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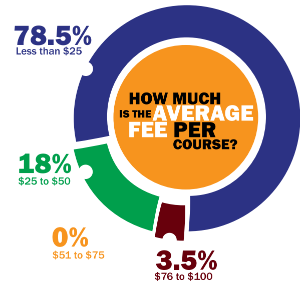
Teaming STEM

With Physical Education pg 9

NSTA Reports

National Science Teachers Association



Are Course Fees Feasible?

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Serving the Community Through STEM

Schools seeking to enhance science, technology, engineering, and math (STEM) teaching and learning have discovered that adding service learning to STEM benefits students, teachers, and the community. The EPICS (Engineering Projects in Community Service) program at Purdue University in West Lafayette, Indiana, helps schools accomplish this. EPICS has engaged thousands of undergraduates in STEM service learning projects since 1995. Founded in 2006, EPICS High (*http://engineering.purdue.edu/EPICSHS*) has helped high school students nationwide connect engineering and computing design projects with community needs.

EPICS has helped interest more students in STEM, says EPICS High Coordinator Mindy Hart. "We find we have a higher population of female and underrepresented students participating in EPICS courses than in traditional STEM courses (44% female and [more than] 50% underrepresented minorities). We are opening STEM career pathways to students who might not have otherwise pursued a STEM degree in a postsecondary setting. We provide hands–on, real–world engineering experience," she maintains.

For teachers, "we are interested in supporting good pedagogy and have a curriculum to help with that. The curriculum is made available to those who attend the training," she explains.

Students from Dunloggin Middle School in Ellicott City, Maryland, have been raising oyster spat (baby oysters) as part of a project to replenish the Chesapeake Bay's oyster population. Here two students count and record data on the numbers and size of oyster spat found on each shell.

EPICS Schools are asked to have at least one teacher attend training.

Next, "we have the school submit a plan of work explaining their project and how they plan to implement it in their school," she notes. "Additionally, we provide technical support for projects, where a teacher may not otherwise have expertise. And…we try to provide as many funding opportunities as possible to our teachers."

She continues, "Through the training and supporting curricular documents, we teach the teachers and students how to identify needs in their own community and thus select a nonprofit partner…[W]e provide one-on-one support for schools needing additional help identifying that partner. A lot of times, their own school or [an] area of their school can be that nonprofit partner."

Roberta Zasadzinski, science teacher at Nazareth Academy in La Grange Park, Illinois, met EPICS High co-founder William Oakes at NSTA's National Conference in Indianapolis in 2012. He arranged for her to receive

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COMMENTARY: **Bobby Jeanpierre**

Inquiry in the Urban Science Classroom: Connecting Curiosity and Creativity

By Bobby Jeanpierre, PhD


Bobby Jeanpierre

Inquiry is at the heart of scientific thinking. Teachers facilitating inquiry in their classrooms that sparks students' curiosity are central to helping those students develop "scientific habits of mind." These habits can be cultivated in our urban science classrooms. Over the past 10 years, I have spent considerable time observing urban K–8 teachers teaching science to diverse student populations. My research has focused on how teachers facilitate inquiry in these settings while facing a variety of challenges that often hinder, rather than facilitate, student learning. In our test–focused school culture, teachers have little time to think about how to spark students' creativity. Therefore, linking inquiry, curiosity, and creativity is not only a challenge for students, but also for their teachers.

The state of inquiry in the urban science classroom is not all dismal. I have found 95% of approximately 345 urban elementary and middle school teachers report they see themselves as facilitators of student learning and not lecture-focused instructors. However, only 52% reported they consider students' interests when planning their science instruction. One explanation for this 43% difference may relate to how the emphasis on testing affects teachers' perceptions of the time available to incorporate students' interests into their lessons. Teachers still have some freedom to make some decisions about curriculum, instruction, and assessments, but that freedom is becoming more and more restricted. In an education system increasingly driven by standards and testing, how do teachers keep curiosity and creativity alive in science classrooms?

Creativity can be defined as the production of something original and useful. Creativity requires divergent thinking (during which one generates many unique ideas) and convergent thinking (when one combines those ideas into the best result). How often do science teachers support creativity in science classrooms? Obviously, the frequency of creativity in U.S. science classrooms varies; yet while observing five urban science classrooms for several years, I found students had little opportunity to think creatively in science classrooms, although some teachers incorporated creativity into their science lessons. For example, in one sixth-grade classroom, students were encouraged to write a poem or song about what they had learned during a unit on clouds and cloud formations. In another, students were instructed to use Tinkertoys® to design their own simple machines. How do we help students and teachers go further in facilitating opportunities to bolster students' creative spirit?

The need to foster student creativity in the classroom is not new. Alessandro Antonietti (1987), in his article "Unlocking Creativity," proposed a series of strategies that would help teachers harness students' creative power:

- Help students realize when creativity is needed and when it is not.
- Have students practice how to carry out a mental operation. Describe the strategy, then give examples of how to apply it in different contexts.
- Develop awareness of mental operations. Ask students, "What are you trying to do now? Why are you doing so? Are the resources available? Are you reaching your goal? Do you think that it is better to go ahead or switch strategy?"
- Develop reflective attitude. Ask students, "Which kind of situation is this? What strategies could you adopt? Which is the most relevant strategy? Are you reaching the goal? Do you think that it is better to go ahead or to switch strategy?"
- Develop means to recognize attitudes and emotions that precede or follow the implementation of a creative strategy, and use them to their advantage. Students need to learn to accept a period of uncertainty or anxiety, aware that such troubles are necessary to develop creative approaches.

This article proposes various strategies, but ends with what I consider the most important: "Help students recognize attitudes and emotions that may affect implementation of a creative strategy."

In 2010, *Newsweek* published a series of articles on the creativity crisis. The articles reported creativity in American schools is decreasing the most in grades K–6. I find this alarming, for it is in these grades that Dewey stated students' attitudes toward science develop. We envision the early K–2 years as time when students should have significant opportunities to learn through play and begin to develop creative habits of mind. If students are not allowed to learn in creative ways during their early years, then the likelihood of them developing these habits dwindles. In fact, developing students' curiosity and creativity during the early elementary years may be crucial in affecting later interest in science, technology, engineering, and mathematics careers.

I see varying levels of excitement and anticipation about the *Common Core* and *Next Generation Science Standards* and appreciate they may help improve science education, especially in urban settings. Yet I suggest the solution is not developing standards alone, but also developing thinking teachers who support thinking students' use of curiosity and creativity to develop the habits of mind needed to inquire deeply by asking significant questions, find relevant solutions, and be inspired to embrace lifelong learning. It is both the quality of standards and the *quality of teaching* that will make the difference in student science learning.

Astrophysicist Neil deGrasse Tyson says it best: "I would teach how science works as much as I would what science knows…In the end, it is the people who are curious who change the world!" ●

Bobby Jeanpierre, PhD, is an associate professor of science education at the University of Central Florida. Prior to university-level teaching, Jeanpierre taught science and mathematics courses to middle and high school students for more than 17 years.

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a stipend to attend EPICS training at Purdue University that summer. She says EPICS "meets the mission of our school…EPICS combines academics with service. What can be better than that: a great reason to use your brain!"

Feeding the Hungry

Schools have found other ways to get involved in service learning. Kristine Denton, seventh–grade service-learning instructor at King Science and Technology Magnet Center in Omaha, Nebraska, says her school wanted to do so because "[we] saw that our urban students were highly engaged with the creation of our school's outdoor urban farm, and we wanted to see how we could take the concept of growing our own food to the next level."

Denton turned to the University of Nebraska at Omaha, which has "a unique Service Learning Academy that connects [preK–12] teachers with university professors and community partners to design service learning projects." During a week-long workshop there, she met "an environmental chemistry professor and Greg Fripp of the nonprofit [food education organization] Whispering Roots. The university has grant funding to start service projects, and through this partnership, they were able to cover the [expenses] for my students to come to the university to do water quality testing with the chemistry professor."

Her students have "been doing successful aquaponic [gardening]…for the past three years. We have two systems in our school and have built systems for local elementary schools," Denton reports. Fripp volunteers to help students maintain the system, while "I [teach] the science behind aquaponics."

"The students donate our harvests every 4–6 weeks to the Open Door Mission homeless shelter, and [see how] their effort makes a huge impact on the life of someone else," she says. Not only are students "introduced to science concepts normally reserved for high school courses, but they [also] learn presentation skills and how to interact with people from the community," she adds. "The students see that there is more to learning science than just taking notes or doing labs in class."

Other teachers value Denton's students' "foundational background" in science, and "because the students are required to write reflections on everything they do in class, their language arts teachers appreciate that students have had practice with descriptive writing," she observes. Their writings reveal "what concepts the students understood, whether or not they understood the purpose or objective of the activity, and if the activity needs to be adjusted for next time," she explains.

Environmental Preservation

Students at Dunloggin Middle School in Ellicott City, Maryland, have many service-learning opportunities, including the Stream Restoration and Wetland Construction Project, which "has served as the seventh–grade student service-learning project since 2005," says science teacher Daniel Blue. "In 2008, we secured funding to construct a wetland area to catch runoff from local fields. Students regularly remove trash from the two streams located behind the school, as well as remove invasive species, re-plant native species to prevent erosion, perform water quality testing, and take macro-invertebrate samplings to help determine stream health," he reports.

On a field trip to the Chesapeake Bay Foundation's (CBF) Philip Merrill Environmental Center last year, students realized how depleted the bay's oyster population had become and wanted to take action. With staff development funding, Blue and Pamela Kidwell, Dunloggin's gifted and talented resource teacher, attended a professional development workshop on oyster gardening sponsored by CBF. "We received materials for construction of the oyster cages and information [about] caring for the baby oysters," he recalls.

They then contacted Kentmorr Marina, which agreed to provide students access to the marina's docks and placement for the oyster cages. Blue and Kidwell obtained baby oysters from the University of Maryland Center for Environmental Science's Horn Point Oyster Hatchery and invited students to work on the oyster gardening project.

As the project progressed, the teachers became acquainted with the hatchery's program director, Don Meritt. "Don visited with the students during their January data collection and also made arrangements for the students to [tour] the oyster hatchery in the spring," Blue relates.

The teachers assessed what students had learned by evaluating their entries in their action plan logbooks, a component of the *Action Research for Community Problem Solving* curriculum. "When we met with the students during school hours, they completed entries [in] their logbooks…At the end of the year, they [wrote] an essay [in which] they shared what they learned, as well as their feelings about the project," explains Blue.

The project "has allowed the students to actively help solve a real-world problem that affects their local and regional environment. It has [given them] access to real scientists and [others working to] preserve the Chesapeake Bay or [who] rely upon the bay for their livelihood. Furthermore, this is a sustainable activity [because each year,] we add new students to the group as the older students [graduate]," he notes.

To the teachers' delight, several former eighth graders "have initiated the project in their high schools this year," he reports. ●

Making a 'Maker Space' Creative and Safe

When the industrial arts teacher at Upper Merion Area High School (UMAHS) retired, "it seemed like a good time to transition" the program to reflect shifts in academic standards, recollects Peter Vreeland, who teaches technical and engineering education and heads the science department at the school in King of Prussia, Pennsylvania.

"The middle school technical education program embraced a philosophy of STEM (science, technology, engineering, and mathematics) education," he says. "We wanted to provide an extension of that at the high school. Our goal is to continue to build on the success of the middle school program by making changes at the high school level…We had a traditional wood shop; we removed tools that were obsolete or unsafe. We consolidated into [the former] machine shop." This created two distinct areas: one where materials were cut and another that became a "maker space" used by a variety of classes—even foreign language classes. "It's a library for people who want to build things after school, too. We hope to expand to one night a month after school [when] students [can] bring their parents."

