Saving Energy at Home and School

Student and Family Guide

2016-2017

NEED

National Energy Education Development Project

ELEMENTARY, INTERMEDIATE, SECONDARY

Message to the Family

Dear Family Members:

The NEED Project's *Saving Energy at Home and School* program provides teachers with curriculum materials that assist them in meeting energy science curriculum standards. With this program, students learn how energy is produced and used. They also learn ways to conserve energy that can easily be applied in their own homes.

Your child is a student participating in this *Saving Energy* program. To demonstrate how the energy conservation lessons your child is studying in class can be applied at home, you will be provided with a Home Energy Efficiency Kit containing several items designed to help reduce electricity and natural gas use in your home. Once installed, these energy conservation measures give families the opportunity to see how low-cost and no-cost measures can make a substantial difference in lowering energy use.

Your Home Energy Efficiency Kit also includes a home survey and we encourage you to work with your child to answer the questions. It is fine if you do not know all the answers. You and your child will learn about the different energy saving measures together. Mailing this survey back to NEED will help students everywhere better understand energy use.

This *Student and Family Guide* will allow your child to do additional research on your home's energy use that will show that your efforts to save energy do make a difference. If possible, we also suggest downloading the U.S. Department of Energy guide, *Energy Saver*. This online pamphlet is a perfect at-home supplement for students and parents alike. When combined with this Student and Family Guide, each Home Activity students are assigned will be a breeze. Download the guide by visiting www.energy.gov/energysaver/downloads/energy-saver-guide.

We are pleased you will be participating in this worthwhile activity and encourage you to contact your child's teacher or The NEED Project with any questions you may have.

NEED
Putting Energy into Education

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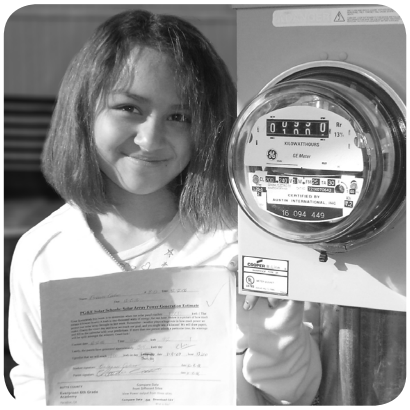

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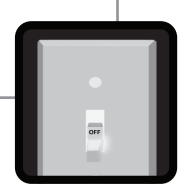


Student Informational Text

The United States uses a lot of **energy**—over two million dollars worth of energy per minute, 24 hours a day, 365 days a year. With a little more than 4.4 percent of the world's population, we consume about 18.6 percent of the world's energy resources.

All of us use energy every day—for getting from one place to another, cooking, heating and cooling rooms, making products, lighting, heating water, and entertainment.

We use a lot of energy to make our lives comfortable, productive, and enjoyable. Most of that energy is from nonrenewable energy sources. It is important that we use our energy resources wisely.

Energy Efficiency and Conservation

The choices we make about how we use energy have environmental and economic impacts. There are many things we can do to use less energy and use it more wisely. These actions include both energy conservation and energy efficiency.

Energy conservation is any action or behavior that results in using less energy. **Energy efficiency** focuses on technologies that use less energy to perform the same tasks or the same amount of work. Buying a dryer that uses less energy is an example of energy efficiency. Drying clothes outside on sunny days is an example of energy conservation.

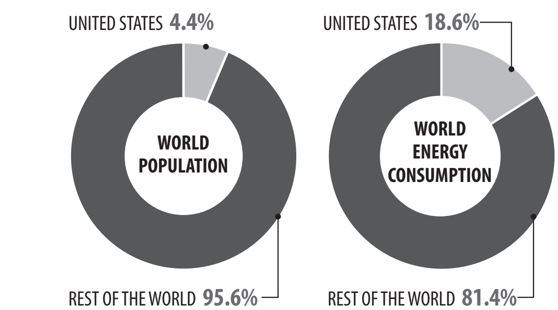
Who Uses Energy?

The U.S. Department of Energy uses categories to classify energy users—residential, commercial, industrial, transportation, and electric power generation. These categories are called the sectors of the economy.

Residences are people's homes. Commercial buildings include office buildings, hospitals, stores, restaurants, and schools. Residential and commercial energy use are lumped together because homes and businesses use energy in the same ways for heating, air conditioning, water heating, lighting, and operating appliances.

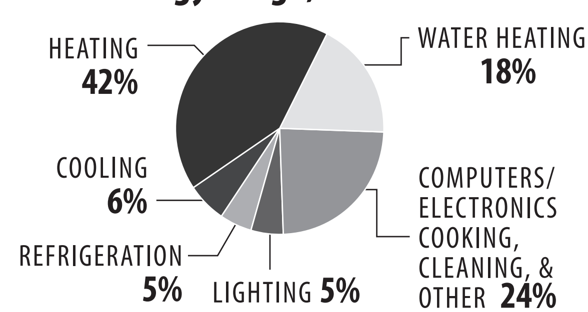
The graphic to the right shows that the electric power generation sector consumed the most primary energy in 2014. However, all of the other sectors, especially the residential, commercial, and industrial sectors, use electricity after it is generated. The other sectors are the end users of electric power. When the residential and commercial sectors of the economy are combined together and electricity consumption is included, the residential and commercial sectors consume more energy than any of the other sectors, with 39.8 total quads of energy. These two sectors actually account for nearly 40 percent of the total energy consumed by the U.S., when electricity is included. The residential portion of the sector consumed 21.6 quads of energy, with nearly 67 percent of this energy coming from electricity. The commercial portion of the sector consumed 18.2 quads of energy, of which 76% is electricity.

