occurred, the Lab takes several animals from genetically diverse populations and introduces, or translocates, them into the inbred population. Animals continue to be translocated until genetic testing shows sufficient diversity for survival.

The Conservation Genetics Lab crosses into the realm of forensics when animals or animal parts (e.g., meat or hides) being shipped internationally are seized by border officials. According to Naidu, forensic genetics can identify the "species, origin and source population of the animal or animal part, as well as whether it was bred in captivity or caught in the wild" by studying its DNA.

***Naidu's dream is that one day wildlife conservation will be a global effort, with universal standards and efficient lab-to-lab communication. Stay tuned!***



## CLASSROOM DISCUSSION

- How would animal forensics differ from human forensics?
- Do you feel our government should fund work in wildlife genetics/forensics?



## Finally, a PCR machine at an affordable price!

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# WALLET-SIZED SMART CARD STORES YOUR MEDICAL HISTORY

By Joy Jones

Not just convenient, but potentially lifesaving. The MyCare Card, no larger than a credit card, holds a patient's medical data (existing conditions, allergies, etc.), and allows the information to be retrieved in a matter of minutes.

Developed by City University London and Coventry University, the MyCare Card is the first device of its type to undergo trials in the U.K. Its development team hopes to undertake a full-scale pilot program soon which, if successful, could allow the system to be available for patient use within three to four years.

If a patient with a MyCare Card falls ill or is involved in an accident, paramedics can retrieve the card from the patient's pocket or handbag, plug it into a laptop, and gain instant access to his or her full medical history. The data can be used to inform on-the-spot decisions as well as to provide hospitals with critical information prior to a patient's arrival. For example, it might prevent a patient with a latex allergy from accidentally being exposed to latex gloves.

## EASY TO UPDATE; SECURE ACCESS

Patients would keep the card in their possession, and be able to alter a range of personal information. When undergoing treatment, patients would turn over the card to the medical professionals so that information from the current visit could be added. Likewise, pharmacies could add information to the card when prescriptions are dispensed. Data would be held securely to prevent unauthorized access should the card be lost or stolen.

Although the MyCare Card is not the first prototype electronic medical record card, it has certain features that distinguish it from its predecessors:



- The underlying software is compatible with many different computers and operating systems
- The system is modular, which means new features are able to be added
- Its open-source design allows a wide range of people to review and contribute to the software development process

And some encouraging news for those who don't consider themselves "tech savvy." According to Professor Kyriacou of City University, "The MyCare Card has specifically been designed to be easy to use regardless of your level of computer literacy."

## CLASSROOM DISCUSSION

- What other uses might there be for Smart Cards?
- What might be the consequences of a breach in security when medical data is involved?



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# ANTIBIOTICS COULD BECOME PASSÉ

By Alida Cataldo



One day, doctors may prescribe amino acids instead of antibiotics to fight common infections. Researchers at the Fraunhofer Institute for Cell Therapy and Immunology IZI in Leipzig have identified 20 short chain amino acids that effectively decimate *Streptococcus mutans*, enterococci, *Staphylococcus aureus*, yeasts, molds and lipid-enveloped viruses without harming healthy cells.

They work fast, too. "Antibiotic peptides unlock their microbicidal effect within a few minutes. They also work at a concentration of less than 1µm, compared with conventional antibiotics which require a concentration of 10µm," states Dr. Andreas Schubert, group manager at Fraunhofer IZI.

This is very good news. Bacteria have evolved to resist most of the antibiotics in use today, even penicillin. In 2010, the World Health Organization found that one-third of the 500,000 people infected with a resistant strain of tuberculosis died. And this year, scientists in Japan uncovered an STD that resists almost all known antibiotics. These and other "superbugs" like Methicillin-resistant

*Staphylococcus aureus* (MRSA) and Carbapenem-resistant *Klebsiella pneumoniae* (CRKP) may soon be distant memories.

## AN OUNCE OF PREVENTION ...

The antibiotic peptides could be applied before the bacteria ever gets to a human. Since they demonstrate no allergy risk when used on food, the peptides could be applied to lettuce, spinach, onions and other greens during production and before ingestion. Not only would this protect humans against infection, it would lengthen the shelf life of treated foodstuffs.

These bacteria-killing amino acids exist in nuts, beans, grass-fed meats, dairy products and seafood. It may be that eating more of these can prevent, or at least minimize, infection in the first place.

### In the meantime, the search for new and/or improved antibiotics continues

- In England, scientists hope to fight burn infections with bacteriophages – viruses which "eat" disease-causing bacteria
- Swiss scientists identified a new class of antibiotics that are effective against gram-negative bacteria
- Merck scientists have produced an antibiotic that inhibits the production of the fatty acids needed to construct MRSA bacteria

## CLASSROOM DISCUSSION

- When do you think amino acids might replace antibiotics? Consider the need for additional research, clinical trials and agency approvals.
- In addition to applying bacteria-killing amino acids to food, how else might they be used to prevent infections?



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# HOLY MOLY — GUACAMOLE!

By Sarah McGann and Gwen Myslinski

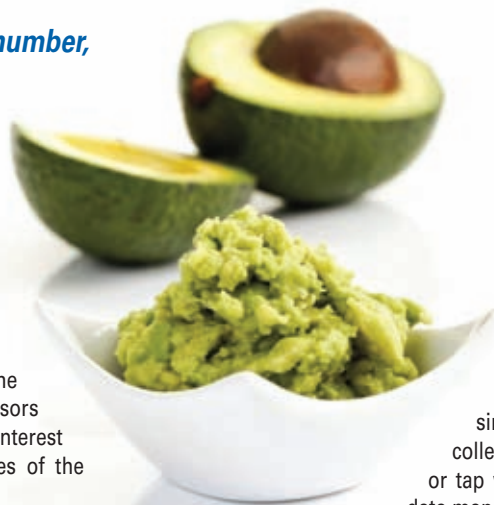
**Avocado's Number...**  
**Whoops, we meant Avogadro's number, the mol.**

## MOL-E, MOL-E, MOL-E

Every year on October 23 from 6:02 a.m. to 6:02 p.m., chemists and science enthusiasts alike honor Italian scientist Amadeo Avogadro's number ( $6.02 \times 10^{23}$ ) with a unique celebration called Mole Day. The mol is a basic measuring unit in chemistry that expresses amounts of a chemical substance, and each year the National Mole Day Foundation sponsors the themed event to encourage more interest in chemistry. This year's theme is "Moles of the RoundTable."