Vreeland says the curricula and activities were designed by the science department, working with the middle school technical education teacher to ensure continuity. "I'm very familiar with what they're doing at the middle school. In all of our courses, we try to have spiraling curriculum. We make sure there's alignment with the middle school, the rules are still the same, the procedures are still the same."

He has 86 students in his technical education and engineering courses this year, the first time they have been offered. "We developed four courses, two with a strong STEM focus. The engineering courses…have a project-based approach…It's a pragmatic approach to how concepts are applied outside [the] classroom," Vreeland explains. "In the science department, we work to identify kids who would benefit from this as an elective course, maybe steer them toward careers in STEM."

Setting up the new program was a "homegrown effort" that required him to work with the local technical high school to ensure the UMAHS program was complementary, not competitive. "It boils down to what vision you have for the space: Our vision is to be as broad as possible…You have to think differently about how to use these spaces," Vreeland explains. "We had a vision our school board [and] parents could understand, students could understand, that helped us get under way." His vision included providing a good curricula and getting feedback from outside agencies on the kinds of experiences students should be having.

"Part of learning is experiencing the processes," Vreeland adds. "For us, it has been rewarding drawing [students] from all different backgrounds."

Casey Shea has been teaching the Project Make course at Analy High School in Sebastopol, California, for three years. When he took over the industrial arts–turned-storage room, he "asked them not to toss anything until I looked at it…There were big tools [such as a planer] we don't use enough to make it worth it for us. More modern tools take up less space." However, he has been bartering some of those tools in exchange for training.

"There was great stuff in the cabinets. You have to look before you throw it out… Just because it's old doesn't mean it's not useful. Even though the way things are made has changed drastically, there's still value in [older] electronics," he says. He has found old circuit boards made from springs particularly valuable for teaching circuitry because the connections can be seen. "I'm struck by how much stuff was done 20–30 years ago, how much of that stuff is relevant again. Some electronics have gone out of favor: They're not useful in modern electronics, but they are good for teaching…You can't dig around in a microchip!"

However, the room contained "a lot of real specialty tools we wouldn't need," he recalls. "With a miter saw, chop saw, drill press, [and] hand tools, we can meet most of our needs. We still have a full[y] functioning wood shop on campus, but we're geared more to digital manufacturing, to [using a] laser cutter [and a] CNC (computer numerical control) router."

He advises others—particularly those who, like him, don't come from an industrial arts background—to observe teachers with hands-on classes, even if the subject matter doesn't seem related. He learned useful classroom management strategies by watching an art teacher who had established routines for cleanup and other class procedures.

Shea says safety training and procedures are something he is "still grappling with," but he hopes to reserve some time next year to create documentation to share with other schools in his district, and hopefully beyond. "Some people have open-sourced [their materials]…I've been looking at

Google forms [for safety assessments]. They offer immediate feedback."

Making Safely

"Sometimes teachers are thrown into this lacking backgrounds [that] address the safety hazards and training in the use of hand and power tools," observes NSTA Science Safety Compliance Consultant Ken Roy. "Districts need to step up and provide training." He also advises educators to set up STEM labs keeping legal standards, including those espoused by OSHA, and professional best practices clearly in view. According to Roy, the three areas to focus on when developing a STEM lab for safer hands-on activities are (in order of priority, based on OSHA standards)

- **Engineering Controls**—controls in the working environment designed to eliminate or reduce exposure to biological, chemical, and physical hazards through the use of engineered machinery or equipment. Examples include glove box, spray booth, wood dust collection system, fume hood, general ventilation, master electrical shutoffs, eyewash, shower, sound dampening materials/equipment, safety interlocks, radiation shielding, and machine guards.
- **Administrative Controls**—measures that focus on reducing employee exposure to hazards. These include safe work practices or standard operating procedures: safety training on operating procedures; housekeeping programs; emergency response drills for spills, fire, and other hazards; equipment preventative maintenance programs; hot work permit programs; safety work zone policies; and safety assessments conducted on equipment use and work zones.
- **Personal Protective Equipment**—a supplementary control method that uses protective equipment and clothing. These items include gloves (for chemicals, welding, biologicals, etc.), safety glasses/splash goggles, aprons, close-toed shoes, earmuffs/plugs, welding helmets, and hand shields. ●

Quotable

We all need to go into the classroom believing our students can and will meet and often exceed our expectations.

—Robert John Meehan, U.S. educator and author

Teaming STEM With Physical Education

Integrating physical education (PE) and science, technology, engineering, and math (STEM) "means that the students are basically getting a kinesthetic STEM lab: They learn about the concept in the classroom, and it is reinforced when they can truly experience it in the gym," maintains Cindy Jones of Clover Hill Elementary School in Midlothian, Virginia. After completing a course in children's engineering, Jones, a PE teacher, has filled the school gym with self-propelled simple machines that give students a workout and teach them engineering and physics principles. The gym also contains a tree house with simple machines, electricity, and magnets; an aerospace mural/target; a climbing rock wall featuring star constellations; and a health mural showing bones and muscles.

Students remember the STEM concepts "because they are visualizing, physically connecting, and mentally comprehending all at the same time," Jones notes. "I had a fourth-grade student on the scooter pulley, and she said, 'Now I get it!...Pulley means to pull!'"

Some students "need hands-on learning, and sometimes that is hard to experience in the classroom," she adds.

Jones has received awards for her *STEM in the Gym* curriculum. Her work has influenced teachers like Steven Joyce, K–5 PE teacher at Newton County Theme School in Covington, Georgia, who says he wondered "how to effectively teach 325 students in [grades 3–5] STEM concepts in a physical activity setting." He found the curriculum "a tremendous help in deciding that stations over a two-week period would be ideal for our school. Along with several modifications (number of stations, safety, and increasing physical activity) and additions (scooters, bowling, and gymnastic rolls), we were able to push through those challenges with huge success."

Joyce collaborated with University of West Georgia physics professors on a grant "from the Newton Educators Foundation to promote STEM into physical education. The advantages for the students in combining STEM into PE were numerous. For example, our students learned the science behind sports and how they relate to each other." He observes, "Science, health, and physical education blend well... These hands-on experiences activated the brain and body to learn the STEM concepts. The students preferred this type of learning."

STEM Workouts

Jeff Knox, PE teacher at L&N STEM Academy in Knoxville, Tennessee, helps his students learn about STEM by having them plan, track, and analyze their workouts on their iPads. "I think data collection and analysis teaches workplace skills and also transfers to student learning," he asserts. "After setting data-driven goals, students design their own workouts and track their progress throughout the year. We use a spreadsheet application for the [PE] classes, and the students learn to chart their data to track progress and set new goals after achievement."

He continues, "The data tracking helps not only with the students' motivation, but also has benefits in other subjects. The graphing and use of measures of central tendency reinforce learned math skills," while "collection and tracking of collected data shows students this science skill has real-world application outside of a laboratory environment."

Knox believes effective STEM education should have "critical thinking embedded into every aspect of all [curricula]. In [PE], the students are challenged with creating solutions to complicated problems, such as the workout creation and dance design projects."

In a partnership with the YMCA and University of Tennessee's (UT) kinesiology department, Knox says his students "will work with graduate students from UT as they conduct their research for their thesis or dissertation. The graduate students have used heart rate monitors, accelerometers, fitness tests, and observations to analyze various movements. Ongoing research will help advance the field of exercise physiology and kinesiology, and our students not only participate as subjects, but [also] are informed about the research process. This partnership is mutually beneficial, and our students benefit from seeing the research process outside of a high school classroom."


CINDY JONES

Student teams in Cindy Jones' PE class at Clover Hill Elementary School in Midlothian, Virginia, learn about wheels and axles while riding scooters in a relay race.

Jumping the Hurdles

Combining STEM and PE presents challenges. Some "are monetary and logistical in nature," observes Joyce. "I have done a simple machines unit before, [so] the ideas were familiar [to] me. Yet I wanted to step up the integration by buying specific simple machines that were designed to be used in a school setting. These costs forced me to look at grants to pay for it."

Jones found the combination "requires lots of set-up time and often homemade STEM resources," she notes. "The gym is a shared facility, so equipment must be stored...for both safety and [to prevent] abuse. The STEM tree house has had to be repaired several times due to after-school activities. [And] since the gym is used for other activities during the school day—such as student class photos, assemblies, etc.—continuity can be an issue.

"Getting professional development, and feeling confident in the STEM content; finding or making equipment; and formulating activities to be both STEM-relevant and physically engaging [so] that the kids enjoy [what they're doing] in the fitness environment" can be difficult, she points out. "Assessment, due to sheer numbers and time allotment," is also an issue, she says. "I see each class once a week for 45 minutes...I see 800 students a week."

Despite these hurdles, the teachers say the STEM/PE team is a winner. For example, according to Joyce, only 25% of his students in grades 3–5 passed a pre-test on simple machines with a score of 76 or better, but that number jumped to 80% on the post-test. And 70% of the students scored 84 or higher on the post-test, he adds.

"Classroom teachers have told me that they can see 'the light come on' in the students' eyes after the kids get the concepts reinforced in the gym," reports Jones. "PE can be an amazing learning environment for almost any academic concept." ●

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BY PATRICK MERRELL

ACROSS
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8 ESPN info
12 Valuable rock
13 "No way!"
14 You, in the Bible
15 Process by which traits are passed on
17 Attain, as a college degree
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21 Seasons when the shortest nights occur
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27 Joke-filled tribute
31 First name of a monk who studied peas
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34 Above all others
35 Astronaut Virgil Grissom's nickname
36 Year ender (abbr.)
37 Copies and then puts up an internet article
40 Opposite of recessive, as a trait
43 Brainstorming result, hopefully
47 Off-base without a pass
48 The study of 15-Across
50 Inform
51 Cupid, to Greeks
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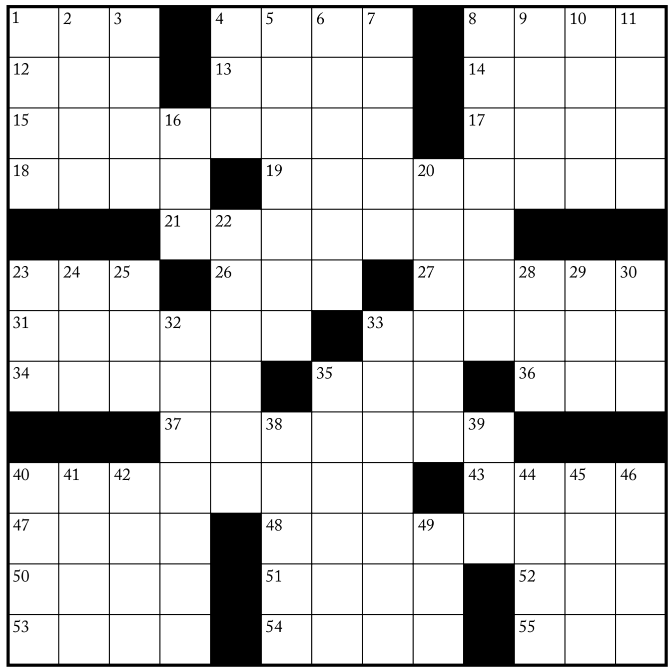
53 On the Mediterranean
54 Atlantic crossers 'til 2003, briefly
55 Sushi-bar sauce

DOWN
1 Hardness-scale inventor
2 Vicinity
3 Arctic bird
4 Video counterpart (abbr.)
5 Glisten
6 Fall
7 Suffix meaning "plant"
8 Brand of cowboy hat
9 Siamese, nowadays
10 Type of handlebars for a triathlete
11 Oak Ridge Nat'l. Laboratory state
16 Actors Westwick and Asner
20 Haul into the stationhouse
22 Major tennis or golf tournament
23 In the past
24 Big coffeemaker
25 Procure
28 Use the + key
29 Employ one's optic nerves



30 Pampering, for short
32 The largest primate
33 Really shouldn't
35 Dead ducks
38 Book innards
39 Put one's posterior down
40 Collected info
41 Has debts
42 Tunneler with tiny eyes
44 "Buenos ___, senor"
45 Sound rebound
46 Dirty white
49 Host or govern ender

ANSWER ON PAGE 23

Try this TOPS IDEA!

