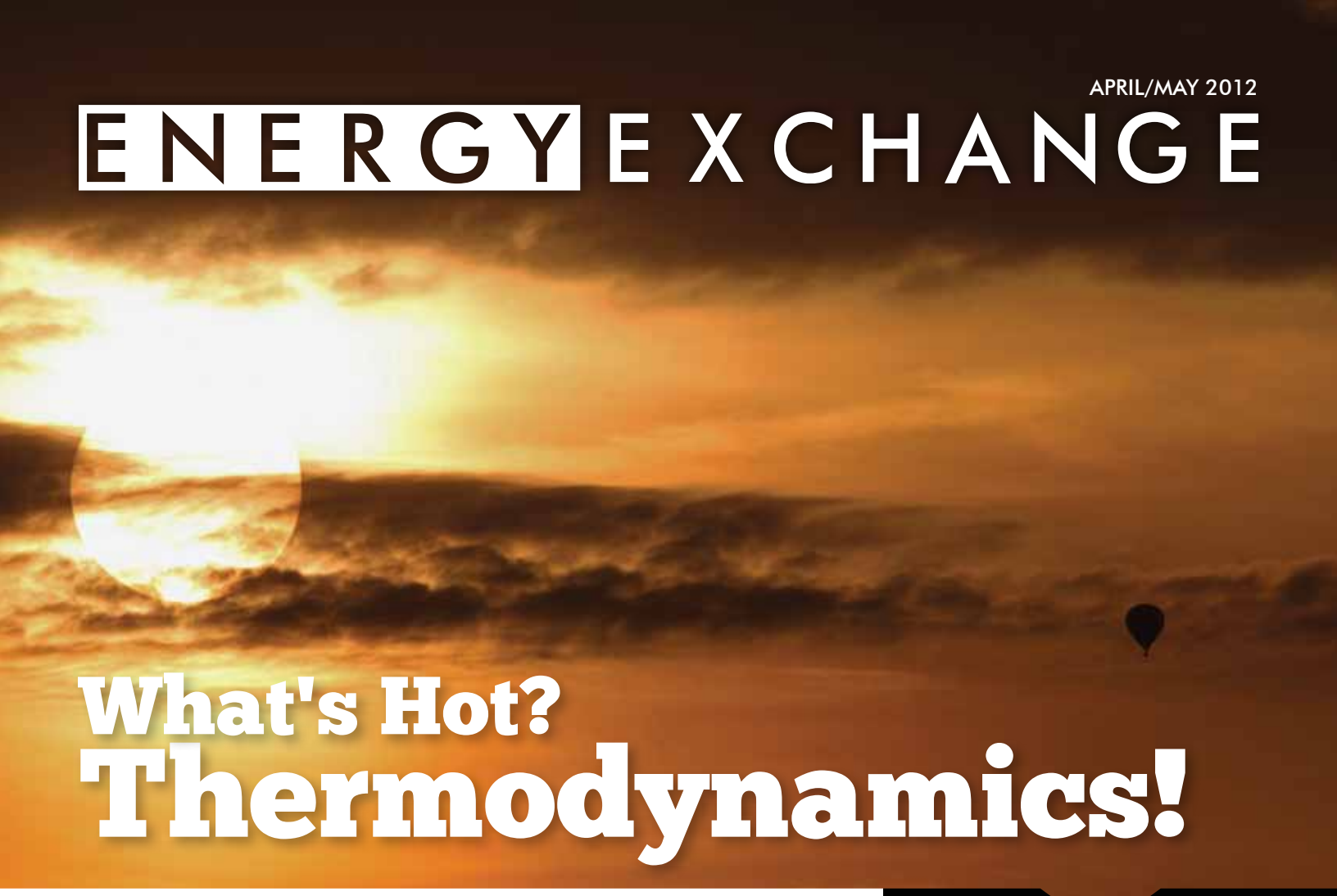
APRIL/MAY 2012

ENERGY EXCHANGE



What's Hot? Thermodynamics!

"Hot enough for ya?"

"It's hot enough to fry an egg on the sidewalk!"