## GETTING THE PARTY STARTED

Prior to the Mole Day celebration is National Chemistry Week, celebrated during the third week of October (October 16-22, 2011). Coordinated by the American Chemical Society (ACS) to raise public awareness and showcase the importance of chemistry in everyday life, this year's theme, "Chemistry – Our Health, Our Future," will focus on the positive effects that chemistry has on nutrition, hygiene and medicine. Local events will be taking place throughout the country: To see what events will be taking place in your community, visit [www.acs.org/ncw](http://www.acs.org/ncw).



National Chemistry Week began as National Chemistry Day in 1987 and was expanded to a weeklong celebration in 1989.

## GET INVOLVED IN HISTORY'S LARGEST CHEMISTRY EXPERIMENT

Did you know that 2011 is also the International Year of Chemistry? To celebrate, the ACS is inviting teachers, students and others to join the 2011 Global Water Experiment. There are actually four experiments, and teachers may do one or all of them. Topics include testing for pH and salinity, treating the water through filtration and purification, and constructing a simple still to perform desalination. Water samples may be collected from rivers, lakes, streams and other nearby water sources, or tap water. Data is collected and reported on the global website and data map, where students can compare results from around the world. The equipment you need can be found in most science classrooms. For more information, visit [acs.org/water2011](http://acs.org/water2011) (the data reporting steps here are streamlined), available in late August.

## CLASSROOM DISCUSSION

- What are items that we use every day and discuss the chemistry in their production (hand sanitizer and lotions, vitamins, toothpaste, etc.)
- How did a chemist like Helen Free (inventor of self-testing systems for diabetes) change medicine?

# LANTHANIDES IN TECHNOLOGY

By April Bailey

Consisting of a group of 15 lanthanide elements plus yttrium, the rare earth elements are all metals, grouped together on the periodic table due to their similar properties.

What sets these elements apart from others on the periodic table is the arrangement of their outer electrons. These electrons can change energy states and release visible light (fluorescence). They can absorb light or UV rays and re-emit the energy as a red or green glow. Additionally, many of the elements of this group have strong magnetic properties. When alloyed with other metals, the result is a very compact, yet strong, magnet.

It is these two main properties that have made these elements highly desirable in the production of today's high technology devices.

Color televisions use europium and yttrium oxides to produce red colors and praseodymium and neodymium to reduce glare on screens. Cameras and binoculars with optical lenses are made with lanthanum oxide while other lanthanide compounds are used in high-intensity lighting and even street lights.

Because of their rich and varied optical properties, rare earth elements are used in glazes for earthenware (adding erbium oxide produces a pink lemonade hue). Europium, the most visible of all the rare earth elements, emits blue and red light when added to phosphors used in the production of computer monitors (even those in small, personal devices such as iPods and cell phones).

Their magnetic property has made them useful in green technology as well. Wind turbines use lanthanide-flecked supermagnets to generate electricity. Auto engines are being made more efficient by using an iron alloy of terbium and dysprosium. This blend expands and contracts efficiently in the presence



The 15 lanthanide elements:

La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu

of a magnetic field, helping sensors, actuators and injectors to perform better. Car batteries used in electric-powered vehicles also rely heavily on rare earth elements.

The technology explosion of the past two decades has seen a rise in demand for rare earth elements. These elements are mined in many areas around the world, including countries such as Brazil, India, China, Vietnam, the United States, Nigeria and Canada. Currently, China has the largest operations available for the mining and processing of rare earth elements. It is expected that more operations will be developed around the world in the near future as demand for high-technology devices rises and because future uses are being explored in fields such as laser technology, telecommunications and medical diagnostics.

## FOR REVIEW

- Name the two important properties that make rare earth elements different from others.
- Lanthanides are used in many industries. Name three.



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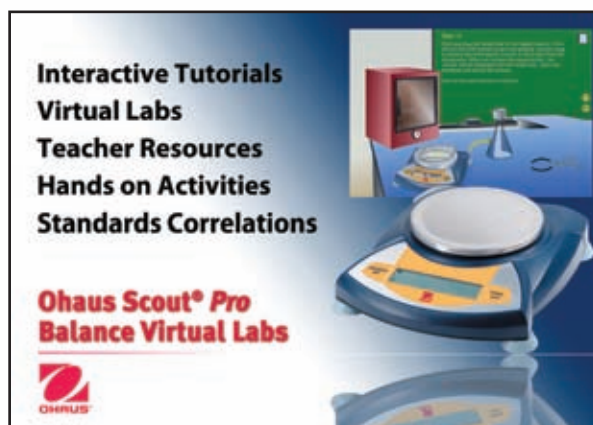
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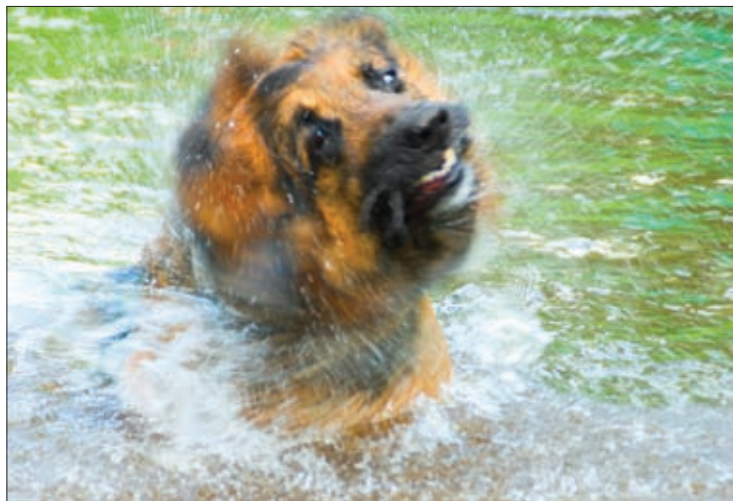
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# SHAKEN, NOT STIRRED