OBJECTIVE

To observe how a bi-material strip bends as its dissimilar sides expand and contract by different amounts. To apply this idea to thermostats.

LAB NOTES / ANSWERS

Photocopy the activity for each student or team.

Step 2. The strip bends toward its aluminum side as it heats up, and away from its aluminum side as it cools down.

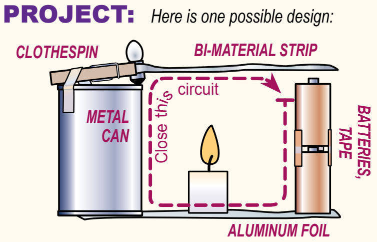
Step 3a. No. On heating, the tape expands (lengthens) faster, bending toward the relatively shorter aluminum. On cooling, the tape contracts (shortens) faster, bending away from the relatively longer aluminum side.

Step 3b. In a thermostat, a bi-material strip acts as a switch, turning the heat on or off. (We call these *bimetal* strips because the two sides are composed of different metals.) As a strip cools, it bends toward an electrical contact, completes the circuit, and turns on the heat. A warming strip bends in the opposite direction, breaking contact. (An air conditioner thermostat closes the circuit as it gets warmer.)

MATERIALS

- Clear tape and aluminum foil.
- A metric ruler and scissors.
- A candle and matches.
- For project: Flashlight bulb, batteries, and various construction materials you have available; drawing above shows one design.

PROJECT: *Here is one possible design:*



EVALUATION

Q. To remove a tight metal lid from a jar, it sometimes helps to hold the lid under hot water. Why is this effective?

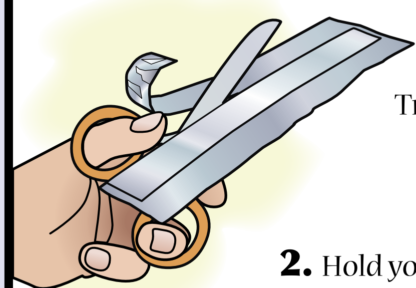
A. Heat expands the metal lid more rapidly than the glass. This increases the space between the two materials, loosening the lid.

FOR SAFETY:

- ✔ Use eye protection.
- ✔ Don't bring strip too near the candle flame.
- ✔ Use foil, a tile, or a plate to protect wood or plastic tabletops.
- ✔ Keep clothing and hair away from flame.
- ✔ Follow your school's safety regulations.

bi-material strip

…adapted from KINETIC MODEL #14 by TOPS Learning Systems



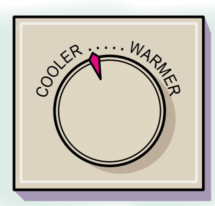
1. Stick about 15 cm of clear tape to the dull side of aluminum foil. Trim away all untaped foil.

2. Hold your bi-material strip high above a flame. Which way does it bend?

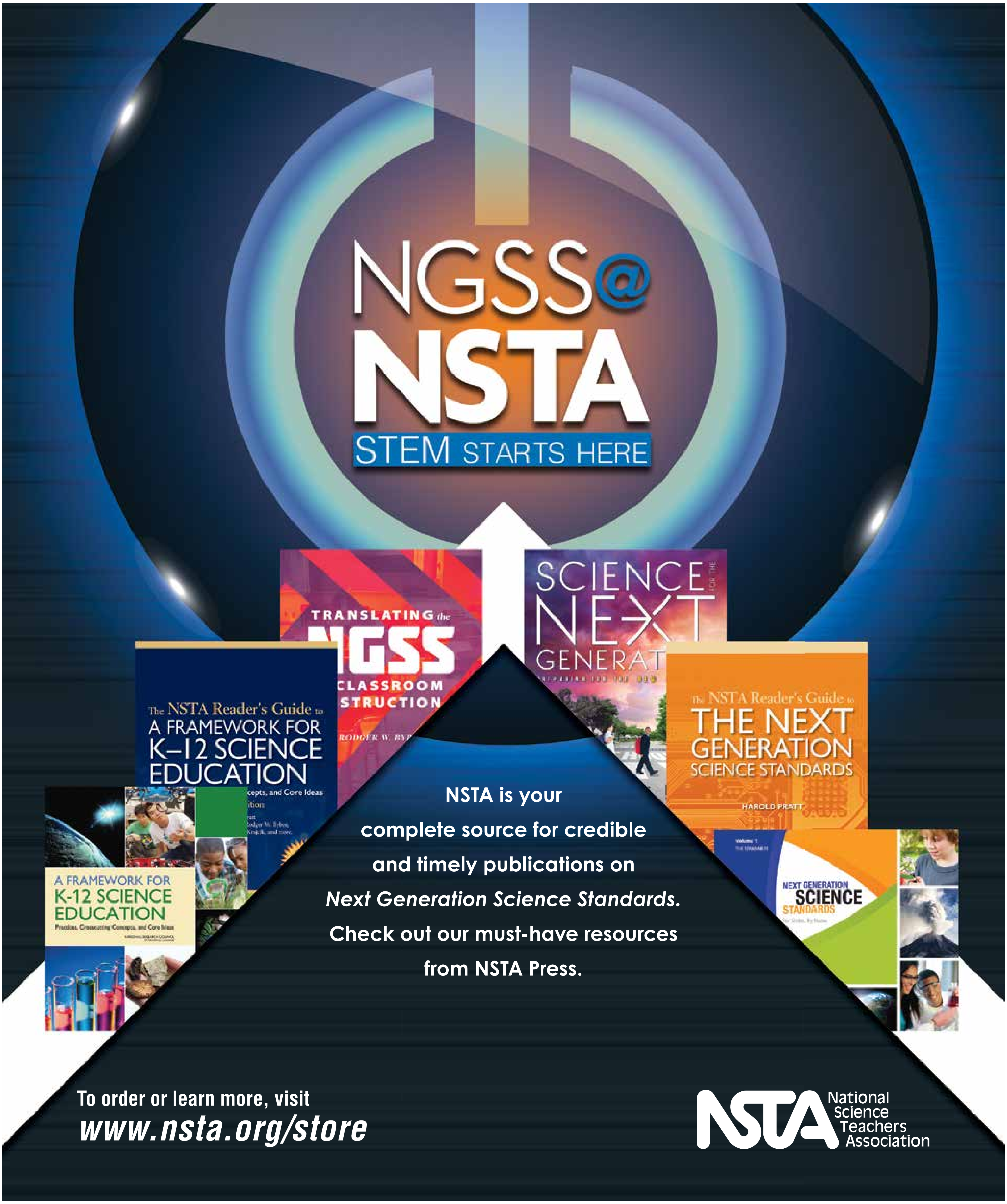
3. Aluminum and tape **expand** when heating, and **contract** when cooling.

a. Are the changes equal for both materials? Explain.

b. How does a bimetal strip work in a thermostat?



* **PROJECT:** Light a flashlight bulb with a candle. Use your bi-material strip, batteries, and other simple things.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Freebies for Science Teachers

Biomimicry Resources. Biomimicry incorporates designs and processes found in nature to solve human problems. At the Biomimicry Education Network (BEN) website (*http://ben.biomimicry.net*), educators can connect with colleagues exploring biomimicry in K–12 science classrooms, nature centers, and college courses worldwide. The website offers classroom curriculum for all grade levels, opportunities to involve students in biomimicry challenges, activities to build students' biomimicry sensibilities, and a blog.

Sparticl.org. A website for students ages 13 and older from Twin Cities Public Television and 3M can spark teens' interest in science, technology, engineering, and math (STEM) fields through an eclectic mix of videos, games, articles, and hands-on activities. Curated by experts from STEM-oriented organizations and universities, the attention-grabbing resources at *www.sparticl.org* have been vetted for accuracy and "teen appeal." Highlights include the video *10 Brilliant Rube Goldberg Machines* and Crypto Quiz, a trivia test involving the study of animals not formally recognized by science. Students can also join the community to rank favorites and share comments on social media, earning points and status in the process.


KEREM BARUT

Everest Expedition on the Web. Montana State University geology professor Dave Lageson chronicled his journey climbing Mount Everest in an interactive web page. Found at *http://bit.ly/Im7UQ6*, and most appropriate for students in grades 5–8, the page includes expedition updates, teacher materials, facts, and a library of multimedia resources about Mount Everest. Students can access profiles of expedition climbers, learn about geologic research conducted on the expedition, and discover facts to amaze friends. For example, did you know Mount Everest, the tallest mountain on Earth, is gaining height each year due to geological forces?

OER Textbook Replacement Courses: Grades 6–12. At Net Texts (*www.net-texts.com*), middle and high school teachers can access Open Educational Resources (OER) Textbook Replacement Courses to infuse static, expensive textbooks with engaging multimedia content. The courses are comprised of resources from Khan Academy and top colleges and universities, and they can be used to replace textbooks completely or supplement a curriculum. Titles include Earth and Space Science, Physical Science, and Life Science (grades 6–8); Science and Technology (grades 8–9); and Biology, Chemistry, and Physics (grades 9–12).

Veterinary Career Videos. Spark middle and high school students' interest in veterinary science with these DVDs from the American Veterinary Medical Association. Produced with funding from GlaxoSmithKline and distributed by the Agency for Instructional Technology, the videos—*Veterinary Medicine: It's More Than You Think* and *Rabies: Simple Steps Save Lives*—introduce students to diverse opportunities within veterinary science. Order copies at *http://avma.ait.net*.

goREACT! Turn your high school students into virtual chemists! Designed for smartphones, tablets, and the web, this chemistry app from Chicago's Museum of Science and Industry (*http://bit.ly/185JvTx*) features an interactive periodic table and more. With goReact, students can initiate nearly 300 virtual chemical reactions by dragging elements into the Reaction Area. In addition, students can view images and videos of their created molecules; select alternate views of the periodic table to learn about the elements' chemical properties; and follow links to additional resources.

Science Visuals Plus. At *http://tacktile.org*, middle and high school educators can access video clips, activity ideas, and lesson hooks to capture students' attention and incorporate into unforgettable lessons (free registration is required). Teachers can search for visuals in nearly every topic taught in middle school and high school science: geology/Earth science, biology, physics, chemistry, astronomy, and engineering. Note that clicking on a single discipline turns up only a sampling of visuals on the topic; use the keyword search to access more resources from multiple disciplines, including images from "around the web."

See Freebies, pg G2

Freebies, from pg G1

Science Scene. This quarterly online magazine for high school educators from Forestry Suppliers aims to move students beyond the book and into the field. Each theme-based issue at *http://bit.ly/1bYcTPs* highlights real-world applications of environmental science through interviews, classroom science lessons, apps, science products, and grant opportunities. The first issue explores the theme "Macro–invertebrates." A corresponding Facebook page enables teachers to share comments on each issue and connect with fellow educators.

CERIDWEN

IMOLD: The Interactive Model of Leaf Decomposition. This project for grades 9–12 from the University of Toledo's Department of Environmental Sciences teaches students about leaf decomposition and how it relates to the Earth's carbon cycle and climate. The site at *http://imold.utoledo.edu* offers animated lessons about decomposition and the carbon cycle; an interactive model that allows students to simulate decomposition for several plant litters in the same and different environments; and standards-based lesson plans for teachers.

