

Overview

Students learn how energy is used, new energy efficient technologies, and ways to conserve energy at home and at school. Youth will explore the concepts of insulation and conduction; interpret the energy information on the name plates of electrical appliances; measure the electric power consumption of electrical appliances; compare energy-related properties of different types of light bulbs.

Student Learning Targets

- I can name 3 ways in which I can conserve energy and/or help my parents save energy.
- I can explain why it is important to save energy.
- I can identify ways that I am already saving energy every day.

NGSS

MS-PS3-3.

Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

Background

American's use more energy per capita than almost any other country. In today's environment, energy conservation is the most effective way to reduce our carbon footprint, save money, and provide for a sustainable energy future. The three biggest uses of energy per household are: personal transportation, home heating and cooling, and home lighting. There are many personal choices that students can make to reduce their own energy consumption in these three areas at home and in school. Practiced behaviors become habits, and a long-term way of life. In addition, students have the ability to influence other family members and friends to reduce energy consumption.

Vocabulary

energy conservation, energy consumption, Energy Star label, carbon dioxide, greenhouse gas, fossil fuels, biomass, insulation, R-value, energy efficiency.

Resource

Energy Star – describes how a compact fluorescent bulb works:
http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.pr_cfls_about

Materials

Per Student:

Science notebook
Pencil

For Class:

Overhead 1: Home Energy Use
Overhead 2: What Can I Do To Save Energy At Home?
Overhead 3: Energy Star
Overhead 5: Energy Use Table
Overhead 6: Where You Can Save In Your House

For Class (continued)

Station A:

2 laboratory thermometers
2 radiation cans
Very hot water
Tape
Various insulating materials (two are provided in the kit, but you may want to try others)

Station B:

5 energy use monitors
At least 2 similar small appliances of different models and energy efficiency (example: hair dryers)
Appliance with ENERGY STAR label or a copy of the label.

Station C: (if didn't do lesson #7 or if want to repeat)

3 identical desk lamps
1 standard incandescent light bulb and 1 compact fluorescent light bulb, and one LED bulb of similar wattage
3 energy monitors

Preparation

Prepare stations with materials. These activities can be done as student assisted demonstrations or by dividing the students into 3 groups to rotate through each station. Invite an energy efficiency expert from local government office, state Energy Department, or energy related non-profit to speak to the class about energy conservation and efficiency. These individuals often have models they can bring to class that are interactive and help students explore the subject deeper. In Clackamas

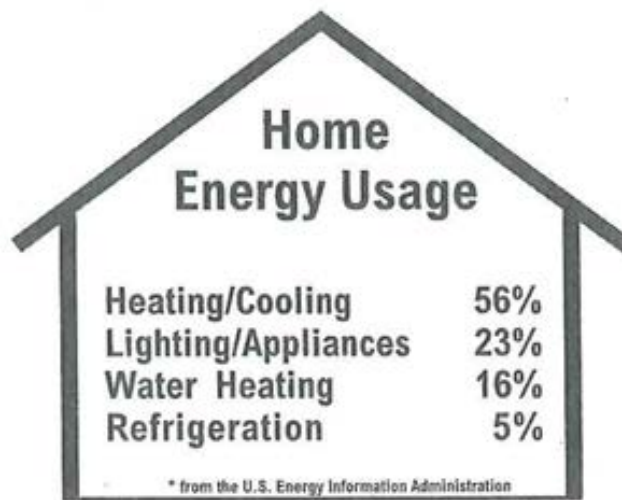
County, Oregon, Kurt Torgerson from the County Office of Weatherization is a great guest speaker.

Time

60 minutes

Procedure

1. Ask students: “What do you think is the biggest use of energy in your home or apartment?” Uncover the answers on Overhead 1 as students provide responses. Ask students to write this information in their science notebooks.