By Terri Sota



**Could a wet dog teach an old washing machine new tricks?** Sounds bizarre, but engineers at the Georgia Institute of Technology are learning a lot about spin drying from some very wet test subjects. Using videography and x-ray cinematography to capture the drying behaviors of assorted soaked species, researchers have observed not only a whole lot of shaking going on, but also quite a bit of physics as well.

While washing machines are effective water wringers, critters are even more efficient in their self-drying efforts. For canines and others, water shedding is essential to body temperature regulation. "If a dog couldn't dry itself, we

calculated that it would have to use 25 percent of its daily calories to heat its body to get rid of the water," says engineer David Hu. "Every time [it] got wet, [it] would get hypothermia and die."

The shaking motion begins at the head, and travels in waves of energy — throughout the animal's body. Because the head can twist (and snap back), it is capable of propagating high-amplitude waves and generating significant energy. The body and skin shake at the same frequency, but the skin travels faster, due to its ability to rotate. When scientists set a fluorescent straw on a wiggling dog's back, they were surprised to see the skin move halfway down the dog's side (in two directions). Subsequently, furry animals depend on looser skin to allow them to stay dry.

Smaller animals, with smaller radii, need to shake faster to achieve accelerations capable of releasing water trapped deep within the fur. These mighty minis can experience forces up to 20 x g. According to researcher Andrew Dickerson, "The bigger the animal, the slower it shakes. A mouse moves its body back and forth 27 times per second, but a grizzly bear shakes only four times per second."

Scientists are continuing to examine how water droplets interact with the hair of different animals. Their hope is to gain a better understanding of the physics of self-drying, and apply that knowledge to improve not only washing machines, but also dryers, painting devices, spin coats and other machines.

## FOR REVIEW

- Why does a smaller animal need to generate more acceleration around its body than a larger animal?

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# IS IT A KITCHEN OR A LAB?

By Valinda Huckabay

*Since ancient times, we've used heat and cold to prepare food. But in more modern times, food preparation has become a study in applied scientific principles.*

## SHIFTING CULINARY LANDSCAPE

Over the last two decades, technology has crept into the kitchen. Preparing food with today's technology requires those in the kitchen to be part chemist/chef.

Leading the way are pioneers such as Harold McGee, who released his book *On Food and Cooking* in 1984, republishing a significant revision in 2004. His was the first volume to translate technical food science into common kitchen applications. Over time, it became the standard chef's reference book, which built an understanding of how cooking transforms food and contributed to a rise in the experimental methods in use today.

In 2010, a group of new-age chefs released their version of cooking with technology — *Modernist Cuisine: The Art and Science of Cooking*. This latest six-volume, 2400-page set highlights the newest forms of laboratory-inspired cooking and underlines the mesh of science and art in today's culinary environments.

The authors (Nathan Myhrvold, Chris Young and Maxime Bilet, who are all scientists, inventors and accomplished cooks in their own right) have incorporated hi-tech approaches, sometimes referred to as molecular gastronomy, from chefs all over the world, such as Heston Blumenthal of The Fat Duck outside London and Ferran Adria of El Bulli near Barcelona.

## NEW TECHNIQUES

Blending the culinary world with the scientific one not only precipitates new

flavor and texture experiences, but also peppers the cooking landscape with new preparation tools:

- **Sous vide:** French for "under vacuum," this process literally vacuum-seals foods so they can be cooked in a water bath at a very specific and consistent temperature
- **Centrifuges:** Spinning at high speed to separate solids that are suspended in liquids, they can remove the pulp from fresh juice as easily as they can remove the fat from a sauce
- **Induction burners:** Using magnetic waves to transfer energy directly to a metal pot, they heat only the utensil rather than the entire kitchen
- **Anti-griddles:** Capable of chilling food to -30°F in an instant, they can create semi-frozen confections with stable, crunchy surfaces and cool, creamy centers

This new world of cooking also utilizes formerly commercial ingredients and food additives such as agar-agar, xanthan gum, carrageenan and sodium alginate to thicken and emulsify these inventive new dishes.

## LOOKING AHEAD

Definitely considered an art form, this blend of science and cooking can be time and budget intensive. Taking up to three hours to prepare one dish, the debate becomes whether these high-tech cooking methods are worth the effort above and beyond more traditional techniques. For those that create with them and enjoy the unique and diverse textures and flavors produced by them, the answer is a resounding "Yes!"


## CLASSROOM DISCUSSION

- What dishes would you create with these new culinary tools?
- Do you think the time and money involved in creating this food is worth it?