We all know that in many areas of the country, temperatures soar in summer and fall in winter. We also know our utility bills are highest when temperatures are at their highest and lowest points. Understanding how thermal energy is transferred from one place to another inside and outside our homes can help keep energy usage down and keep energy costs lower. Thermal energy is always transferred from high temperature areas to low temperature areas – you never put an ice cube in hot coffee and have the ice cube get colder and the coffee get hotter! Thermal energy is transferred through three mechanisms: radiation, conduction, and convection.

Radiation is the transfer of energy via electromagnetic waves. Radiation can pass through a vacuum, and is the way energy is transferred from the sun to the Earth's surface. Radiation is also how a space heater transfers energy to the room it is in. The intensity of the radiation depends on the source, the distance of the target from the source, and the angle between the waves and the surface of the target. During the summer, the sun is almost directly overhead. Therefore, the maximum amount of energy is transferred to the Earth's surface, and we experience the hottest weather. As radiant energy from the sun strikes the Earth's crust, it is absorbed and transformed to thermal energy – what we commonly refer to as "heat." Station 3 in *Science of Energy* includes a comparison of the temperature standing in the sun vs. in the shade and is used to demonstrate how radiant energy is transformed into thermal energy. Lab Three in *Thermodynamics* demonstrates how the reflectivity of a surface will influence the rate of energy transfer via radiation and can be used as an extension in understanding how cloud cover and snowpack keep temperatures down

See THERMODYNAMICS, page 4

USING THIS IN THE CLASSROOM:
Summer's almost here, and it's time to start planning for the next school year. One of the challenges teachers face is how to combine real-world experiences with the standards they are required to teach in class. Add to that the desire to collaborate with teachers in other departments or grade levels, and planning can become nightmarish. However, the NEED curriculum can help you accomplish what you need to while still teaching basic science concepts and working with teachers in other content areas. In this issue of Energy Exchange we focus on thermodynamics, or how thermal energy is transferred.

Image courtesy Flickr user Dirk-Jan Kraan, creative commons

WANT A MERIT BADGE IN NUCLEAR SCIENCE?

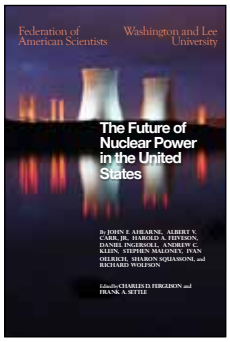
NEED HAS YOU COVERED

NEED Facilitator, DaNel Hogan is a new Boy Scout Badge Counselor for Nuclear Science

During the NEED Staff and Facilitators Meeting in Nevada in late February, DaNel Hogan, Distinguished Einstein Fellow at the U.S. Department of Energy and NEED facilitator, prepared and delivered a 4 hour nuclear science program for Boy Scouts from Henderson, Nevada. NEED student Patrick Keene, son of NEED's general counsel David Keene and Curriculum Associate Maureen Keene, hosted his fellow Boy Scouts from Henderson, Nevada Troop 420 for a day of learning about quarks, fission, fusion, radiation, atomic structure, nuclear power generation, health physics, and so many more things. DaNel was proclaimed a Boy Scout BADGE MASTER by the scouts who thought it was the coolest badge work they had done. Of course it was – with M&Ms as protons and neutrons and NERDS candy as electrons!

Workers weld some of the 58 steel plates that will form the Vogtle Unit 3 containment vessel bottom head being built by Southern Company.

NUCLEAR ENERGY IN THE NEWS AND IN THE CLASSROOM



You may have heard that two new nuclear reactors are currently being constructed by Southern Company in Burke County, Georgia. In addition, a new report, *The Future of Nuclear Power in the United States*, has just been published by the Federation of American Scientists and Washington and Lee University. This ten-chapter publication gives details about the funding structure, regulatory process, and emerging technologies related to building new nuclear power plants or adding additional reactors to existing power plants. With an increasing emphasis on the relationship between carbon dioxide emissions and global climate change, many people are wondering what role, if any, nuclear power will play in reducing greenhouse gas emissions.