2007 Secondary Energy Info book,
The NEED Project, Manassas, VA

Tell students they will do activities today to help them better understand how they can use less electricity by:

- Using energy efficient electric appliances, light bulbs, and vehicles.
 - Taking simple actions to use less energy with the electric appliances and vehicles they currently have.
 - Insulating our homes properly to save on heat and cooling.
2. Ask students if they think it is important to save energy and why. Facilitate discussion around shortages of non-renewable energy sources, energy use that causes pollution or other threats such as environmental degradation (greenhouse gases and climate change) and human health concerns (nuclear plants release of radioactive materials). For example, “Remember that carbon dioxide is a greenhouse gas. Human electricity and transportation needs for

energy from fossil fuels and biomass have greatly increased the amount of carbon dioxide in the atmosphere. Since the industrial revolution around 1800, the level of carbon dioxide has increased about 30 percent in the atmosphere, leading to global warming and climate change. Generating electricity accounts for a large portion of carbon dioxide in the U.S. The general rule of thumb is that generating one kilowatt-hour of electricity produces 1.6 pounds of carbon dioxide in the atmosphere. Thus, it is critical to reduce the amount of electricity we use.”

Explain to students that while engineers are working to solve some of our energy problems with new “green” technologies, people can do much more by reducing how much energy we use through conservation.

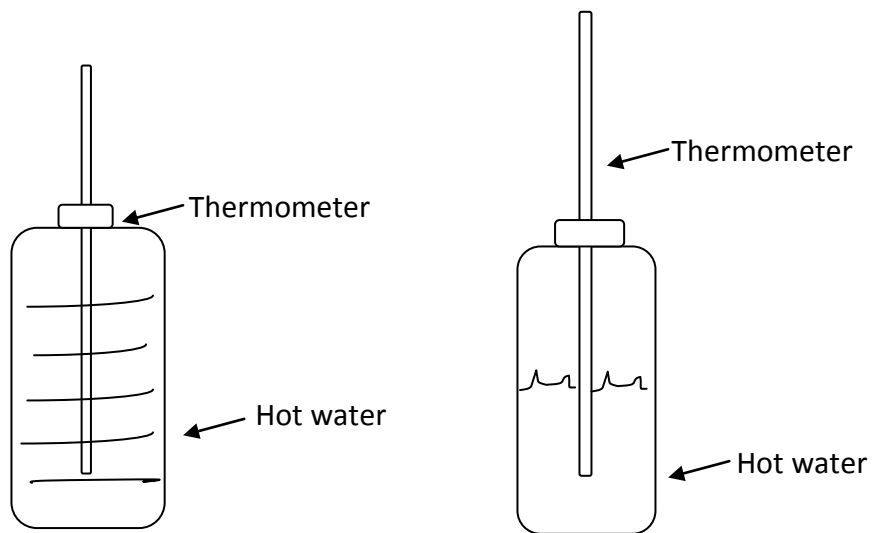
3. Using Overhead 2 ask students how many things they can do at home to save energy. Have students give you examples and write them on Overhead 2. Suggestion: categorize students’ responses:
 - 1) Heating / Cooling
 - 2) Lighting / Appliances
 - 3) Water Heating
 - 4) Refrigeration
4. **Station A: Insulation**
 - a. Remind students that “heating and cooling systems use up more energy than any other systems in our homes.” Most homes use electric or natural gas furnaces to heat them and electric air conditioners and fans to cool them. About 43 percent of your family’s utility bill is for heating and cooling the home. The energy sources that power these heating and cooling systems put out 150 million tons of carbon dioxide into the atmosphere each year. They also lead to acid rain. You can save money and conserve energy, while protecting the environment by having a home with proper insulation, sealing air leaks, closing windows, and using energy –saving behaviors (examples: adjusting thermostat, closing windows, doors and blinds, shading with deciduous trees).
 - b. Ask students to try and remember the electricity usage graphic you showed at the beginning of class. Ask them if they “remember one of the biggest uses. The one used to heat and cool the school/home air. How can they save electricity here?” Take suggestions and remind students to dress appropriately for the weather to reduce heating/cooling bills and keep windows

and doors shut so as not to let the heat in or out. “Close the door, you are letting the heat out.”

