

ENERGY EXCHANGE



HERE'S A BRIGHT IDEA

Of all the things we use that require energy, few are as easy to control as the way we light our homes and schools. We are reminded to turn off lights by stickers on the switch plate, parents telling kids to turn off lights, and then there are motion sensors that turn off the lights for us. While there are lots of things we cannot control, such as the weather, we can control much of the energy we consume. Managing these energy users can have a significant impact on how much energy we use and how much that energy costs us at home and at school. As the winter holidays approach, we all begin thinking about the twinkling and flashing of holiday lights. Understanding lighting, even our holiday lights, is important when we think about using electricity wisely at home. Remarkably, solar energy accounts for less than one percent of total energy consumption in the United States, according to 2010 data released by the Energy Information Administration.

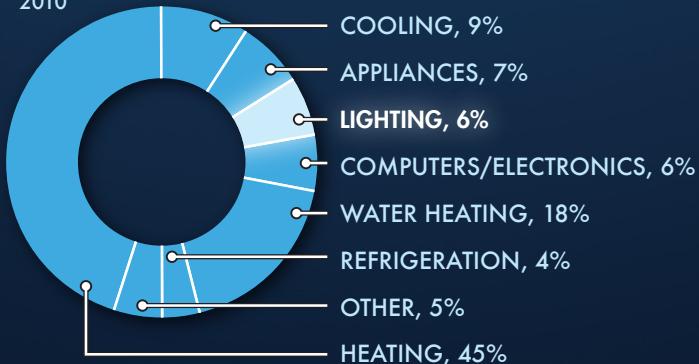
Since the incandescent light was perfected by Thomas Edison in 1879, the incandescent light bulb has been the standard for lighting the interior of our homes. The concept behind the incandescent light is simple: run electric current through a filament that is suspended in a vacuum inside a glass bulb. The filament will heat up, and get so hot that it glows, producing the light we need. That glow requires a LOT of energy.

In spite of its wide use, the incandescent light is extremely inefficient, using only about 10% of the energy it receives to actually produce light. The other 90% of the energy produced is heat. If you've ever changed an incandescent light bulb right after it burns out, you know how hot it can be!

Fortunately, other sources of lighting are readily available on the market that are both affordable and much more efficient in their use of energy. The new standard for energy efficiency is the compact fluorescent light, or CFL, which works on the same principle as the large fluorescent tubes installed in schools and office buildings. Electricity causes mercury vapor to release ultra violet light, which strikes a coating on the inside of the tube, and is changed into visible light. This method of illuminating a dark room uses a quarter of the energy of an incandescent bulb that produces the same amount of light.

HOME ENERGY USE

2010



TEXAS SCIENCE TEACHERS TRAIN ON CARBON CAPTURE, UTILIZATION, AND STORAGE INSTRUCTION

Over 30 science teachers from Texas recently participated in an intensive training workshop on a new curriculum on carbon capture, utilization, and storage (CCUS). The workshop was hosted by the National Energy Education Development (NEED) Project, with support from the U.S. Department of Energy's Office of Fossil Energy and the U.S. Energy Association.

The course, hosted at the Houston Museum of Natural Science, equipped high school and middle school teachers with additional knowledge to confidently instruct on the science of energy and CCUS using dynamic, hands-on activities and simulations. As a result, students in Texas will soon be experiencing for themselves why carbon capture is important, how carbon dioxide can be utilized, and available methods of storage. Additional workshops are scheduled this fall throughout the United States in areas where CCUS projects are active, under construction, or planned.

CCUS is a process designed to separate CO₂ from the flue stream of coal and natural gas fueled power plants. The isolated CO₂ is transported in liquid form to improve production at existing oil and gas fields, with the CO₂ then stored, or sequestered, in the same geologic formations. With increasing domestic fossil fuel production as a result of advanced exploration and drilling techniques, students with an understanding of CCUS principles will gain increased appreciation of how energy is produced, as well as gain interest in a potential career field.

