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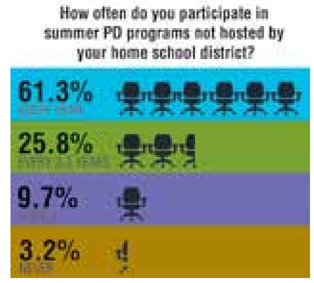
Hands-On Science
Through Aquaponic Gardening pg 14

NSTA Reports

National Science Teachers Association



Reflecting on Summer PD
NSTA MEMBER POLL pg 6

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GRAB BAG
Pull-Out Section!

Teaching STEM in 3D

"Our school does not have a 3D printer," says Davia Parker, science teacher at James G. Blaine Elementary School in Chicago, Illinois. "However, I took all of [the] fifth and sixth graders (approximately 300 students) on a walking field trip to [a nearby high school]...to see them do a demonstration of the printer," she relates. "The students learned that a single computer-generated picture...can now not only be reproduced on a flat sheet of paper, but can become a three-dimensional figure!"

Glen Bull, a professor of STEM (science, technology, engineering, and math) Education at the University of Virginia (UVA) in Charlottesville, says while various types of 3D printing technologies exist, "most of the relatively affordable desktop 3D printers commonly used in schools today employ a similar method. A filament of plastic is drawn from a spool into a heated nozzle. As the plastic melts and is extruded through the nozzle, a computer program moves the nozzle to deposit drops of plastic at precisely specified locations. The 3D printer gradually builds a shape layer by layer through this process.

"Objects can be created [with] Computer-Assisted Design (CAD) programs that allow a shape to be drawn with a mouse, or by scanning (i.e., digitizing) an existing physical object to create a digital reconstruction in the computer. Once the shape has been designed, it can be saved as a .stl (stereolithographic) file. The file can then be sent to the 3D printer in a manner similar to the way that a word-processed document is sent to a 2D printer," he explains.

THADDEUS DRYJA

In an elementary physical science class, a student and his mentor use an Afinia Model H 3D printer to fabricate a catapult for a force and motion unit.

After watching the printer demonstration, "students saw a direct correlation between math and technology," notes Parker. "This is also important as it relates to science because it opens up several avenues whereby students can express things from their scientific minds technologically."

Over the summer, Michelle Basile, upper-school science teacher at St. Patrick's Episcopal Day School in Washington, D.C., worked on a grant to design a STEM unit incorporating 3D printers. She plans "to have students use Tinkercad [a CAD program] and the engineering design model to fiddle with the dimensions of a propeller boat to optimize speed. Each group will have multiple chances to build their boat prototype using the 3D printer, and then refine their design. My math colleague, Beth Cole, will [cover] concepts like ratios (boat size:propeller size), 3D geometry, and linear velocity equations...In science, I will [cover] density, displacement, drag, buoyancy, and the form follows function concept," she explains.

Basile says she and Cole sought to "thoughtfully look at the existing curriculum in our math and science departments (grades 5–6) to see how we can exploit and improve the interconnectedness and exposure students have to STEM material. We want to break down the departmentalized silos of STEM education so children understand the material they are learning

See 3D Printing, pg 8

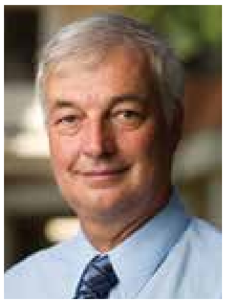
The Elementary Value of Integrated Curricula pg 3

COMMENTARY: **Katie Morrison and Wayne Snyder**

The Elementary Value of Integrated Curricula

By Katie Morrison and Wayne Snyder

Katie Morrison



Wayne Snyder

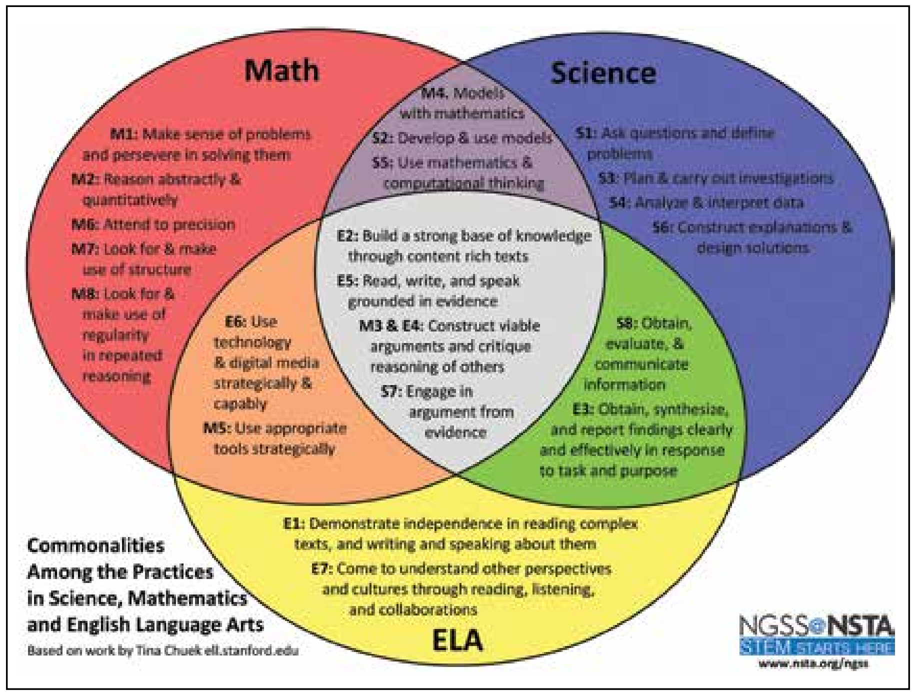
Time demands on elementary school teachers are high, as we teach all of the core subjects as well as specialty areas. Yet it is crucial to lay the foundations of major scientific concepts and scientific practice and thinking skills for our youngest students. How can we do it? One approach is integrating science with core academic subjects benefiting both elementary teachers and students.

The Common Core State Standards in mathematics and English language arts (ELA) require an integration of the common skills for science, math, and ELA. Through an integrated curriculum, students gain familiarization with and confidence in combining the concepts, skills, and practices of all three areas. Math and ELA exams requiring students to analyze graphs, research questions, and write argumentative essays of science content combine subject areas.

In our experience, teachers save planning and classroom time by investigating a single topic through multiple subject areas. Students benefit from the depth achieved by studying a topic across several disciplines and by revisiting terminology, skills, and concepts from subject to subject. Students are invested in the process and subject matter. The learning centers of their brains are engaged.

The key components of a successful integrated curriculum include

- Asking conceptual or experimental questions, collecting information, forming conclusions, and communicating through the four ELA modes (speaking, listening, writing, and reading) are incorporated.
- Much of the process is student-centered. Students wrestle with the questions, have autonomy in the process, research and gather information, and continually write and share along the way.
- Teachers listen to the students, analyzing and encouraging their thinking while guiding them to appropriate answers and successful skills.
- The focus is on the objectives of all of the subject areas, instead of one central subject and peripheral coverage of others. Technology, social studies, and the arts can be easily included.
- A central topic or question unifies the interdisciplinary study.



Where should teachers start? Choosing a science topic, read-aloud book, or other subject-area focus provides a platform for brainstorming and creating an interdisciplinary study. If teachers have a particular science topic they want to focus on, that topic can inspire ELA, math, and social studies curricula or vice versa. While brainstorming possible connections around a science topic, ask these questions: What engaging questions could you ask? What would be a good book to read aloud to students? What resources could students read independently to learn more? How can we use creative and expository writing to enhance writing skills? What social studies areas relate? How could we integrate correlated math problems?

Including a longer read-aloud book during an integrated study allows students to become invested in the plot and characters, eager to follow their adventures and learn more about the topics in the story. The daily reading creates continuity and provides inspiration for math problems, social studies topics, new vocabulary, and creative writing assignments.

For example, a fiction book called *The Wanderer* by Sharon Creech, about a young girl's sailing adventure, inspired a curriculum incorporating multiple subjects. Students investigated weather, experimented with convection, and modeled ocean currents, building their scientific practices. Expository and creative writing, presenting their findings, and nonfiction reading about weather increased student ELA skills. Math problems designed around sail measurements and boat building incorporated geometry skills and practice and included a formal math writing assignment.

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NSTA Reports

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Commentary, from pg 3

Students learned to tie knots, sing sea shanties, and build model sailboats, adding diversity to the curriculum. As the science topic appeared in other subject work, skills, concepts, and vocabulary were reinforced. Teachers enjoyed the project, noting the creative links among science and other subjects increased student investment and practice in math and language arts skills and "aha" moments as students connected ideas and skills across disciplines.

Today's integrated lessons are not only designed to be a group of activities around a single topic, but also add a purpose to the learning experience. Research enhancing our understanding of the brain and how students learn (e.g., Hardiman 2012) and effective teaching (e.g., Marzano 2001) recognizes the impact of deeper learning experiences such as project-based learning and a science, technology, engineering, and mathematics focus—or even further expanded to embrace the arts. Engaging learners with a central focus including scientific inquiry, mathematical modeling, and the ELA skills necessary to learn and communicate creates a more powerful learning experience for all students. ●

References

Hardiman, M. 2012. *Brain-targeted teaching for 21st-century schools.* Thousand Oaks, CA: Corwin Press.

Marzano, R.J., D.J. Pickering, and J.E. Pollack. 2001. *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: ASCD.

Katie Morrison teaches science at the University Child Development School in Seattle, Washington, and also leads science program workshops for K–8 teachers.

Wayne Snyder has been a science teacher in upstate New York; assistant director of the Caltech Precollege Science Initiative in Pasadena, California; and assistant professor of practice, working with math and science teachers, at Claremont Graduate University in Claremont, California.

Try this TOPS IDEA!

conduction & convection

...adapted from **HEAT #15** by TOPS Learning Systems

OBJECTIVE

To appreciate that water is a good *convector* of heat, but a poor *conductor*.

SAFETY NOTE

Keep loose hair and clothing away from the candle flame. Always supervise students.

LAB NOTES

Consider using this only as a demonstration for younger students.

INTRODUCTION

Heat travels by ***conduction***, ***convection*** and ***radiation***:

Conduction: Heat causes atoms and molecules to vibrate more energetically. These in turn agitate nearby particles, transferring thermal motion through the material. Conduction happens more rapidly with metals than with non-metals, because free outer electrons in metals collide and transfer their thermal motion more quickly.

Convection: Atoms and molecules in fluids (liquids and gases) move more energetically as they absorb heat. Fluid nearest a heat source thus expands, rises, and displaces cooler fluid above it that sinks nearer the heat source to be heated in turn.

Radiation: Radiant heat energy travels through space as a wave, partly electric and partly magnetic. It fits between light and microwaves on the electromagnetic spectrum. (This lab does not experiment with radiant heat.)

Step 3. Heating water at the top leaves solid ice below.

Step 4. Heating water at the bottom melts ice at the top.

ANSWERS

5. Water is a poor heat conductor. Heat absorbed at the top of the tube was only slowly conducted downward. Even as the water boiled above, ice remained unmelted below.

But water is a good heat convector. Heat absorbed at the bottom causes water to expand and rise, melting the ice above. Cool water sinks to the bottom where it can be heated, resulting in even heating throughout.

EVALUATION

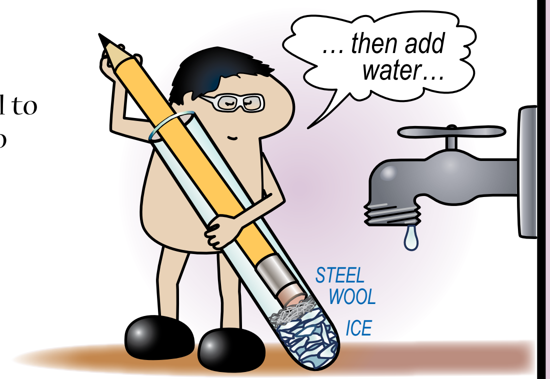
Q: Should you apply heat at the bottom or the top to boil a pan of water? Explain.

A: Heat the bottom of the pan to efficiently circulate the heat upward by convection. (If applied top down, heat travels slowly by conduction.)

MATERIALS

- Safety goggles.
- Small test tube (to boil water quickly).
- A candle with drip tray, or Bunsen burner.
- Steel wool.
- Crushed ice (wrap cubes in a towel and pound with a mallet, rock, or heavy mug).
- A clothespin or test tube holder.

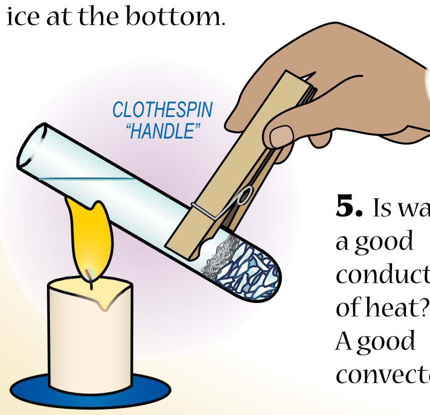
1. Fill a test tube 1/5 full of crushed ice. Use your pencil to push in a little steel wool to hold the ice firmly in place.



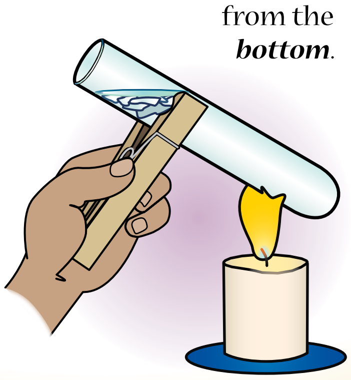
2. Now fill the test tube with water. The ice must stay at the bottom.

3. Try to boil water at the ***top*** of the tube without melting the ice at the bottom.

4. Repeat this experiment without steel wool. Let the ice float as you heat from the ***bottom***.



5. Is water a good conductor of heat? A good convector?



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

Reflecting on Summer PD

NSTA Reports recently asked teachers to reflect on their summer professional development (PD) experiences. While more than 60% said they took part in some form of summer PD not hosted by their school or district every year, nearly 13% said they did so only rarely or never. Content knowledge was the focus of most educators' summer PD efforts (73%); 26% said they concentrated on pedagogy. Genetics and biotechnology, the Next Generation Science Standards, nanotechnology, and mastery learning were among the subjects participants said they were pursuing.