- c. Remind students that “buildings need insulation to provide resistance to heat flow because heat naturally flows from warmer areas to cooler areas. You can prevent heat flow by using insulation. Some materials are better insulators than others. The more heat flow resistance the insulation provides, the less electricity needed to cool and heat homes and the more money saved.” In winter the heat moves from the building to the outside wherever there are leaks or lack of sufficient insulation. In the summer, the heat moves from the warmer out-of-doors to the inside of buildings. To maintain human comfort, the heat lost in the winter must be replaced through the heating system using electricity or burning biomass and fossil fuels that give off carbon dioxide. In the summer, the heat penetrating from the out-of-doors is cooled using electric fans and air-conditioners. If a building is properly insulated it will use less energy to stay warm in the winter and cool in the summer.

“An insulator’s resistance to heat flow is measured or rated in terms of its thermal (heat) resistance or **R-value**. The higher the R-value, the better the material insulates.”

- d. Tell them “in this activity you will insulate one metal radiation can (of a set of two), with one of several insulating materials; then measure and record the heat loss from hot water in the cans to determine the insulating properties of the material over time. You will compare the insulating properties of the different materials.”
- e. Ask a student volunteer to remove the tops from the cans, and select an insulation material to wrap around one of the cans and tape.
- f. Fill both cans with hot water and have students replace the tops.
- g. Have students suspend a thermometer through the hole in each top, making sure it does not touch the bottom or the sides of the can.



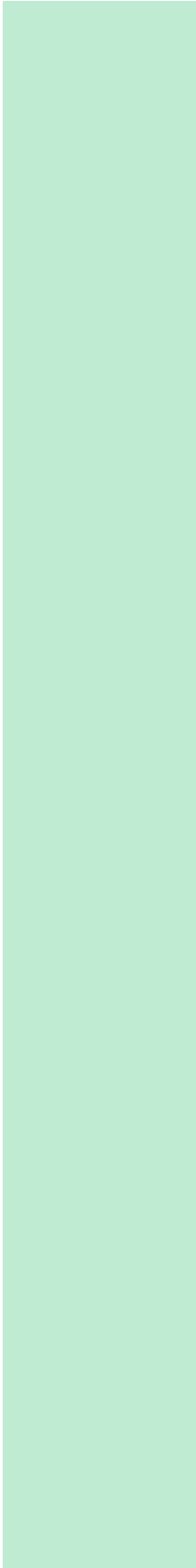
Experiment insulated can

Control non-insulated can

- h. Have students record the temperature of the water in the cans. Remember to check the temperatures again at the end of Lesson 12.
- i. **Note: You can do this experiment a second time using a different insulating material and compare results.**
- j. Have students compare the insulated can results to the uninsulated can and draw a conclusion. Have students record data in notebooks.

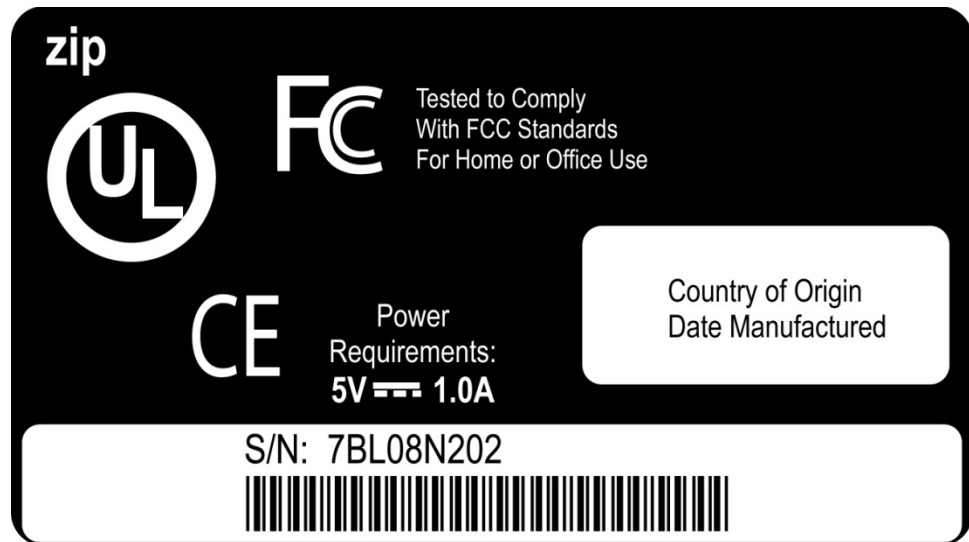
5. Station B: Energy Efficient Appliances