The NEED Project is a nationwide non-profit organization that has worked for over 30 years to put high quality and engaging energy curriculum materials in the hands of classroom teachers. NEED utilizes a national network of 65,000 K-12 classrooms to provide energy education curriculum and training

to the energy workforce of tomorrow. This extensive network gives NEED the ability to successfully improve energy education throughout the United States.

This CCUS curriculum is available to thousands of science teachers in the NEED network. It aims to familiarize science students with CCUS technology and policy issues, while empowering them to become leaders on energy issues.



CO₂ is piped into a jar containing rocks and vegetable oil, simulating how the addition of CO₂ extracts oil from reservoirs.

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Lighting

CONTINUED FROM PAGE 1

The most recent development in lighting is the Light Emitting Diode (LED). While designs vary widely, the basic premise is that several LEDs, are connected together to function as one light source. LEDs are very durable, easy to manufacture, and don't get hot. The cost of an LED is still more expensive than a CFL, but as demand increases, the price of LEDs continues to fall.

Many holiday light manufacturers have begun to produce strings of LED lights that use significantly less energy than standard lights with incandescent bulbs. LEDs last longer than incandescent light strings, use less electricity, and cost about the same amount.

Plan your holiday displays with energy efficiency in mind. LEDs are more efficient, but turning off the lights saves the most energy. Turn off those holiday lights, or use timers to reduce the amount of time they light. Using energy wisely is always a great idea. Don't forget that sharing your knowledge is important. Send NEED your great efficient holiday lighting photos or post them to our Facebook page.



Teacher Tips

The activities in this edition of *Energy Exchange* are designed to get your students thinking about how we light our interior spaces. Older students will construct an incandescent light, and then coupled with "The Facts of Light" and "Comparing Light Bulbs" from pages 27-28 of *Monitoring and Mentoring* (Teacher and Student Guides available at

www.NEED.org), students will see the economic impact of making energy efficient lighting choices. Younger students will compare incandescent holiday lights to a string of LED holiday lights and be able to make recommendations to their parents. Don't forget to tell us how you liked the activities too!

THE NEED PROJECT



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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.

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TRY THIS!

What drives the world economy? Is it energy? Natural resources? Human resources? Good fortune? Teaching students to understand how all of these factors (and more), come together to increase or decrease a country's wealth and independence can be quite a challenge. We have an activity that can help students learn how a global economy functions, how many individuals contribute to the success of a country's economy, and how the availability of needed resources can determine whether a country thrives or struggles to succeed. It's called Global Trading Game, designed for intermediate and secondary classrooms.

The premise of the activity is that groups of students represent the geologists, miners, advisers, and traders of a country. They are presented with a plastic tub of "land" that represents their country and contains their natural resources. Each student within a group assumes a different role, and they all work together to acquire the energy resources from the land, reclaim the land, and trade the



various commodities on the global market. The further students continue into the activity, the more they learn about the impact that available resources, acquiring those resources, and reclaiming the land can have on the quality of life for citizens of a country.

You can find Global Trading Game on our website by clicking on the Educator tab and selecting it from the list of curriculum resources. If you use the activity, let us know how it goes! We love to hear how you are using our curriculum guides in your classrooms.

PRIMARY AND ELEMENTARY ACTIVITY

HOLIDAY LIGHTING COMPARISON

MATERIALS

- 1 String of 100 incandescent, indoor/outdoor holiday lights
- 1 String of 100 LED, indoor/outdoor holiday lights
- 2 Kill-A-Watt™ Monitors
- Copies of activity page for students
- Copies of Monitoring and Mentoring and Building Buddies pages.