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# MOUNTAINS THAT ROAR

By Terri Sota

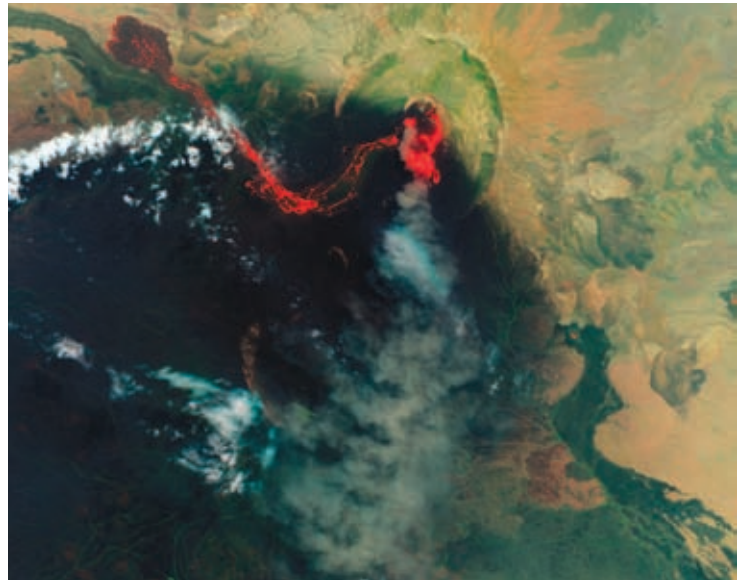
For the first time in recorded history, the Nabro volcano erupted in the East African nation of Eritrea. On June 12, the dormant giant awoke, spewing great plumes of ash northward and over the Middle East. Nabro is just one of 15 currently active volcanoes dispersed around the world.

The Nabro eruption impacted thousands in Eritrea and neighboring Ethiopia, temporarily suspended local air traffic and injected large quantities of sulfur dioxide into the atmosphere. Scientists, dependent on satellite imagery to track the flow of lava, had to wait weeks until the clouds of ash, water vapor and gas dissipated and the volcano could be observed.

Three of the volcanoes demonstrating new or ongoing activity are located throughout Kamchatka, Russia. At 4835 meters, Klyuchevskoi is the tallest and most active in the region. On July 3, this basaltic stratovolcano — a volcano characterized by its steep, conical shape and viscous lava flows — blasted molten rock and ash 23,000 feet above sea level.

Almost all of the volcanoes demonstrating activity, including those in Russia, are located in the Pacific Ring of Fire, a horseshoe-shaped 25,000-mile area that boasts over 75 percent of the world's active and dormant volcanoes. Indonesia comprises the southeastern end of the active horseshoe and has three volcanoes showing signs of life: Batu Tara, Lokon-Empung and Dukono. The latter has demonstrated 60 years of continuous explosive eruptions, culminating in the mid-1990s. In early July of this year, an ash plume was observed rising to 10,000 feet.

Following the Ring of Fire around to the north and west are volcanoes located in the Philippines, Japan, Russia, Guatemala and Chile. Only Kilauea in Hawaii and Nabro in Africa are outside the designated "Ring."



For current information on these and other volcanoes, visit the Smithsonian/USGS Weekly Volcanic Activity Report online at: <http://www.volcano.si.edu/reports/usgs/index.cfm>.

## FOR REVIEW

- What does the location of so many volcanoes in the Ring of Fire tell you about where volcanoes form and how they are triggered?

# END OF A SPACE ERA

By Terri Sota

*After 30 years of space shuttle exploration, the shuttle launched for the last time on July 8, 2011. Atlantis, in its final appearance — after more than 30 missions — carried a four-person crew and provisions to the International Space Station.*



Triumph and tragedy are likely to be the legacy of the program, and big questions regarding the future of the U.S. space program have yet to be addressed. The first "reusable orbital flight" — the Columbia — was launched on the morning of April 12, 1981. In command of the two and a half-day test flight were Commander John W. Young and Pilot Robert L. Crippen. Since then, more than 130 missions have been logged, by five similarly designed spacecrafts: Columbia, Challenger, Discovery, Atlantis and Endeavor. Unlike their rocket predecessors, which disintegrated in stages passing through the atmosphere, the space shuttles were specifically designed for repeated transport use.

The space shuttle program cost \$196 billion and fell short of its advanced billing; ultimately, it was not as inexpensive, safe or reliable as promised originally. Its accomplishments were, however, great. In addition to the scientific discoveries resulting from the various missions, the Hubble telescope and the building blocks of the International Space Station were carried into orbit by the shuttles. On a more human/political scale, the space shuttle program was an exercise in détente and a successful collaboration between the U.S. and Russia.

Sadly, the Challenger and Columbia disasters are forever etched in the minds of all who witnessed the former exploding in mid-air and the latter disintegrating upon re-entry. Fourteen crew members perished.

After the three remaining shuttles retire to various museums, the Obama administration and Congress have directed NASA to develop a new rocket that can travel deep into space. Few details are available, and few other projects have been revealed to the public. There is, however, much discussion regarding funding cuts and fears of a great brain drain. According to Albert D. Wheelon, a former aerospace executive and CIA official, "The good guys see the end coming and leave." What the future holds is indeed ... up in the air.