These current events provide an excellent opportunity to tie classroom lessons to real-world application. NEED has curriculum units for intermediate and secondary classrooms you can use to teach your students about nuclear energy, uranium fuel production, and power plant design and operation. The curriculum units provide background information, research opportunities, classroom discussions, and hands-on activities to help your students understand the benefits and drawbacks of nuclear power. You can access all of the printed materials by going to the NEED web site and clicking on the Educators tab.

Teachers do the Half Life activity with M&Ms.

THE NEED PROJECT

The NEED Project
Putting Energy into Education

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The NEED Project is a 501(c)(3) nonprofit education association providing professional development, innovative materials correlated to the National Science Education Content Standards, ongoing support, and recognition to educators nationwide.

Energy Exchange is published by NEED for educators and students. We welcome your questions, comments, and suggestions.

THERMODYNAMICS, continued from page 1

on Earth. Solar 4 from *Photovoltaics* helps students understand how the angle of the sun impacts the amount of energy that reaches a surface.

In the summer, we want to keep our houses and school buildings cool and comfortable. Sunlight streaming in through the windows increases the temperature in the rooms. It keeps our cooling costs down if we close the blinds or draw the drapes and keep the interior of those living spaces shaded. Page 41 of the *Secondary Energy Infobook* includes a diagram illustrating how homes can be designed to be shaded all summer long. Roof overhangs that are the right depth shade the interior of the house during the hot summer months, yet allow sunlight inside during the winter months. This is called passive solar heating and is an important aspect in designing homes that use very little energy from a utility company. By controlling the amount of radiation that reaches your home or classroom's interior, you can keep it comfortable all year long.

Conduction is the transfer of energy by direct contact with a hotter object. A pan on an electric burner is a good example of how we use conduction. Materials that make the best conductors are those in which energy is easily transferred. A table of common substances and their conductivities is listed in *Thermodynamics* on page 11. You can use this table to help your students explore which materials make the best conductors and which materials make the best insulators.

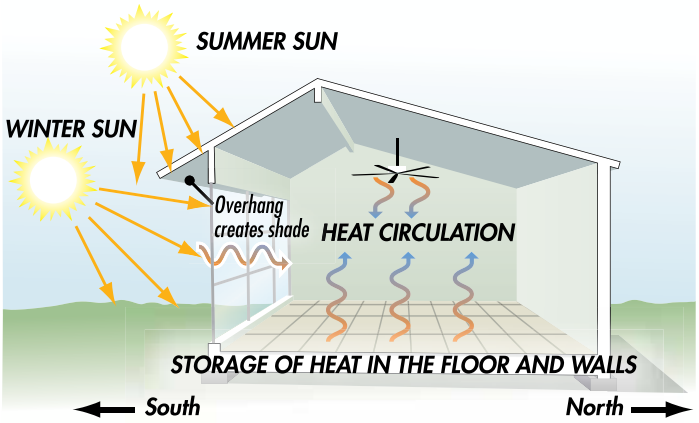
Having a well-insulated home is important to keep thermal energy from being conducted through the walls, windows, and doors. If you have poorly insulated walls and attic spaces, or single-pane windows, your home will conduct thermal energy very easily and your air conditioner will have to work harder in the summer. Because gases are the best insulators, having double- or triple-paned windows will help minimize the amount of energy conducted through your windows.

Our new energy efficiency and conservation curriculum module, *Science of Buildings*, explains how materials are rated for their insulating properties. One activity in this unit, Conduction and Insulation, shows students how different materials insulate. The Insulation Investigation from *Monitoring and Mentoring* can also help your students understand which materials make the best insulators and develop a general understanding of how insulation works.

Convection is the transfer of energy through moving fluids, usually water or air. Forced-air furnaces, central air conditioning systems, and ocean currents all move thermal energy via convection. While transferring thermal energy in this way is often desirable, it is possible to have convection occurring that works against our efforts to keep our living spaces comfortable. If windows and doors are not closed properly, or have gaps around them, air can enter from outside and undermine our ability to remain comfortable.