PRIMARY PROCEDURE

1. Read “Lighting” on page 4 of Building Buddies Student Guide aloud to students. The guide can be found at: <http://www.need.org/needpdf/Building%20Buddies%20Student%20Guide.pdf>.
2. Discuss ways everyone can help save energy at school, and at home.
3. Introduce LED (light emitting diode) lighting to students. Show them a photograph of an LED, or if you have an LED flash light or light bulb, let them see how small the LED is inside. Explain that LEDs use very little energy, and can be made to be very bright.
4. Ask students if they hang holiday lights. Show them the two strings of lights you’re going to work with for the activity.
5. Show students the Kill-A-Watt™ monitor, and explain what they’re designed to do. Refer to the master on page 31 of the Monitoring and Mentoring Teacher Guide for more information on the Kill-A-Watt™ monitor.
6. Plug one string of lights into one monitor, and plug the other into the other monitor.
7. Find a place in your classroom where you can leave them plugged in continuously for 24 hours. Include a sign for the custodial staff informing them to not unplug the lights because the lights are part of the classroom experiment. Plug both monitors in at the same time.
8. 24 hours later, read the total kilowatt hours used.
9. What did we learn? Ask students to write to their families explaining what they learned.

ELEMENTARY PROCEDURE

1. Distribute Monitoring and Mentoring Student Guides, or copies of page 6, to each student. The guide can be found at: <http://www.need.org/needpdf/Monitoring%20Mentoring%20Student%20Guide.pdf>.
2. Introduce LED (light emitting diode) lighting to students. Show them a photograph of an LED, or if you have an LED flash light or light bulb, let them see how small the LED is inside. Explain that LED’s use very little energy, and can be made to be very bright.
3. Ask students if they hang holiday lights.
4. Show students the two strings of lights they will use in the experiment. Have students write a prediction about which will use less energy on their activity sheets or in their science notebooks.
5. Distribute copies or project page 45 from the Monitoring and Mentoring Student Guide. Show the students the Kill-A-Watt™ monitor. Explain what they are designed to do.
6. Explain to students that you are going to compare the amount of energy each string of lights uses by recording the data from the monitors.
7. Ask students how long the strings should be left plugged in for a good measurement. With your guidance, have students decide on a period of time to leave the lights plugged in before recording data.
8. Plug one string of lights into one monitor, and plug the other into the other monitor.
9. Plug the monitors into electrical outlets at the same time.
10. Allow the agreed-upon time to pass.
11. Read the total kilowatt hours used for both monitors.
12. Complete the data chart.
13. What did we learn? Ask students to write to their families explaining what they learned.

PRIMARY ACTIVITY PAGE

Circle all the ways you can save energy at school:



LEAVE FAUCETS ON



LEAVE LIGHTS ON



RECYCLE



CLOSE BLINDS ON
SUNNY DAYS

Circle all the ways you can save energy at home:



USE NATURAL LIGHT



LEAVE VIDEO GAMES TURNED
ON WHEN NOT USING THEM



TURN LIGHTS OFF
WHEN NOT NEEDED



RIDE A BIKE INSTEAD OF
HAVING YOUR PARENTS DRIVE

HOLIDAY LIGHT DATA:

Kilowatt hours used by incandescent lights: _____

Kilowatt hours used by LED lights: _____

Circle the lighting type that used the least energy:



LED HOLIDAY LIGHTS



INCANDESCENT HOLIDAY LIGHTS

ELEMENTARY ACTIVITY PAGE

PREDICT

Which lights will use the least amount of energy?

DATA

1. Amount of time lights were left plugged in: _____
2. Amount of electricity (kilowatt hours) used by incandescent lights: _____
3. Amount of electricity (kilowatt hours) used by LED lights: _____
4. Explain how to figure out the amount of electricity used by one string of lights in one hour:

5. Calculate the amount of electricity used per hour by each light string:

Incandescent	LED

INTERMEDIATE AND SECONDARY ACTIVITY

MAKE AN INCANDESCENT LIGHT BULB

MATERIALS

- 2 Digital multimeters
- 3 Alligator Clips and Wires
- 8 D cell batteries
- Cookie sheet or pie pan
- Electrical tape
- Empty bath tissue tube
- Empty glass quart-sized jar
- Masking tape or self-adhesive labels
- Mechanical pencil refill leads (graphite), any size
- Toothpick
- Safety goggles

PRECAUTIONS

1. Wear safety goggles during this activity.
2. All references to “lead” in this activity are to pencil lead made of graphite, not elemental lead metal.
3. The pencil lead “filament” gets very hot. The alligator clips and wires that are holding it will also get hot. Allow them to cool for a few seconds before handling.
4. A glass jar must be used because of the amount of thermal energy released by the filament. A plastic container will melt.
5. Read the entire procedure before starting. Work out a method for completing the activity and gathering the data together.
Suggestion: In a group of two, have each person monitor a meter and collect data on output.