The Center for Geoscience Education and Public Understanding. Earth science educators of all levels will appreciate this clearinghouse of geologic resources culled from federal agencies, science societies, nonprofits, and institutions of higher education. Developed by the American Geosciences Institute for the entire K–12 spectrum, the clearinghouse contains curricula, image collections, videos and animations, virtual field trips, professional development opportunities, career information, and more at *http://geocntr.org.*

Learning From Worms. A high school unit from University of Washington's Genome Sciences Education Outreach asks this question: *What Can We Learn From Worms? How the Model Organism Nematode* C. elegans *Maintains Balance in a Changing Environment.* Students investigate worms' responses to varying levels of salt (osmotic stress) to explore how genes and the environment interact to determine traits in living organisms. The unit contains five lessons (each with teacher background information and student worksheets), a final assessment, and a PowerPoint presentation. Access the unit matrix at *http://bit.ly/1dlnh8Y.*

The ArtSource Curriculum. Middle and high school educators seeking to integrate the arts into science and other subjects will appreciate this resource. Each unit of study at *http://bit.ly/1fH7n9l* focuses on a work of art from dance, music, or theater and identifies universal themes reflecting the essence of the selected work. For example, *The Story of Babar, the Little Elephant* features lessons and discussion questions that emphasize the themes of "Transformation" and "Power of Nature" and includes background facts about elephants.

AP Science Test Prep. At Varsity Learning Tools, registered educators can access practice questions, tests, and digital flashcards to help high school students prepare for Advanced Placement (AP) exams in chemistry, biology, physics, environmental science, and other subjects. Teachers can create custom tests and monitor individual and class performance, or students can use the practice problems on their own. The site at *www.varsitytutors.com/classroom-assessment* also offers test practice for K–12 assessments in reading, math, and other subjects.

What's the Purpose? Students Talk About Writing in Science. With the advent of *Common Core State Standards* and the increased emphasis on nonfiction reading and writing in today's classrooms, this 2005 article from the National Council of Teachers of English is more relevant than ever. The article considers science writing experiences in two fourth-grade classrooms in Michigan and offers insight from interviews with students about the sense students were making of the writing they did during science classes. Read the article at *http://bit.ly/1bTuNkO.*

AARON LOGAN

National Geo: Big Cats Education. K–12 educators and students can explore the importance of big cats and the conservation efforts to protect these large predators with lessons, videos, and activities from National Geographic Education. At *http://bit.ly/oTAWj0,* see big cats in action in videos like *How to Track a Snow Leopard* and *Cheetah Speed,* or learn about them in activities like Cats and their Coats (grades K–2), Big Cats and Their Habitats (grades 3–5), African Savanna Community Web (grades 6–8), and Captive Breeding Species Survival (grades 9–12).

Innovative Technology in Science Inquiry (ITSI) Project. ITSI engages students in grades 3–12 in STEM activities involving modeling, computational thinking, and real-time data acquisition. Through customizable curriculum units addressing topics in engineering, biology, chemistry, physics, and math, students will draw prediction graphs, collect real-time data with sensors, answer open-response questions, capture snapshots of their work with interactive models and digital microscopes, and draw conclusions based on their findings. View the curriculum matrix at *http://bit.ly/1cN6eYB.*

OpenEd Educational Catalog. With a searchable database of more than 250,000 Common Core–aligned videos and games curated by educators, OpenEd offers a range of open-source content for K–12 classrooms. Visitors to *https://www.opened.io* can search the site by keyword, subject, and grade, and by any one of the 3,300 *Common Core State Standards* currently in place, as well as by *Next Generation Science Standards,* national geography standards, and others. Teachers can also create courses and playlists to share with students and others (free registration is required).

Energy Foundations for High School Chemistry. Visit *http://bit.ly/1cfkitW* to access fully-developed laboratory investigations, demonstrations, readings, and multimedia to teach the big ideas about energy in your high school chemistry classroom. The resources are categorized in four areas: What Is Energy? How Do We Use Energy? How Can Energy Change? and Energy Theories. Each content item, as well as the entire resource collection, can be downloaded in PDF format.

Quarked! Adventures in the Subatomic Universe. Imagine a world in which children know the small and abstract parts of science as well as they know their favorite TV characters. Kansas University physics professors and educators are making that vision a reality through *www.quarked.org,* a kid-friendly website about particle physics. Targeted to students ages 7–12 (and their families), the website presents video, games and apps, lesson plans, and links that explore subatomic physics and familiarize students with terms and concepts.

Connected Classrooms. The Google+ social community for K–12 educators at *http://connectedclassrooms.withgoogle.com* features virtual field trips and "hangouts" (video conversations with multiple participants, broadcast live on Google+) on topics in science and nature, art and music, and social studies. Visit the website to register to participate in upcoming events or browse the archived collection. Past events have featured scientists and education experts from the Seattle Aquarium, the Minnesota Zoo, Zoo Atlanta, the Solar Impulse hangar, and Google Maps. ●

News Bits

- **Through the Kenan Fellows Program, a newly funded National Science Foundation (NSF) initiative, middle school teachers in North Carolina and their students will have the opportunity to engage in real research and discovery.**

North Carolina teachers chosen for the program will collaborate with scientists to develop course modules for their classrooms with a specific focus on scientific research. Though the five-year project is slated to begin in North Carolina, plans call for expanding the program to additional school systems and states each year. The goal is to ultimately recruit 10,000 science teachers nationwide for the program.

"We will have students making new scientific discoveries, improve the learning outcomes of those students, get teachers excited about the work, and find ways to scale this up for use across the country and beyond," says Rob Dunn, associate professor of biology at North Carolina State University and principal investigator of the NSF grant. Learn more about this $7.3 million "citizen science" initiative at *http://kenanfellows.org*. North Carolina teachers should apply at *http://education.yourwildlife.org* by **February 9.**

- **Microwave ovens are good for more than just TV dinners: They're also great for organic chemistry labs!**

Leah Eller, assistant professor at St. Mary's College of Maryland, and her colleagues have recently received one of the NSF's highly competitive Transforming Undergraduate Education in STEM grants to develop a new organic-laboratory curriculum using microwave technology. Microwaves reduce the time it takes for organic reactions to occur from several hours to a few minutes. "It's not just about cutting back on time, [however]," Eller says. "It's what we're doing with that extra time. Students will have the opportunity to gain conceptual knowledge instead of just running the experiment and saying, 'Yes, it worked,' or 'No, it didn't work.'" Using microwaves, she contends, will allow more time for experimental design and analysis, troubleshooting, and debriefing.

Learn more about the project at *http://bit.ly/1bL9GkN*.

- **At Medgar Evers College Preparatory School in Brooklyn, New York, eighth-grade students not only take physics courses, but also take the Regents exam in physics—a rigorous test many New York high school students don't even take—and 90% of them pass it.**

Medgar Evers, a New York City public school for grades 6–12, admits students who show academic promise. The student body is 97% African American, and four out of five students receive a free lunch. Student enrichment also occurs during a required six-week summer session, with academics in the morning and sports and other activities in the afternoon.

Those who pass the Regents exam in physics are able to take more advanced physics courses in high school and college. "If kids are young enough, then they won't know to be intimidated [by the subject]," says longtime physics teacher Jason Klein. "It seems to work here." Read more at *http://nydn.us/Ian3nh*. ●

What's New

FROM U.S. GOVERNMENT SOURCES

National Institutes of Health (NIH)

Drugs and Our Brains

The National Institute on Drug Abuse (NIDA) offers fact-based, online resources to educate K–12 students, teachers, and parents about how drugs affect the brain and body. At NIDA for Teens (*http://teens.drugabuse.gov*), students ages 11–15 can access animated illustrations, quizzes, and games to learn about the topic. The Sara Bellum blog (*http://teens.drugabuse.gov/blog*) offers addiction science research and news, and PEERx (*http://teens.drugabuse.gov/peerx*) presents facts, videos, and information about the use and abuse of prescription drugs.

At the Parents and Educators page (*www.drugabuse.gov/parents-educators*), NIDA provides age-appropriate resources for K–12 classrooms. For example, NIDA's Brain Power! curriculum offers learning modules for grades K–5 and 6–9 that teach students about their brains and why they should protect them. High school students (grades 9–12) study the brain by learning about addiction using the curriculum *The Brain: Understanding Neurobiology Through the Study of Addiction.*

Biomedical Beat Research Blog

Give your middle and high school students an inside look at medical sciences through *Biomedical Beat,* an online digest of current, cutting-edge research news from the NIGMS at *http://biobeat.nigms.nih.gov.* Through short, easy-to-read articles about science and scientists, *Biomedical Beat* illustrates the latest concepts and advances in a range of fields, including cell biology, chemistry, and genetics. The blog format allows students and educators to post comments and questions about articles, as well as access additional resources.

Findings Magazine

Meet Emily Scott, a biochemist whose passions include studying enzymes and scuba diving. You can learn about Emily's research, and her life outside the lab, in *Findings* magazine, a free publication from the NIGMS. Designed for middle and high school students, *Findings* introduces readers to careers in the sciences, describes recent research advances, and includes a science-based crossword puzzle or other activity. Current and past issues are available at *http://publications.nigms.nih.gov/findings.*

Cell Day 2014

On February 28 from 10 a.m. to 3 p.m. Eastern Time, National Institute of General Medical Sciences (NIGMS) scientists will host a web chat to "cell"-e-brate the smallest form of life—the cell—and introduce middle and high school students to careers in research. On Cell Day, the scientists will field questions from students, teachers, and the public. Past questions have included these: How many cells are in the body? How do cells end up forming tumors? What kinds of jobs are up and coming in cellular biology? What are HeLa cells, and why are they so special? For more information, classroom resources, registration, and a transcript of Cell Day 2012, visit *www.nigms.nih.gov/cellday.*

U.S. Department of Energy (DOE)

ScienceLab Education Resources

The DOE's ScienceLab at *www.osti.gov/sciencelab* provides students with homework help, project ideas, competitions, internships, activities, and more. Geared toward K–12 students, but equally useful for educators, the website unifies the DOE's science, technology, engineering, and mathematics (STEM) education content in a single location, providing easy access to vetted STEM education resources. Students can search for resources by grade level (elementary, middle, and high school) or by topic (Things to Do, Science Info, At the Lab, Work and Learn, and Competitions).

Have a science question not easily answered by textbooks or online references? Check out the Ask-a-Scientist feature, run by Argonne National Laboratory, which boasts a library of more than 20,000 responses, with new ones being added. If students can't find their questions in the archives, ask away: The experts will answer!

National Oceanic and Atmospheric Administration (NOAA)

ESSEA Ocean and Climate Learning Modules

The Earth System Science Education Alliance (ESSEA) is a NASA-, National Science Foundation–, and NOAA-supported program aimed at improving geoscience instruction for K–12 teachers. In the program, teachers take inquiry–based online courses created by participating institutions to increase their Earth science knowledge and find effective ways to teach it. Typical courses are 12–16 weeks long and are comprised of 3–4 learning modules. While the modules are designed for teachers taking ESSEA courses, they can also be used with K–12 students. The modules feature situations, connections to the standards, resources, and sample investigations. Unless a module is labeled K–4, it can be adapted for grades 5–12. In addition, the web pages How to Use This Site With K–12 Students (*http://esseacourses.strategies.org/k12.html*) and Inquiry Strategies to Use in Your Classroom (*http://esseacourses.strategies.org/inquiry.html*) offer tips for using the modules with students.

NOAA has 16 ESSEA modules exploring ocean and climate change at *http://esseacourses.strategies.org/module.noaa.html*. Titles include K–4 Oceans (Air, Land, Living Things, and Water); K–4 Keepers (Air, Land, Living Things, and Water); and Ocean Acidification.

National Aeronautics and Space Administration (NASA)

Global Climate Change Education (GCCE) Learning Modules

NASA's GCCE ESSEA courses are designed to help teachers increase their Earth science knowledge and improve instruction. Teachers can also use the course learning modules with students. The modules feature situations, connections to the standards, resources, and sample investigations. Unless a module is labeled K–4, it can be adapted for grades 5–12. In addition, the web pages How to Use This Site With K–12 Students (*http://esseacourses.strategies.org/k12.html*) and Inquiry Strategies to Use in Your Classroom (*http://esseacourses.strategies.org/inquiry.html*) offer tips for using the modules with students.