More than half reported participating in PD experiences online (58%), at a college or university (58%), and on-site in a school district facility (51%). Slightly more than a third (35%) said they participated in PD events conducted in the field. (Respondents were allowed to select more than one response to the question.) The majority of teachers taking the survey, 80%, said they had specific plans to extend their summer PD into the school year. Those plans included independent study (54%) most often, as well as course extensions (37%), following up on the instructor's recommendations for additional resources (45%), and conducting a presentation on their PD experience for their colleagues (37%) (more than one response was allowed).

One-third of teachers paid for their own summer PD, another third attended programs funded by the hosting organization, and 20% said their schools paid all fees for approved programs. Less than 7% reported obtaining grant funding, and a similar number reported their school district paid a portion of fees for approved programs.

Here's what science teachers are saying about summer PD:

The opportunity to learn new and exciting scientific information to bring back to my students. Learning with other teachers rejuvenates me! —*Educator, Middle School, Florida*

A chance [to] focus on development without the requirements of daily class work.—*Educator, Elementary, Virginia*

I am able to concentrate on PD and learn from it without it interfering with my job.—*Educator, High School, Connecticut*

It gives me a chance to learn about new research in science, and deepen my understanding of weaker content areas, while also learning new pedagogical approaches.—*Educator, High School, [State not specified]*

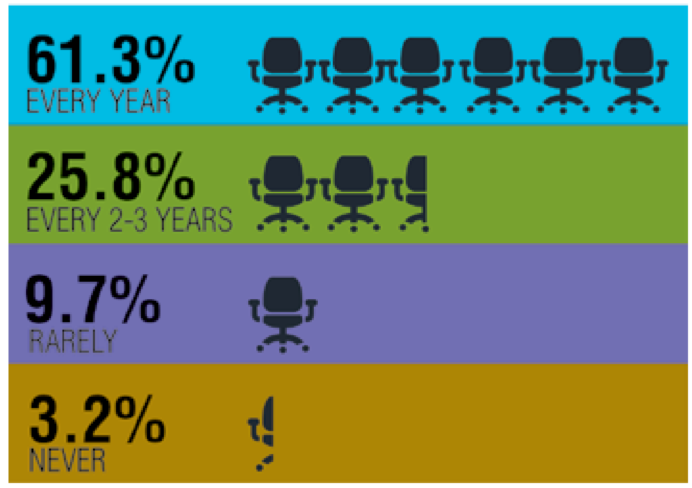
Summer PD programs allow me more time to focus on the program itself. —*Educator, Middle School, Maryland*

Time to reflect.—*Educator, Middle School, Massachusetts*

I value connecting with colleagues and expanding my PLC [professional learning community] because it helps me to reflect on my teaching and improve for the sake of my students. —*Educator, Elementary, South Carolina*

Love getting a new idea to use. Like feeling like I'm still learning myself. Enjoy meeting new colleagues.—*Educator, High School, Pennsylvania*

How often do you participate in summer PD programs not hosted by your home school district?



Education and networking—keeps me fresh, and learning is the ultimate high.—*Educator, High School, Massachusetts*

I feel reinvigorated during summer PD because I can really plan how to use the knowledge to help my students. I save the more intense PD for summer because there is just more time to delve into it.—*Educator, Middle School, Wisconsin*

Summer PD allows me to meet with national leaders in science and education and collaborate with teachers across the country.—*Educator, Middle School, Connecticut*

Collaboration. —*Educator, Middle School, New Jersey*

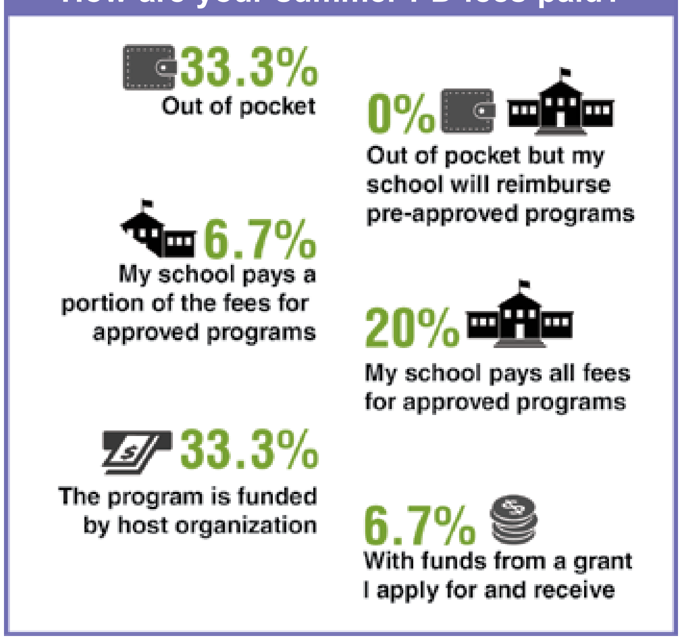
The opportunity to learn something new because isn't that what teaching is all about?—*Educator, Middle School, High School, Michigan*

Being a student and also learning. Not planning any lessons. Learning ways to enhance my teaching.—*Educator, High School, New York*

I like that the summer PD programs I attend are mainly hands-on and all about kids. They are usually not revolving around test data. Sometimes I receive grants, and those help greatly with the expenses.—*Educator, Elementary, California*

Current techniques and curriculum development. Gives me new information on the latest educational trends dealing with required curriculum. Helps to keep [me] excited and innovative in

How are your summer PD fees paid?



my teaching strategies and techniques, which then helps spark student excitement and [a desire] to learn.—*Educator, Elementary, Wisconsin*

I'm not distracted by the everyday events in the classroom. There is time to reflect on the material and find ways to incorporate it into the curriculum.—*Educator, High School, Illinois*

I can truly learn without the pressures of teaching at the same time.—*Educator, Middle School, South Carolina*

Time to reflect and improve teaching—during the school year, we are too busy while in the midst of it. —*Educator, High School, Missouri*

It gives me an opportunity for fresh thinking and ideas with new people and opportunities. —*Educator, Elementary, Massachusetts*

The time I have free to do them. —*Educator, Middle School, New York*

Best I ever went to was an AP [Advanced Placement] Chemistry Workshop at Loyola University. The teacher wasted no time, and I left feeling pretty prepared.—*Educator, High School, Illinois*

Time to take a week and completely immerse myself into a topic. [I am] unable to do [this] during [the] school year. —*Educator, Middle School, New Jersey*

I like the flexibility to take and participate in programs of my choice and not mandated for my position. It gives me liberty to pursue personal interests and expand knowledge on subjects that are relevant to my teaching.—*Educator, Elementary, Texas*

Fun, cool things that are useful. —*Educator, High School, Michigan*

I like to be able to focus on the PD... It is easier to do in the summer without the day-to-day teaching routines. —*Educator, Middle School, Florida*

There is more time to help with the yearly curriculum during the year. —*Educator, High School, California*

It helps gear me up for teaching a new class.—*Educator, High School, Indiana*

There is time to reflect on what I learned [from] the experience and organize materials into my curriculum. —*Educator, Middle School, Michigan* ●

Quotable

Learn to see things as they really are, not as we imagine they are.
—Vernon Howard, U.S. author and philosopher (1918–1992)

3D Printing, from pg 1

in these classes is not only mutually related, but [also] the relationship between the content is essential for solving real-world problems."

Bringing 3D Printing to Schools

With support from a 2010 National Science Foundation (NSF) Innovative Technology Experiences for Students and Teachers grant, Bull collaborated with Hod Lipson, director of Cornell University's Creative Machines Laboratory, to develop a 3D printer for schools. The Fab@School 3D printer "is relatively easy to assemble and costs less than $1,000 in parts," he notes. The newly created FabLab Classroom program now provides fourth- through eighth-grade classrooms in Virginia and Texas with 3D printers, software, and lesson plans for teaching science concepts via engineering design.

In 2012, UVA and two Virginia school systems began planning a jointly directed Laboratory School for Advanced Manufacturing (Lab School). Bull and his colleagues obtained $5 million from the Commonwealth of Virginia, the two school systems, the U.S. Department of Education, and several industry and foundation partners to support this endeavor. Starting this fall, middle school classrooms in the Buford Engineering Design Academy and the Jouett Engineering Design Academy will be connected with UVA's K–12 FabLab via a videolink. A joint task force of more than 30 faculty and graduate students from UVA's School of Engineering & Applied Science and its Curry School of Education will support science teachers in the Lab School.

Bull points out that while the Next Generation Science Standards (NGSS) recommend integrating engineering in science education, "just printing out a static object doesn't necessarily result in learning either science or engineering. The use of technology has to be aligned with instructional objectives." For example, in a unit on sound, "students might first learn the underlying theoretical context, then consolidate their understanding by designing and fabricating a working speaker and analyzing its acoustic characteristics," he contends.

As teachers identify hard-to-teach concepts, Lab School engineering students and faculty are working with them "to develop mechanisms and apparatus that can be used to illustrate and illuminate these concepts," says Bull. So far, these products include working speakers, wind turbines, motors, generators, and communication equipment. He notes that digital designs allow educators to both disseminate and replicate apparatus.

Safety First

Any new technology introduces new safety concerns. "Environmental experts do not yet have conclusive data regarding the environmental impact of desktop 3D printers, but suggest that they should only be used in well-ventilated areas," Bull reports.

"The [printer's] nozzle heats up to about 250 degrees Celsius, and the platform, 100 degrees Celsius. Gloves need to be worn, [and students told not to touch] the nozzle," warns Kaye Ebelt, a science teacher at Target Range School in Missoula, Montana, who has tried 3D printing with her students. She is working with the Lab School as part of her Albert Einstein Distinguished Educator Fellowship at the NSF.

"Safety glasses need to be worn when removing the object from the platform. A spatula is used to scrape the object off, and sometimes little plastic chips can go flying by your face," she points out. "Separating the raft from the object using a utility knife is also a safety concern. Demonstrating how to use this knife safely is important. [Also,] if the [printer's] platform is not completely level, it can cause uneven printing. This can result in a corner of the object warping, and [it] can even burn," she cautions.

Besides physical safety concerns, 3D printers present other issues. "Since I am just [starting to incorporate this] technology, the challenges so far have been mostly technical," says Jill Jensen, science specialist at Glacier Hills Elementary School in Eagan, Minnesota. "I've had to learn our district policies on cloud computing, as well as find a way to access software such as Tinkercad. Our district tech department has never had a request for creating e-mail accounts for students so young before. We are working on finding safe methods to allow students to access such design software or find alternatives to account creations."

KAYE EBELT

Students in Kaye Ebelt's science class at Target Range School in Missoula, Montana, fabricate a vertical ball launcher using a 3D printer.

Classroom Applications

"Our class received digital files of pre-designed parts of a vertical ball launcher" designed by Bull's team, says Ebelt. "It took the students 18 hours to print 16 parts, and many filament clogs in between," she reports.

In her lesson involving the ball launcher, students first "analyzed velocity and acceleration by examining a falling ball video. The video showed the position of the ball in successive tenth-of-a-second intervals. They recorded the distance and created graphs showing velocity and acceleration," she explains.

"Using the 3D-manufactured ball launcher, they conducted the same velocity and acceleration experiment, only [they] measured the ball as it was launched upward. They created [similar] velocity and acceleration graphs… and compared the results," she relates.

She marvels at how her students' vocabulary increased: "Words like initialize, extrude, withdraw, and filament will be forever etched in their minds." While testing the ball launcher, she says she heard them make observations such as "the pin should be longer so it won't fall out all the time. The piston should be skinnier so it doesn't create so much friction when it pushes the ping pong ball up."

With their newly acquired knowledge and confidence, Ebelt's fifth graders gave presentations about the printer "to every class in the school," she says. When one of the parts broke, another student responded calmly, "Oh, that's okay. We can just print a new part and replace it," she recalls.

Ebelt says using the printer in her classroom "resulted in an increased awareness of how to successfully integrate STEM into one interdisciplinary lesson."

Integrating Art

In September, Jensen's school will open the "STEAM Room," a new laboratory that combines art with STEM and will house a 3D printer. Her students made cardboard automata motion boxes using the printer when it arrived in June. She believes this technology is "a great connection to the NGSS. As I find ways to use [it], instead of focusing on one task or creation, I am looking at the scientific and engineering practices students are using, the disciplinary core ideas in place, as well as the crosscutting concepts that can be identified...I have been collaborating with our art specialist to find projects [in which] students can apply engineering design processes to art creations and ways to incorporate art principles into science demonstrations.

"3D printing technology allows students to see an idea come to life before their eyes," says Jensen. "Then at some point, the model doesn't turn out quite right: The scale is wrong, it doesn't stand up like it was going to, it doesn't fit where it is supposed to go—which allows a whole new set of learning to take place and a perfect application of the engineering design cycle." ●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Integrating STEM Through PBL

Science teachers are challenged to teach more than just science. As calls to integrate science, technology, engineering, and math (STEM) increase, some teachers are turning to project-based learning (PBL) as a way to integrate STEM, language arts, history, and other subjects. Professional development (PD) programs like the Virginia Initiative for Science Teaching and Achievement (VISTA) and the STEM Learning Studios are studying ways to help teachers do just that.

VISTA (*http://vista.gmu.edu*) offers four PD programs—one each for elementary teachers, middle and high school teachers, school division science coordinators, and science education faculty—held at six universities across the state. The program is supported by a Department of Education Investing in Innovation (I3) Fund validation grant, according to Mollianne Logerwell, PhD, VISTA director of science education at George Mason University in Fairfax, Virginia. "The elementary academy is the main piece of the program for a month in summer, including two weeks of summer camp for kids," she explains.

Teacher participants learn about creating lessons that feature hands-on science, inquiry-based learning, and PBL and include the nature of science. They also practice what they've learned during the kids' summer camp before devoting the final week to developing their own PBL units. During the summer camp, teachers "plan and implement camp [activities]. If it's not their teaching days, they're helping and observing" other teachers or participating in PD sessions with scientists and engineers, says Logerwell.

"During the academic year, there are two fall follow-up sessions, one at the end of September and one at the VAST (Virginia Association of Science Teachers) conference," she continues. After attending the VAST conference, VISTA participants "stay an extra day for PD with us and wrap up the program." The teachers receive a stipend, teacher resources, and time with an instructional coach who visits the classroom on three days during the school year.

Virginia elementary teachers who apply to VISTA are randomized into treatment and control groups. The treatment group attends the summer they apply; those placed in the control group gather data for a year, then come as a treatment group the second year.