The expression "heat rises" comes from an understanding of how convection currents work. As fluids are heated, they expand, and become less dense. Because less dense materials will rise above more dense materials, warm air rises above cooler air (which is why hot air balloons seem to defy gravity), and warm water rises above cooler water. Lab Three in *Thermodynamics* contains two activities designed to help your students understand convection. The Home Airflow Simulation in *Science of Buildings* demonstrates how air infiltration can affect the comfort level of homes, especially those with more than one level and a basement.

PASSIVE SOLAR HOME



HELP YOUR STUDENTS VISUALIZE THERMAL ENERGY TRANSFER

TIME

- 1 class period

MATERIALS

- 2 Large buckets
- Lots of scrap paper, crumbled into wads
- Students
- A sense of humor

PROCEDURE

1. **Conduction:** Have students stand in a line. Place one bucket, with the paper wads, at one end of the line, and the other bucket, empty, at the other end of the line. The student nearest the full bucket picks up a piece of "thermal energy" and passes it to the next person, and it is "conducted" down the line. The first person continues to pick up pieces of paper and pass them along the "conductor" until the bucket is empty.
2. **Convection:** Students stand in a line again. However, this time, the student nearest the full bucket picks up a paper wad and carries it to the empty bucket on the other side of the room. The students follow the first person in turn, forming a "current" of student "fluid" that carries the "thermal energy" from one bucket to the other.
3. **Radiation:** Give each student one or two paper wads. Have them line up across the back of the room so they are all facing the front of the room. You take the empty bucket and stand at the front of the room. The students then throw the paper wads at the empty bucket you are holding, and radiate the "thermal energy" from high to low.

How does this all fit in with your energy unit? Start with *Science of Energy* just as you normally would. Follow that with *Thermodynamics* so your students have a strong understanding of how thermal energy is transferred. Finally, Career and Technical Education teachers and science teachers can collaborate and go through *Science of Buildings* to understand how the building uses energy.

PRIMARY/ELEMENTARY ACTIVITY

HEATING WATER WITH SOLAR ENERGY

Note: Use this activity to address a common misconception – heat from the sun heats the Earth. Radiation, convection, and conduction are explained in "What's Hot? Thermodynamics!" on page 1 of this newsletter, including a demonstration of the concepts to engage visual and kinesthetic learners.

QUESTION

During a camping trip, your family heats water in a pot over the campfire. The hot water is used to wash hands before lunch. It is your job to collect the wood for the campfire, but, you'd rather go fishing. Can you use energy from the sun to heat water instead?

MATERIALS PER GROUP

- Sandwich-size, zip-close bag (water tight)
- 2 Student thermometers
- Room temperature water
- Area with direct sun light

PROCEDURE

1. Place one thermometer into the bag.
2. Fill the bag with 500 mL of water (2 cups).
3. Carefully press out extra air and seal the bag.
4. Place the bag in a sunny spot.
5. Record the time, air, and water temperature in the chart below.
6. Record data every hour until lunch time.

DATA

Time	Air Temperature	Water Temperature
	____°C/____°F	____°C/____°F
	____°C/____°F	____°C/____°F
	____°C/____°F	____°C/____°F
	____°C/____°F	____°C/____°F

CONCLUSION

1. How did energy from the sun heat the water in the bag?

2. What would happen if you moved the bag into the shade?

INTERMEDIATE AND SECONDARY ACTIVITY

GEOTHERMAL EXCHANGE SIMULATION

BACKGROUND

In most areas of the country, geothermal energy can be used to heat and cool homes. Since the temperature four to six feet underground remains fairly constant all year long (although it varies by your latitude), the underground temperature is warmer than your unheated home during the winter and cooler than your uncooled home during the summer. A geothermal heat pump (also known as a geothermal exchange system) takes advantage of this and exchanges heat with the earth, warming or cooling a home using a renewable source of energy. A heat pump moves heat energy from one place to another, instead of generating heat, like a conventional furnace or air conditioning system. Therefore, a geothermal exchange system is much more efficient and saves a lot of energy.

QUESTION

How does geothermal exchange occur?