PROCEDURE

1. Tape all of the batteries together with electrical tape, in series (positive-to-negative in line), pulling the tape tight for a good connection between the batteries.
2. Tape the black lead of one multimeter to the negative end of the battery assembly. Make sure it is tightly connected to the battery.
3. Connect the red lead from the same multimeter to the appropriate place for measuring 0-10 Amperes DC. Label this multimeter “Current.”
4. Label the other multimeter “Voltage.”
5. Tape one alligator clip/wire to the positive end of the battery assembly. Make sure it is tightly connected to the battery.
6. Take the other two alligator wires, and clip the toothpick between them. Align the wires on the outside of the bath tissue tube so they extend beyond its end and the wires drape down the sides. Tape the wires to the tube as shown. The toothpick helps keep the alligator clips aligned so you don’t break your pencil lead later in the activity.
7. Tape the bath tissue tube to the cookie sheet or pie pan so it stands up with the alligator clips sticking up in the air. This is the base for your light bulb.
8. Connect one alligator clip from the bath tissue tube to the alligator clip attached to the battery assembly. To this connection, add the red lead of the voltage multimeter. Make sure the connection between all three wires is secure. Tape in place, if necessary.



9. Connect the black lead of the voltage multimeter to the other alligator wire from the light bulb base. At this point, the circuit should be an open circuit, with the red lead of the current multimeter plugged in but not touching anything.
10. Remove the toothpick from the light bulb base and replace it with a piece of pencil lead.
11. Turn the jar upside-down and place it over the light bulb base.
12. Turn the current multimeter on to measure 0-10 Amperes DC.
13. Turn the voltage multimeter on to measure 0-20 Volts DC.
14. Touch the red lead from the current multimeter to the connected wire and voltage meter red lead, completing the circuit.
15. Record the maximum value of current (Amps) registered on the multimeter. It should go from zero to the maximum very quickly, then start to decline.
16. Record the first voltage (Volts) registered on the multimeter. It should go from zero to a higher number right away, then begin to increase.
17. If your teacher agrees, leave the circuit connected until the light bulb "burns out" and record observations. Remember that the alligator clips holding the pencil lead will get very hot and should be allowed to cool before handling. Also, the jar will get warm, and might get hot. Use caution when removing it from the light bulb base.
18. Replace the burned-out filament with a new one, and repeat steps 14-16.
19. Use the voltage and current measurements to calculate the amount of power used by the light bulb, using **Power = Voltage × Current**.



DATA AND OBSERVATIONS

Trial #	Voltage (V)	Current (A)	Power (W)
1			
2			
3			

EXTENSION

If time and materials allow, use different thicknesses of graphite and compare the power used to light them.

Lead Thickness	Trial #	Voltage (V)	Current (A)	Power (W)
	1			
	2			
	3			

ANALYSIS

Based on your observations, explain why incandescent light bulbs are inefficient. Use your data to support your analysis.

LET THERE BE LIGHT

Special Thanks to Jennifer Butte-Dahl, Nokero for this guest article.

Most of us take light for granted. We think about it occasionally, on stormy days when the lights go out, and around Earth Day, when we remind ourselves (and our kids) to turn the lights off. It is hard for us to imagine that almost 30% of people living on this planet have no access to reliable electricity. Kerosene lanterns and candles are not just for stormy days in these communities, they are standard fare. So we're glad that the United Nations has declared 2012 the International Year of Sustainable Energy for All - to remind us that light remains a privilege for many, and that solar technology is an affordable and accessible energy solution, not only for off-grid communities, but for all of us. Remarkably, solar energy accounts for only one percent (1%) of total energy consumption in the United States, according to 2009 data released by the Energy Information Administration.