"It's absolutely fabulous, the best thing I've ever done," enthuses Jayne Reck, a science teacher at the Mary G. Porter Traditional School in Prince William County, Virginia. With 25 years of teaching experience, Reck has participated in the elementary program for two years, once as a participant and once as a VISTA staff member. "I'm sort of a role model…I've been there, done it, done PBL in the classroom. The last week is writing a PBL [unit]; they'll have lots of questions."

Reck immediately recognized the program's impact with her students. "I did a PBL [unit] on oceanography with the…entire fifth grade. By the end, the kids were acting like scientists, looking at themselves as scientists, using scientific terms…They drove it; they told me what we needed to do next…Science fair projects had more engineering," she remarks.

Furthermore, the fifth graders' scores on Virginia Standards of Learning (SOL) tests improved. "We had a 100% pass rate in fifth-grade science this year," she says. "In schools, because it is so data-driven, teachers teach to the test; kids spit out [data] and forget it. With PBL, everything is connected; the kids start seeing connections…Once you see the outcome, you realize this is the way to teach. I've done less teaching [in the last year]. The kids take over their learning: They're learning through discovery. It is something I will do through the rest of my teaching career," she declares.

Second-grade teacher Laurie Goss from Arlington, Virginia, describes the program as challenging. "While I had experience with (PBL), this is really digging deep," she explains. "The first couple of days of camp were unsettling. We were trying out a new system, working with people I'd just met. It was just a lot of 'new' and a lot of hard work. After a couple [of] days of camp, I was having a ball. The things we were talking about were working, kids were learning. The last week [creating a PBL unit] was learning curve–hard," she recalls. "I really liked the last week. We had returning teachers for support and support science staff. As a generalist, I had to have really good understanding of a topic. It's not cookie-cutter: You have to really understand direction and context; to have access to scientists was really helpful."

The VISTA program for secondary teachers, which is also randomized into treatment and control groups, targets teachers in their first or second year of teaching. Treatment group participants receive graduate courses focused on topics ranging from classroom management to diversification, a $1,000 stipend, $1,000 in science supplies, attendance at the VAST conference, and 15 days with a teaching coach over two years. Teachers in the control group receive a $1,000 stipend for collecting data.

Overall, VISTA's four programs have "influenced about 80% of students in Virginia with science teaching," asserts Patrick Linehan, PhD, VISTA's chief operating officer. "We think the program does in fact warrant consideration of expansion [to other states]."

Workforce Collaboration

During STEM Learning Studios (*http://nctaf.org/learning-studios*), run by the National Commission on Teaching and America's Future (NCTAF), teachers are "building on a collaborative culture to work on PBL opportunities ...and alongside workforce partners to help them develop PBL opportunities linked to the real world of science and engineering," says Jeffery Dilks, NCTAF's senior director of Learning Studios. Workforce partners include government agencies and private industry. "The teams of teachers are interdisciplinary—science, math, technology or engineering, special education, language arts. Teams are selected by building leadership and [participate in] three days of [PD] in the summer."

Dilks recounts the idea behind the STEM Learning Studios started "as we compiled research on [professional learning communities]…Teachers working in collaborative groups are an effective way to change what's going on in school and engage in PD."

Launched in Maryland, the program has expanded to include schools in New Hampshire and Virginia. "We utilize the Buck Institute [for Education's (*www.bie.org*)] approach, more or less…[W]e guide them through the collaborative process and have the workforce partners come in. We try to guide them through the [PBL] process, which results in an essential question that will shape their teaching through the year. Teachers come back once each academic quarter…[to] work on specific activities they'll have in the classroom, work on additional [PD], debug. They have additional opportunities to talk with scientists or engineers..."

"We create various online collaborative spaces, and science and engineers may visit classrooms," adds Dilks. "Teachers may take field trips to their partner [site]. "

"Teachers are working on open-ended, real-world problems," notes Laura Coscarelli, Learning Studios program manager. For example, students in Howard County, Maryland, used satellite mapping to study how their school affects the local environment, as well as learn about proportions and scale.


EVAN CANTWELL/CREATIVE SERVICES/GEORGE MASON UNIVERSITY

During the Virginia Initiative for Science Teaching and Achievement science camp, teachers and students explore energy conversion during a project-based learning unit.

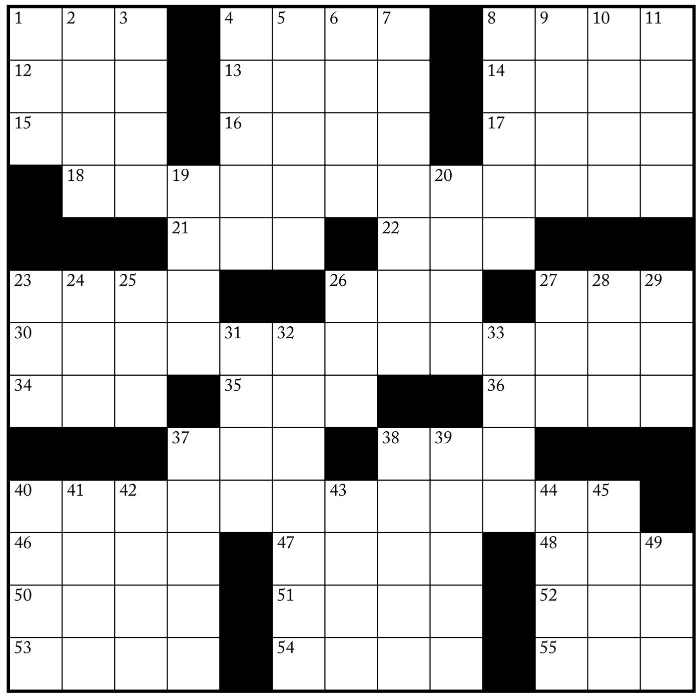
The biggest hurdle with training and implementing PBL is time. In response, Learning Studios has "moved collaboration online as much as possible," explains Coscarelli.

Some Howard County teachers compared student performance between classes that used PBL and others that did not. They found student scores were not "much different on [standardized tests], but there were differences on open-ended, constructed-response" questions, says Dilks. He hopes "the school district continues indefinitely" to work with STEM Learning Studios as teachers progress to "allowing students to ask [their own] questions." ●

BRAINSTARTER

WEIRD SCIENCE

BY PATRICK MERRELL



ACROSS

1 ___ Planck (30-Across biggie)
4 Make ingots
8 Behave like electrified neon
12 Maker of the chess computer Deep Blue
13 Palo ___, CA
14 House overhang
15 Ginger ___
16 Enrico Fermi's "goodbye"
17 Numbered hwys.
18 Mysterious connection between subatomic particles
21 Earth turner
22 Mary ___ cosmetics
23 Result of an "Aha!" moment
26 Snapshot, briefly
27 Unit of atmospheric pressure
30 It describes the behavior of matter at the smallest level
34 Circled area in a Venn diagram
35 Donkey
36 Title for crystallographer Kathleen Lonsdale
37 Comet material
38 Beer container
40 With 55-Across, paradoxical thought experiment used in 30-Across discussions
46 From Bangkok
47 "10-4, good buddy" utterer
48 Atop, poetically
50 Long geochronology periods
51 Away from the wind, at sea
52 ___-la-la
53 Luxurious
54 Take a breather
55 See 40-Across

DOWN

1 One-named rapper with the hit "Paper Planes"
2 Competent
3 Wolverine, Storm, and Rogue
4 Chocolate source
5 Draw ___ in the sand
6 Male deer
7 Handyman's hardware
8 Covered with pathogens
9 Like "fashionable" partygoers
10 Pizza cooker
11 ___ Nile virus
19 More or less follower
20 Apiece
23 Figures for geniuses
24 Expected in
25 Ingest calories
26 British leaders (abbr.)
27 South American slitherer
28 Robotic assembler in a factory
29 Wheat relative
31 Mexican menu choice
32 Trade-in for sale
33 Rim
37 Like physicist John Stewart Bell, countrywise
38 Pair below one's femurs
39 Long-legged wader
40 Instructions part
41 Sound from a toy train
42 Albert Einstein's first son
43 Suffix with flex
44 Campus military org.
45 Blood fluids
49 Lab maze runner

ANSWER ON PAGE 35

the SCIENCE OF A-HA!

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NSTA

Hands-On Science Through Aquaponic Gardening

Educators around the country are using aquaponic gardening to teach students about science and sustainability. The aquaponic system combines aquaculture, or growing fish, and hydroponics—growing vegetables without soil. The fish tank and the grow bed are connected, and water pumps from the fish tank to the grow bed and flows back to the fish tank. The fish produce ammonia, which is transformed by bacteria into nitrate, a natural fertilizer. The plants then absorb the nitrate.

"[T]he aquaponic garden [is] part of a larger project on sustainability education," says Philip E. Otienoburu, visiting professor of biology at Johnson C. Smith University (JCSU) in Charlotte, North Carolina. "Using this system, we are able to demonstrate the cycling of nutrients through a system...We are able to demonstrate the importance of ecological conservation of mobilized resources...[O]ur aquaponic setup helps to open up discussions on food security and sustainable agriculture."

He continues,"This hands-on approach to science helps to put theoretical principles into perspective, as [students] see the real impact of sustainable systems on agricultural systems. For instance, they are able to see how to control insect pests with their natural enemies: [T]hey were able to control aphids using ladybug beetles. They also appreciate that the pesticide or fertilizer-free system is better for the environment and more likely to produce healthier food crops."

Colin Delos Reyes, science teacher at Lahainaluna High School in Lahaina, Hawaii, says that while his school's aquaponics garden "started out as a concept in sustainability and local food production, it was also many students' first time actually growing something." The garden provides "a hands-on approach to learning about the biogeochemical cycles, sustainability, capillary action, measuring nitrite/nitrate levels and maintenance (calculating) of micronutrients (iron mostly), and photosynthesis," he notes.

Cheryl Gerken, librarian at Davis Bilingual Elementary School in Tucson, Arizona, says her school's system "is located in a corner of our library because we had no other space to put it…We do a lot of science in the library, and I have developed a project around aquaponics that involves nutrition, global issues regarding water resources, plants, the nitrogen cycle, and comparisons to conventional farming. My younger students do a lot of observations and scientific drawings, while my older students are able to do more formal investigations and projects."

Last fall, after studying "the nitrogen cycle, aquaponics versus conventional farming, plants, the system itself and how it works, tilapia, nutrition, and an overview of aquaponics," Davis fifth graders held an Aquaponics Expo, says Gerken. Students' families and community members were invited to hear the students' presentations. They also harvested tilapia, lettuce, and wheatgrass from the system. She says, "I have noticed a real shift in student willingness to try a variety of 'green things.'"

Students at Johnson C. Smith University in Charlotte, North Carolina, introduce tilapia into the university's first aquaponic garden.

Troubleshooting Problems

JCSU's aquaponics facility "was constructed within a greenhouse structure that did not anticipate the extra-warm summer months. Our cooling fans were overwhelmed, leading to overheating within the tanks…We lost quite a few fish in the process and had to install a cooling system," Otienoburu recalls.

"[S]tudents have been front and center in troubleshooting any and all problems that have arisen in the system by actively engaging in solution-driven diagnostics. This, we find, helps them to [become] better at solving problems in other facets of their lives," he maintains.

"Pump breakdowns were one problem, but we usually just needed to clean the pump," says Delos Reyes. "One of the big challenges were aphids and other pests…we couldn't use pesticides," so they had to be removed manually. This led to "students doing research on non-lethal forms of pest control… [W]e will probably be building a PVC shade cloth greenhouse around the plants [this] year, but these challenges made the learning even more authentic since it involved students [in] problem solving," he contends.

"We had about 25 fish die right after Christmas break," Gerken recalls. "With their knowledge of the nitrogen cycle, water quality, and the system itself, students were able to troubleshoot amazingly well. I even had a second grader theorizing about a possible bacteria breakdown in the nitrogen cycle."

Funding and Supplies

Gerken's school received "a Community Food Bank grant that gave three Tucson schools a complete aquaponics system," she says. The system includes "a 350-gallon fish tank, a 150-gallon fish tank, four grow beds…and all the materials required…We also have four light fixtures with four bulbs each," she notes. "Had we purchased the unit, it would have cost around $5,000. Our consultant, Aecio D'Silva, created a portable unit using a…cart for less than $200: The fish tank is below, the grow bed (a mortar mixing bin) has a siphon through the middle of it, hydroton [grow media], a pump, and the PVC piping and tubing to deliver the water...We generally need to spend about $200 every six months or so [on supplies]," she estimates. Her school's PTA provides the funds.

"We used plastic 55-gallon drums from a cleaning business, PVC pipes, cement, hollow tile blocks, pallets, a pond pump, and cinder. The only thing we really bought was the pump and the PVC; everything else was either recycled or found in the area…The pump ran about $50, and the PVC stuff was maybe $15," explains Delos Reyes, who paid for that first system himself.

"The original system ran for about a year, but we have created a bigger system that we started at the end of the last school year. This system was donated by the Maui Economic Development Board," he notes.

JSCU's garden is funded by the Duke Endowment, according to Otienoburu. "Most of the costs associated with the aquaponics facility went into the construction of the greenhouse structure…We felt the need [for this,] as we are an academic institution with a wide reach beyond the walls of the university, and wanted to have an outdoor laboratory that was accessible all year round to our students and the communities we serve."●


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Putting NGSS Into Practice, K–12

Reactions to the spring release of the Next Generation Science Standards (NGSS) continue to ripple across the United States. Some states, including Maryland, Kansas, and Rhode Island, already have adopted the NGSS, while others contemplate adoption. Even in states that do not formally adopt them, the NGSS could influence state standards.

"I hope the new science standards encourage teachers to move toward doing science, really looking at science and engineering practices," says Chris Embry Mohr, a science teacher at Olympus High School in Olympia, Illinois.

"It's going to revolutionize science education," exclaims Emily Miller, an ESL (English as a Second Language) and bilingual science specialist for second and third grades at Hawthorne Elementary School in Madison, Wisconsin. "The standards are going to help prepare our students with next-century skills."

"It's important [for stakeholders] to know classroom teachers were intimately involved in writing the NGSS," contends Kenneth Huff, a middle school science teacher in the Williamsville Central School District in Williamsville, New York. Huff, Miller, and Mohr were part of the NGSS writing team. Huff continues, "One-half of the 41 members [of the writing team] are current teachers. An awareness of how the NGSS were created involves understanding the trajectory from earlier documents such as the *Benchmarks for Science Literacy* through the [National Research Council's] reports, such as *How Students Learn Science in the Classroom* and *Taking Science to School*, leading up to *A Framework for K–12 Science Education*.