Population Versus Energy Consumption, 2014



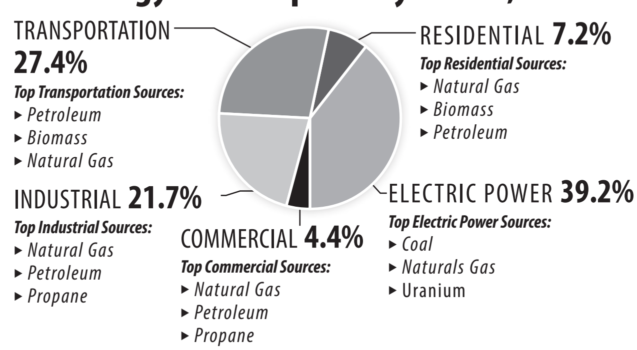
Data: Energy Information Administration

Home Energy Usage, 2014



Data: U.S. Department of Energy

U.S. Energy Consumption by Sector, 2014



The residential, commercial, and industrial sectors use electricity. This graph depicts their energy source consumption outside of electricity.

Data: Energy Information Administration

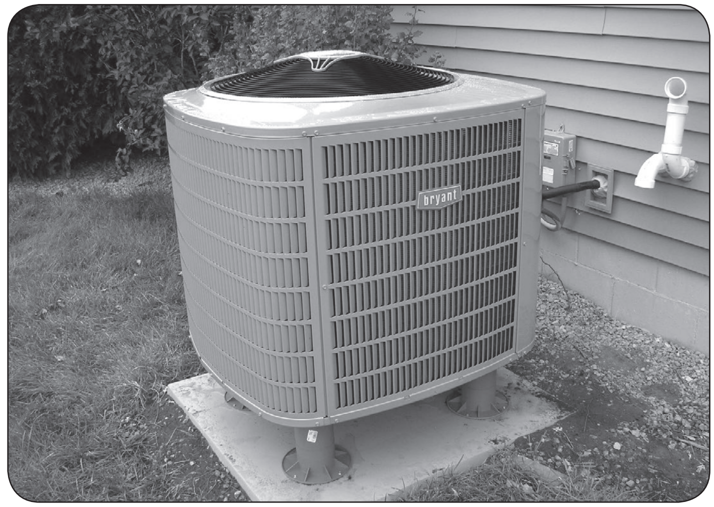
Residential/Commercial Sector

The residential sector includes houses, apartments, and other places where people live. The commercial sector includes schools, businesses, and hospitals. The residential and commercial sectors are put together because they use energy for similar tasks—for heating, air conditioning, water heating, lighting, and operating appliances.

The typical family can spend about $2,200 a year on utility bills. Roughly two-thirds of this cost is typically spent on electricity, while the rest is spent mostly on natural gas and fuel oil.

Much of this energy is not put to good use. Heated or cooled air leaks out of homes through doors and windows, attics, walls, floors, ceilings, and basements that are not insulated well. Some machines and appliances use energy 24 hours a day, and we waste energy with bad habits.

AIR CONDITIONING SYSTEM



PROGRAMMABLE THERMOSTAT

INSULATION

Image courtesy of Owens Corning

Heating and Cooling Systems

Heating and cooling systems use more energy than any other systems in our homes. Natural gas and electricity are used to heat most homes, electricity to cool almost all. About half of the average family's utility bills is for keeping homes at comfortable temperatures. The energy sources that power these heating and cooling systems can contribute carbon dioxide emissions to the atmosphere. Using these systems wisely can reduce environmental emissions.

With all heating and air conditioning systems, you can save energy and money too, by having proper **insulation**, sealing air leaks, maintaining the equipment, and practicing energy-saving behaviors.

Programmable Thermostats

Programmable **thermostats** automatically control the temperature of buildings for time of day and can save energy and money. During heating seasons, for example, they can lower the temperature during the day when no one is home and at night. In the morning and evening, when people are awake at home, they can automatically raise the temperature. Most consumers set the temperature higher than recommended during heating seasons and lower than recommended during cooling seasons. A temperature setting of 68°F (20°C) during the day and 60-62°F (13-14°C) at night during heating seasons is comfortable if people dress warmly and use warm blankets. During cooling seasons, a temperature setting of 78°F (25°C) is comfortable if people dress appropriately and use fans to circulate air. Many programmable thermostats come with pre-loaded settings. Proper use of the pre-programmed settings on a programmable thermostat can save your family up to $180 every year in energy costs.