- a. Explain to students that some appliances we use in our homes and schools use more energy than others. We can use a monitor to measure how much electricity each appliance uses.
- b. Show student volunteers how monitors work and how to read them (directions attached). Belkin energy use monitors will display annual carbon dioxide footprint, cost, and energy use by pushing the three different buttons while the monitor is plugged into the appliance.
- c. Explain that newer models of appliances are sometimes more energy efficient than older models of appliances because scientists and engineers have designed them to use less energy as they learn more. Ask them if anyone's parents have just purchased energy saving appliances and what it was. As a group,



have students compare two models of the same appliance one older and less efficient than the other. Using the chart on Overhead 5 “Energy Use,” record results from the energy use monitors. If available have students compare other appliances you bring in or that are available in the classroom; record and compare.

- d. Have students measure the energy usage of a computer, TV, or such, in “on” and “off” modes (or sleep mode) to determine if some machines use energy even when they are in sleep mode or turned off. (Optional: you may want students to take home monitors to test appliances at home with their parents.)
- e. Inform them to look for an electric meter on the outside of their house with an adult who can explain how it works. Explain that the meter keeps track of all the electricity the house uses and is reflected in the electric bill their parents have to pay. The more electricity you use the higher the electric bill.
- f. Explain to students that appliances that are energy efficient have an **ENERGY STAR** label on them (Overhead 3). This means that they have met the highest standards set by the federal government for energy efficiency. When shopping for a new appliance you should look for the ENERGY STAR label. Show students an appliance with an Energy Star label.
- g. Every machine that runs on electricity has an electric nameplate on it. The nameplate is usually a silver sticker has information about the amount of electricity the machine uses. Show students the nameplates of the appliances you monitored and compare.



"Electric Nameplates 1." *Saving Energy - Monitoring & Mentoring Student Guide*. Manassas, VA: NEED Project, 2009. 26. Print.

6. Station C: **Light Bulb Investigation**
 - a. Ask students, “what was the other large piece of the energy use pie? **Lighting**”. “How can we save energy here?” **Use of natural light, turn lights off when leaving the room, use energy efficient bulbs.** Remind students of the activity in Lesson 7 where we compared how much heat was generated by incandescent, CFL, and LED bulbs: “Which bulb generated the most heat and thus was least efficient?” (Answer: incandescent)
 - b. Student volunteers will put an incandescent bulb, compact fluorescent, and light emitting diode bulbs in each of three table lamps. Have students attach the Belkin monitors to the three lamps. Record wattage, cost, and carbon dioxide footprint on Overhead 5 “Energy Use.”
 - c. After completing all stations, review the data and conclusions with the entire class. Ask students if anyone wants to share something new they learned.
7. Conclude by reviewing the lists they generated on “How Do I Save Energy At Home.” Using Overhead 6 and the accompanying teacher reference page, discuss their answers and any other ways they hadn’t thought of.
8. Remind them that next time you meet they will become energy engineers and use new technology to look at alternative energy

Assessment

sources that are renewable and less harmful to the environment and people.

Have students make a poster to pin up at home or in school of ways that they individually plan to conserve energy. Give students time to work in groups to share ideas and decorate their poster.

Career Connections

PGE supports teachers with a host of resources for energy and safety education

http://www.portlandgeneral.com/community_environment/community_involvement/our_programs/classroom_support.aspx

It might be 'out there' but this website has speakers who all claim to be experts and passionate about energy. Look at their bio's and give them a call if you are interested. If you don't ask, you don't get.

<http://www.cesa.org/assets/Members-Section/Meetings/Spring-Meeting-2012/Guest-Speaker-Short-Bios-Compilation-final.pdf>

Each February, the BEC orchestrates a major community initiative, sending hundreds of professional engineering and technology volunteers into K-12 classrooms across Oregon to ignite interest in science and math. Science, Technology, Engineering and Math (STEM) skills are essential to a vital economic future for Oregon and the nation.