"This awareness will help teachers to better understand how the NGSS are different from earlier standards. For example, there's a clear delineation of science inquiry. We're not replacing inquiry, rather more fully defining inquiry and expanding that view to include practices such as scientific argumentation," he adds.

Just as the new standards are the result of a team working together, Huff, Miller, and Mohr encourage teachers to form a professional learning community with their colleagues as they examine the NGSS and analyze their current practices.

"Teachers should start with the big ideas from the Framework. Where we [elementary teachers] have fallen short is we've taught isolated units; we've not seen the big picture. The first step in teaching NGSS is to start with the big idea. I look at my units—at what I usually teach—and I look for the big idea from the Framework and make that accessible to my students. And these big ideas lead to the smaller ideas that we usually focus on. Then the driving question needs to be changed to focus on the big idea. And now with NGSS, we teachers need to use teaching strategies that provide access for all students. One strategy we see over and over that is particularly effective is making science relevant to students' lives," Miller says.

"If you're talking about water, make the investigation about water quality in the neighborhood...Contextualize the science to students' homes and community," she advises. "In terms of learning the practices, start slow, take small steps, focus on one practice you want to get good at, and remember you don't have to feel overwhelmed by all you need to learn. So far, my district is not overhauling the curriculum."

She also suggests teachers read the case studies in Appendix D, All Standards, All Students: Making the Next Generation Science Standards Accessible to All Students, to "get an idea of what teachers can do in their classrooms to increase science achievement for diverse students. We researched strategies and combined our experiences into vignettes to show actual lessons being taught. The case studies include, for example, working with girls, [English language learners], students from low socioeconomic status, students from diverse races and ethnicities," and different grade-level examples, Miller explains. "Just take a look at the case studies and try some of the strategies in your classroom, see what happens. I really want to see teachers opening up Appendix D and using the case studies to be more successful with all of their students!"

She suspects that "the practices will come easily to teachers. And the cross-cutting concepts will gradually come. Most of us [elementary teachers] don't have really deep content knowledge. A lot of us have just a few credits of science from our university days. I don't think science is a lot of elementary teachers' passion. I hope we see a lot of professional development pop up that increases deep content understanding. We're opening doors for more integration, not just getting students to communicate about science ideas, although that's important, too! Reading, writing, and math should always be included. Students can be more engaged in reading and writing when the topic is a science phenomenon that they just investigated in class."

Huff suggests teachers will find it helpful "to think about how to integrate the three dimensions of the Framework into their instruction. The focus is no longer on solely just the content. What will be meaningful for teachers is to examine their current instruction and think about a general analysis of a unit that they teach…it would be very valuable if they select one unit this upcoming year, [and] ask themselves if what they're teaching aligns with the vision of the Framework and the NGSS. Some questions to consider are [these]: Can you identify opportunities to address science and engineering practices, crosscutting concepts, and disciplinary core ideas? Did instruction include time and opportunity for students to learn? Were there potential opportunities to make connections to common core state standards?"

For high school teachers, Mohr expects the crosscutting concepts "are going to be hard in the sense that crosscutting is looking at big ideas and looking at connections between sometimes abstract ideas or seemingly unrelated ideas. For example, one crosscutting concept is patterns. When I was working with a middle school teacher, she came up with examples of seemingly unrelated ideas; she could have her students look at models of neurons in the nervous system, blood vessels in the circulatory system, and look at the pattern of size of stems on a tree" and compare the structural patterns of each. "I don't think that's something teachers normally think of, let alone students," she observes. She suggests teachers read Appendix E, Progressions Within the Next Generation Science Standards, and the Framework, as well as examine their practices. "If [teachers] feel like they're not as deep or as far along in the process as they should be, I would recommend teachers put together informal or formal groups of peers to discuss how they're implementing the new standards and have conversations to clarify their understanding," she adds.

"Depending on the district, the next step is an analysis of the current curriculum and a look at the course mapping models in Appendix K [Model Course Mapping in Middle and High School for the Next Generation Science Standards] to come up with a three- to five-year plan, identify professional development needs, and see how they can accomplish that," Mohr says. "Don't necessarily try to do it by yourself. My district is working with two other districts. We've already spent more than 40 hours coming up with a preliminary course map and a preliminary plan. It's something that's going to take a while."

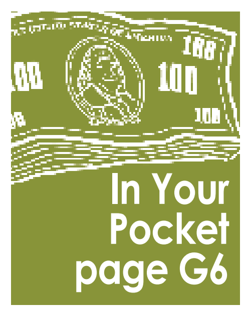
Huff also shares some tips for transforming current lessons into NGSS–style units that he learned during a workshop presented by Rodger Bybee and Kim Bess at the 2013 NSTA National Conference in San Antonio. "Be aware of the quality resources [available] through NSTA [including journal articles and online content]. There are a plethora of archived webinars on NGSS [on the NSTA website at *www.nsta.org/ngss*]…What I like about these is that teachers can watch at their leisure or can form a study group at their school or district," Huff notes.

"Even if one's state adopts the standards, teachers need to realize they will not be implemented the next week or next month…To fully actualize the vision of the Framework and NGSS, as teachers, we need to be deliberate [and] reflective, and embrace collaboration within [our districts and states]," he says. "The key point is to understand the conceptual shifts emanating from the Framework. This is also helpful to teachers because when new resources arrive, teachers will better understand if [the resources] are well-grounded in the vision of the Framework and if they are genuinely quality instructional materials or if merely labels and a few words have been changed to make it appear that way." ●

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:



Freebies for Science Teachers

MindShift's Teachers Guide to Using Videos. Visit *http://bit.ly/ZU9coT* for valuable tips, video links, and ideas for inspiring students to use videos as a conduit to ask questions and learn in all subjects. Part I of the guide discusses websites with high-quality video content for classroom use; Part II covers websites that can help educators learn how to curate and evaluate video content; and Part III presents ideas on how to effectively weave online content into the curriculum, including the role of online content in the flipped classroom.

Earth Science and Evolution Courses. The American Museum of Natural History and Coursera are offering science courses for educators (see *www.coursera.org/amnh*). Each four-week course includes weekly lecture videos, articles, discussion questions, and a culminating assignment to help integrate course content into the classroom. In the Dynamic Earth course (grades 7–12), participants examine geological time scales, radiometric dating, and how scientists "read the rocks." Those taking the Evolution course (grades 7–12) learn the history of evolutionary theory, human evolution, and the societal implications of modern evolutionary theory.

Popular Astronomy Lectures Now on YouTube. The Silicon Valley Astronomy Lecture Series presents noted scientists giving nontechnical, illustrated talks on recent developments in astronomy. Videos of more than a dozen lectures from the past and present are now available online at *www.youtube.com/SVAstronomyLectures*. The lectures address diverse topics such as the formation of galaxies, black holes in space, the history of our solar system, and Saturn's Moon Titan. Additional lectures are expected to be added to the collection soon.

Geoscience Resources. Use the materials at *http://bit.ly/11lVp8f* to introduce middle school to college students to the Global Positioning System (GPS) and the many ways GPS is used in geodesy. Resources include animations, tutorials, lesson plans, and links to geoscience projects. Student activities explore concepts such as creating and reading time series plots; learning to analyze GPS data; and using the web-based data viewing tool EarthScope Voyager Jr. to visualize relationships among earthquakes, volcanoes, and plate boundaries in the western United States.

Be a Tree Hero. Encourage K–12 students to participate in the U.S. Department of Agriculture's Asian Longhorned Beetle (ALB) Hunt and help preserve our nation's forests. The Asian longhorned beetle, an invasive pest, destroys trees and has been found in several states across the country. Classroom resources, including a video, identification worksheets, and educator guides, are available at *www.asianlonghornedbeetle.com*. The resources teach students what the beetle looks like, what the signs of ALB infestation are, and what to do if an infestation is spotted.

Social Justice and Science. *Teaching Tolerance* magazine's Summer 2013 issue contains articles to help educators learn how to use science lessons to address social justice issues, as well as articles that show how students can learn about community health, equity, and sustainable food systems through food justice programs at school. Of particular interest is "Just Science," which features examples of student science investigations in middle and high school classrooms that led to positive social changes in underserved communities. Access the issue at *http://bit.ly/124F3sa*.

The Sound (Graphs) of Music. The book *Where Does Sound Come From? Data and Graphs for Science Lab*—written by researcher, author, and composer M. Schottenbauer for high school and university levels—presents scientific data relating to the science of sound production. The free preview contains sound graphs from string, woodwind, brass, and percussion instruments recorded by different scientific instruments, such as a gas pressure sensor, an anemometer, a dual range force sensor, and a microphone. Teachers can use the materials to promote students' graph-reading, comparison, contrast, and calculation skills. Read chapter previews at *http://bit.ly/12qIdkE*.

See Freebies, pg G2

Freebies, from pg G1

Chemical Safety Video. The Occupational Safety and Health Administration (OSHA) has set a December 2013 deadline for all employers—including schools—to provide training for teachers and staff to know how to read the new Globally Harmonized System (GHS) chemical labels. (To learn more, read the *NSTA Reports* article "Farewell MSDSs; Welcome SDSs!" at *http://bit.ly/11amoYY.*) To meet that need, Flinn Scientific has produced a 21-minute video written specifically with teachers in mind. The video, *Required GHS Training: The Right to Understand,* can be viewed online at *www.flinnsci.com/GHS.*

Arctic Resources. The Alaska Wilderness League provides resources for K–12 educators to bring the Arctic and the Arctic National Wildlife Refuge into their classrooms. Found at *http://bit.ly/15yYDcx,* highlighted activities include Adaptations in the Arctic, in which elementary students study the habitat and ecology of the region and the adaptations of the animals that live there. Middle and high school students can learn about Arctic adaptations through Skull Boxes, a hands-on activity in which students construct and examine life-size paper models of Arctic animal skulls.

Spark 101's Interactive Videos. Engage high school students in real-world problems and highlight inspiring science, technology, engineering, and math (STEM) careers using the videos at *www.spark101.org.* In each video, a STEM professional presents a problem and potential solutions for students to explore. The videos incorporate natural stopping points for teachers and students to choose a solution, then compare it to the real outcome. Problems are posed by a podiatric surgeon, polar explorer, network engineer, estuarine ecologist, space scientist, and others, showcasing the diversity in STEM careers.

GAME: IT 10,000—A STEM Initiative. This game-design course from STEM Fuse (*http://bit.ly/14wO1Ld*) is basically a computer programming class with dashes of physics, math, engineering, and business mixed in. Students progress from simple "drag-'n'-drop" programming to writing code and developing original computer games. Along the way, students learn the math and physics concepts used to develop games, how the engineering cycle is used to design games, and more. The course works as a stand-alone elective, a supplement to math or physics classes, or an after-school program. Teacher training is available.

Seven Steps to Winning Grant Money. From identifying a problem in your school that needs correcting and developing a solution for it to matching a grant to your situation and completing the application accurately and on time, the practical tips suggested at *http://bit.ly/13ZFy7T* take the mystery out of grant-getting. With patience, organization, and persistence, your school can soon be "in the money."

ClimateChangeLIVE. This website brings climate learning to K–12 classrooms through digital webinars, webcasts, and lesson plans. The resources are culled from programs at federal agencies and nonprofits with an interest in climate science, and the "live" web component allows students to learn about climate change science directly from climate experts as well as interact with them. Check out the fall webinar schedule at *http://climatechangelive.org.*

EarthCam for Kids. You'll find kid-friendly, fun, and educational webcams from around the globe at *www.earthcamforkids.com.* Select the "cam" category of your choice (e.g., Amazing Animals, Weather or Not, Out of this World, etc.), and search for footage to enhance your elementary science instruction. Be prepared: "Cam" views are stationary, so unless the subject of interest is in the vicinity, you may not see much on the screen. However, some organizations (e.g., the Greenville [South Carolina] Zoo, Giraffe Cam) provide archived footage showing cam highlights.

Dynamic Earth Pop-Up Book. Looking for a cool arts-integration project that highlights scientific communication and teaches middle level students about plate tectonics? Your students can make a pop-up book on the topic at *http://earthpopupbook.weebly.com.* This website presents how-to instructions for a six-day unit, including a project overview, videos, and daily lesson plans. The unit was originally implemented with the help of a visiting artist, but the website enables "artists" of every level to create a terrific and informative book!

"Science Bob" website. Visit *www.sciencebob.com/index.php* for attention-grabbing experiments, video demonstrations, science fair project ideas, reader-submitted questions, and research help—all designed to get elementary and middle school students excited about science. Video demonstrations like The Fizz Inflater and The Screaming Quarter or experiments like Try Some Lava in a Cup and The Exploding Lunch Bag are just some examples. The experiments double as demonstrations, but they include additional inquiry questions for students to research and test.

The Fluid Ether App. Why does water swirl when you push it? Middle level students can explore the physics of fluid motion with this physics simulator app from Iridescent at *http://bit.ly/12DuMBd.* Using the app, students create currents that move balls, break boxes, and collect coins. As the game progresses, students also create visualizations of fluid flow to share. The Fluid Ether is one in a series of apps exploring intangible systems of the natural world; future apps will address gravity, momentum, projectiles, light, and electricity.

Reach Every Child. Thousands of educational resources for K–college educators have been compiled at *www.reacheverychild.com.* Developed collaboratively by The Horace Mann Companies and educator Alan Haskvitz, the site offers lesson plans, websites, and teaching tips to enhance instruction in core subjects and specialty areas like computers, business, and sports/games. Pick a subject and subsection of your choice, then you can access the vetted resources. For example, clicking on Science, then Chemistry, turned up a website with 1,300 chemistry revision quizzes and another with an element-themed *Concentration* game.

Biodiversity Module: Grades 9–12. Project Learning Tree (PLT) has released a new learning module for high school students exploring many aspects of biodiversity. Available at *www.plt.org/biodiversity,* the module presents activities addressing the role of invasive species on biodiversity, the issues surrounding management of protected areas, and the effects of pesticides on biodiversity. Other secondary modules focus on Biotechnology, Forests, and Municipal Solid Waste (click on Curriculum Overview, then Secondary Curriculum, to preview them).