Insulation and Weatherization

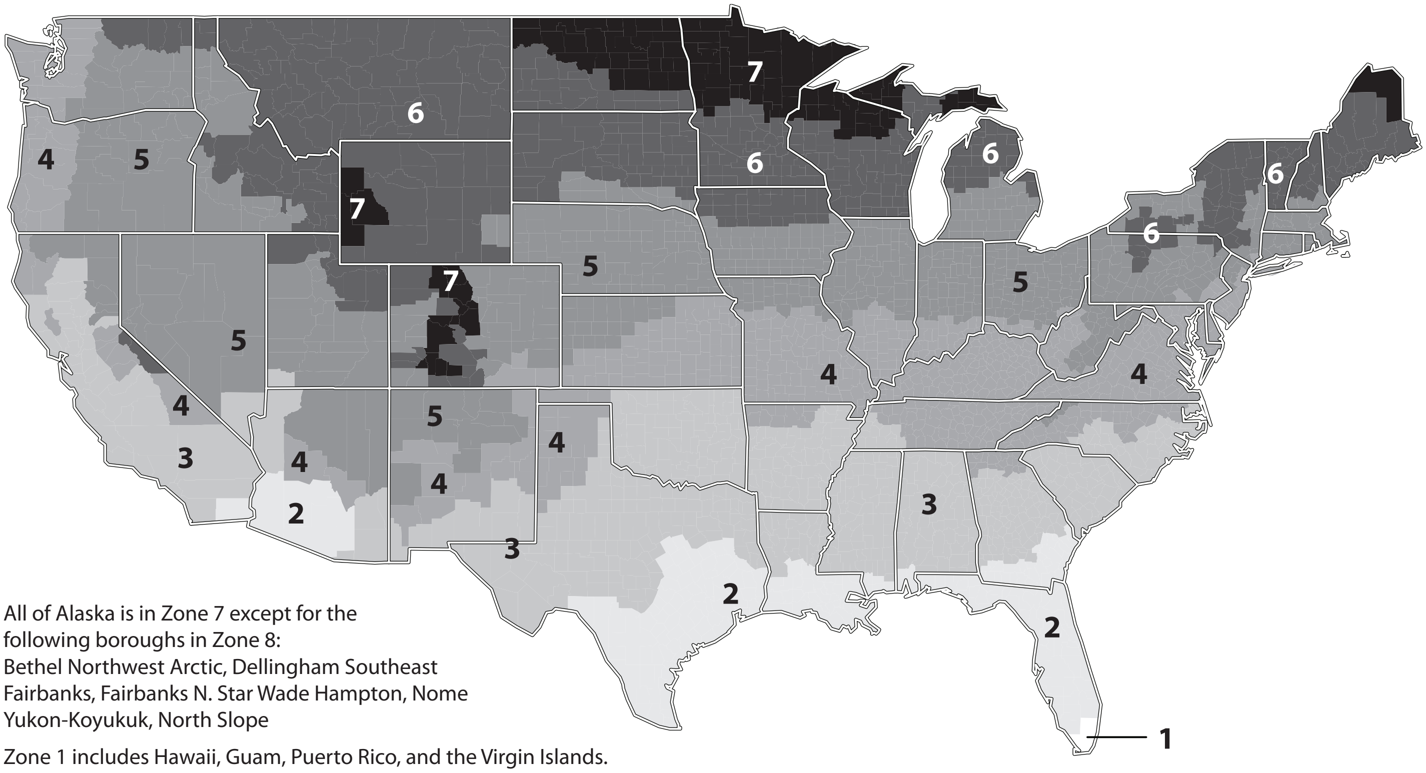
Warm air leaking into your home in cooling seasons and out of your home in heating seasons wastes energy. You can reduce heating and cooling costs by investing a few hundred dollars in proper insulation and weatherization products. Insulation is rated using an **R-value** that indicates the resistance of the material to heat flow. The R-value needed varies, depending on the climate, ceilings, walls, attics, and floors. In very cold climates, a higher R-value is recommended.

Insulation wraps your house in a blanket, but air can still leak in or out through small cracks. Often the effect of many small leaks equals a wide open door. One of the easiest energy-saving measures is to caulk, seal, and weather-strip cracks and openings to the outside. Home performance professionals can seal air leaks in attics and basements. Homeowners can typically save up to $200 a year in heating and cooling costs by air sealing their homes and adding insulation.

Doors and Windows

Some of a home's air leaks occur around and through the doors and windows. Doors should seal tightly and have door sweeps at the bottom to prevent air leaks. Insulated storm doors provide added barriers to leaking air.

Recommended R-Values for New Wood-framed Homes



All of Alaska is in Zone 7 except for the following boroughs in Zone 8:
Bethel Northwest Arctic, Dellingham Southeast Fairbanks, Fairbanks N. Star Wade Hampton, Nome Yukon-Koyukuk, North Slope

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands.

ZONE	ATTIC	CATHEDRAL CEILING	WALL INSULATION: CAVITY	WALL INSULATION: INSULATION SHEATHING	FLOOR
1	R30 to R49	R22 to R38	R13 to R15	None	R13
2	R30 to R60	R22 to R38	R13 to R15	None	R13, R19 to R25
3	R30 to R60	R22 to R38	R13 to R15	R2.5 to R5	R25
4	R38 to R60	R30 to R38	R13 to R15	R2.5 to R6	R25 to R30
5	R38 to R60	R30 to R60	R13 to R21	R2.5 to R6	R25 to R30
6	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25 to R30
7	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25 to R30
8	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25 to R30

Data: U.S. Department of Energy

Most homes have more windows than doors. The best windows shut tightly and are constructed of two or more pieces of glass. Caulk any cracks around the windows and make sure they seal tightly. With older windows, install storm windows or sheets of clear plastic to create added air barriers. Insulated blinds also help prevent air flow—during heating seasons, open them on sunny days and close them at night. During cooling seasons, close them during the day to keep out the sun.