MATERIALS

- 4 Bendable straws
- Nail
- Scissors
- Tape
- 2 Small cups
- 13x9 Baking dish
- Tongs
- Paper towels
- Heating pad
- Kitchen hand towel
- Cold water
- Digital or instant read thermometer
- Ice
- Hot water
- Safety goggles
- Oven mitt

Note: This model WILL leak water. Use a protected surface and place towels underneath cups.

PROCEDURE

1. Set up the model similar to Fig. 1.

   Poke a hole in the bottom of one cup, and the side of another.

   Use scissors to snip into the long end of three straws. Pinch each cut end and insert it into a short uncut end of another straw, and tape the joint. The last straw should be joined at the short end, then trim the straw as needed once inserted into the collection cup.

   Insert the free straw end into the drain cup. (If needed, use tongs to pull the straw through the hole.)

   Tape the straws to the bottom of the 13x9 dish to keep the model stable.

2. **Heating Season**: moving heat from the earth to your home

   Turn the heating pad to high, and place under the 13x9 dish. Place paper towels under the cups (Fig. 2).

   Place a towel over the straws in the dish. Wait about ten minutes for the heating pad to warm the model.

   Pour ice water into the drain cup. Use an instant read thermometer to take the temperature of the water entering the system (Fig. 3) and record it in the data table.

   Take the temperature of the water filling the collection cup and record in the data table.

   Pour the water out of the cups.

FIG. 1 MODEL SET-UP

FIG. 2 MODEL SET-UP

FIG. 3 HEATING SEASON MODEL

3. **Cooling Season:** moving heat from your home into the earth to cool your home

   SAFETY: Use extreme caution when handling, pouring, or holding the cup with hot water. Splashes and drips could burn. Wear safety goggles and an oven mitt when handling hot water.

   Heat water in a hot pot to no more than 100°F or 37°C. Water that is too hot may melt the cup.

   Fill the 13x9 pan with ice. Cover the model as much as possible.

   Pour hot water into the drain cup (Fig. 4). Use an instant read thermometer to take the temperature of the water entering the system and record it in the data table.

   Take the temperature of the water filling the collection cup and record in the data table.

   Pour the water out of the cups.

FIG. 4 COOLING SEASON MODEL

DATA

	Starting Temperature	Ending Temperature	Temperature Change
Heating Season			
Cooling Season			

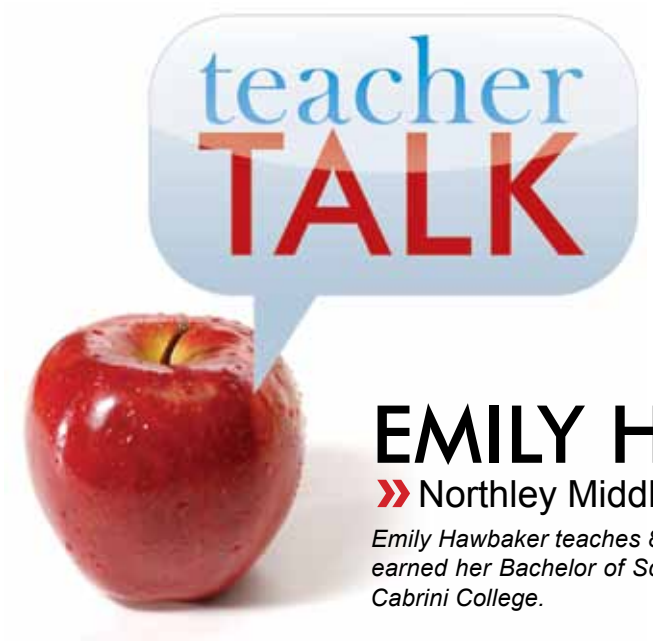
CONCLUSION

1. Explain how heat moves by conduction.
2. How would adding more straws to the system affect the temperature change?
3. Draw a picture to show how you would redesign the model to create a more efficient exchange of energy. Write a paragraph describing how your system works.