Environmental Education App. Earth Day Carol (*www.earthdaycarol.org*) is a green retelling of Charles Dickens' *A Christmas Carol.* In this version, Plastic Bottle Scrooge is visited by the ghosts Plastic Past, Plastic Present, and Plastic Future. The message of "reduce, reuse, and recycle" is conveyed through animation, pop-up facts, and kid-friendly narration. The app is most appropriate for the elementary and middle levels and can be a starting point for discussions about the importance of protecting the environment. Don't miss the reviewers' photographs of creative projects inspired by the story! ●

News Bits

- **Attention, proponents of the "flipped classroom": A new study from the Stanford Graduate School of Education (GSE) shows that a "flipped flipped classroom" might be better for student learning. The study found students learned best when they did hands-on projects before reading texts or watching videos on their own before class—instead of the other way around.**

In the study, students used an interactive, tabletop learning environment called BrainExplorer, which simulates the way the brain processes visual images. Half of the students worked with BrainExplorer first, then read about the neuroscience of vision; the other half read first, then used Brain Explorer. The group who used BrainExplorer first showed a 25% increase in performance on the final test compared to those who read first.

"Our results suggest that students are better prepared to understand a theory after first exploring by themselves, and that tangible user interfaces are particularly well-suited for that purpose," says Bertrand Schneider, a GSE graduate student who led the study. Read more about this "exploration first" model of learning at *http://stanford.io/1aLdWlW.*

- **In today's digital world, the ability to analyze and interpret data is crucial. To help prepare students for these tasks, the Education Development Center (EDC) has launched the Oceans of Data Institute. The institute is part of the EDC's effort to infuse teaching and learning about "big data" into K–16 science, technology, engineering, and math (STEM) courses.**

"The increasing availability of digital, sharable data presents a huge opportunity for society to answer whole new kinds of important questions," says EDC Senior Research Scientist Ruth Krumhansl, who directs the institute. "To meet the promise of big data, students today need to become proficient in data-based inquiry skills that move well beyond those taught in traditional science and mathematics classrooms."

The institute brings together academics, researchers, practitioners, and educators to help meet this opportunity head on. Digital tools and curriculum materials are currently being developed for use in STEM classrooms. The institute's first product, an Earth science curriculum, will be used in school classrooms for the first time this fall. To learn more about the institute or to get involved, visit *http://bit.ly/16eGmkX.*

- **As part of a Rutgers University program that involves undergraduates in making documentary films about science, students have produced a three-minute trailer for an upcoming documentary they are filming, *Antarctica: Beyond the Ice,* supported by the National Science Foundation (NSF).**

The trailer (see *http://beyondtheice.rutgers.edu*), includes footage and interviews with NSF-funded researchers at the Long-Term Ecological Research Project at Palmer Station, on the West Antarctic Peninsula. The researchers are studying the area's complex marine ecosystem—which supports everything from phytoplankton to seals to penguins and humpback whales—as well as the impacts of warming on the polar regions.

"We're always looking for ways to connect our film students with important science," says Dena Seidel, director of the Rutgers Center for Digital Filmmaking. "There are a lot of students in our program who used to be in the sciences. Many come to our film center because they are looking for innovative and dynamic ways to learn science—but also seek creative ways to use their knowledge to advance scientific literacy."

The project will produce a full-length film for television broadcast and three educational media versions for classroom and web-based learning. In addition, a *Beyond the Ice* online community will be created through interactive and interconnected social media. This community will feature enhanced blogs highlighting specific research team findings and interactive classrooms, as well as interactive conversations with scientists and collaborative science stories posted by students. Read more about the project at *http://1.usa.gov/1bRIPIk.*

- **Fans of the groundbreaking television series *Cosmos: A Personal Journey,* get ready: Fox is planning to reboot the series in 2014.**

Renowned astrophysicist Neil de Grasse Tyson will host, and Seth McFarlane, of *Family Guy* fame, will produce the new documentary series. *Cosmos*—originally hosted by astrophysicist Carl Sagan—was the most successful public television show of its time. And new host Tyson seems like a perfect fit for the remake: He met Sagan as a 17-year-old applicant to Cornell University, where he was personally invited to "check out" Sagan's lab. Read more at *http://bit.ly/11gQlqt.* ●

Carl Sagan

Neil deGrasse Tyson

What's New

FROM U.S. GOVERNMENT SOURCES

U.S. Geological Society (USGS)

Climate Connections Videos

The USGS is answering America's climate change questions through its Climate Connections video series on YouTube (see *http://bit.ly/145N5uN*). In these videos, USGS scientists discuss climate questions posed by people across the nation—including some middle and high school students from North Carolina and Washington, D.C. In North Carolina, they asked, "Do all scientists agree that climate change is occurring?" and "Will the climate change abruptly or slowly over time?"

Students in Washington, D.C., wondered, "If you could change one thing about climate change, what would it be?" and "Will climate change impact humans or animals more?"

The videos are appropriate to share with middle and high school audiences. Seeing students ask questions of working scientists and listening to scientists' answers may be just the inspiration your students need to develop a stand on climate change issues and get proactive about protecting the environment.

U.S. Environmental Protection Agency (EPA)

Chemical Safety in Schools

EPA's Safe Chemical Management in Schools website at *http://1.usa.gov/17EfE6L* provides one-stop access to many programs and resources available to help prevent and resolve environmental issues in K–college schools. For example, the Toolkit for Safe Chemical Management includes documents to guide school and district leaders through the processes of removing inappropriate or unnecessary chemicals from schools; preventing future chemical mismanagement issues in schools through training, curriculum and policy change, and long-term management solutions; and raising awareness of chemical issues in schools and promoting sustainable solutions.

The Resources page offers similar materials with a practical edge. These documents can help a school assess the health of their school's environment and learn how to conduct a chemical inventory. Other resources include "green-themed" labs and classroom activities and fact sheets about environmentally friendly cleaning products and procedures.

The Healthy School Environment Web Resources link has online resources to help teachers, school administrators, staff, school nurses, parents, architects, design engineers, and facility managers address environmental health issues in schools.

Energy Star Kids

The EPA's Energy Star Kids website at *http://1.usa.gov/12k4C8n* provides elementary and middle level students with facts about energy, tips to lower energy consumption even in their own rooms, and The Quickest Ever Slideshow on Global Warming, which can help them better understand the concept and the need for energy conservation. A Word Bank offers a glossary of energy terms; teachers and parents can access a database of renewable energy activities from the U.S. Department of Energy, as well as environmentally themed *Horton Hears a Who* and *The Lorax* student activity books and a *Lorax* poster.

National Institutes of Health (NIH)

NEI Ask a Scientist Videos

The National Eye Institute (NEI) has produced four brief videos in which elementary students ask NEI scientists about some of the vision-related topics they're most curious about, such as optical illusions and colorblindness, as well as the hows and whys of becoming a scientist. The videos would be useful as enrichment to a What Is a Scientist? or similar unit for elementary students. The scientists' simple, straightforward answers make it easy for students to relate to the speakers and believe that they, too, can be scientists. Access the videos on NEI's You Tube site at *http://1.usa.gov/18l6S15*.

Biology and Genetics Resources: Grades 9–12

Enrich your science education curriculum with free materials from the National Institute of Health's National Institute of General Medical Sciences (NIGMS). NIGMS offers booklets on cell biology, genetics, and chemistry; classroom posters on cell biology, chemistry, and science careers; articles and fact sheets about numerous biomedical research areas; and a digest of research advances. The resources are targeted for high school students, but some may be adapted for use with other grade levels. The document "Using Our Material in Your Classroom" (under For Teachers) offers tips and answers to frequently asked questions to help educators make the most of the resources in their classrooms. Visit the NIGMS Science Education page at *http://1.usa.gov/14pDGok* to learn more.

National Science Foundation (NSF)

Sustainability: Water Video Series

Explore the future of water through Sustainability: Water, a seven-video series produced by NSF and NBCLearn (see *http://1.usa.gov/1aVZaLM* for links to the series). The videos can raise awareness and spark discussion about the importance of managing the water system and conserving this natural resource. Each video features an NSF-supported scientist explaining a specific challenge and how these challenges are affecting the water supply. Topics include Sierra Nevada snow pack and snow melt; the water cycle; the Ogallala Aquifer; dead trees and dirty water in the Rockies; Los Angeles and water imports; urban streams in Baltimore; and Lake Erie and nutrient loading. The videos are appropriate to share with middle and high school students. Not only do the videos emphasize the diversity of work that scientists do, they also clearly show that every issue has multiple sides and highlight the importance of being a scientifically literate, informed citizen.

National Aeronautics and Space Administration (NASA)

Hurricane and Severe Storm Sentinel Mission Video

NASA's Hurricane and Severe Storm Sentinel mission uses the agency's Global Hawk Unmanned Aerial Vehicles to study tropical storms and hurricanes. This video, targeted for middle level and informal audiences, describes the mission, reveals details about the Global Hawk aircraft, and offers a glimpse inside the command centers of both the ground-based pilots and the scientists who analyze satellite images to assist in flight navigation. The video concludes with information about getting students involved directly from the classroom through computer monitoring of the Global Hawk's flight patterns and participating in live chats with the ground-based pilots and scientists. Find out more at *http://bit.ly/11iwesZ*.

Spacecraft 3D

This NASA-created app at *http://bit.ly/TlWf2X* brings some of the agency's robotic spacecraft to life in 3D. The app uses animation to show how spacecraft can maneuver and manipulate their outside components. Spacecraft 3D is among the first of what are known as augmented-reality apps for Apple devices. Augmented reality provides users (in this case, probably middle to high school students and space enthusiasts of all ages) a view of a real-world environment where elements are improved by additional input.

Spacecraft 3D uses the iPhone or iPad camera to overlay information on the device's main screen. The app instructs users to print an augmented-reality target on a standard sheet of paper. When the device's camera is pointed at the target, the spacecraft chosen by the user materializes on screen. In this way, users get a close-up view of these robotic explorers, see how they move, and learn about the engineering feats used to expand our knowledge and understanding of space. This app literally puts a spacecraft in the palm of your hand.

Engineer a Satellite: Grades 9–12

During this high school–level activity from NASA, available at *http://bit.ly/MVnDjp,* students construct a scale model of an Earth-observing satellite. Students learn about NASA's Aura satellite, which studies the Earth's atmosphere, including air quality, the ozone hole's changing size, and links between ozone chemistry and climate.

Next, students follow several steps to build the scale model of the satellite. They must select the scientific instruments they would like their satellite to have. They then calculate the power requirements for the subsystems. Finally, they construct the model from cubes, beads, and other assorted materials. The website includes student worksheets, instructions, and background information about various satellite types.

National Oceanic and Atmospheric Administration (NOAA)

Climate Education Resources

Teaching Climate, NOAA's newly redesigned web page at *www.climate.gov/teaching,* offers a searchable database of reviewed K–12 climate education resources produced over the last 10 years as part of various NOAA, NASA, and NSF federal education grant projects. The resources have been rigorously reviewed by teams of subject experts for scientific accuracy, pedagogical soundness, and usability. Educators can search for resources by type (e.g., Visual, Videos, Demos and Experiments, and Interactive Tools) or by audience (e.g., grade levels from intermediate to upper and lower college, informal, and the general public).

Click on Teaching Climate Literacy to access *Climate Literacy: The Essential Principles of Climate Science,* a standards-aligned framework for educators who want to teach climate science. The Professional Development section lists upcoming webinars and other events for educators to learn more about climate change.

U.S. Department of Agriculture (USDA)

Team Nutrition Curriculum: PreK–6

USDA's Team Nutrition curriculum at *http://teamnutrition.usda.gov/garden.html* can help preschool and elementary students connect gardens with nutrition messages in the classroom and cafeteria and at home. The resources teach children to think positively about fruits and vegetables and foster an awareness of where foods come from.

In Grow It, Try It, Like It! Preschool Fun With Fruits and Vegetables, very young students explore three fruits and three vegetables inside and out. In The Great Garden Detective Adventure (grades 3–4), students grow, harvest, prepare, and taste fruits and vegetables; develop a class cookbook; track their fruit and vegetable consumption; and share their knowledge with their school and families. In Dig In! (grades 5–6), students learn about plant behaviors and nutrition as they design, grow, and harvest a garden of fruits and vegetables.

National Park Service (NPS)

NPS Videos and Podcasts

These video and audio recordings from the NPS show students what park scientists do and provide an inside look at some of the issues facing our national parks. Most appropriate for middle and high school students, the videos introduce the legacy of George Melendez Wright, the father of "Park Science"; investigate ocean ecology; and explore biodiversity. Another series examines White-Nose Syndrome, a fungal disease currently threatening bat populations in national parks, and the efforts to identify and respond to this disease. Teachers can use the clips to generate discussion about real-world problems in nature and how scientists and others work to solve them. Watch the videos at *http://nature.nps.gov/moviespodcasts.cfm.*

U.S. Department of Energy (DOE)

Wind Power Resources

At the DOE's Wind Powering America website at *www.windpoweringamerica.gov/schools,* K–college educators can learn about wind basics and find curricula to teach students about wind power and how energy from the wind is generated. The curriculum is culled from various organizations, projects, and universities with an interest in wind energy education (e.g., 4-H, the KidWind Project, California Energy Commission, U.S. Energy Information Agency, Boise State University, and others). Teachers can access lesson plans, videos, and websites about wind and energy (e.g., the National Renewable Energy Laboratory's Student Resources on Wind Energy). High school teachers, in particular, will appreciate the site's searchable database of colleges and universities with wind energy education programs (click on Education and Training)—a tool for guiding students interested in pursuing careers in the field. ●

In Your Pocket

Editor's Note

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

Syngenta Grow More Vegetables Seed Grant Program

This program provides vegetable seeds for gardens that help educate the local community. All applicants who meet the required criteria will receive seeds. Three recipients in each category—elementary and middle school, high school and Future Farmers of America chapters, and community groups and organizations—will also receive a materials donation or gift card and a Flip camera to capture images of their garden.

Seed grants are available for schools and nonprofit organizations with 501(c)(3) status. They can be used to start new gardens or enhance existing ones. Apply by **September 15;** see *http://bit.ly/15ppfwV.*

FirstEnergy Mathematics, Science, and Technology Education Grants

FirstEnergy provides grants to support classroom projects and professional development initiatives focused on science, technology, engineering, and math (STEM). Grants of up to $500 are available for preK–12 educators and youth group leaders in communities served by FirstEnergy's operating companies (located in Maryland, New Jersey, Ohio, Pennsylvania, Virginia, and West Virginia). Projects that enrich student learning and include the study of electricity and its production are of special interest.

Application materials are available at *http://bit.ly/13mKznZ*. Grant projects must be completed during the 2013–2014 school year. Apply by **September 16.**

Target Field Trip Grants

Target provides grants of $700 to K–12 schools nationwide. Field trips should connect students' classroom curricula to out-of-school experiences and take place between February and December of 2014. Schools and nonprofit organizations within 100 miles of a Target store may apply.