Moisture

Moisture is a term used to describe water in both liquid and vapor form. Like heat and air, it is important to have the right amount of moisture in a building. Most moisture indoors exists as water vapor. The amount of water vapor in the air plays an important role in determining our health and comfort.

Humidity is a measurement of the total amount of water vapor in the air. It is measured with a tool called a **hygrometer**. Relative humidity measures the amount of water vapor in the air compared to the amount of water vapor the air is able to hold, which depends on the temperature of the air.

Air acts like a sponge and absorbs water through the process of evaporation. Warmer air, with greater energy, can support more water vapor than colder air, which has less energy. When cold air from outdoors is heated, it feels very dry and makes the occupants of the building uncomfortable. Furthermore, moisture in the air in a room will help it resist changes in temperature, which can reduce the number of times a heating or air conditioning system has to run. The correct humidity level can also help promote a healthy indoor environment. Humidity levels should be kept between 40% and 60%. Using a dehumidifier in the summer and a humidifier in the winter can help condition the air to maintain appropriate humidity levels.

Landscaping

Although you cannot control the weather, you can plant trees to block the wind and provide shade. Properly placed trees and bushes can reduce the energy needed to keep your home comfortable. Deciduous trees, for example, are good to plant on the south side of a building in the Northern Hemisphere, since their leaves provide shade in summer and their bare branches allow sunlight through in the winter.

Appliances and Machines

Appliances, machines, and electronic devices use about 29 percent of a typical household's energy, with refrigerators, freezers, clothes washers and dryers at the top of the list. Any appliance that is designed to change temperature uses a lot of energy. You can save energy by:

- turning off appliances and machines when you aren't using them;
- using the energy-saver setting on dishwashers and refrigerators;
- keeping the doors closed as much as possible on refrigerators and freezers—know what you want before you open the doors;
- being aware that many machines use energy even when turned off—save energy by unplugging them; and
- using machines and appliances during the morning and evening, not during peak demand time.

When you shop for a new appliance, you should think of two price tags. The first one covers the purchase price—the down payment. The second price tag is the cost of operating the appliance. You'll pay the second price tag on your utility bill every month for the next 10 to 20 years. An energy efficient appliance will usually cost more, but it will save a lot of money in energy costs. An energy efficient model is almost always a better deal.

ENERGY STAR®

When you shop for a new appliance, look for the **ENERGY STAR®** label—your guarantee that the product saves energy. ENERGY STAR® qualified appliances incorporate advanced technologies that use less energy and water than standard models. A list of energy efficient appliances can be found on the ENERGY STAR® website at www.energystar.gov.

CHANGE FOR THE BETTER WITH ENERGY STAR

EnergyGuide Labels

Another way to determine which appliance is more energy efficient is to compare energy usage using **EnergyGuide labels**. The government requires most appliances to display bright yellow and black EnergyGuide labels. Although these labels do not tell you which appliance is the most efficient, they will tell you the annual energy consumption and operating cost of each appliance so you can compare them.

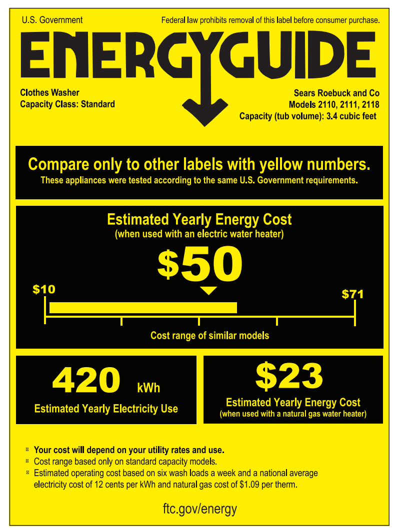
Refrigerators, for example, use about five percent of household energy. Refrigerators can last for a very long time. Replacing an older refrigerator with a new energy efficient model can save on energy bills. With older models, a large amount of electricity can be saved by setting the refrigerator temperature at 37–40°F (3-5°C), the freezer temperature at 5°F (-15°C), and making sure that the energy saver switch is in use. ENERGY STAR® refrigerators are about 10 percent more efficient than non-ENERGY STAR® models.

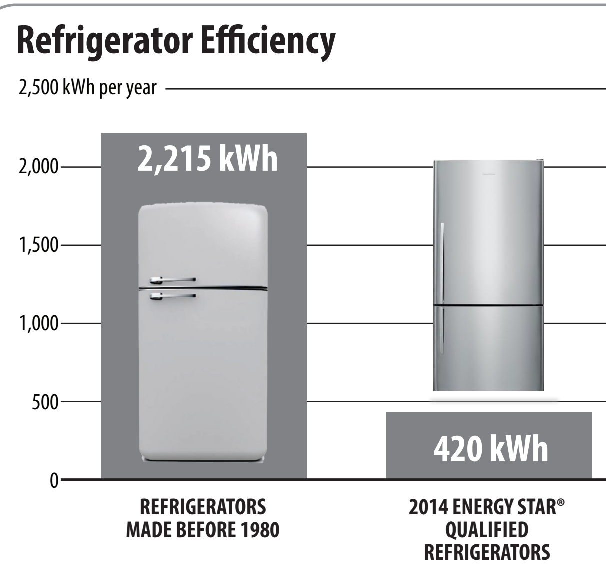
Refrigerators should also be airtight. Make sure the **gaskets** around the doors are clean and seal tightly. Close the door on a piece of paper—if you can easily pull out the paper when the door is closed, you need to replace the gaskets.