## FOR REVIEW

**If students could decide where to direct the focus of future space exploration:**

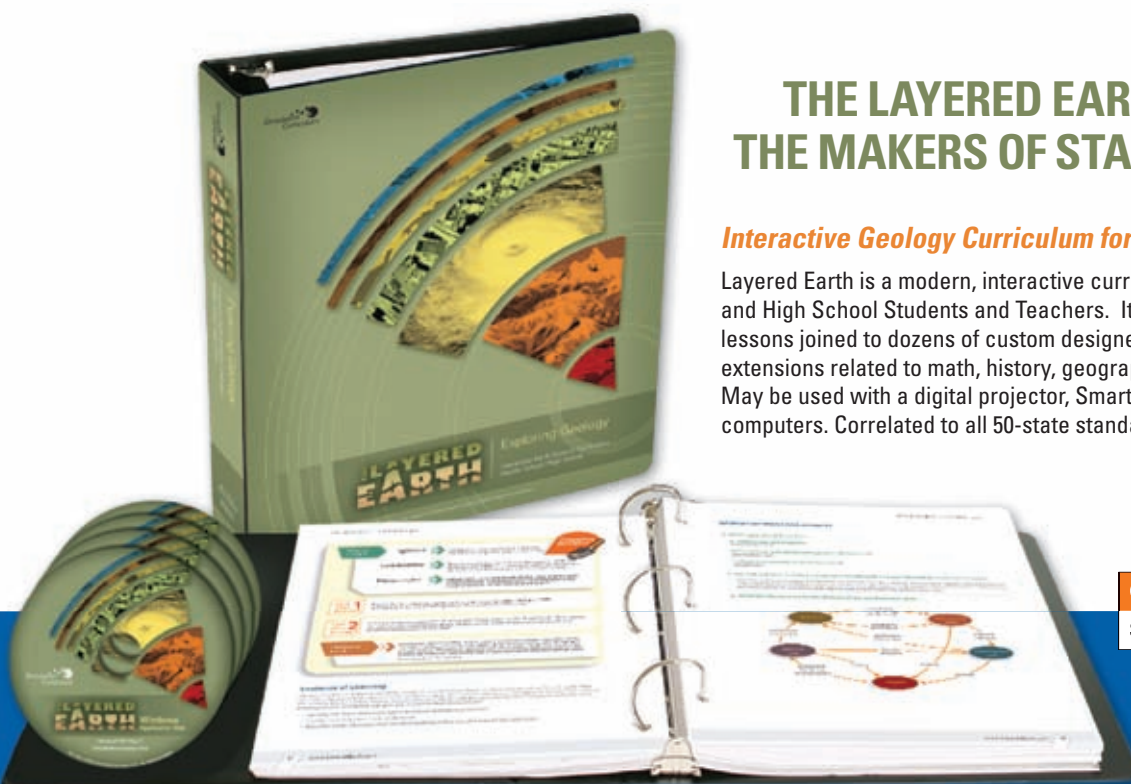
- Where would they like NASA to send space vehicles?
- Would they like to see civilians accompanying NASA personnel?
- What do they see as the impediments to sending humans further into space?



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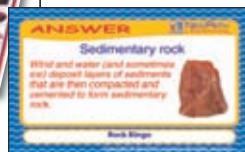
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## THE BEETLE BATTLE

By Gwen Myslinski

Summer is winding down and the cooler temperatures of fall are approaching, but that doesn't stop many from gathering around an inviting bonfire. Have fun with friends, enjoy the gooey deliciousness of S'mores, but help stop the spread of the Emerald Ash Borer beetle and other pests by using/purchasing local firewood and burning it completely.

### EMERALD ASH BORER

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an exotic beetle from Asia that was discovered in southeastern Michigan near Detroit in the summer of 2002. Though it can't be proven, many suspect it arrived in the United States several years earlier, carried on solid wood packing material carried in cargo ships or airplanes.

The EAB larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients, slowly killing the tree. Since the beetle's arrival, it has killed at least 50-100 million ash trees in 15 states and Ontario, Canada, and it threatens to kill most of 7.5 billion ash trees throughout North America. That is an estimated value of more than \$25 billion for items like the Louisville slugger, church pews, hockey sticks, playground equipment and many other items. Ash trees are very valuable because the wood is strong, hard and durable; it doesn't shrink when it dries like some wood; and it matures faster than oak trees.

### WHAT'S BEING DONE

There is a national effort to limit the spread and impact of the insect. First, quarantines are in place to prevent infested ash firewood, logs or nursery trees from being transported and starting new infestations. Additionally, eradications of outlying infestations, where all ash within half a mile of infested trees are cut



and destroyed, is being implemented in many areas. Finally, more research is being conducted to understand the beetle's life cycle and find ways to detect new infestations, control EAB adults and larvae, and contain the infestation.

### Quick Facts About EAB

- It attacks only ash trees
- Adult beetles are metallic green and about half an inch long
- Adults leave a D-shaped exit hole in the bark when they emerge in spring
- Woodpeckers like EAB larvae; heavy woodpecker damage on ash trees may be a sign of infestation
- Firewood cannot be moved in many areas of the 15 states and Ontario, Canada, because of the EAB quarantine

### CLASSROOM DISCUSSION

- Propose ways to promote community involvement in the "slow the spread" effort
- Work cooperatively to produce an effective EAB outreach campaign

# WORLD FOOD DAY 2011

By Gwen Myslinski

World Food Day is a worldwide event designed to increase awareness and understanding to alleviate hunger. It is held every year on October 16 to commemorate the founding of the UN Food and Agriculture Organization (FAO) in 1945. In the United States, the event is sponsored by 450 national, private voluntary organizations, and is recognized by over 100 local chapters of the United Nations Associations.

World Food Day has been held each year since 1981, each with a different theme. This year's theme is "Food prices — From crisis to stability." For more information about World Food Day visit <http://worldfooddayusa.org>.