To learn more and apply online, go to *https://corporate.target.com/corporate-responsibility* and click on Education (under the Areas of Commitment heading). Apply by **September 30.**

Project Learning Tree GreenWorks! Grants

GreenWorks! grants fund neighborhood improvement projects that teach students about the environment and allow them to "learn by doing." Past projects have included habitat restoration, watershed improvement, energy conservation, recycling, outdoor classrooms, and school gardens. Grants of up to $1,000 are available to students, educators, or community members with project ideas, and $3,000 grants are offered to help Project Learning Tree (PLT)–registered schools implement PLT investigations.

Applicants must have attended or be registered to attend a PLT workshop. Projects should involve at least one community partner and secure at least 50% matched or in-kind funding. Apply by **September 30** at *www.plt.org/greenworks.*

Kids in Need Foundation Teacher Grants

Sponsored by Office Depot and Jo-Ann Fabric and Craft Stores, these grants help preK–12 teachers provide innovative learning opportunities for their students. Projects that use common teaching aids creatively, approach the curriculum from an imaginative angle, or tie nontraditional concepts together to illustrate commonalities are encouraged. The ability to replicate proposed projects is also important, since winning project ideas are published on the foundation's website.

Grants of between $100 and $500 are available; typically, between 300 and 600 grants are awarded. Applicants must register for the rewards program at Office Depot or Jo-Ann Fabrics to access the grant application form. PreK teachers can apply for grants through the Jo-Ann Fabrics application only. All applicants will receive poster-making materials and bulletin board supplies.

See *http://bit.ly/13V2nJZ* for details. Apply by **September 30.**

P. Buckley Moss Foundation Education Grants

The foundation awards grants to preK–12 teachers who use art as a learning tool for students with special needs. Grants of up to $1,000 are awarded for new or evolving programs that integrate art into the curriculum. Submit proposals by **September 30;** see *http://bit.ly/18oUz16.*

MATHIEUDU68

Green Thumb Challenge Grant

Presented by The Green Education Foundation and Gardener's Supply Company, this $1,000 award goes to exceptional youth garden programs that have demonstrated success and impacted the lives of young gardeners and their surrounding communities. Programs involving K–12 students or youth groups are eligible. Applicants must submit a 10-minute video chronicling the success of the garden, a digital portfolio, or scanned artwork with descriptions. Refer to *http://bit.ly/NMYblp* to apply by **September 30.**

Captain Planet Foundation Grants

The 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 those who have secured 50% matching or in-kind funding—though grants of up to $2,500 are available. Ideal projects will incorporate both environmental education and service opportunities for youth. Apply by **September 30;** consult *http://bit.ly/N4BTqL* for more information.

American Horticultural Society Great American Gardeners Awards

These awards honor individuals who have advanced the art, science, and environmental responsibility of horticulture in North America. Several awards are presented to educators. The Jane L. Taylor Award, for example, recognizes an individual, organization, or program that has inspired and nurtured future horticulturists through youth gardening. The Teaching Award is given to an individual whose own horticultural knowledge has contributed to others' understanding of the plant world and its influence on society. And the Liberty Hyde Bailey Award honors someone who has made a significant lifetime contribution to the study of horticulture.

Nominate a colleague for one of these awards at *http://bit.ly/18oXgQr* by **September 30.**

The Safeway Foundation's Grants

The foundation provides grants to nonprofit organizations with a mission in these areas: education, health and human services, assistance for persons with disabilities, or hunger relief. Funds must support communities in states where Safeway operates stores: Alaska, Arizona, California, Colorado, Delaware, Hawaii, Idaho, Illinois, Maryland, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Washington, Wyoming, and Washington, D.C.

Typically, grants of between $2,500 and $10,000 are available; in Delaware, Maryland, Virginia, and Washington D.C., grant amounts range between $1,000 and $5,000. Apply by **October 1;** see *http://bit.ly/13Bbk3G*.

Tellabs Foundation Grants

The foundation provides grants for communities where Tellabs employees live and work. (The company's headquarters are in Naperville, Illinois, and Tellabs has offices in Vienna, Virginia; Littleton, Colorado; Santa Clara, California; and Dallas, Texas.) Grants support local and national education initiatives, with a focus on STEM, and programs that encourage understanding and protection of the environment.

Grants typically exceed $10,000. Programs should have 501(c)(3) or equivalent status. Letters of inquiry must be mailed and received by **October 1.** Visit *http://bit.ly/UqfkEc* for more information.

Pentair Foundation Education Grants

The foundation provides grants to support education, sustainability, and workforce readiness in communities where Pentair operates. (Pentair has locations in more than 50 cities in 23 states: Alabama, California, Colorado, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Minnesota, Missouri, New Hampshire, New Jersey, New York, Nevada, North Carolina, Ohio, Pennsylvania, Rhode Island, Texas, Virginia, Washington, and Wisconsin.)

The foundation funds education programs serving both traditional and nontraditional learners, from early education to postsecondary and beyond. Of particular interest are K–12 STEM and robotics programs. Apply online by **October 1** at *http://bit.ly/L1hQbj*.

Frances R. Dewing Foundation Grants

The foundation awards grants to projects focused on early childhood education (for children from age two to sixth grade). Of particular interest are programs at new or unusual education organizations or institutes in the United States with novel educational methods for this population.

Grants range from $1,000 to $20,000; the average grant is $5,000. Tax-exempt status is required. Submit proposals by **October 1;** see *http://bit.ly/Nj43la*.

Association of American Educators (AAE) Classroom Grants

Grants of up to $500 are available for various projects and materials, including books, software, calculators, audiovisual equipment, and lab supplies. Full-time educators who have not received a scholarship or grant from AAE in the last 18 months are eligible. Apply by **October 1** at *http://bit.ly/LC3Evc*.

Air Force Junior ROTC Grant

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

Summer Programs

Editor's Note

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

Mickelson ExxonMobil 2014 Teachers Academy. Looking for your own summer camp experience? This weeklong academy—sponsored by golfer Phil Mickelson and his wife Amy of the Mickelson Foundation and Exxon Mobil—provides teachers of grades 3–5 the knowledge and skills they need to ignite their students' passion for science and math. Instructors from NSTA and Math Solutions Professional Development will lead daily sessions designed to deepen teachers' content knowledge and model instructional strategies to support connections and student learning in these subjects.

The 2014 academy will take place in late July at the Liberty Science Center in Jersey City, New Jersey. The academy covers all expenses for this five-day program, including travel, lodging, and food. Teachers can be referred by a student or apply to the program themselves. One hundred teachers will be selected; notifications are sent in mid-April.

Visit *www.sendmyteacher.com* for details. Apply by **October 31.**

Golfer Phil Mickelson (center) is surrounded by teachers attending the 2013 Mickelson ExxonMobil Academy.

Announcing Your Summer PD Program

Educators seeking information on summer professional development (PD) programs rely on this column in *NSTA Reports* and our online calendar at *http://bit.ly/OBEu2r.* To announce your program, e-mail the following information to *nstareports@nsta.org:* program dates and application deadline, location, relevant websites, registration fees (if applicable), contact person(s), and the grade levels/positions eligible to attend (i.e., elementary teachers, teachers of grades 7–12, science education supervisors, etc.).

While all program announcements will be posted online, those chosen to appear in *NSTA Reports* must meet one of these conditions:

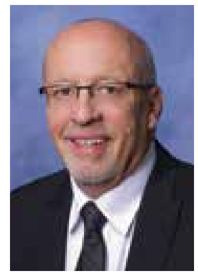
- offer a stipend for participants,
- offer tuition-free credit,
- reimburse participants for some expenses (such as travel costs), or
- be offered by/through a nonprofit group, government entity, or university.

If your program qualifies for publication in *Reports,* please submit the information at least two months prior to the issue you would prefer the announcement to appear in (remaining issues are November 2013 and January 2014 through May 2014). Print announcements will be published one time only on a space-available basis.

Want to get even more visibility for your program? Visit *www.nsta.org/exhibitsadv* for information about advertising it in NSTA publications. ●

New Standards Create Professional Opportunities

By Bill Badders, 2013–2014 NSTA President



With the release of the Next Generation Science Standards (NGSS), based on *A Framework for K–12 Science Education*, and the Common Core Standards in English Language Arts and Mathematics, NSTA and our nearly 60,000 members have a great opportunity to influence the direction of science, technology, engineering, and mathematics (STEM) education for many years. From preschool to elementary, from middle school to high school, and from college and beyond, we prepare all students with science content and engineering practices so they can enjoy the beauty and wonder of the natural world, make everyday decisions based on scientific understanding, and potentially pursue careers in science, technology, and engineering.

My presidential theme—Building and Sustaining Teacher Leadership in Science, Standards, and Literacy—focuses on these standards, as well as developing and building the leadership to make them a reality for all students.

The importance of science in modern life is well documented, and each year, more careers require a solid understanding of scientific knowledge. The NGSS will be the blueprint for designing STEM programs and curriculum to ensure students are career-ready. But we must also understand that literacy is an essential part of what scientists do and is authentic to scientific practice. Most states have adopted or are using the Common Core Standards in English Language Arts, which in turn drive curriculum development as well as assessment tools. Because of this, we must capitalize on the synergies between science and literacy. This is especially true for elementary teachers, who often are pressured to address literacy, sometimes at the expense of science instruction. We must find ways to promote the integration of science and literacy. Science and literacy are mutually supportive and use many of the same cognitive strategies. Research supports the concept that reading and writing are best learned in the context of a content area, and science is the ideal place for literacy learning.

As a former elementary teacher, it is clear to me that science educators will play a vital role in the implementation of the NGSS and the Common Core. We know for any reform or improvement in science education to succeed, what happens in the classroom ultimately makes the difference. This is where teacher leadership becomes vital. Every teacher has the potential to lead, and that leadership can take many forms. You can lead by modeling exemplary science teaching. You can advocate for quality science programs and curriculum in your school district. You can serve on local and state curriculum committees. You've already taken one step by joining NSTA, but you can also join professional science teacher organizations at the local and state levels. You can recruit parents, science professionals, and informal

One of the things that I've been focused on as president is how we create an all-hands-on-deck approach to science, technology, engineering, and math… and to make sure that all of us as a country are lifting up these subjects for the respect that they deserve.

—President Barack Obama, Third Annual White House Science Fair, April 2013

science venues to help provide more diverse opportunities for students. No matter what form your leadership takes, now more than ever, we need you to take the lead in providing students with the kind of quality science experiences the NGSS advocates.

NSTA will play a major role in implementing the NGSS. NSTA can assist in your leadership efforts by providing a growing body of resources including journals, books, online courses, e-newsletters, webinars, interactive resources, social networks, teacher academies, the Science Store, and the NSTA Learning Center. In addition, the area and national NSTA Conferences on Science Education will feature dedicated session strands focused on both NGSS and literacy. Some school districts may provide professional development (PD) funding, or you may be able to access reading PD dollars within your district to attend these conferences.

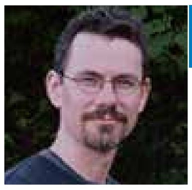
When we consider President Obama's "all hands on deck" call, we could use military terminology. We need a "frontline" formed by NSTA and science teachers leading the charge and a supply line filled with resources from NSTA, state organizations, and individual teachers. What we cannot afford is to have anyone disengaged!

I look forward to working with you throughout my presidential year. Together we impact science education and provide quality teaching and learning for all. Please share your thoughts with me at *bbadders@nsta.org*. ●

Quotable

Get in touch with your inner geek. When you do that, you give your students permission to do the same.

—Ainissa Ramirez, U.S. scientist and educator



BLICK ON MEDIA

Video Games and the Physics Engines That Drive Them

By Jacob Clark Blickenstaff, PhD

When you launch a projectile in Angry Birds, and it flies toward those snorting green pigs, how far will it go? What path will the bird take through the air? How much of the structure will it knock down? The answers to all these questions are determined by the physics engine that underlies the game. A physics engine performs the simplified calculations needed to simulate some version of real-world physics. (However, game designers in general are more concerned with creating an entertaining game than with simulating actual physics.)

I am not the first person to notice that Angry Birds (AB) can be used to teach physics. Rhett Allain is a physics teacher and blogger who has written a book, published by National Geographic, called *Angry Birds Furious Forces* (*http://bit.ly/13sHIqr*). Rachel Connolly has also blogged on the topic (*http://to.pbs.org/163MGw1*). While Allain and Connolly look specifically at AB, I want to address the physics engine that underlies this type of program.

Due to the relatively slow computer processors available, early physics engines could only handle the simplest of situations. If you remember Pong, it had just a white square bouncing back and forth between two white bars. The speed and direction of the "ball" only changed when it hit a "paddle." Pinball simulators produced later had a ball that behaved as though it was on a slope, accelerating toward the bottom of the screen, and bouncing differently depending on the surface it interacted with. That complexity required a more sophisticated physics engine, and more computing power. Modern video games simulate collisions between cars on realistic roads, the running and jumping motions of an avatar, and the trajectories of dozens of objects in a simulated 3D environment. And they do it all in real time, so the action happens as fast as it would in reality.

Even so, physics engines have to make approximations and compromises to keep the pace of play fast enough for the user to become immersed in the world of the game. If the calculations take too long, the game slows, and nothing brings a gamer back to reality faster than a spinning hourglass. What kind of "cheats" do the physics engines make to avoid this problem? The simplest engines use "rigid body physics." That is, objects in the game do not bend, they just move from place to place and rotate. That simplification saves a huge amount of time in the calculations, and usually does not appear notably unreal to the player. (In AB, the pieces of pig-inhabited structures do not bend before breaking.)

Objects with a complex shape (a pig's head, say) can be modeled in the calculations as an oval instead of having ears that stick out. This may substantially affect how they roll or bounce, so this cheat is rarely used now that computing power is relatively inexpensive.

I've recently been playing a game on my iPhone called Tiny Wings. I control a bird by making it either flap

Science teachers can use the popularity of simple games like Angry Birds to motivate interest in projectile motion, forces, and energy.

its wings or tuck them in. When wings are tucked in, the bird falls faster than when its wings are flapping. The wings are too small to hold the bird up even when flapping, though. The ground below the bird has many small hills. To make progress, I have to let the bird descend the slopes and flap on the way up. With the right timing, the bird will gain kinetic energy from all the downhill slides, and make large parabolic leaps. Taking ideas from Allain's AB lessons, students could compare the flapping and wings-tucked-in accelerations of the birds in Tiny Wings.