KITCHEN EXHAUST SYSTEM

Kitchen exhaust fans remove moisture from the air, which prevents mold growth and other related problems that can occur from excess water vapor.

ENERGYGUIDE LABEL





Data: ENERGY STAR®

Lighting

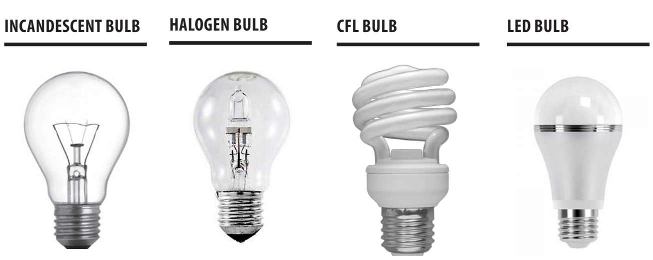
Legislation under the Energy Independence and Security Act put restrictions on how much energy light bulbs use. Traditional bulbs, called **incandescent** bulbs, have been replaced by more efficient bulbs like **halogens**, **compact fluorescents**, and **light emitting diodes** (LEDs) on store shelves.

Lighting accounts for five percent of a home's energy use, which translates to about 11% of the home's electricity bill. Much of this is the result of using inefficient lighting. Many homes still use incandescent lighting. Only 10 percent of the energy consumed by an incandescent bulb actually produces light; the rest is given off as heat. There are other more efficient lighting choices on the market, including halogens, fluorescents, and LEDs. Halogens are sometimes called energy-saving incandescent bulbs because they last slightly longer, and use less energy than traditional incandescent bulbs, however they can burn hotter than incandescent lights do. Fluorescent lights produce very little heat and are even more efficient. Most schools use fluorescent tube lighting throughout the building, but may use incandescent bulbs in other spaces around the school.

Fluorescent lights use 75 percent less energy than traditional incandescents and reduce environmental impacts. Converting to compact fluorescent light bulbs (CFLs) in your home is one of the quickest and easiest ways to decrease your electricity bill. You will save a $30-$80 in electricity costs over the lifetime of every 100-watt incandescent bulb you replace. CFLs provide the same amount of light and save energy.

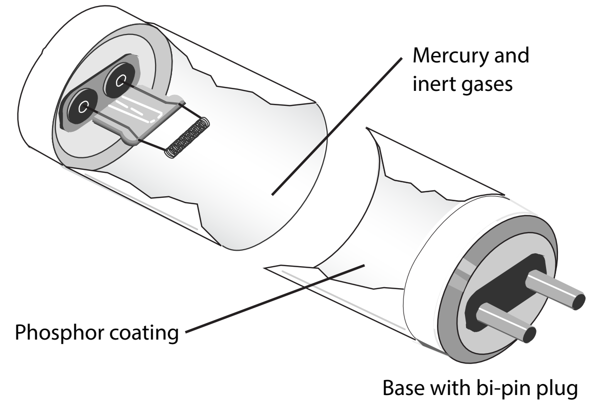
A fluorescent lamp is a glass tube lined inside with a phosphor coating. The tube is filled with argon gas and a small amount of mercury. At the ends of the tube are electrodes that generate an electric field when electricity flows through them. The energized electrons cause the mercury gas to emit UV (ultra violet) light. The invisible UV light strikes the phosphor coating, which emits visible light.

Fluorescent lights have ballasts that help move the electricity through the gas inside the bulb. There are two types of ballasts, magnetic and electronic. Electronic ballasts are more efficient than magnetic ballasts and can eliminate flickering and noise.



LEDs offer better light quality than incandescent bulbs and halogens, last 25 times as long, and use even less energy than CFLs. LEDs now have a wide array of uses because technology has improved and costs have decreased. It is possible to see CFL use decrease as LED costs continue to improve.

Fluorescent Tube Lamp



In fluorescent tubes, a very small amount of mercury mixes with inert gases to conduct the electric current. This allows the phosphor coating on the glass tube to emit light.

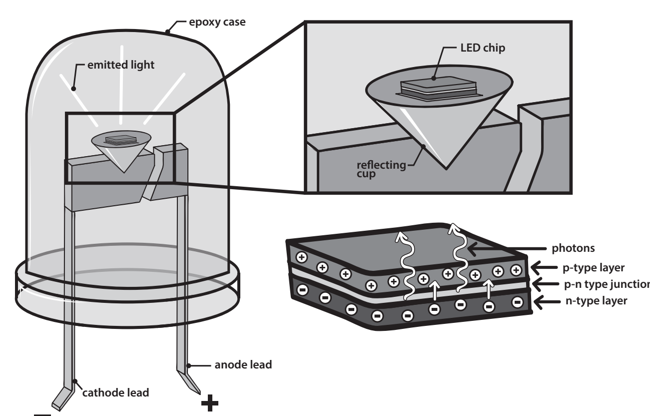
Compact Fluorescent Light Bulbs

CFLs come in a variety of styles for different purposes. CFLs use about one-third the energy of a halogen incandescent.

Did You Know?

Only 10 percent of the energy used by a traditional incandescent bulb produces light. The rest is given off as heat.