<http://www.becpdx.org/nem/>

Explore Careers in different types of energy

Want a sense of the type of jobs that are out there and where your career could go? We've compiled a substantial list of industry job descriptions to give you a clear idea of what jobs may fit your needs, and the experience and education you will need to qualify for these jobs. This list is not all-inclusive as the green energy industry is still developing and new job descriptions emerge frequently. Salary ranges are based on an average across all U.S. major markets and can vary greatly based on location.

Use Drop down menu to pick one of many Energy and alternative energy careers.

<http://www.myenergygateway.org/career-options>

Once you have a career that sounds interesting go to Education and type your career into Search

<http://www.myenergygateway.org/education>

How many schools and how many majors did you find?

Choose one of the schools to explore. Name, Location, How large is it? What Programs do they offer? How much will it cost? What kind of degree could you get? What are the Pros and Cons of attending?

Lastly, go to INTERNSHIPS

Getting an internship is one of the best things you can do to land your first job in the industry. Search for organizations that offer internships, ranging from formal annual programs to short term internship opportunities. Click on the application or contact the company for more information.

<http://www.myenergygateway.org/internships>

Or you can go to:

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy accelerates research, development, and deployment of advanced energy technologies in renewables and energy efficiency. As these new technologies are launched into commercial use, they create new jobs for American workers—strengthening U.S. energy security, environmental quality, and economic vitality. A clean energy career can be any occupation that is affected by activities such as conserving energy, developing alternative energy, reducing pollution, or recycling. Select the clean energy area below to explore careers, competencies and skills needed for a job or career.

<http://energy.gov/eere/education/explore-clean-energy-careers>

RESOURCES:

Short Videos that demonstrate energy conservation

A family is carelessly and unknowingly wasting energy from the moment they wake up. Until something unexpectedly happens—cartoon with no words. Very graphic/fun.

<http://www.youtube.com/watch?v=1-g73ty9v04>

The Office of Energy Efficiency and Renewable Energy (EERE) periodically produces videos that explain certain aspects of renewable energy and energy efficiency technologies. The following videos describe the technologies, research, and program activities within EERE.

<http://www1.eere.energy.gov/multimedia/videos.html>

INTERACTIVE

The Nature Conservancy's carbon footprint calculator measures your impact on our climate.

Our carbon footprint calculator estimates how many tons of carbon dioxide and other greenhouse gases your choices create each year.

<http://www.nature.org/greenliving/carboncalculator/>

National Geographic's Personal Energy Meter

No matter where you live, your energy use contributes to carbon emissions. Use this interactive tool to calculate your personal carbon footprint based on information specific to your location. See how you measure up against others, and how choices you make at home and in the way you travel could help to protect the atmosphere.

<http://environment.nationalgeographic.com/environment/energy/great-energy-challenge/global-personal-energy-meter/>

**also has good current events on this page to do with energy!

FIELD TRIP

Visit Forest Grove HS house that HS students built. They have received Platinum level energy ratings.

<http://www.fghsvikinghouse.com/Pages/default.aspx>

<https://www.facebook.com/pages/Forest-Grove-High-School-Viking-House/474332499297005>

http://videos.oregonlive.com/oregonian/2014/05/forest_grove_high_school_vikin.html

OTHER RESOURCES

Reduce What You Can, Offset What You Can't.™ That's our motto, and we're proud of it.

Everyone has a responsibility to reduce their individual carbon footprint, and there are lots of ways to do so. We encourage everyone to think about their lifestyle decisions and find opportunities to reduce their climate impact. Fact sheets and ideas for all ways to save energy

<http://www.carbonfund.org> <http://www.motherearthnews.com/renewable-energy/save-money-on-energy.aspx#axzz37HEWVNGnrg/reduce>

Mother Earth News

These days, it's more of a win-win than ever to save on energy. Every time you lower your utility bills, you put more money back in your bank account. And lower energy bills also means

less energy consumed, which means less harmful emissions released into our environment. And what makes this an even better deal is you don't have to overhaul your home (or buy a new one) to make it more energy efficient. There are many easy, effective things that you can do, with little investment and little or no DIY experience, to save energy at home. Here's a list of 10 ideas to get you started. Also has Green Cars, Green Homes and other great links and short videos.

<http://www.motheearthnews.com/renewable-energy/save-money-on-energy.aspx#ixzz37HEmVdfz>