Some of the most sophisticated (and therefore accurate) physics engines are used in creating computer animations for films. These perform so many calculations that they cannot be run in real time. Hours and hours of computing time can be required to draw each frame if a complex fluid is being simulated, for example. This time lag is not a problem when making a movie, so the level of detail and realism in film animation is generally greater than in video games.

Science teachers can use the popularity of simple games like AB to motivate interest in projectile motion, forces, and energy. Students can collect either qualitative or quantitative data within the game and use that data to determine the details of the game's underlying physics engine. ●

Jacob Clark Blickenstaff is an independent education consultant located in Seattle, Washington. Read more Blick at http://bit.ly/amBgvm.

Quotable

Education is not preparation for life; education is life itself.

—John Dewey, U.S. educator, psychologist, and philosopher (1859–1952)

MS. MENTOR, **Advice Column**

Positing the Essential Questions, What to Do on the First Day of School

We are being asked to post "essential questions" in our classrooms this year. I'm not sure what makes a question "essential" and how this would help students. Would I need a different question each day for my biology course?

—John, Boston, Massachusetts

My knowledge and experience with essential questions relates to the *Understanding by Design* framework from McTighe and Wiggins. But other interpretations are possible, so you should ask your principal what she has in mind. (Perhaps she could model this in a faculty meeting or professional development event?)

Basically, whether you use the term essential questions, big ideas, key understandings, or themes, the purpose is to focus student learning on important concepts that unite and underlie the lessons or chapters in a unit. They help students make interdisciplinary connections and see the bigger picture of science beyond the vocabulary and facts. Most models suggest using them at the unit level, rather than for every lesson.

Essential questions, big ideas, or themes provide a context for the topic and address "Why are we learning this?" During each lesson, students revisit the question, connecting new content or experiences with previous learning. An Earth science teacher I observed posed the question, "How does the surface of the Earth change over time?" As students investigated processes such as plate tectonics, erosion, deposition, or asteroid impact, she guided them to reflect on the question and record their connections in their notebooks.

I've seen teachers display the questions on the whiteboard, on a bulletin board, in a PowerPoint, or on a flip chart. In some classes, students put them in their science notebooks. The location should not be as important as how students use them.

Both the Next Generation Science Standards (NGSS) and *A Framework for K–12 Science Education* describe and focus on a limited number of core ideas and crosscutting concepts—the big ideas of science. As I learned more about the NGSS, I found examples of questions in the "Storyline" narratives on the website. These questions could be adapted for your units. For example, these are life science questions for secondary grades:

Performance Expectations by Disciplinary Core Idea (DCI) (*http://bit.ly/16u1uZ2*)

From Molecules to Organisms: Structure and Processes

- How can one explain the ways cells contribute to the function of living organisms?

Ecosystems: Interactions, Energy, and Dynamics

- How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?

Heredity: Inheritance and Variation of Traits

- How do living organisms pass traits from one generation to the next?
- How are characteristics of one generation passed to the next?

Biological Evolution: Unity and Diversity

- How do organisms change over time in response to changes in the environment?
- What evidence shows that different species are related?

Performance Expectations by Topic (*http://bit.ly/M4SIW9*)

Structure, Function, and Information Processing

- How do the structures of organisms contribute to life's functions?

Growth, Development, and Reproduction of Organisms

- How do organisms grow, develop, and reproduce?

Inheritance and Variation of Traits

- How are the characteristics from one generation related to the previous generation?

Matter and Energy in Organisms and Ecosystems

- How do organisms obtain and use matter and energy?
- How do matter and energy move through an ecosystem?

Interdependent Relationships in Ecosystems

- How do organisms interact with other organisms in the physical environment to obtain matter and energy?
- How do organisms interact with the living and non-living environment to obtain matter and energy?

Natural Selection and Adaptations

- How does genetic variation among organisms in a species affect survival and reproduction?
- How does the environment influence genetic traits in populations over multiple generations?

Natural Selection and Evolution

- How can there be so many similarities among organisms, yet so many different plants, animals, and microorganisms?
- How does biodiversity affect humans?

Unfortunately, some principals may think of the questions as something to check off during a walkthrough. I had a principal who noted that while he was in my class, I did not address the essential question. I responded that his 10-minute visit did not include the beginning and end of the class, when we made the connections!

I'm looking for suggestions on what to do with students on the first day of school. I'm starting my first year teaching science at a middle school.

—Shelly, Illinois

Put yourself in the students' place. On the first day, they're subjected to six, seven, or eight teachers reading the syllabus, describing their grading system, and going over laundry lists of class rules. By the end of the day, everything blends together, and the following day, students won't remember who said what. They might appreciate a break from this scenario.

Save your syllabus discussion and safety contract for another day in the first week. You could start with a brief description of the purpose of the science course, including any big ideas that serve as a theme or organizer. Rather than explaining all of the rules, describe the overall expectations on which the rules are based. For example, I would tell students that respect was most important in my class: I would respect them, they would respect me, they would respect one another, and we would all respect the learning process. (One year, after I said this in an elective class, a student stood up and left the room. The other students stared at him, and one remarked, "I guess he wanted a class where he could be disrespectful!")

Depending on the length of your class period, you could then use an activity to get to know your students' personalities and interactions. (However, until you have their safety contracts on file, avoid any activities in which students use chemicals, flames, projectiles, or heat sources.) In a recent discussion on the NSTA members–only chemistry e-mail list, several teachers posted some examples:

- Franklin W. suggested the marshmallow challenge. Students have 20 pieces of spaghetti, one meter of tape, one meter of string, one marshmallow, and eight minutes. Working in teams, they have to build a structure to raise the marshmallow as high off the desk as possible. They then measure to the top of the marshmallows, and the highest wins.
- Ryan R. asks students to arrange themselves in alphabetical order by first names or chronologically by birthdate, and then sit in the corresponding numbered seat.
- Karen D. gives her students a deck of cards (or some index cards) and asks them to build a structure.
- Dave D. groups students and gives each group a "secret" object. Their goal is to write a list of observable characteristics so other groups can identify it.

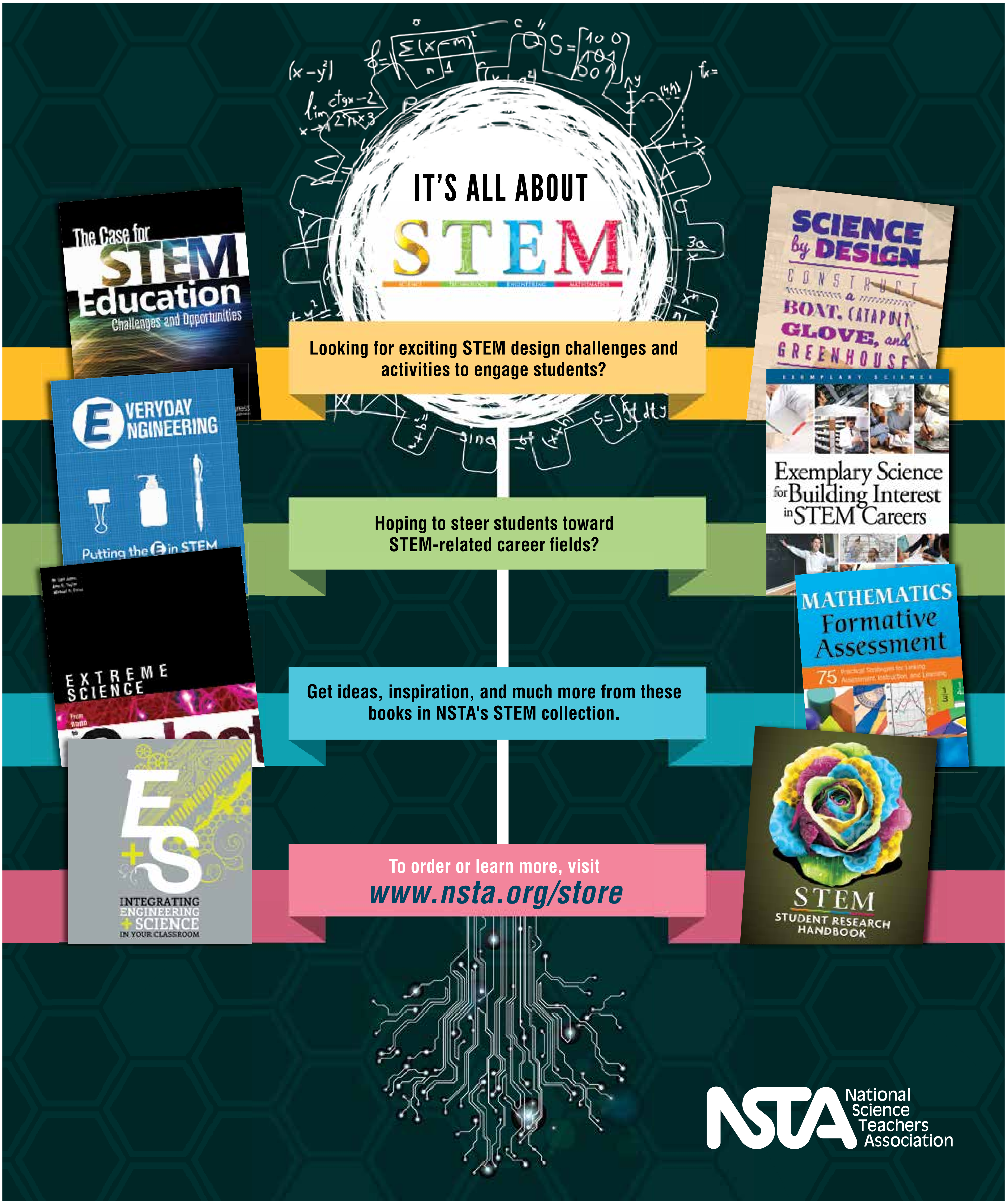
As students do an activity, you'll have a chance to observe their thinking and problem-solving skills. You can start to identify the leaders, organizers, followers, thinkers, disrupters, class clowns, and bystanders.

If time is an issue, you could do a brief demonstration to get their interest. You could also try a formative assessment probe from the *Uncovering Student Ideas in Science* book series from NSTA. Try a different one in each class to gain a cross-section of previous experiences or misconceptions. You'll also get a writing sample from the students.

Some required housekeeping tasks may be expected of teachers on the first day. When I taught in a large, two-story middle school, my principal wanted us to check attendance to ensure students found their way to their classrooms. I dutifully called names, but I usually mispronounced a few or called students by their full name rather than a preferred nickname. Although the students often found this hilarious, I was embarrassed. So I started asking the students to introduce themselves. I could annotate my list with a phonetic spelling or nickname.

The first day of school is exciting, stressful, busy, and a little scary for students (as well as their teachers). As a teacher, you want to set a welcoming tone for your students and communicate your passion for science and your interest in helping them learn.

Check out more of Ms. Mentor's advice on diverse topics or ask a question at www.nsta.org/msmentor.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NSTA National Science Teachers Association

Social Media as a Teaching Tool

On NSTA's members-only Pedagogy e-mail list in January, teachers discussed how they use social media in their classrooms. Brad Graba, Advanced Placement Biology teacher at William Fremd High School in Palatine, Illinois, described a project he uses to teach a unit on the cell. "I had the students run a campaign to get one organelle elected president of the cell (thanks to Marna Chamberlain of Piedmont High School in Piedmont, California, for the idea)." But Graba added a twist to her idea: "I asked the students to create a Twitter account in the name of their organelle to campaign for their organelle and smear other organelles," he relates.

By coincidence, a British biologist who researches the Golgi body (an organelle), Anne Osterrieder, was searching on Twitter "to see if anyone was mentioning Golgi body in their tweets so she could keep up on current research," says Graba. When Osterrieder discovered Graba's students' tweets, she began tweeting with them (see her blog post at *http://bit.ly/12VDi0C*). "Soon, scientist friends of hers were tweeting with my students, helping them research their favorite organelles and smear other organelles. The campaign was dubbed #organellewars, and it took on a life of its own," he reports.

Among those following the campaign was John Runions, a cell biologist at Oxford Brookes University in the United Kingdom. Runions, who also hosts the BBC Radio Oxford series *Dr. Molecule* (*http://drmolecule.org*), discussed #organellewars on the air. In addition, several other scientists blogged about it, and it made "front-page news for our school paper," Graba notes.

Besides fame, Graba and his students derived many benefits from #organellewars. "I've gained a lot of valuable contacts and resources with the scientists who participated with us. Whenever I have questions I can't answer myself, I go to them now. [Also,] my students were more engaged in this project than any I've ever run in my classroom, and were getting great help from biologists around the globe…It turned out to be the most rewarding project I've ever done in my classroom," he concludes.

In the Media Lab at Marymount School of New York, 12th graders in Eric Walters' atmospheric science class filmed a viral video about women's access to water worldwide.

ERIC WALTERS

Many school districts block Twitter, but "my school district was really liberal compared to others, I think, in terms of social media access for students," Graba remarks. "I would encourage teachers who want to use social media and have restrictive policies in place to push their district to lift some restrictions from the students. We should try to use social media in our classes to model good usage, and to help our students produce a positive digital footprint. Employers are asking potential employees about their social media accounts now. Wouldn't it be cool for one of our students to be able to say, 'Look at this cool stuff I produced on social media!'?"

Graba ensured all students could complete the project without using Twitter. "There were certain parts of the project that were required (a poster, a presentation, a brochure), and then there was an 'extras' piece that was required, but there were many options for this—they could create flyers, stickers, buttons, Facebook pages, Twitter pages, etc.,…I tried to be sensitive to the fact that some parents are not going to want their 14-year-old child on Twitter or Facebook, and did not want to penalize students because they did not have access to Twitter."

Chats With Scientists

To help his students connect with scientists, Adam Taylor, who teaches biology, zoology, and physical science at John Overton High School in Nashville, Tennessee, created #SciStuChat (*http://sg.sg/scistuchat1*), a Twitter chat held monthly during the school year. "Twitter gives people immediate access to [one another]. It is the easiest way to get students talking with scientists."

#SciStuChat "gives students a chance to ask questions. They also get to see that scientists are real people, [and] science happens more than just in the classroom," Taylor maintains. He finds the scientists using Twitter and Google searches, and "scientists who have participated previously also invite their scientist friends," he notes.

Topics discussed have included genetically modified food, evolution, cloning, DNA, sharks, and life on other planets. Though some topics could raise eyebrows, "when controversial topics have been discussed, we have had no issues," he reports. "When we discussed evolution, we had a few students disagree with some of the student and scientists' responses to questions. However, generally speaking, the students are polite to each other and do not take things too seriously."