Inside an LED



LEDs have been commonly found in electronic devices and exit signs. Now they are offered as affordable options for lighting in homes and businesses. Light emitting diodes contain **semiconductors** like solar panels; the difference is in the way the electrical energy is used by the LED. Three layers within the LED – p-type, n-type, and a **depletion zone** – combine to produce light. A minimum voltage is needed to energize electrons and they move from the n-type layer to the p-type layer. When the electrons move back again, they emit light that we see. The section of text called "How Light Emitting Diodes Work" below explains this process in more detail.

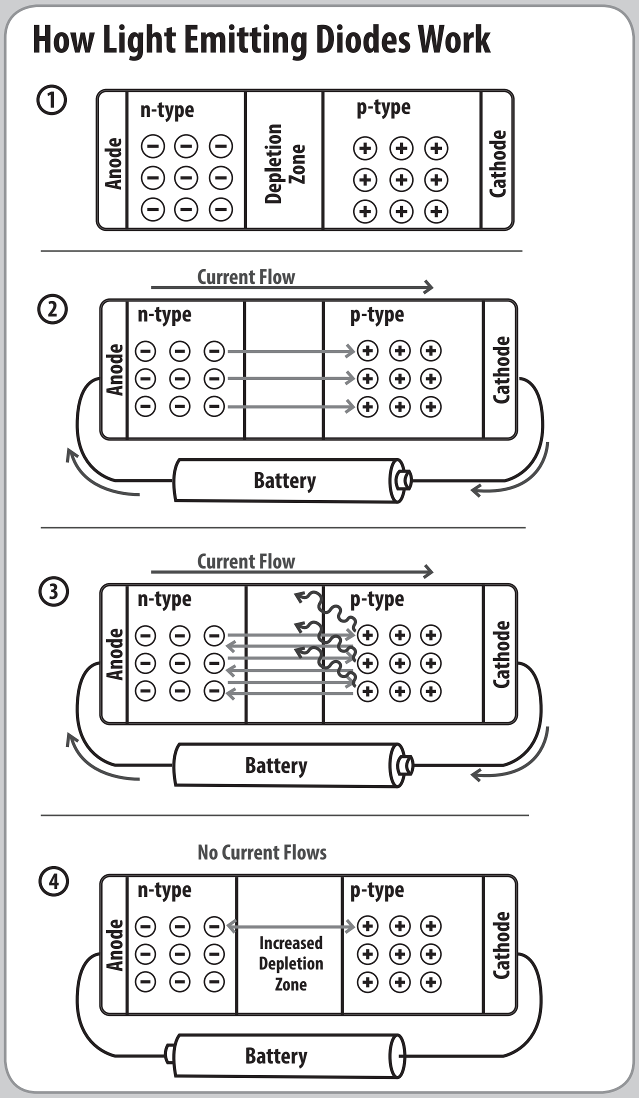
One of the quickest and easiest ways to immediately decrease your electricity bill is to install CFL or LED bulbs in the place of incandescent or halogen bulbs. For every 100-watt incandescent bulb replaced, a savings of $30-$80 can be realized over the lifetime of the bulb. A CFL uses 75 percent less energy than an incandescent, and an LED bulb uses even less energy. CFL and LED bulbs last longer than incandescent bulbs, too. Each type of bulb has benefits as well as drawbacks. For example, a CFL is less expensive than an LED, but it is more fragile, contains mercury, and is not always dimmable. An LED is more durable than a CFL, but it is heavier and is sometimes more expensive. Both types are available in a wide variety of shapes and light colors. When shopping for a replacement bulb, look for ENERGY STAR® rated bulbs for the best quality and energy efficiency ratings, and make sure the bulb you buy produces the same brightness of light, as measured in **lumens**.

There are a few ways you can save energy on lighting in the home:

- switch incandescent bulbs to CFLs or LEDs;
- shut off lighting when exiting the room; and
- use natural light by opening blinds or curtains when possible.

How Light Emitting Diodes Work

1. Diodes are made of semiconductors and conducting materials that need to be added to the semiconductor. In an LED the most common conductor added is aluminum-gallium-arsenide (AlGaAs). The AlGaAs is "doped" by adding small amounts of another material. One material will have more valence electrons than AlGaAs, and another doping material will have fewer electrons. The two doped materials are put together in a crystal. The material with more electrons is the "n-type" (n for negative) and the material with fewer electrons is the "p-type" (p for positive). When these materials are sandwiched together, the electrons move to balance themselves out. The area between the materials, called the p-n junction, is also called the "depletion zone."
2. Connecting a power source to the diode, such as a battery, provides electric current that carries electrical energy. The electrons in the n-type are repelled by the electric current, and move through the depletion zone to the p-type. They are energized, and will want to return to their original, unenergized state in the n-type.
3. When the electrons move back through the depletion zone to the n-type, they release energy as light. This is the light that we see from the LED. This process continues over and over again–electrons absorbing energy, moving, then moving back and releasing the energy, until the power supply is disconnected or depleted.
4. Connecting the power supply in the wrong orientation does not allow the LED to work. Instead, it merely increases the size of the depletion zone. Therefore, it is important that LED's be wired to their power supply in the correct orientation.



Water Heating

Water heating is a significant energy expense in homes. It typically accounts for about 18 percent of the average utility bill. Heated water is used for showers, baths, laundry, dish washing, and cleaning. The greatest cost of washing dishes, bathing, and washing clothes comes from the energy required to heat the water. There are four main ways you can lower your water heating bills:

- use less hot water;
- turn down the thermostat on your water heater;
- insulate your water heater and water pipes; and
- buy an ENERGY STAR® or energy efficient water heater, dishwasher, and washing machine.