Cat. No.	Price
S93903	48.50

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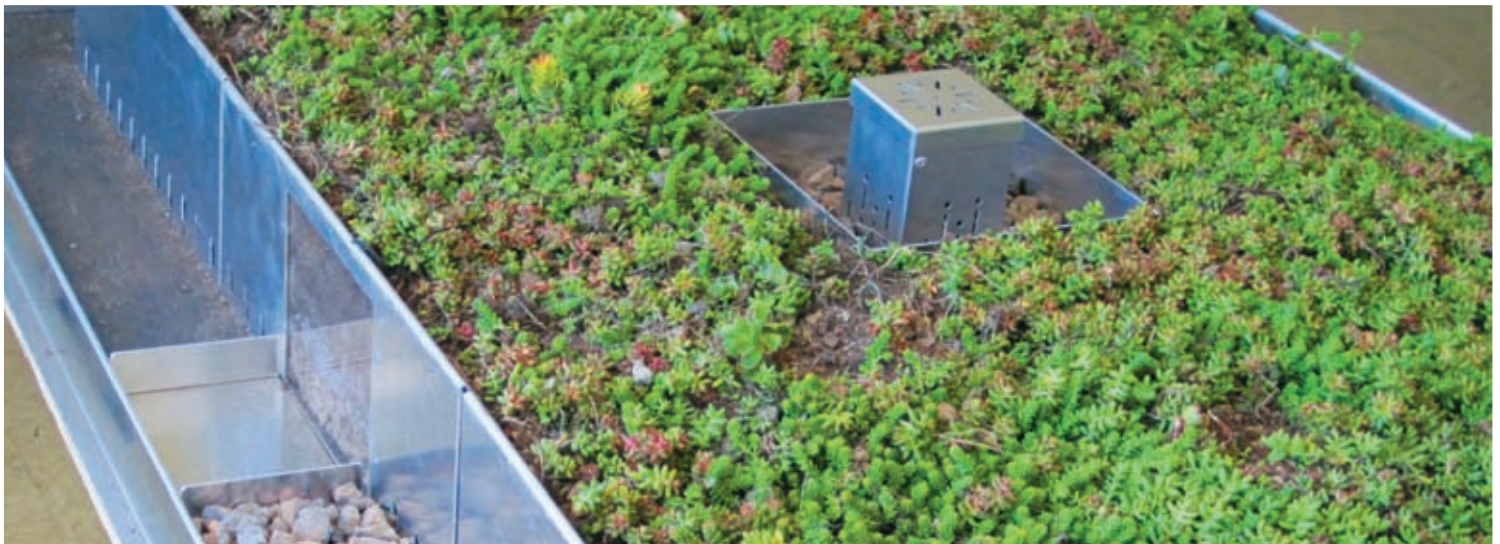
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- All entries must be received by Friday, September 12, 2011, to be considered for the EarthBox Ready to Grow Kits
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- All entries must include essay, contact name, e-mail address, mailing address and phone number to be considered for publication
- Winner will be determined by Friday, September 16, 2011, and will receive kits no later than Friday, September 23, 2011

## CLASSROOM DISCUSSION

- How can growing your own garden help to promote food security?



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## INFORMATIVE AND INTERACTIVE QR CODES

By April Bailey

To understand a Quick Response (QR) code and its power, you first need to get familiar with a regular bar code.

Bar codes are optical, machine-readable representations of data. This data is represented in a linear, or one-dimensional, fashion with each bar of a bar code embedded with certain information. The cumulative set of these bars provides a snapshot of factual data about the item that it is placed with a level of end-user interactivity that is limited. Data in bar codes is merely part of a brief, one-way knowledge exchange: how much does the item cost, who signed for the package; how much does the pallet weigh, etc.?

With QR codes, data can be embedded on a two-dimensional matrix – both vertically and horizontally. This arrangement allows much more storage per code – up to several hundred times the amount of data carried by ordinary bar codes. It also allows the flexibility of embedding different types of data, including those that encourage further information discovery and active engagement on the part of the user. For example, hotlinks to websites; contact information that can be stored, dialed or e-mailed by touch; sales material like menus with usable coupons; garden planting guides; movie reviews in video format; interactive maps and more can be readily and quickly accessed from devices (typically smart phones) with reader applications. This act of linking from a user's device directly to physical world objects is called "object hyperlinking" or "hardlinking."

### A PRACTICAL BENEFIT OF A QR CODE CAN BE SEEN IN THIS SCENARIO:

For a high school science class, each student is assigned a chemical element and told to explain all aspects about the element. One student is researching Oxygen, and collects almost everything he wants to include in his report, but is



still looking for something unique. After a little extra digging, he comes across a poster of the periodic table where QR codes have been used to represent each element. He scans the code for Oxygen and goes directly to a documentary video clip from the University of Nottingham, giving him just the information he needs for his report.

Want to know what he found? Scan the QR code in the image or check out "The Periodic Table of Videos" – a great collection of QR codes put to use.

### FOR REVIEW

- Name three public places where QR codes would be useful to an individual looking for more information
- What did the student in the example learn about Oxygen after watching the video?

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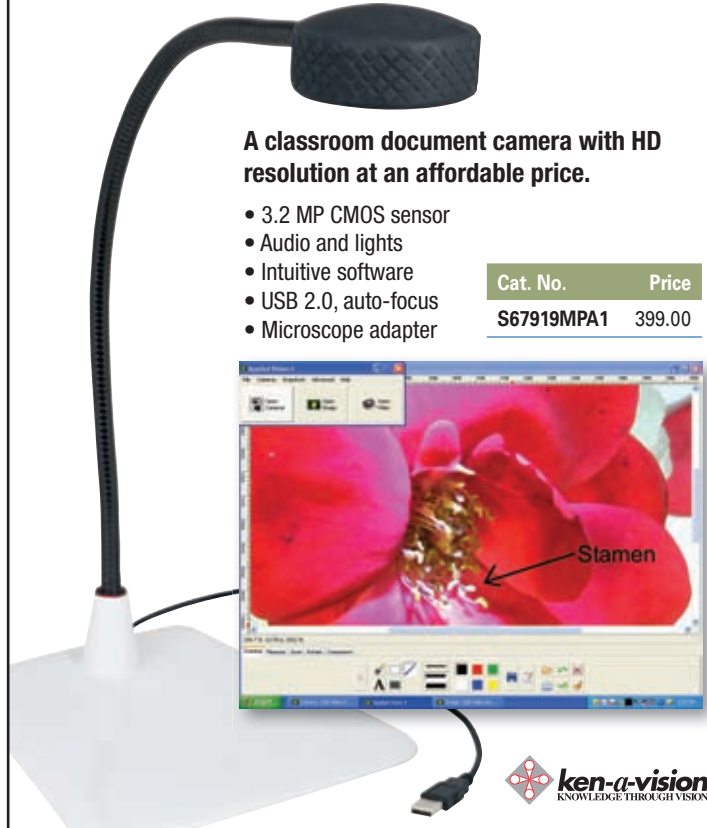
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## ROBOTIC ARM MOVES WITH YOU, LIKE YOU