That is why we are so excited about Nokero (short for "No Kerosene"), an innovative company in Denver, Colorado that designs high-quality, low-cost solar-powered products.

Nokero technologies are designed to eliminate the need for harmful fuels, such as kerosene, used in off-grid communities around the world for light. Nokero solar lights and cell-phone chargers are also incredible teaching tools, illustrating the difference that solar can make in the lives of children around the world.

Nokero knows that encouraging kids to learn about solar technology, and play with it, will produce energetic, excited and eager solar ambassadors. In Namibia, in Haiti, and here in the United States, Nokero is working to bring solar lights into schools. In the Navajo Nation, for example, Nokero and their partner Eagle Energy, a renewable energy non-profit, are working with school libraries and tribal leaders to make lights available to kids living "off the grid." Kits of lights are available in school libraries. Teachers can use them during the day for renewable energy lessons. At night, students can check the lights out to do their homework. The solar bulbs are part science lesson, part learning tool.

Nokero recently launched the Nokero Ed™, a light designed specifically for kids, which charges in the sun by day, and clips onto a book by night. Ed™ is a safe alternative for kids around the world who traditionally study by the toxic light of a flickering kerosene lamp. In line with the National Environmental Education Foundation's 2012 theme of



Nokero donated a dozen of their Ed™ solar education lights as prizes for the NEED Project's Annual Youth Awards Program for Energy Achievement, and they were a huge hit. We are looking forward to continued work with Nokero to bring solar energy into classrooms across the country.



'Greening STEM', Ed™ is also designed to inspire environmental stewardship and provide educators with a practical tool for bringing the environment into US classrooms.

teacher **TALK**



ELLIE VANDIVIER

» Harlow Early Learning Center, in Harrodsburg, Kentucky

Ellie Vandivier teaches all subjects to Kindergarteners at Harlow Early Learning Center, in Harrodsburg, KY. Ellie received her Bachelor's of Arts Degree in English from The University of Kentucky, with a Masters Degree in Early Childhood Education from Eastern Kentucky University.

WHAT IS UNIQUE ABOUT YOUR TEACHING STYLE?

I attempt to make learning fun for my students. I want them to love school and to really enjoy learning. I feel this is done by incorporating some of the things that the students are interested in and topics that are pertinent to their world. Lots of hands on activities are a must, which makes NEED materials right up our alley!

WHY IS IT IMPORTANT TO SPEND TIME FOCUSING ON ENERGY IN YOUR CURRICULUM, ESPECIALLY IN KINDERGARTEN?

I believe students need to understand what energy is, including its forms and sources, as well as the impact it has on our environment. Wasted energy costs money and affects everything in their world, and this is something students need to realize. Grasping this at a young age, or at least having a sense of knowledge about energy, is very important for future interest and understanding.





HOW DOES THE USE OF NEED MATERIALS AID YOU IN TEACHING ABOUT ENERGY AND IMPACT YOUR STUDENTS?

The NEED curriculum and materials provide me a guideline to follow, which aids me in planning and developing relevant lessons. The ideas, materials, and most importantly hands-on nature of everything, are extremely beneficial and useful in my Kindergarten class. My students absolutely love using NEED materials. Like I mentioned before, Kindergarteners learn best through hands-on experimentation. The materials allow them to take the knowledge they have learned and apply it in a natural setting. It is fun watching them manipulate the materials and talk to each other about what they are observing.

HOW DO YOU INCORPORATE YOUTH AWARDS PROJECTS INTO YOUR CURRICULUM?

We incorporated our Youth Awards projects throughout our entire curriculum. While we washed milk jugs each day for recycling, we practiced counting. We then figured out how many we did weekly, to not only have a great running total of the impact we were making, but we were also extending the lesson and math associated with this. We used our recycled art project to meet some of our practical living components. The plug load and light studies gave the students an opportunity to use numbers as well. Our recycling projects were part of our science curriculum and throughout each activity and lesson we were always working on our writing skills. We also read many books about energy, recycling and our environment. With so many activities, that were "out of the classroom," it was like we were playing and working to improve our school, all the while "accidentally" learning.