EXTENSION

Research geothermal heat pumps (check out www.energysavers.gov), and write a few paragraphs describing the advantages and disadvantages to installing and operating this kind of heating and cooling system. Do you think it would be a good investment for your family home? Explain why or why not.

THANKS! Activity developed by NEED Teacher and Facilitator, John McLaren, Centreville High School, Centreville, Virginia.



EMILY HAWBAKER

» Northley Middle School, Aston, PA

Emily Hawbaker teaches 8th grade Physical Science at Northley Middle School in Aston, PA. Emily earned her Bachelor of Science Degree at Penn State University and her Masters in Education at Cabrini College.

WHAT IS UNIQUE ABOUT YOUR TEACHING STYLE?

At Northley Middle we have an inclusion type classroom setting where I will teach all students at every academic level in eighth grade. To address such a diverse group of students, I stay upbeat, using a lot of humor and transitions in my teaching style. To connect with my students and keep them engaged, I often reference movie or song quotes, where my students can relate. I have a great passion for working with young people, and try to instill a sense of passion in my students' work as well. Their success is important to me, and teaching them to be actively engaged in their learning is one of my ultimate goals.

WHY IS TEACHING ENERGY IMPORTANT TO YOU AND YOUR SCHOOL?

For my students to be productive citizens it is pertinent for them to understand energy, not only because they will use energy on a daily basis throughout the rest of their lives, but also because understanding energy conservation can save them money. Northley is a school located on the outskirts of Philadelphia, PA, so we have a wide variety of utility providers within a close proximity. Many of my students' parents are employed at these coal, nuclear and hydropower plants, making the topic of energy even more intimate to them and their family. We feel like energy is so important that we spend an entire 9-week grading period on the subject.

HOW DID YOU FIND OUT ABOUT NEED?

I attended a workshop about 5 years ago and absolutely fell in love. After chatting with NEED's Executive Director, Mary Spruill, during lunch, I decided to go "all in" with teaching energy. A year later I had the privilege of being invited to attend PECO's "Energizing Education" grant program, in which Northley is a 4th year participant. With this grant we have been able to purchase The NEED Project's Hydropower, Monitoring and Mentoring, Solar, Wind and Science of Energy kits. These kits and their components are used throughout the entire year.

Emily Hawbaker (right) and fellow teacher Debbie Blaisse celebrate Ben Franklin's birthday.

WHY DO YOU USE NEED MATERIALS AND HOW DO THEY IMPACT YOUR STUDENTS?

The NEED Project is wonderful for me to use for numerous reasons. For one, all of the activities are "hands-on" and very interactive. The most beneficial thing about the NEED curriculum being so interactive is that my students are learning from each other rather than just me. With such a wide range of students, I feel like this is the best way for them to learn. My students actually get excited to learn and interact with the entire curriculum, which is easily printed or downloaded at www.NEED.org. The web site is very easy to use, and allows me to find lessons and have them ready to teach in no time at all. Also on the web site is the Graphics Library, which provides the best graphics to illustrate energy concepts to my students. Through the use of the curriculum, and especially the kits, my

students have become interested in saving the school and also their community money by saving energy. Their favorite tool is the Kill-A-Watt meter in the Monitoring and Mentoring Kit, which allows them to plug in appliances and assess their use of electricity. The NEED Project's materials are easily the best out there, and that they are updated annually is very important so my students are presented with the most relevant and up to date information. Also with the variety of utility providers so close to our school, NEED's unbiased presentation of energy is very important as well.

WHAT ARE SOME INTERESTING WAYS YOUR STUDENTS HAVE USED NEED MATERIALS?

Every year we host a Northley Energy Expo day, where we invite the neighboring 5th grade students, parents, community, and relevant businesses to our school to partake in an entire day of energy and information. The students facilitate this day, educating the attendees on numerous energy topics. We have had students investigate the different energy sources, create videos, and showcase what they have learned. We will also connect information to some of the local news articles in our community to stay on the cutting edge. Students also facilitate the Science of Energy Kit, showcase the tools in the Monitoring and Mentoring kit, especially the student favorite Kill-A-Watt meter, present displays of ways to save energy, utilize many components of the solar, wind and hydro kits, and also invite the local businesses and community to present some options on their specific jobs and services.