Currently, 22 GCCE ESSEA learning modules from NASA are available at *http://esseacourses.strategies.org/module.nasa.html*. Titles include Arctic Oscillation; Carbon City; Energy for Me: Sustaining My Community With Renewable Resources; K–4 Climate (Air, Land, Living Things, and Water); Mountain Glaciers: Going, Going, Gone; and Sunspots.

Pioneering Mars Curriculum, Activity Guide

This curriculum for grades 5–8 introduces NASA's Pioneering Mars project (*www.pioneeringmars.org*) while teaching students about scientific problem solving and experimental design. The Pioneering Mars experiment seeks to understand the growth of cyanobacteria in a Mars-like environment. The cyanobacteria would effectively scrub the Martian atmosphere of carbon dioxide and alter the planetary environment to enable photosynthesis to occur.

In the curriculum at *http://bit.ly/192s2Nf,* each unit addresses a core component of the project and leads students through the processes of researching and synthesizing information. The lessons span academic disciplines and address reading, math, writing, and science content. All activities are tied to *Next Generation Science Standards* and *Common Core State Standards* for grades 5–8. While designed primarily for middle level use, high school teachers can easily adapt the curriculum.

Cosmic Times 2019

Share your students' visions of Cosmic Times 2019! How much closer will we be to solving the mysteries of dark energy and the nature of the universe? What tools will we have then that we lack now? In this project for grades 7–12, students create a newsletter, web page, audio podcast, or video describing their ideas about where we will be scientifically in the year 2019. Speculations must be based on today's science and technology. Teachers can submit students' creations to the Cosmic Times website; the best submissions will be showcased online. For a lesson plan and submission guidelines, visit *http://1.usa.gov/15hMIi9*.

Art and the Cosmic Connection

In this interdisciplinary program at *http://discovery.nasa.gov/art,* students engage in space science education by becoming artist explorers! They learn to analyze images of planets and other smaller celestial bodies with basic art concepts paralleling scientific practice. Scalable for any grade level from K–college, this resource combines art, science, and storytelling. Materials include an educators guide, a PowerPoint presentation, Presentation Notes, and Space and Earth Images. In addition, an Interactive Poster highlights student artwork and the NASA images that inspired it, as well as art concepts such as shape, line, color, value, and texture.

U.S. Environmental Protection Agency (EPA)

Environmental Health Program

Recipes for Healthy Kids and a Healthy Environment, a program for grades 4–8, can excite students about environmental health and empower them to take action. Lessons at *http://go.usa.gov/DCKx* include Environmental Health 101; Pesky Pests and Household Hazards; Breathing Easy; Be Sun Smart; Climate Change and You; Keeping All of Our Waterways Clean; Healthy Water Inside; Sustainable Foods, Healthy Eating, and Community Gardens; and All Together Now—Air, Water, Food, and Shelter.

U.S. Department of Agriculture (USDA)

Soil Infographics

Unlock the Secrets in the Soil, a collection of infographics from the USDA's Natural Resources Conservation Service, colorfully illustrates soil health: what soil is made of, what's underneath it, and what soil does. The downloadable images, available at *http://1.usa.gov/1fRQ00S,* would be useful additions to K–12 Earth science and environmental science classrooms; teachers can also use the infographics to share conservation messages in class or on community websites and e-newsletters.

U.S. Department of Education (ED)

Science Efficacy of Ninth Graders

First Follow-Up: A First Look at Fall 2009 Ninth Graders in 2012, a National Center for Education Statistics (NCES) report, introduces new data from the High School Longitudinal Study of 2009, collected in Spring 2012 when most sample members were in 11th grade. The analyses at *http://1.usa.gov/1cxMIQV* examine students' math and science efficacy; students' educational expectations; students' math performance on an algebra assessment, including gains since grade 9; and students' initial planning for postsecondary educational application and enrollment.

A Look at NAEP and TIMSS Results

The NCES recently released *U.S. States in a Global Context: Results from the 2011 NAEP–TIMSS Linking Study,* a report from a study initiated to enable states to compare the performance of their students with that of students in other countries. The study links the National Assessment of Educational Progress (NAEP) scale to the Trends in International Mathematics and Science Study (TIMSS). Results come from the data of eighth-grade students in all states/jurisdictions that participated in the NAEP mathematics and science assessments. Read the executive summary or the full report at *http://1.usa.gov/1b30lUh.* ●

In Your Pocket

Editor's Note

Visit www.nsta.org/publications/calendar *to learn about more grants, awards, fellowships, and competitions.*

Lawrence Scadden Teacher of the Year Award in Science Education for Students With Disabilities

Co-sponsored by Science Education for Students With Disabilities (an NSTA Associated Group) and Reaching the Pinnacle for Students With Disabilities, New Mexico State University, this award recognizes excellence in science teaching for students with disabilities. The honoree will attend the NSTA National Conference in Boston in April, be recognized at the Science-Abled Breakfast, and receive $1,000 for travel expenses. K–12 science, general education, or special education teachers in public or private schools with at least five years of teaching experience may apply by **January 20** at *www.sesd.info/scadden.htm.*

National Chemistry Olympiad Mentors Needed

The American Chemical Society (ACS) is accepting applications from U.S. high school teachers for mentor positions with the U.S. National Chemistry Olympiad (USNCO). During their three-year term (2014–2017), mentors help prepare top USNCO students for the International Chemistry Olympiad.

The first summer in the program, mentors work with students in a two-week study camp in Colorado Springs, Colorado; in their second and third summers, mentors accompany students to the International Chemistry Olympiad and serve on the International Jury. Mentors receive an honorarium, and the ACS covers most travel expenses.

Mentors should have a background in one or more of the following areas: organic chemistry, inorganic chemistry, analytical chemistry, physics, or biochemistry. They should have classroom experience and demonstrate involvement in special projects or activities with students. Apply by **January 24;** see *http://bit.ly/183rzKw* for details.

Amgen Award for Science Teaching Excellence

These awards recognize extraordinary contributions by educators in the United States, Canada, and Puerto Rico who advance science literacy by motivating students and using creativity in the classroom. Nine science teachers from select communities in California, Colorado, Kentucky, Massachusetts, Rhode Island, Washington, Puerto Rico, and Canada will receive a $5,000 cash award; their schools will also receive a $5,000 grant for science resources, professional development for the school's science teachers, or the expansion or enhancement of the school's science program. Apply by **January 29** at *http://bit.ly/10PuJ32.*

Fund for Teachers Grants

PreK–12 teachers can use these grants to support professional development experiences of their own design, occurring anywhere in the world. Individual teachers receive up to $5,000 and groups receive up to $10,000 to conduct their own summer projects. Application instructions vary by state; check eligibility and apply online by **January 30** at *www.fundforteachers.org.*

Captain Planet Foundation Grants

The Captain Planet Foundation awards grants to schools and nonprofit organizations that share its mission: to help youth better understand the world through active, hands-on learning experiences that improve the environment in their schools and communities. Preference is given to requests of $500 or less and to those who have secured 50% matching or in-kind funding; grants of up to $2,500 are available. Ideal projects will incorporate both environmental education and service opportunities for youth. Apply by **January 31;** consult *http://bit.ly/N4BTqL*.

SPIE Education Outreach Grants

SPIE, the international society for optics and photonics, provides grants for optics- and photonics-related education outreach projects. Schools, youth clubs, universities, science centers, optics centers, industry associations, and optical societies are eligible for grants of up to $5,000. Projects are judged by their potential to impact students and increase optics and photonics awareness. Apply by **January 31;** consult *http://spie.org/x36692.xml*.

MAXIMUS Charitable Foundation Grants

The MAXIMUS Charitable Foundation awards grants to organizations that help disadvantaged youth achieve self-sufficiency and personal growth. Grants of up to $5,000 are available. Apply by **January 31;** see *http://bit.ly/LgNOpd*.

American Association of School Librarians Collaborative School Library Award

The American Association of School Librarians (AASL) presents this award to recognize collaborations between school librarians and teachers. Recipients will have executed a project, event, or program to further informative literacy, independent learning, and social responsibility using the school library. School librarians must be AASL members.

Winners receive $2,500. See *http://bit.ly/1gZtp7w* for details; apply by **February 1.**

Toshiba America Foundation Science and Math Improvement Grants

Science and math teachers of grades 6–12 with innovative classroom project ideas may apply for these awards. Applications requesting less than $5,000 are accepted year-round. Requests of more than $5,000 are due by **February 1.** Visit *www.toshiba.com/taf*.

American Honda Foundation Grants

The American Honda Foundation awards grants of between $20,000 and $75,000 to youth education programs focused on science, technology, engineering, and math (STEM) and the environment. Programs should be imaginative, creative, youthful, forward-thinking, scientific, humanistic, or innovative. Public and private elementary and secondary schools, public school districts, and nonprofit organizations with 501(c)(3) status are eligible. Apply by **February 1** at *http://bit.ly/OnjIiB*.

Visions of Exploration STEM Grants

These grants from the Air Force Association and *USA Today* help provide lessons and resources to enhance students' understanding of STEM and aerospace education. Lessons are aligned with *Common Core State Standards,* and classrooms are provided access to *USA Today* in print and online. Registration is open to all educators; grants are available on a first-come, first-served basis. Apply by **February 1** at *http://bit.ly/187VtNJ*.

Air Force Jr. ROTC Grant

The Air Force Association provides grants to promote aerospace education. Funds must be used for aerospace-related items, such as books, materials, or field trips to an aerospace museum, Air Force base, or other aerospace facility. Awards up to $250 are available for classrooms and Junior ROTC units. Apply by **February 10** online at *http://bit.ly/18sWJ3p*. ●

Summer Programs

Editor's Note

Visit www.nsta.org/publications/calendar *to learn about more summer professional development opportunities.*

Global Teacher Fellowship Program. Through this program, the Rural Trust provides fellowships for the professional and personal development of 25 rural teachers. Recipients design their own summer learning experiences and attend a two-day, place-based learning institute the following fall. Fellows are encouraged to pursue international study experiences over the summer from which to develop place-based curricula meeting their state's content standards. Grants of $5,000 are available for individual teachers; teams of two or more can apply for grants of $10,000.

Full-time K–12 teachers with four years of teaching experience who teach at least 60% of the time in rural communities are eligible. Counselors, media specialists, and other personnel with four years of teaching experience who work in a teaching setting at least 60% of the time may also apply. Apply by **January 30;** see *http://bit.ly/1fEcyH5.*

Siemens Teachers as Researchers (STARs). This program selects 40 educators to attend one of two programs held at the Oak Ridge National Laboratory in Tennessee. For two weeks in June or July 2014 (with all expenses paid), STARs will study and conduct research with the nation's top scientists and collaborate with teams from world-renowned labs to conduct their own research projects. They'll gain skills and content they can use in their science, technology, engineering, and math (STEM) classrooms.

STARs is sponsored by the Siemens Foundation and Discovery Education, in partnership with Oak Ridge Associated Universities, and is part of the Siemens STEM Academy, a professional development initiative to advance STEM teaching in the United States. STARs applicants must be full-time teachers who intend to continue teaching in the 2014–2015 school year, teach one or more STEM course in grades 6–12, and be a U.S. citizen or a permanent resident alien. Apply by **February 4;** see *www.siemensstemacademy.com.*

Siemens STEM Institute. In another Siemens STEM Academy program, 50 middle and high school STEM teachers will be selected to participate in a hands-on immersion program with all expenses paid. Teachers will learn about new tools and technologies in the field, engage with top STEM leaders and scientists, and gain a behind-the-scenes look at national STEM institutions. The institute will take place August 3–8 at Discovery Communications headquarters near Washington, D.C.