WHAT PIECES OF THE NEED CURRICULUM ARE MOST IMPORTANT TO YOU?

This past year we used the following kits and materials: The Primary Science of Energy Kit, EnergyWorks Kit, Blueprint for Success, Primary Energy Infobook, Monitoring and Mentoring Kit, and Building Buddies to teach our entire Kindergarten curriculum. The Infobooks and energy kits are so useful. Our school's utility provider, LG&E/KU, chose NEED to facilitate their Children's Energy Education Program, which allowed us to receive these awesome kits and materials at no cost at all to our school. There have been a countless number of students impacted by these materials, due to our Kindergarten students facilitating activities and lessons that will impact and educate students throughout the entire district, and the staff as well.

HOW DO YOU INVOLVE YOUR COMMUNITY WITH YOUR ACTIVITIES AND CLASSES?

We invite numerous guest speakers into our classroom to teach us new things. We also partner with businesses interested in energy education. This year we were invited to work with a local factory where we visited the factory and learned how "big people" recycle and save energy at work. The kids then got to plant 3 trees at the factory in honor of their recycling program. It was a great experience. We also made recycling flyers this year to remind our community to help us take care of our earth. With this, the local newspaper inserted them in their edition to reach most members of the community. We also involved the community by asking parents and community members to send in items for us to use in recycling projects, which we then decorated and improved our school's appearance and functionality.



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IN THIS ISSUE

Here's a Bright Idea

Of all the things we use that require energy, few are as easy to control as the way we light our homes and schools. Understanding lighting, even our holiday lights, is important when we think about using electricity wisely at home.

Texas Science Teachers Train on Carbon Capture, Utilization, and Storage Instruction

Over 30 science teachers from Texas recently participated in an intensive training workshop on a new curriculum on carbon capture, utilization, and storage (CCUS).

Activities: Lighting

Primary and Elementary students analyze the electricity usage of different types of holiday lights. Intermediate and Secondary students make their own incandescent light bulbs.

Teacher Talk

Also in this issue, NEED sits down with Ellie Vandivier for Teacher Talk. Ellie is a teacher at Harlow Early Learning Center in Harrodsburg, KY.

WHAT'S NEW AT NEED?

Happy Holidays from NEED

As the days get shorter and the weather in some regions of the NEED network gets cooler, all of us at NEED say thank you and Happy Holidays to our teachers, students, sponsors and partners. The people we work with each year make NEED the extraordinary program it is. We are grateful to have each and every one of you involved in NEED programming. In 2013, NEED will bring you new curriculum, additional opportunities for teacher training, and more. Be sure to check out www.need.org and our Facebook and Twitter to stay connected.

More Workshops on the Way

Don't forget to check the NEED Events calendar at www.need.org to watch for workshops in your region. Did you attend a workshop last year and enjoyed it? Please share your opinions with others – we want every 2012-2013 workshop FILLED to capacity. NEED's sponsors and partners provide the resources needed to bring energy education curriculum and kits to schools across the country.

Not too soon to get started on Youth Awards!

It is never too soon to start planning your Youth Awards Project! Document your classroom activities, do outreach, teach and learn about energy. Deadline for submission of Youth Awards Portfolios is April 15, 2013. And don't forget the NEED Youth Leadership Award Scholarship deadline is April 15, 2013. The National Recognition Ceremonies are in Washington, D.C., June 21-24. For more information and applications visit: [### 2013 NEED Energy Conference for Educators in Albuquerque](http://www.need.org>Youth-Awards.</p></div><div data-bbox=)

NEED's National Energy Conference for Educators (really summer camp for teachers) is set for July 14-19, 2013 in Albuquerque, New Mexico. Conference registration includes lodging and most meals for \$1,100.00. To apply and request a scholarship visit: www.need.org/summertraining.