NEW AND NOTEWORTHY

NEED ACTIVITIES IN PUERTO RICO!

NEED teacher Joan Rosario is a long-time NEED teacher who has attended NEED workshops and the National Energy Conference for Educators several times. Joan and her Kindergarten students work hard to learn and teach others in their community about energy and the importance of making smart energy decisions. Students learn in class and then take their knowledge home and share it with their families. "My students really like the solar energy materials and information. The kids apply the knowledge received in class about conserving energy", says Joan. The students participate in solar cooking day, build solar water heaters, build small solar homes, and work with photovoltaics to understand electricity generated from solar energy. The year wraps up with a family celebration and fair for students to share their work. "I am so proud to be part of this project because in Puerto Rico we have excellent weather conditions to use renewable sources of energy. My kids enjoy all the classes and use their own imagination to come up with great ideas. Kids Teaching Kids really works."

WE NEED YOUR HELP TO UPDATE OUR ENERGY BIBLIOGRAPHY!

We are currently updating our list of great, teacher approved, energy-related trade books for K-12 students. If you have a few favorites, please let us know! Include the title, author, ISBN number, and a 2-sentence description or review of the book. Look for an updated bibliography on our web site soon! Send ideas to info@NEED.org.

YOUTH AWARDS PROGRAM

Don't forget! Youth Awards entries are due on April 15, 2012! For information on how to participate in NEED's Youth Awards Program for Energy Achievement visit www.NEED.org/Youth-Awards.

NEED EDUCATOR WINS AWARD

Congratulations! Kevin Crosby, NEED and PG&E Solar Schools Teacher at Independence High School in Bakersfield, California, was selected to receive the California Teachers Association Human Rights Award for his work in Physically/Mentally Challenged Students' Issues. The award is given to an individual whose activities have helped achieve significant progress on behalf of equal opportunity for physically and/or mentally challenged students. Kevin's demonstrated work with his students is a showcase of his work, dedication, and commitment to all students. Independence High School's Falcon Autistic Solar Team received the NEED Youth Award for Energy Achievement for their work as well. Way to go Kevin and the Falcon Autistic Solar Team!

PECO, NEED, AND UNITED WAY

Thanks to a grant from PECO, the United Way and NEED have teamed up to provide curriculum and training to four afterschool programs in the greater Philadelphia area. The United Way agencies – Salvation Army, Overbrook Environmental Center, Girls, Inc, and Boys and Girls Clubs – all received training and Science of Energy, Monitoring and Mentoring, and Wind, Solar, and Hydropower Kits. The program is designed for use with grades 4–8, includes a community outreach effort and NEED's Home Energy Efficiency Kits. Students participating in the program will come together at PECO for an end of school-year celebration to share what they learned.

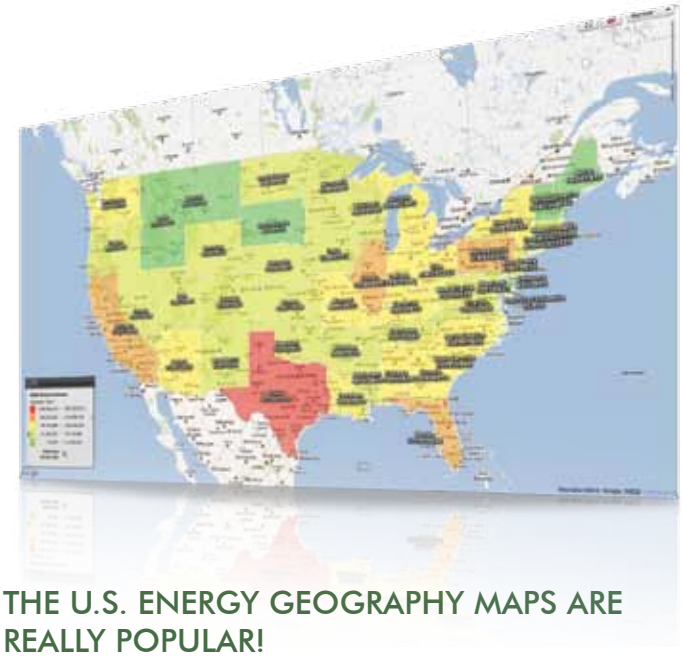
THE NEED ENERGY CONFERENCE FOR EDUCATORS IS JULY 15-19, 2012