Taylor doesn't use the monthly Twitter chats to assess what his students have learned. "However, at the end of discussions, all participants are asked to share two things they learned during the discussion. It is required participation ([with] alternate assignments for those who cannot participate). I also see the value of the interactions when I hear students talking about it the next day. Many students are reluctant to participate, but most who do enjoy it and come back next time," he relates.

Eventually, other schools discovered #SciStuChat. "As far as I know, we have had six schools participate, one

See Social Media, pg 28

Social Media, from pg 27

in Nashville, two in Kentucky, one in Indiana, one in Arizona, one in New Mexico, and one in Canada—[a]nd a single teacher at each school. We have not had parents join the discussion (they have been invited), but we have had older siblings of students participate," Taylor recalls.

He admits he has faced some challenges: "Part of the reason we do #SciStuChat in the evening is because Twitter is blocked at school. My principal gave me permission to use it at school anyway. For the first couple of years, students and I used a work-around to use Twitter in class. Sometimes scientists join our discussion during class."

He continues, "All work-around and back-door options have been blocked by the district. I have been prodding the district for three years to unblock Twitter. Other influences have been at work as well, and now the district is looking to unblock it for high school. The specialized filtering cost more…Because of the cost, we will not be using the special filtering this year."

Access has been a problem. "Sadly, not all the students have devices or computers at home with internet. In addition, some students' parents will not allow them to get Twitter accounts…I embed the class Twitter feed on the class website so students can still find the information they need," he explains.

Storifying Sandy

"My [12th-grade] students in atmospheric science have used Storify to tell their personal stories about Superstorm Sandy," says Eric Walters, director of technology and science educator at Marymount School of New York. "For students in [New York City], hurricanes seem like a remote natural occurrence—disasters that happen only in places like Florida, Louisiana, or the Caribbean. This project required them to understand hurricane formation and development, hurricane tracking, [and] the hurricane's path in relationship to upper-air patterns (left-hooking hurricanes are unusual!). Often they associate the worst damage with the biggest hurricanes; here, there was significant damage, over a very wide area, from a not-too-powerful hurricane, that impacted them directly."

The students' Storify projects (*http://bit.ly/186cqsN*) revealed their feelings about Sandy. "The course description for atmospheric science states that we focus on 'the physical and dynamic processes that shape weather and climate.' So often, we forget the social and emotional impact of weather and climate," Walters contends.

"Superstorm Sandy was a teachable moment: It was intensely personal for every student and teacher. Having students tell their personal stories through Storify allowed each student to, hopefully, come to terms with their own personal impact of Sandy," he explains.

"We live in a 24/7 news cycle. We also live in a 24/7 education cycle. Leveraging social media—and this 24/7 approach to journalism—allows my students to curate content, be it photos, blogs, or tweets, into their own immediate context for learning," he adds.

After completing that project, Walters' students began another, H20pportunities: Women and Water (see *http://bit.ly/13BnL4A*), exploring sanitation and its impact on women globally.

"Water and access to water may seem like a pure social justice issue, but why beneficial water ends up in one location as opposed to another is pure climate," he points out. "Students needed to understand global wind patterns, the water cycle, precipitation formation, and water transport—both above ground and below ground."

For this project, student teams created Facebook and Twitter pages, a viral video, and a 15-minute live broadcast. "[S]tudents worked independently; they met during a weekly 'flex period' for 45 minutes (basically, they could work anywhere in the school building; we used TodaysMeet [*http://todaysmeet.com*] as a backchannel). Making sure students stayed on task and reported in after their weekly meetings was important," he notes. ●

TOP 10 REASONS TO ATTEND

1. **PERFORMANCE:** You and your students deserve to be excellent in science.

2. **LEADERSHIP:** New skills, knowledge, and activities help build educational leaders who influence others to do extraordinary things.

3. **DISCOVERY:** Looking at the world with a new perspective brings innovation and creativity in the classroom.

4. **MOTIVATION:** Expert speakers, educators, and scientists serve to inspire and stimulate.

5. **PASSION:** Sharing it with your peers, your mentors, and the leaders in science education is contagious.

6. **EXPERTISE:** Educators are the best when they are well-versed in their field.

7. **INSPIRATION:** You'll hear stories from renowned authors and presenters that will move you to act.

8. **GROWTH:** Your conference experience will expand your world personally and professionally.

9. **FREEBIES:** Exhibiting companies from across the nation will offer you hundreds of classroom giveaways, new products, and samples.

10. **CONNECTIONS:** You'll meet peers, mentors, leaders, and acquaintances for support and friendship.

NSTA National Science Teachers Association

NSTA PRESS: *SCIENCE BY DESIGN: CONSTRUCT A BOAT, CATAPULT, GLOVE, AND GREENHOUSE*

Integrating Science and Technology

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 Science by Design: Construct a Boat, Catapult, Glove, and Greenhouse, *developed by TERC, edited for publication here. To download the full text of this chapter, go to* http://bit.ly/14tiU57. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Construct-a-Glove is aligned with the National Science Education Standards for process and content standards in both physical science and biology, as shown in the Standards and Benchmarks Connections. Through inquiry and design, students develop conceptual understanding of heat energy transfer, cell metabolism, and thermal regulation. Because design activities motivate inquiry and inquiry informs design, students engage in the iterative processes of scientific inquiry and technological design through a variety of hands-on activities.

Schedule

The minimum time needed to complete the core unit is about 12 class sessions. More time will be needed if you include the enrichment activities.

In Construct-a-Glove, students are given the Design Brief challenge and instructions for making a quick-build insulated glove (about three class sessions). During the research and development phases (a minimum of seven class sessions), students identify relevant factors and variables, design and conduct experiments, and contribute to a product development team. They develop a physical model of their design, test, measure, analyze their data, and redesign if necessary. Students search for combinations and configurations of materials that can improve the performance of their prototype glove. Teams critique one another's prototypes and learn to build on the experience and insights of other groups. In the Communication activity (two class sessions), the team composes a product prospectus.

Key Ideas

Each key science idea used in Construct-a-Glove is covered in a text reconstruction exercise in Appendix B. The first exercise, on homeothermic processes, involves a very simple reconstruction and is intended as an introduction to text reconstruction.

Homeothermic Process (Maintaining a Constant Internal Body Temperature)

The measured and perceived warmth of a hand is related to its direct connection to the body's heat engine and the hand's relatively large ratio of surface area to volume. Variables that add complexity to an insulated glove system design relate to the multiple functions of the hand: an appendage for body cooling, environmental sensing, and manipulating objects.

Heat Energy Transfer Processes, Insulation Materials, and Dexterity

Student teams measure temperature change over time as a gloved hand is exposed to cold. Properties of various materials are explored for their effect on hand warmth and dexterity.

Inquiry and Design

Experiments are designed by students to supplement "fair test" comparisons of several manufactured gloves. Students conduct "hands-in" research to determine combinations of glove materials that balance thermal effectiveness with dexterity for a specific function. Working in development teams to design and construct an insulated glove system prototype, students present their research and development effort in a product prospectus.

Student Portfolios

The following items can be accumulated in portfolios for summative assessment:

- Pretest: Snapshot of Understanding
- Initial questions: Design Brief
- Individual information search
- Brainstorming record: Identifying Factors and Variables
- Problem statements: Team Situation Analysis
- Research and results: Investigating Heat Transfer and Insulation; "Fair Test" Comparison
- Group process description: Inquiry Process and Design Process
- Development Assignment
- Team Feedback
- Evaluation of prototype: Reflections on Design
- Group summary documentation: Creating a Product Prospectus
- Post-test and self-assessment: Snapshot of Understanding

Activity 1—Insulated Glove Design Brief

Overview: Insulated Glove Design Brief

In this activity, you will be researching, designing, building, and improving an insulated glove system. You will use both technological design and scientific inquiry as processes to investigate and improve the performance of your prototype.

Design Challenge

As a member of a product research and development team, design an insulated glove system that keeps the tip of your index finger as warm as possible in uncomfortably cold surroundings, while maintaining dexterity for a specific function.

Scope of Work

- Quick-Build: Build and test an initial glove design according to instructions, and identify variables you can control to create an improved insulated glove.
- Research: Investigate heat transfer and insulation, and conduct a "fair test" comparison.
- Development: Specify function, redesign, build, and test; collect data and analyze patterns of results; then finalize your prototype for critical review.
- Communication: Present a product prospectus that summarizes your team's final design, including documentation such as sketches, data, specifications, and limitations.

Snapshot of Understanding

What I Already Know About Homeothermy, Heat Transfer, and Research and Development

The unit of study you are about to begin will challenge you to design, build, and performance-test a prototype model of an insulated glove. To meet the performance specifications, you will have to investigate heat transfer physics, biological temperature regulation, and insulative effectiveness of materials and configurations. Before you begin, record a sample of what you already know by answering the following questions. This is not a test; rather, it is a series of questions that ask about your current knowledge of key ideas in this unit. At the end of the unit, you will answer similar questions and compare what you have learned.

1. What are the parts of the hand?
   a. What are the functions of a hand (e.g., sensing, temperature regulation, manipulation)?
   b. Make a sketch of a hand, and label the important parts and functions.
2. List as many special-purpose kinds of gloves as you can. Place a "T" by those specifically designed to provide thermal protection. For example, a welding glove is designed to provide thermal protection, so you would put a "T" next to "welding" in the list.
3. Think of a time when your hands were really cold. What were you trying to do? How did you warm them? Which heat transfer process did you use? (e.g., radiation, conduction, convection)
4. What test(s) could you perform to determine if an animal is "warm-blooded" (homeothermic) or "cold-blooded" (poikilothermic)?
5. To maintain your relatively constant body temperature of 36°C, what does your body do automatically? What are some things you do purposefully to make yourself warmer or cooler?
6. What are temperature and heat, and how are they related? ●

Mark Your Calendar
NSTA Dates to Remember

(All dates are deadlines unless otherwise specified.)

September 17—Have you considered nominating yourself or a colleague to serve on **NSTA's Board and Council**, but aren't sure about the obligations of the various posts or the process? Join Lois Mayo for a free web seminar discussing the leadership opportunities and how to complete an application. More information is available from the NSTA Learning Center; see *http://bit.ly/Eo1MU*.

September 19—**National Chemistry Week** is October 20–26. Are you ready to explore "Energy: Now and Forever!" with your students? Join this free **NSTA Web Seminar** featuring resources for middle and high school science teachers. The seminar will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to *http://bit.ly/Eo1MU*.

September 26—Intrigued by the challenge of the Toshiba/NSTA ExploraVision Awards program, but not sure how to incorporate the competition into your classroom? ExploraVision Ambassadors, teachers of past winning teams, will share their experience and tips during a free **NSTA Web Seminar, What Is ExploraVision and How Can I Use It in My Classroom?** The session will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to *http://bit.ly/Eo1MU*.

October 1—You know how you assess your students, but how do you assess your own learning and performance? Contribute your insight and experience with **"Measuring Your Effectiveness,"** the theme of the April/May 2014 issue of *Science & Children*, just in time to help your colleagues reflect on another school year. The editors are seeking manuscripts explaining how educators analyze programs and support materials, determine professional development needs, evaluate curriculum, and more. For more information, see the call for papers at *http://bit.ly/agiF5g*.

October 1—Interested in applying for the **Shell Science Teaching Award,** and want to make your application as strong as possible? Norma Neely and previous awardees will offer advice and examples from their award submissions during a free web seminar at 6:30–7:30 p.m. Eastern Time. More information is available from the NSTA Learning Center at *http://bit.ly/Eo1MU*.

October 3—Middle and high school science teachers (grades 6–12), don't miss this free **NSTA Web Seminar, Developing a Competitive Application for the Shell Science Lab Challenge,** focused on helping teachers hone their applications for this valuable award. Share your replicable approach to teaching science with limited resources for a chance to win a school science lab makeover support package valued at $20,000! The seminar will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to *http://bit.ly/Eo1MU*.

October 15—What are the elements of a winning award application? Join Carrie Launius to learn more about the **NSTA Teacher Awards program** and what it takes to be honored with one of these valuable awards during a free web seminar at 6:30–7:30 p.m. Eastern Time. More information is available from the NSTA Learning Center at *http://bit.ly/Eo1MU*.

October 29—Do you know all the resources the NSTA Learning Center has to offer? Explore some of the more than 3,700 free resources during a **free NSTA Web Seminar, The NSTA Learning Center: An Online Portal for Teacher Professional Learning.** All participants will receive one free SciPack, (an online, interactive learning module valued at $40), a certificate of participation, and 100 Learning Center activity points for attending and completing the post-program evaluation. An archive and related PowerPoint presentation will be available at the end of the program. The session will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to *http://bit.ly/Eo1MU*.

November 1—How do you access resources outside your school to enhance your students' learning experiences? The Summer 2014 issue of *Science & Children* will feature manuscripts on the theme, **"Resources From Informal Science Centers and Funded Projects."** Share how you identify resources, recruit and train volunteers, partner with informal science centers, and more. For more information, see the call for papers at *http://bit.ly/agiF5g*.

November 8—Applications for **the Shell Science Teaching Award** are due now! The award honors K–12 science teachers who have positively affected their students, schools, and communities through their exemplary science teaching. Find more information and download an application at *http://bit.ly/alRFmJ*.

November 14—Learn how to use the My Library feature in the NSTA Learning Center to create custom collections of resources for your own reference and to share with your colleagues during **NSTA Learning Center Collections: Grouping and Sharing Resources, a free NSTA Web Seminar**. The session will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to *http://bit.ly/Eo1MU*. ●

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Applications are being accepted for the offices of president-elect, Multicultural/Equity in Science Education director, Preservice Teacher Preparation director, and Research in Science Education director. In addition, applications for district directors are being accepted for these districts:

- District I (Connecticut, Massachusetts, Rhode Island),
- District VI (North Carolina, South Carolina, Tennessee),
- District VII (Arkansas, Louisiana, Mississippi),
- District XII (Illinois, Iowa, Wisconsin),
- District XIII (New Mexico, Oklahoma, Texas), and
- District XVIII (Canada).

All applications must be submitted electronically to *nominations@nsta.org* by **October 9.** For more information on the NSTA Board and Council, visit *www.nsta.org/nominations*.

Quotable

Scientists seek truth by being persistently self-critical. It is exciting when our findings survive our efforts to poke holes in them. And when they don't survive, we learn something new. Knowledge wins either way!

—Rebecca Saxe, associate professor of cognitive neuroscience, Massachusetts Institute of Technology