Participants must be full-time teachers who intend to continue teaching in the 2014–2015 school year, teach one or more STEM course in grades 6–12, strongly desire to improve teaching and learning in the classroom, and be a U.S. citizen or a permanent resident alien. Apply at *www.siemensstemacademy.com* by **February 4.**

UMass Nanotechnology Summer Institute. Teachers will explore basic science and engineering concepts in nanotechnology and discover how they can be integrated into a science, math, or technology classroom. The program is open to teachers of these courses at the middle and high school level. Content will be aligned with the Massachusetts Science and Technology/Engineering Framework, and participants will begin developing curriculum units for their classrooms, to be implemented in the fall.

The institute runs July 7–11 at the University of Massachusetts (UMass) Amherst. Participants receive a $375 stipend, food, parking, lunches, and funds for materials; housing is provided for those outside the commuting radius. Participants also can earn free professional development points or graduate credits at a reduced cost. Applications are due **April 1,** though late applications will be accepted if space is available. See *www.umassk12.net/nano.*

Earthwatch Teach Earth Educator Fellowships. Educator Fellows spend one to two weeks on an Earthwatch Expedition to research and explore environmental concerns. The program allows K–12 teachers to work in the field and bring the knowledge they gain back to their classrooms. Fifty participants will be selected. Recent projects have included Spotting Songbirds in the Rockies in Wyoming and Climate Change and Caterpillars projects in Arizona and Ecuador.

Expedition and transportation costs, along with a stipend, are provided. Apply by **May 1;** see *http://bit.ly/1bY049H.*

McDonald Observatory Summer Teacher Workshops. The observatory in the Davis Mountains of West Texas, will host six summer workshops for K–12 teachers. Teachers will meet astronomers and discuss current research, practice basic astronomy skills, tour the facility's telescopes, and conduct nighttime observations. Topics, dates, and recommended grade levels are

- Explore Our Solar System (June 19–21, grades K–8);
- Telescopes, Instruments, and Observations (June 23–25, grades 6–12);
- Worlds Beyond Our Solar System (June 26–28, grades 6–12);
- Giant Magellan Telescope (June 29–July 1, grades 8–12);
- Star Dust—Linking Distant Galaxies to Us (July 8–10, grades 8–12); and
- Earth and Space Science (July 31–August 2, grades 8–12).

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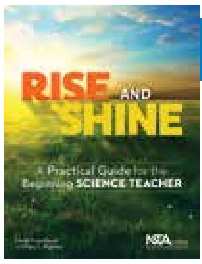


NSTA PRESS: *RISE AND SHINE: A PRACTICAL GUIDE FOR THE BEGINNING SCIENCE TEACHER*

Chapter 7: Teaching Strategies

Editor's Note

NSTA Press publishes high-quality resources for science educators. This series features just a few of the books recently released. The following excerpt is from Rise and Shine: A Practical Guide for the Beginning Science Teacher, *by Linda Froschauer and Mary L. Bigelow, edited for publication here. To download the full text of this chapter, go to* http://bit.ly/1aNbESH. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

After many years of teaching and reflecting, you will have a collection of successful strategies to use with your class. This will become your own personal repertoire to use in situations you face every day. During your years of trying various strategies, you will find that some work fabulously for you in many situations, while others are more focused and work better in limited situations. Don't expect all teaching strategies to work for you every time. If a strategy doesn't seem to work, reflect on possible reasons. But don't be afraid to try new ways to reach students and support them in learning science.

Motivating Your Class

Think about your own learning experiences. In what situations were you most eager to learn? Was it in a class when the teacher enthusiastically dove into each experience, or was it a class when the teacher introduced you to new information in a dour manner? Your students will react to the way you communicate with them. You are the most significant motivating factor in your classroom.

You can threaten, cajole, plead, or reward students into doing what you want, but the ultimate decision about how much to participate is made by the students. Here are some ways to create lessons that will help you motivate students:

- Make it real. To foster intrinsic motivation, try to create learning activities based on topics that are relevant to your students. This is easy to do in science with topics such as DNA and heredity, forensics, simple machines, weather and climate, and environmental issues. Use local examples, events in the news, and technology, and take advantage of teachable moments that connect the subject with your students' real-life interests, concerns, hobbies, and backgrounds.
- Provide audiences for student work. When students know their work will be placed on display, published, read aloud, or shared with parents, they may take it more seriously and will likely give it their all.
- Create appropriate rigor. Students perform best when the level of difficulty is slightly above their current ability level. If the task is too easy, it promotes boredom and may communicate a sense that the teacher believes the students are not capable of better work. A task that is too difficult may feel unattainable and create anxiety or a sense of defeat.
- Use projects and open-ended questions. These assignments give students an opportunity to use their higher-level thinking skills and creativity. Open-ended questions also eliminate some of the risk of failure students may feel.
- Celebrate successes. Give frequent, early, and positive feedback that supports students' beliefs that they can do well. Students can also learn by watching a peer succeed at a task.
- Establish a sense of belonging. In an academic environment, research shows that students who feel they belong have a higher degree of intrinsic motivation and academic confidence (Goodenow 1992; Marzano, Pickering, and Heflebower 2010; Wilms 2000). Students say their sense of belonging is fostered by a teacher who demonstrates warmth and openness; encourages student participation; is enthusiastic, friendly, and helpful; and is organized and prepared for class.
- Provide choices. Students can have increased motivation when they feel some sense of their role in constructing their experiences. Allow students to occasionally pick their own lab partners or select from alternate assignments. Full-inquiry investigations provide a feeling of empowerment because students are given many opportunities for making choices as they complete the investigation. More complex ways to involve them is through "contract learning," in which students can determine their own due dates, assignments, or products.
- Ask students to evaluate themselves. When students know they will have input in the evaluation of their work, they are more likely to work toward the goals. This input is supported through providing students with a rubric that establishes accountability.
- Strategize with struggling students. Identify the learning problems students face. Be specific in addressing their needs, and communicate your belief in their abilities. Then, go on to support them in their learning.
- Arouse students' curiosity. This can be done through provocative questioning or by providing intriguing examples, such as a discrepant event. A discrepant event puzzles observers; it is contrary to what students expect (a discrepancy in understanding), causing them to wonder about what is occurring. With proper guidance from you, students will attempt to figure out the discrepancy and begin the process of seeking an explanation for the situation. This might be a connection to previous learning or may initiate a new question or inquiry. A quick internet search will provide you with many examples of discrepant events (see the resources list at the end of this chapter).

Once the motivation momentum is established, step back and see how much students can accomplish. But don't rely on infrequent motivational tools to keep them going. You must be diligent about this strategy and make it a part of what you do each day. Keep motivation in mind as you plan.

Modeling

In working with students, you can't assume anything. For example, you might ask them to brainstorm, reflect, read and take notes, or review for a test, but they may not really know how to do these. They could exhibit their frustration through disruptive behaviors, adding to their problems. Model the processes you want them to use through "think alouds," in which you literally talk your way through a process, making the process visible (and audible). Make some intentional mistakes, verbalize how you recognize the errors, and ask the students how you could deal with the errors.

Show the students what a well-written lab report, project, data summary, diagram, or science notebook looks like. Take notes together at first to show students how to find and record important information. Break tasks into small, doable components. Plan for most assignments to be completed in class at first, so you can guide the students through the task. After a while, these "scaffolds" can (and should) be scaled down for most students; other students may need continued support.

The basic guideline here is to consider what you want your students to provide and then give them an example. Don't just tell them what is expected: Show them. ●

NSTA MEMBER POLL: **What You're Saying**

Are Course Fees Feasible?

Schools take a number of approaches to resolving budget shortfalls, from holding bake sales to applying for grants. Some even charge fees for classes that require consumable materials or expensive equipment, but the practice, particularly in public schools, raises concerns for educators and parents alike. In a recent informal *NSTA Reports* poll, a majority of respondents (60%) indicated their schools and districts do not charge fees for science courses. At schools that do charge fees, educators indicated the most common practices were to charge a fee for all science courses (60%) and at all levels (91%). Most participants (78.5%) reported the average fee per course was less than $25.

Schools charging fees for science took measures to minimize the impact on economically-disadvantaged students by allowing them to request waivers based on financial needs (87%) or to use funds from a parent organization or other group to pay fees (13%).

The question of fees generates strong reactions. **Here's what science teachers are saying about course fees:**

I think the only time it is applicable to charge for a science class in public education would be if a student purposely broke some lab equipment. *—Educator, Middle School, High School, Minnesota*

Course fees do not belong in public education. Qualified students should have access to any course regardless of their families' ability to pay a fee. *—Educator, Middle School, California*

We do not charge fees, but some of our school's science programs run fundraisers to earn money for supplies for investigations.*—Other, Middle School, High School, Texas*

They are an unfortunate necessity. District funding barely replaces chemicals used each year.*—Educator, High School, South Carolina*

I think they are a necessary evil with today's shrinking school budgets. If we didn't have the fee, it would be very hard to run labs and activities. *—Administrator, High School, Illinois*

I don't like that we have to charge them. But we get no budgeted [funds] for science lab supplies, so we charge a fee, have no penalty if a student does *not* pay, and what is not covered by fees collected is bought for out-of-pocket by our teachers each year.*—Educator, High School, Virginia*

The school district and the state [do] not allocate enough money to run a science program. If the students want to participate in the hands-on activities, they need to invest a small amount of capital so that can happen.*—Educator, High School, Alabama*

It is a necessity based on the abysmal state of school finances today. *—Educator, High School, Ohio*

An Equity Issue

It places one more barrier to equality. Students whose parents have money can afford the more expensive equipment and labs; those whose families are strapped for cash once again get less...No fees unless there is an equitable, impersonal way to get money for *all* students at *every* school.*—Educator, High School, California*

I think allowing fees for science sends a message to the students that science is only accessible to wealthy people with disposable income.*—Educator, High School, Pennsylvania*

I feel it does create inequality, because Earth science/environmental science is "free" to take, but chemistry and physics cost money.*—Educator, High School, Ohio*

They could be a way of discouraging less economically advantaged students from getting valuable science training. Even if programs are offered, some kids won't fill out the paperwork or express interest because they feel ashamed of their economic status. *—Educator, Middle School, High School, Iowa*

The Case for Fees

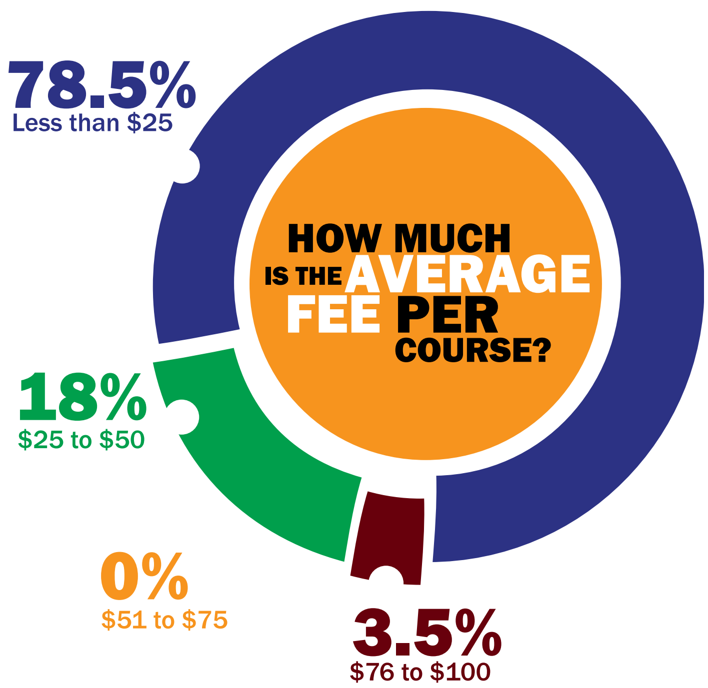
I couldn't teach labs or offer materials in my classes without them! What are the alternatives? Teachers buying their own supplies? I already get paid below the line for my own children to qualify for free and reduced[-price] lunch!*—Educator, High School, Institution of Higher Learning, Indiana*