By Alida Cataldo

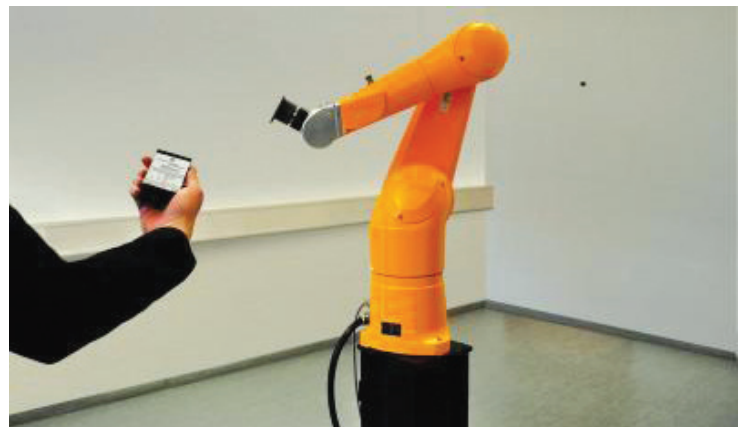
Scientists at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart have designed a robotic arm that catches balls. What's remarkable is that the six-jointed arm with a catcher attachment at its end is controlled by a handheld input device. When the human moves his arm, the robotic arm replicates the movement. Inertial sensors in the device detect human movement and transmit data to the robot. Special algorithms consolidate the data of individual sensors to recognize a pattern of movement and detect it in "free space."

Potential for this technology is far-reaching. For example, programming of industrial robots can be faster and easier. Instead of having a human take a lot of time to "teach" a robot with the commonly used laser tracking system, the human can use the inertial sensor device to "show" the robot what to do in just minutes.

This new technology has applications in medicine as well. A patient with a prosthetic will be able to control its movement more smoothly and naturally. Currently, electromyographic (EMG) sensors are used to control prosthetic motors. But the inertial sensor is comprised of multiple electrodes applied to a surface area, allowing muscle movement to be sensed more fully and transmitted more quickly.

### ROBOTICS HAVE COME A LONG WAY

The first robotics patent was granted in 1961 to George Devol, and Unimation was the first to produce a robot based on Devol's design. The "programmable transfer machine" was designed to simply transfer objects in close proximity from one point to another. The robots were programmed in joint coordinates and hydraulic actuators made them move.



In 1969, the "Stanford arm" was created by Victor Scheinman at Stanford University. This arm had a wider operating area, which made it useful for industrial uses like assembly and welding. The interest in industrial robots grew in the late 1970s, and technology marched on. Today, robots work in manufacturing plants, operating rooms, military installations and law enforcement operations around the world.

### CLASSROOM DISCUSSION

- This new robotic arm replicates human movement from a distance. How might it be used by medical personnel, the military, law enforcement, other sectors?
- Robotic arms have been around since 1961. What do you think will be the next breakthrough in the robotics field?

# INTRODUCING THE HEAVYWEIGHT CHAMPION OF THE WORLD

By Gwen Myslinski

The periodic table was created in 1869 by Russian scientist Dmitri Mendeleev. He had the idea to categorize the elements so that each element had a higher atomic weight than the one on its left; additionally, he placed similar chemical properties next to other elements in the same column. His system of arranging elements by characteristics and atomic number is still in use today as new elements are added, including elements 114 and 116.

After their discovery, a decade of experimentation, and a three-year review process, the International Union of Pure and Applied Chemistry (IUPAC) published a report officially adding the ultraweighted elements 114 and 116 to the periodic table. These unofficially named elements are the heaviest members of the table with atomic weights of 289 and 292 atomic mass units, respectively. The previous heavyweight champs were copernicium (285) and roentgenium (272). The two new elements are radioactive and exist for less than a second before decaying into lighter atoms. In fact, element 116 turns into element 114, and element 114 transforms into the slightly lighter copernicium.



During the review process, the IUPAC also heard arguments for elements 113, 115 and 118, but concluded that the results do not fulfill the necessary criteria for new elements at the present time.

## PERIODIC TABLE FUN FACTS

- **Missing letter:** The only letter that does not appear in the periodic table is the letter J
- **High-tech:** Terbium is used in many applications, such as fiber-optics, iPods, Blackberries, wind turbines and energy-efficient light bulbs
- **Most abundant:** Hydrogen makes up about 90 percent of the world by weight
- **Most compounds:** Carbon has almost 10 million known compounds, and organic chemistry is the branch of science dedicated to studying carbon compounds
- **Least abundant:** Francium results from the breakdown and decay of actinium, and has an extremely short half-life, a matter of minutes; scientists estimate that there are no more than a few ounces of Francium in existence on the Earth at any given time
- **Most surprising:** Oxygen is the third most abundant element in the universe and is highly reactive. Although oxygen is best known for being part of the atmosphere, it only accounts for 21 percent of the air; it is even more common in the Earth's crust — making up almost half of it. It also makes up about 66 percent of the human body and 90 percent of water, as well as the ozone layer

# ROBERT WILHELM BUNSEN (1811-1899)

By Alida Cataldo



*Immortalized by the gas burner bearing his name, Robert Wilhelm Bunsen, a German chemist, didn't invent it (Michael Faraday did). But, along with physicist Gustav Robert Kirchhoff, Bunsen did invent the spectroscope and improved Faraday's burner for his work in spectrum analysis.*

Kirchhoff had had the idea to separate light using a prism. But to study the spectra, Kirchhoff and Bunsen found that: "The lines show up the more distinctly the higher the temperature and the lower the luminescence of the flame itself. The gas burner described by one of us has a flame of very high temperature and little luminescence and is, therefore, particularly suitable for experiments on the bright lines that are characteristic for these substances."