The easiest way to cut the cost of heating water is to reduce the amount of hot water you use. This can be done with little cost and minor changes in lifestyle. For example, a five minute shower uses 10-25 gallons of water. You can cut that amount in half by using a low-flow shower head.

Other ways to conserve hot water include taking showers instead of baths, taking shorter showers, fixing leaks in faucets and pipes, and using the lowest temperature wash and rinse settings on clothes washers.

Most water heater thermostats are set much higher than necessary. Lowering the temperature setting on your water heater to 120°F (49°C) saves energy. Lowering the temperature 10 degrees Fahrenheit (6°C) can result in energy savings of $12-$30 annually. Buying a high efficiency water heater can save $40-$140 a year.

Cooking

Cooking food is another task that uses energy—usually natural gas, electricity, or propane. Most homes have several appliances for cooking food—stoves, ovens, microwaves, and toaster ovens. To save energy when you are cooking:

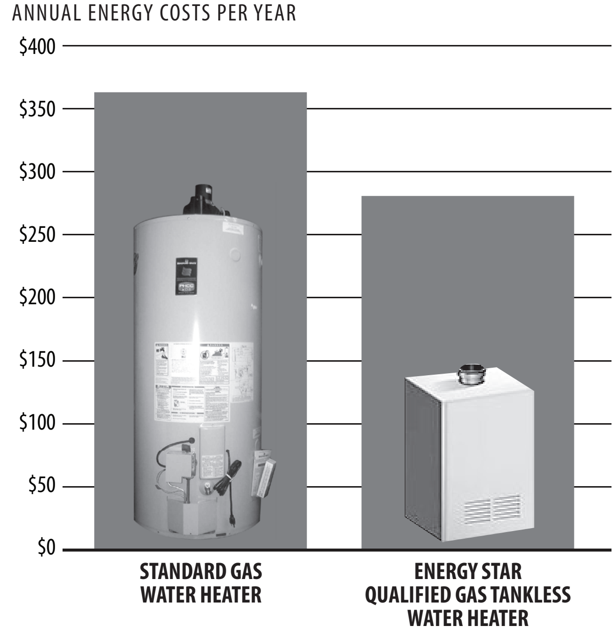
- Use a toaster oven or microwave instead of the oven whenever you can. These smaller appliances use less energy.
- Preheat the oven for only five minutes.
- Leave the oven door closed so hot air does not escape. Use a timer instead of checking on the food every few minutes.

Transportation Sector

Americans make up about 4.4 percent of the world's population, yet we own 15.6 percent of the world's automobiles. The transportation sector of the economy accounts for more than 27 percent of total energy use. America is a country on the move.

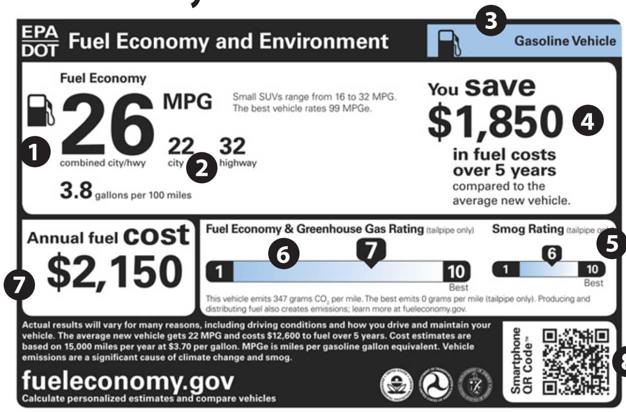
For model year 2016, the average motor vehicle uses 665 gallons of gasoline every year. You can achieve 10 percent fuel savings by improving your driving habits and keeping your car properly maintained. Over the life of a vehicle, your family can save a lot of money on gas by choosing a fuel-efficient model.

Water Heater Comparison



Data: ENERGY STAR®

Fuel Economy Label



1. Combined city/highway MPG for this vehicle compared to other in its class
2. Estimated range of MPG for most drivers
3. Type of fuel used in the vehicle
4. Estimated savings over five-year period compared to the average new vehicle
5. Smog rating for tailpipe emissions compared to other vehicles
6. Combined fuel economy and emissions rating compared to other vehicles
7. Estimated fuel cost based on 15,000 miles per year at $3.70 per gallon
8. QR code to direct buyers to more information

The corporate average fuel economy standard (regulated by the U.S. government, also known as CAFE) required for new passenger cars, light trucks, and SUVs, is 34.1 miles per gallon (combined city and highway mileage). There are some dedicated electric vehicles on the market today that can achieve the equivalent of over 100 mpg. If you buy a fuel-efficient vehicle, you can save a lot on fuel costs and reduce greenhouse gas emissions. Compare the fuel economy of vehicles you are considering, and make fuel economy a priority. All cars must display a fuel economy label that lists the estimated miles per gallon for both city and highway driving, like the one above, to help you compare.

Industrial Sector

Manufacturing the goods we use every day consumes an enormous amount of energy. The industrial sector of the economy consumes about one-fifth of the nation's energy. In industry, energy efficiency and conservation are driven by economics—money. Manufacturers know that they must keep their product costs low so people will buy them.