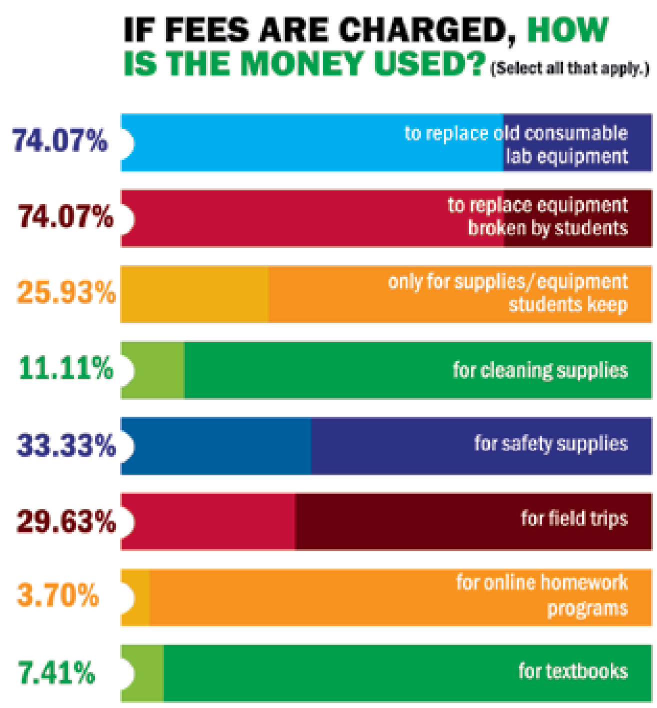
Our school has a modest ($75 per year) student fee. No differentiation for difference in courses taken. There is help for those who have difficulty paying. We used to have fees per science course that were greatest for the upper-level lab courses. But we felt it discouraged some families from allowing their children to enroll in the upper-level sciences, so that was scrapped about 10 years ago. *—Educator, High School, Ohio*

I used to teach in another state where a minimal science lab fee was charged. It permitted teachers to purchase needed non-replenished materials and also provide more activities in general for students. The students were higher achieving as a result and had a much more positive attitude toward science, even if they didn't like the subject. *—Educator, Middle School, Florida*

I think it's a good idea for elective courses, not required ones.*—Educator, High School, Missouri*

I wish our school could at least request them. The law in California now prohibits us from even asking for donations, and that has significantly impacted my abilities to procure materials for labs.*—Educator, High School, California*





BLICK ON TV

Legendary Science in *Grimm*

by Jacob Clark Blickenstaff

I come to the television series *Grimm* late, as it is now in its third season, and I had not seen any episodes before this fall. As my wife is an English professor who specializes in studying folklore's influence on literature, I find this a bit surprising. After checking out a few episodes, and perusing the *Grimm* wiki (*http://bit.ly/1jhz4VZ*) for a while, I believe this series is worth catching up on, and it contains pieces useful for sparking classroom conversation about biology, chemistry, and physics.

Grimm is set in Portland, Oregon, and focuses on police detective Nick Burkhardt and his partner, Hank Griffin. In the first episode, Nick begins to see things no one else can. He catches brief glimpses of monstrous features on people who otherwise appear normal; first, a woman walking down the street, then a suspect being interviewed at the police precinct.

On the same day when remains of a red-hooded jogger are found in a local park, Nick's librarian aunt appears on his doorstep. She reveals that he is a descendant of the Brothers Grimm, a lineage that comes with certain powers and responsibilities. Fundamentally, the creatures described in fairy tales are real, and as a group are known as Wesen. Wesen have a variety of special powers, including superhuman strength, very sensitive noses, and the ability to breathe underwater. While Nick (as a Grimm) sometimes can see what Wesen really look like, other humans are unable to recognize them. Many Wesen are unobtrusive, and live peacefully among the general populus, while others are violent and very dangerous. (The *Grimm* wiki I mentioned earlier includes a full rundown of all the species of Wesen and their characteristics.)

The pilot episode focuses on a Blutbad (German for "bloodbath"), the Wesen at the core of tales of the Big Bad Wolf. Notice the jogger attacked at the start of the episode was wearing a red-hooded sweatshirt…As the pilot episode ends, viewers are in the same position as Nick: We have just begun to understand that a parallel society of Wesen is living alongside humans, and it is the Grimm's responsibility to protect humans from dangerous Wesen.

Setting the show in Portland allows for a wide range of habitats to be populated by Wesen. The Columbia River, one of the largest rivers in North America, runs through Portland and forms the border between Oregon and Washington. This habitat is ideal for aquatic Wesen, like naiads. Portland is close to significant stretches of temperate rainforest, regions with cool summers, mild winters, and annual rainfall of more than 140 cm (55 inches). These dark, damp forests were used frequently in *The X-Files* and again provide a spooky backdrop for *Grimm*'s Wesen. Finally, the urban center of Portland is an ideal habitat for those who thrive in densely populated areas (the rodent-like and insect-like Wesen).

A recent episode focuses on a community of naiads, mermaid-like Wesen who have gills to breathe underwater and can swim very, very fast. Naiads also must live near water, as their skin will dry out and they will die of dehydration if unable to enter the water every 24 to 36 hours. When transformed into their naiad form, they have webbed hands and feet, along with gills on their neck. Naiad qualities appear to be a combination of amphibian (requiring moisture) and piscine (having gills and capable of swimming swiftly).

Questions of chemistry and physiology arise when I consider a humanlike creature breathing with gills:

- How much oxygen is dissolved in water, compared to the amount in the air?
- Based on that, how much water would have to pass over the gills to get enough oxygen?
- And then, how large would gills have to be to obtain enough oxygen for a human-sized creature to survive?

A couple of quick internet searches reveal that oceans and rivers typically have 8–10 grams of dissolved oxygen per liter of water. The temperature, salinity, and local population of aquatic plants significantly impact dissolved oxygen levels. Air has 30 to 40 times as much O_2 per liter (about 20% of the atmosphere is oxygen). This means it would take 30 to 40 times as much water as air to provide enough oxygen. Adult humans typically exchange about 0.5 liters of air with a resting breath, so at rest, gills would have to process 15–20 liters (4–5 gallons) of water. I know I would find it quite challenging to move 4 gallons of water through my nose or mouth several times a minute. A human-sized naiad would require gills at least as large as their lungs, running the length of their torso.

All of this leads me to conclude that a warm–blooded, human-sized creature would have great difficulty breathing underwater with gills—particularly when clothed. Fish are able to survive with gills in part because they are *poikilotherms:* They take on the temperature of their environment, so their energy and oxygen needs are much less than those of warm-blooded animals.

The naiads' webbed hands and feet would certainly make them more efficient swimmers than humans are: We have to keep our fingers close together to cup and push against the water, while webbing would enable hands and feet to push with a larger "paddle." Adding the increased strength that most Wesen seem to have, I could imagine a naiad might be able to double or even triple a human's swimming speed over a short distance. The world record for the 50-meter freestyle is about 20 seconds, so the average speed of a swimmer with that pace would be 50m/20s or 2.5 m/s. If we imagine that a naiad could triple that speed, and travel at 7.5 m/s, she would cover the 50 meters in less than 7 seconds. Wow! Even so, it appears that the naiads were depicted as moving even faster in the *Grimm* episode.

Biology, chemistry, and even physics teachers can take advantage of Wesen characteristics in *Grimm* to discuss adaptations, physiology, and kinematics. ●

Jacob Clark Blickenstaff is the program director for Washington State Leadership and Assistance for Science Education Reform in Seattle. Read more Blick at http://bit.ly/amBgvm.

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JUDY MCKEE: **Life After Retirement**

Writing a Successful Retirement Story

"Retirement was the toughest thing I've had to do after 38 years," reports a retired NSTA member. Although people react differently to retirement, concern is typical when contemplating the next chapter of our lives. Some worry about the loss of stimulation and structure that accompanies teaching. Others fear the programs they invested in so deeply won't continue without them. Some wonder about redefining friendships with colleagues absent regular contact. Concerns about aging and outliving financial resources also preoccupy teachers considering retirement.

Tackling worries head-on with a friend who is retiring might be helpful. Discussing concerns, interests, and values can result in a better understanding of how best to make future years personally rewarding and financially sound. Senior or community centers may offer forums on retirement to help sort out these issues.

I recommend *How to Retire Happy, Wild, and Free: Retirement Wisdom That You Won't Get From Your Financial Advisor,* by Ernie Zelinski. The book provides a holistic approach to the fears and hopes people have, including helping them envision retirement goals without vast sums of money.

During the Practicalities and Possibilities session for retirees at the 2013 NSTA National Conference in San Antonio, people requested information on how to reinvent their work life after leaving their teaching careers. They were eager to channel their energy and experience into situations both financially and personally rewarding.

A recent AARP survey found 80% of baby boomers hope to continue working in some form after age 65. Several books are available on how to obtain jobs later in life, whether it's part time, a second career, or volunteer work. One NSTA member recommends *Don't Retire, Rewire* by Jeri Sedlar and Rick Miners. The book can help you identify what kind of work will best fit your talents, interests, and time constraints and offers guidance for obtaining a suitable job.

Dana Dunnan

Taking time to consider what he valued outside teaching made it easy for Dana Dunnan to transition to a fulfilling retirement. He combined his expertise as a high school teacher of science and journalism to become a writer. He began his career as a high school chemistry teacher, later adding physics, English, and journalism classes.

He taught at Phillips Exeter Academy Summer School, worked at Harvard Graduate School of Education as a teaching practitioner, and helped Massachusetts develop curriculum frameworks and accompanying assessment. He worked with Glenn Seaborg, winner of the 1951 Nobel Prize in Chemistry, to produce materials used in high school chemistry classes worldwide. Dunnan also taught at Masconomet Regional High School in Boxford, Massachusetts, for more than 20 years before retiring in 2000.

Dunnan says he "eased" into writing after he left teaching by publishing magazine articles. After working for the Howard Dean presidential campaign in 2004, he wrote a book about it. While helping a retired professional wrestler produce a memoir, Dunnan realized how much he enjoyed the process and began to write about his own career. He says, "The floodgates opened; [I was writing up] to 1,000–3,000 words a day, in the space of just a few hours each morning." His manuscript evolved into two books, *Notes to a New Teacher* and *Chalkdust Memories*.

Although his graduate work at Stanford University helped prepare him for teaching, there was much he hadn't learned about life in front of a classroom. In his books, Dunnan shares anecdotes and knowledge he gained over the course of his career from UCLA basketball coach John Wooden, *Boston Globe* reporter and ESPN commentator Bob Ryan, and others. Asked if he thought teachers are properly schooled in ways to handle many of the situations they face each day, Dunnan says he isn't sure any perfect training exists to prepare somebody for what can sometimes seem like combat. But he thinks the more often teachers are presented with different situations in the real world of teaching, then think about and discuss how to handle them, the better prepared they will be.

All teachers can attest they've experienced times of struggle and triumph. Dunnan didn't avoid discussing the struggle in *Chalkdust Memories*. He gives an honest review of his life in the trenches, his own challenges, mistakes, and lessons learned. Humorous anecdotes are scattered throughout both books. Dunnan says, "I think humor is a great coping mechanism, and if you don't have a sense of humor, teaching is going to be awfully hard."

He continues, "The time spent figuring out what was fulfilling for me before retirement has been as valuable as any financial investment I made. By knowing what I wanted, I knew what financial [means I would need to] meet my emotional needs. I am happier than I've ever been, healthy, and stress-free. I could not have pictured a retirement as wonderful as I am enjoying."