Join NEED for the 2012 National Energy Conference for Educators to be held in Arlington, Virginia. The conference is designed to provide participants with five days of energy education content and classroom tools. Hosted in Arlington, Virginia (Metropolitan Washington, D.C.) the conference promises to energize teachers and provide valuable professional development for all attendees. NEED seeks sponsors willing to provide scholarships for interested teachers. Registration to the conference is $1,100. To apply, visit www.NEED.org/summertraining.

WELCOME ANETA SHUTTLESWORTH

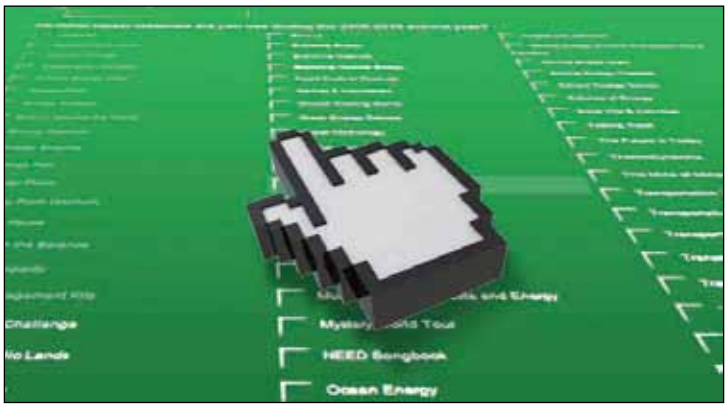
NEED is happy to have Aneta Shuttlesworth join the team in Manassas, Virginia as our Accounting and Office Manager. Aneta comes to NEED from Pathways to Housing, a nonprofit organization dedicated to helping find affordable and emergency housing for individuals and families. Originally from Poland, Aneta recently passed the U.S. Citizenship Exam and was sworn in as an American Citizen in February.

With a degree in accounting and many years of experience, NEED has a new member of the team dedicated to making the organization as great as it can be. Aneta lives in Northern Virginia with her husband and 5 year old daughter.



THE U.S. ENERGY GEOGRAPHY MAPS ARE REALLY POPULAR!

Teachers and students continue to rave about the U.S. Energy Geography mapping tools available at www.NEED.org/maps. These maps showcase energy resources around the country, allowing students to compare one region to another and to research each of the nation's leading energy sources.



TELL US WHAT YOU THINK!

As you wrap up your school-year, we want to hear from you – about your use of NEED curriculum, participation in training, additional resources you may need, and more. Visit www.NEED.org to share about your programs this year! You help make us better! Those participating in the survey will be entered to win a NEED hands-on kit of your choice!

DON'T FORGET!

The NEED Pre and Post Polls are online to help assess student knowledge of energy before and after you use NEED in the classroom. Did you take the Pre-Poll? Make sure to log back in and take the Post-Poll with your students as well. Didn't take the Pre? Go ahead and take the Post-Poll anyway. Any data points we can collect help improve NEED programming in the classroom.

THE NEED PROJECT
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IN THIS ISSUE

Thermodynamics
As things heat up this summer, NEED's materials can help make teaching thermodynamics cool.

Nuclear in the News and in Your Classroom
Nuclear energy has been in the news recently with the building of several new reactors across the country. NEED looks into ways to teach nuclear in your classroom.

Activity: Heating Water With Solar Energy
In this primary and elementary activity, students learn how solar energy can be used to heat water.

Activity: Geothermal Exchange
In most areas of the country, geothermal energy can be used to heat and cool homes. This activity demonstrates how it's done.

Teacher Talk
Also in this issue, NEED sits down with Emily Hawbaker for Teacher Talk. Emily is a teacher at Northley Middle School in Aston, PA.

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