The "gas burner described by one of us" became known as the Bunsen burner. Bunsen's improvement consisted of premixing gas and air before combustion to get the high-temperature, nonluminous flame they needed. Within five years, the Bunsen-Kirchhoff spectroscope was born. From that came Bunsen's discoveries of cesium and rubidium, and others' discoveries of thallium, indium, gallium, scandium, germanium and helium.

## PROLIFIC INVESTIGATOR AND INVENTOR

Born on March 31, 1811 in Göttingen, Germany, Bunsen received his doctorate in chemistry at age 19. He traveled for a few years, then returned to Germany to teach at the Polytechnic Institute in Kassel, the universities of Marburg and Breslau, and the University of Heidelberg, from where he retired in 1889.

During his career, Bunsen's discoveries and inventions advanced organic chemistry, gas measurements and analysis, elemental spectroscopy and geology. In 1834, he discovered hydrated iron oxide, the antidote to arsenic poisoning. But he almost died from arsenic poisoning and lost an eye to a sliver of glass when the compound exploded. He invented the ice calorimeter, a filter pump and the zinc-carbon electric cell, which led to his invention of a photometer. In 1841, he developed a carbon electrode, the "Bunsen battery," that was used on a large scale to produce arc light in electroplating.

Upon retirement, Bunsen left chemistry to pursue his interest in geology. Never married, he died in Heidelberg on August 16, 1899.

## FOR REVIEW

- Why was the gas burner named for Bunsen and not for its inventor, Faraday?
- How are Bunsen's inventions used today? Give examples for the spectroscope, filter pump and photometer.

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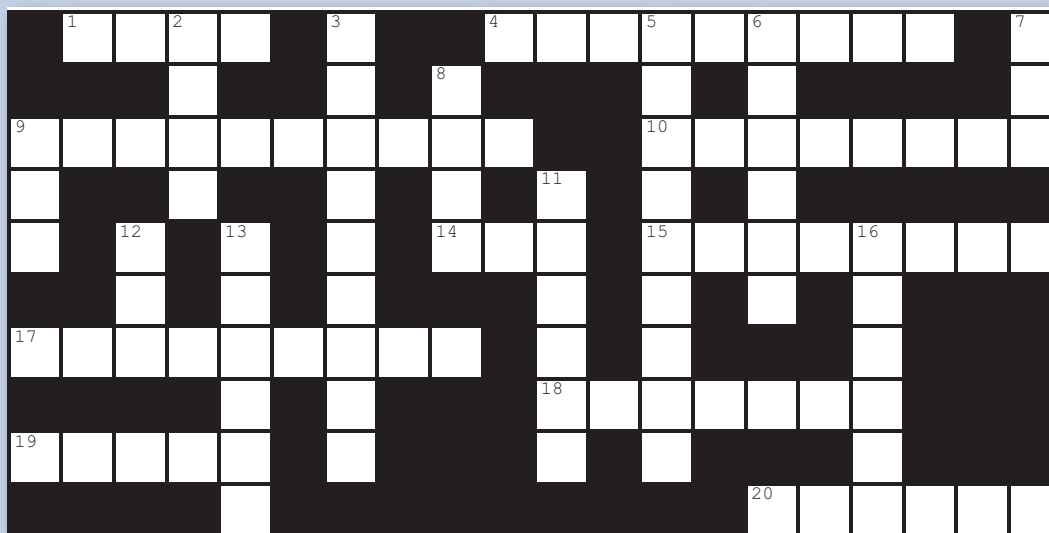
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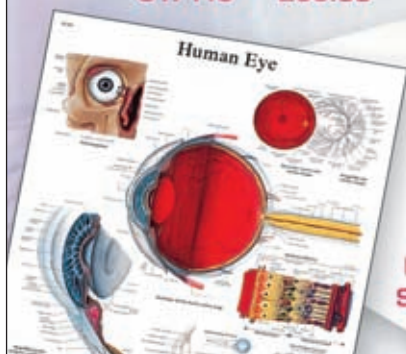
- Across**
- Type of animal the U.S. was able to grow in the lab. (p. 6)
  - The Ring of Fire, home to 75 percent of all volcanoes, is shaped like this. (p. 16)
  - Scientists make use of these heavenly bodies to observe eruptions. (p. 16)
  - Italian Scientist Amadeo \_\_\_\_\_. (p. 11)
  - Substance extracted from hair, bones, etc. for analysis. (p. 7)
  - Sensor that enables robotic arm to replicate human movement. (p. 21)
  - What are the burners called that use magnetic waves to transfer energy directly to a metal pot? (p. 15)
  - National Chemistry Day takes place in what month? (p. 11)
  - Emerald ash \_\_\_\_\_. (p. 18)
  - Ozone is an alternate form of which chemical element? (p. 22)
- Down**
- Type of cells used as starting material for growing meat. (p. 6)
  - First company to produce a robotic arm. (p. 21)
  - What is this year's theme for World Food Day, Food prices - From crisis to \_\_\_\_\_? (p. 19)
  - The bigger the animal, the \_\_\_\_\_ it shakes. (p. 14)
  - How many elements were added to the periodic table in 2011? (p. 22)
  - What part of the animal begins shaking first? (p. 14)
  - The number of volumes of the new cookbook Modernist Cuisine: The Art and Science of Cooking. (p. 15)
  - MyCare Card can be read by plugging into a \_\_\_\_\_. (p. 8)
  - Cause of vanishing bees. (p. 4)
  - Name of new medical history smart card. (p. 8)
  - From the first shuttle mission to the last, approximately how many years transpired? (p. 16)

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