Judy McKee is a past chair of the NSTA Retired Members Advisory Board and serves on the board of directors for the Council for Elementary Science International. She has spent her own "retirement" running a consulting business, teaching methods courses for graduate school, mentoring new teachers, and writing. ●

MS. MENTOR, **Advice Column**

Discussion and Argumentation, Channeling Student Enthusiasm

After a lab activity, I try to engage students in a discussion of their findings. I use a variety of strategies to involve the students, but I find they don't really know how to have a meaningful discussion without interruptions, off-topic statements, or inappropriate language. Do you have any suggestions?

—Rosalie, Portland, Oregon

You didn't mention your grade level, but I suspect this issue occurs for both elementary and secondary teachers. Students are exposed to television talk shows in which people yell at and interrupt one another, make unsubstantiated claims, or call others derogatory names. Texting and tweeting have replaced in–depth, face-to-face conversations. In some classrooms, a "discussion" may be limited to students giving short responses to teacher-directed questions. Students may try to dominate discussions by intimidating or ridiculing other students. Many students find it much easier to laugh at another's comment or say "You're stupid!" than to present a meaningful alternative.

With a heavy focus on reading and writing, the other components of communication—speaking and listening—may be overlooked or taken for granted. And yet, the ability to hold a conversation with others is an important skill in the real world. A recent *Edutopia* blog post addresses this topic (*Teaching Your Students How to Have a Conversation;* see *http://bit.ly/17vZwGD*). These positive conversations contribute to an atmosphere of respect in the classroom, and students should come to understand their role in promoting this respect.

It's important for teachers to model the expected type of conversation. Demonstrate the language students should use during a discussion: *That's an interesting observation because… Could you please explain that again? I don't understand. Do you mean that… But what about…What would happen if… It's been my experience that… I agree/disagree because… I would add that… What evidence do you have for…Could you add more about…*? (The *Edutopia* blog post mentions that some teachers post these and other discussion stems in the classroom as a reminder for students.) Many of my middle and high school students were self-conscious about using this kind of language. I witnessed a lot of eye-rolling and nervous laughter at first, and I had to be persistent (my students might say relentless) before everyone caught on.

I observed an elementary classroom in which the teacher used several discussion strategies to cut down on interruptions. A quick glance at the interrupter, a shake of the head, or a quiet signal discouraged some. In a particularly effective strategy, the student who was describing the findings of an investigation was given a microphone (a nonfunctioning one from the technology department). No one was allowed to say anything while that student had the mike. The student could then pass the mike to another who had a question or comment.

In a discussion, listening is as important as talking, and wait time is an effective strategy to promote listening. After you pose a question or discussion topic, wait four to five seconds before calling on a student. Some students (including those for whom English is their second language) may need time to compose their thoughts. This seemingly "dead air" is actually thinking time, and research has shown students' responses are often at a higher level of complexity. After a student's response, pause for more wait time. During these few seconds, the student may elaborate on the response, or another student may volunteer to contribute. Before you respond, call on other students for follow-up: "Do you have anything to add?" or "Do you agree/disagree?" To acknowledge other students, before offering your feedback or comment, you can say, "I noticed your hand was up, too. What were you going to say?"

By creating an environment conducive for discussion in your classroom, you're preparing students to engage in arguments from evidence, one of the Science and Engineering Practices in the *Next Generation Science Standards*. As students engage in investigations, they develop claims and support them with evidence. They use both verbal and writing skills to critique ideas, propose alternate explanations, and communicate their understandings.

I'm a new elementary teacher, and I love seeing how students get excited doing hands–on science activities. But the students can get out of hand, and I have a hard time focusing them on the activity. Any advice on channeling their enthusiasm with good classroom management would be great!

—Carolyn, Hartford, Connecticut

Most students of any age enjoy being active mentally and physically. As you noted, the key is to capitalize on the enthusiasm of your students in productive ways.

It's important that students understand a science activity is as much of a learning event as a worksheet, lecture, technology application, or teacher-led discussion (and probably more so). You want them to enjoy the activity, talk with one another, and leave their seats (if appropriate), but students must understand that the activity is purposeful and not "free" time. So before they begin, introduce the activity's purpose, and emphasize what students are expected to produce after completing it (e.g., a report, a table or graph, a drawing, a model, a list of questions, a summary, or new ideas to share). For example, you could introduce an activity this way: "Can you remember a time when your heart was beating really fast? [Discuss.] Today we're going to explore how your heart rate changes with physical activity. During the investigation, you'll collect data in your notebooks, and then we'll compare and discuss our findings." (Remind students of any safety issues.)

Before class, gather all of the materials and make them accessible for students. I found it helpful to have a numbered tray for each group, stocked with necessary supplies, and an itemized list to help students inventory and return the materials. Keep additional items handy.

Teachers often assume students know how to work cooperatively, but we know assumptions are not always correct! Demonstrate or model the routines you expect (such as getting materials) and appropriate language for group work. For some classes, I had to help students practice the routines. One thing that worked for me was to establish teams of 3–4 students. We changed the teams periodically, but students knew where their workstation was and who was in the group (this saved a lot of time and discussion). Each team member had a colored dot on his or her notebook: red, yellow, blue, and green. For an activity, I would say, for example, that the red dots would be the recorders, the yellow dots would be the equipment managers, the blue dots would be the question-askers, and the green dots would supervise the cleanup (substitute your descriptions of the roles you would have). For the next activity, I would change the roles, so everyone had a chance at each. The roles were clearly defined, and I modeled the expectations of each.

During the activity, walk around, ask students about what they're doing, and reinforce appropriate behaviors. Use this time to make formative assessments of students' skills in lab and safety procedures, measurement, and data recording. Immediately address individual students or groups who are off-task or engaging in unsafe, disruptive, or distracting behaviors. If these behaviors start to get out of hand, stop the activity and refocus the students' attention.

It's hard to estimate how long a new activity will take. Give yourself and the students enough time, even if you must continue the lesson the next day, to avoid rushing through it. If some groups complete the activity in less time than you thought, provide some suggestions for extensions or additional ideas to investigate, rather than letting them use this as unstructured time.

Before the class period ends, allow sufficient time to summarize or debrief on the activity (and clean up). This gives students time to settle down, focus on what they did, and transition to the next class.

For more ideas, see the July 2009 issue of *Science Scope,* which featured the theme "Classroom Management." The articles would be appropriate for upper-elementary classes, too. ●


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(All dates are deadlines unless otherwise specified.)

January 21—Bring science and math together with a dash of space science to pique your students' interest with **a free NSTA Web Seminar, Percentage and Volume: Space Food and Nutrition—How Much Is Waste?** Participants will learn how students can use ratios to compare the mass and volume of packaged food before and after repackaging for spaceflight and determine the usable and waste portions. The session runs at 6:30–8 p.m. Eastern Time (ET) and will repeat on **April 1.** For more information or to register, visit *http://bit.ly/Eo1MU.*

January 22—Find out how to take engineering out of this world with **Engineering Design Challenge: Spacecraft Structures, a free NSTA Web Seminar.** Participants will receive an overview of the design challenge and information about materials. The session runs at 6:30–8 p.m. ET and will repeat on **February 26**. For more information or to register, visit *http://bit.ly/Eo1MU.*

January 27—Educators of students in grades 6–8, don't miss this chance to learn more about student rocketry while making connections to the *Next Generation Science Standards* during **Center of Mass and Center of Pressure: Engineering a Stable Rocket, a free NSTA Web Seminar.** The session runs at 6:30–8 p.m. ET. This web seminar will be repeated on **March 31** at 7:30 p.m. ET. Registration will open on the day following the first offering. For more information or to register, visit *http://bit.ly/Eo1MU.*

January 29—Try out two activities from NASA's *On the Moon Educator Guide* and explore how they can be used to address disciplinary core ideas and crosscutting concepts from the *Next Generation Science Standards* during **Engineering Design Process: On The Moon, a free NSTA Web Seminar.** The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

January 31—Dare your students to conduct research and demonstrate their critical-thinking abilities while discussing innovative applications of science, technology, engineering, and mathematics by having them participate in the **2014 DuPont Challenge**. Visit *http://thechallenge.dupont.com* for more information.

February 4—Design challenges engage students through hands-on activities with real-world applications. Find out how to use water safety in space to hook students into learning about engineering design, Earth systems, and Earth and human activity during **Engineering Design Challenge: Water Filtration, a free NSTA Web Seminar**. The session runs at 7:30–9 p.m. ET. This seminar will be repeated on **March 18** at 6:30 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 5—Does water exist on Mars—or did it ever? **Chemistry of Water: Mars Exploration—Is There Water on Mars?, a free NSTA Web Seminar,** explores this question through an inquiry-based lesson covering concepts such as the effect of atmospheric pressure and vapor pressure on the boiling point of water. The session runs at 7:30–9 p.m. ET. This seminar will be repeated on **May 13** at 6:30 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 6—How does the International Space Station produce breathable oxygen for the crew? Learn more about it and an activity to use with students during **Electrolysis of Water: Math and Science @ Work—A Breath of Fresh Air, a free NSTA Web Seminar**. The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 12—Find out how to guide your students through the NASA Balloon Aerodynamics Challenge during **Engineering Design: Forces and Motion—Balloon Aerodynamics Challenge, a free NSTA Web Seminar.** This activity incorporates national science, technology, and mathematics learning standards into the curriculum and addresses the *Next Generation Science Standards*, as students use the engineering design process to design, build, and test a mechanism with the goal of achieving neutral buoyancy. The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 13—How does radiation affect living things? Explore this topic and a hands-on activity from NASA during **Radiation Biology: Ultraviolet Radiation and Yeast, a free NSTA Web Seminar**. The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

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February 18—Can your students use their knowledge of statistics and weather to determine where solar energy is most available in the United States? Learn how to use NASA satellite data with students during **Analyzing Solar Energy Graphs: MY NASA DATA, a free NSTA Web Seminar**. The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 20 —Find out how students can apply science and engineering practices while learning about energy and matter as part of the **Engineering Design Challenge: Thermal Protection System, a free NSTA Web Seminar.** The session runs at 6:30–8 p.m. ET. This seminar will be repeated on **April 17**. For more information or to register, visit *http://bit.ly/Eo1MU.*

February 24—The search for life on Mars can be guided by an understanding of Earth's extremophiles (organisms living in extreme environments). Learn more about NASA's Mars exploration goals and review background information on extremophiles during **Properties of Living Things: Searching for Fingerprints of Life on Mars, a free NSTA Web Seminar**. The session runs at 6:30–8 p.m. ET. For more information or to register, visit *http://bit.ly/Eo1MU.* ●

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Crocs Bait Birds

Next time you see a stick floating in a swamp, a crocodilian might be lurking beneath. A study published online in *Ethology, Ecology & Evolution* in November 2013 revealed crocodiles and alligators have been observed using sticks to lure nest-building birds into reach.

Researchers at reptile zoos in both India and Florida noticed crocodiles and alligators lying in shallow water with sticks across their snouts. The crocodilians would remain relatively still, and when a bird would approach the stick, the crocodilians would attack, sometimes successfully. Theorizing the sticks were being used as bait, the researchers conducted systematic observations at four locations—including two rookery sites for egrets, spoonbills, and white ibis—in Louisiana. They found the alligators "displayed" sticks on their snouts most frequently during the birds' mating season, when the birds were looking for sticks with which to build nests. Alligators in the rookeries displayed sticks more frequently than those living outside the rookeries as well.

The researchers concluded the crocodilians used the sticks as bait to entice the birds within range, stating their report is the "first known case of predators timing the use of lures to a seasonal behavior of the prey."

Read the study at *http://bit.ly/IPIN7N*. ●