Since energy is one of the biggest costs in many industries, manufacturers must use as little energy as possible. Their demand for energy efficient equipment has resulted in many new technologies in the last decades. Consumers can have an effect on industrial energy use through the product choices we make and what we do with the packaging and the products we no longer use.

A Consumer Society

Not only is America a consumer society, it is also a 'throw away' society. Americans produce more trash than any other developed country. The average person throws away approximately 1,600 pounds of trash a year!

The best way for consumers to reduce the amount of energy used by industry is to avoid buying unnecessary products and to repair and reuse items wherever possible. Buying only those items you need, as well as reusing and recycling products, can reduce energy use in the industrial sector. The 4 R's of an energy-wise consumer are easy to put into practice. Managing waste saves money, energy, and natural resources, and helps protect the environment.

Reduce

Buy only what you need. Buying fewer goods means less to throw away. It also means fewer goods are produced and less energy is used to manufacture them. Buying goods with less packaging also reduces the amount of waste and the amount of energy used.

Reuse

Buy products that can be used more than once. If you buy things that can be reused rather than disposable items that are used once and thrown away, you save natural resources. You will also save the energy used to make them, and reduce the amount of landfill space needed to contain the waste. Savings also result when you buy things that are durable. They may cost more, but they last a long time and do not need to be replaced often, saving money and energy.

Repair

Many people throw away products when they break and buy new ones. Many of these products could be easily and cheaply repaired. Always consider repairing a product before throwing it away. It saves energy, money, and natural resources.

Recycle

Make it a priority to recycle all materials that you can. Using recycled material to make new products almost always consumes less energy than using new materials. Recycling reduces energy needs for mining, refining, and many other manufacturing processes.

Recycling steel saves 75 percent of the energy needed to make products from raw iron ore. Recycling aluminum cans saves 92 percent of the energy required to produce aluminum from bauxite. Many other products can also be recycled and contribute to savings in energy and resources.

Recycling is only part of the process to save energy. Consumers also need to make an effort to buy recycled goods. Many products now have labels that tell consumers how much recycled material they contain.

Energy Sustainability

Efficiency and conservation are key components of **energy sustainability**—the concept that every generation should meet its energy needs without compromising the needs of future generations. Sustainability focuses on long-term actions that make sure there is enough energy to meet today's needs as well as tomorrow's.

Sustainability also includes the development of new clean technologies for using fossil fuels, promoting the use of renewable energy sources, and encouraging policies that protect the environment.

LESSON 1

Forms of Energy

All forms of energy fall under two categories:

POTENTIAL

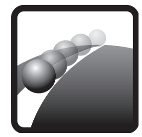
Stored energy and the energy of position (gravitational).

CHEMICAL ENERGY is the energy stored in the bonds between atoms in molecules. Gasoline and a piece of pizza are examples.

NUCLEAR ENERGY is the energy stored in the nucleus or center of an atom – the energy that holds the nucleus together. The energy in the nucleus of a plutonium atom is an example.

ELASTIC ENERGY is energy stored in objects by the application of force. Compressed springs and stretched rubber bands are examples.

GRAVITATIONAL POTENTIAL ENERGY is the energy of place or position. A child at the top of a slide is an example.



KINETIC

The motion of waves, electrons, atoms, molecules, and substances.

RADIANT ENERGY is electromagnetic energy that travels in transverse waves. Light and x-rays are examples.

THERMAL ENERGY or heat is the internal energy in substances – the vibration or movement of atoms and molecules in substances. The heat from a fire is an example.

MOTION is the movement of a substance from one place to another. Wind and moving water are examples.

SOUND is the movement of energy through substances in longitudinal waves. Echoes and music are examples.

ELECTRICAL ENERGY is the movement of electrons. Lightning and electricity are examples.

Energy Source Matching

Write the number of the energy source on the line next to its definition.

1. Petroleum	______	**Black rock burned to make electricity.**
2. Wind	______	**Energy from heat inside the Earth.**
3. Biomass	______	**Energy from flowing water.**
4. Uranium	______	**Energy from wood, waste, and garbage.**
5. Propane	______	**Energy from moving air.**
6. Solar	______	**Energy from splitting atoms.**
7. Geothermal	______	**Portable fossil fuel used in grills.**
8. Hydropower	______	**Fossil fuel for cars, trucks, and jets.**
9. Coal	______	**Fossil fuel gas moved by pipeline.**
10. Natural Gas	______	**Energy in waves from the sun.**

LESSON 1

Forms and Sources of Energy

In the United States we use a variety of resources to meet our energy needs. Use the information below to analyze how each energy source is stored and delivered.

1 Using the information from the *Forms of Energy* chart and the graphic below, determine how energy is stored or delivered in each of the sources of energy. Remember, if the source of energy must be burned, the energy is stored as chemical energy.

NONRENEWABLE

Petroleum ______________________

Coal ______________________

Natural Gas ______________________

Uranium ______________________

Propane ______________________

RENEWABLE

Biomass ______________________

Hydropower ______________________

Wind ______________________

Solar ______________________

Geothermal ______________________

2 Look at the U.S. Energy Consumption by Source graphic below and calculate the percentage of the nation's energy use that each form of energy provides.

What percentage of the nation's energy is provided by each form of energy?

Chemical _____

Nuclear _____

Motion_____

Thermal _____

Radiant _____

What percentage of the nation's energy is provided

By nonrenewables? ______

By renewables? ______

U.S. Energy Consumption by Source, 2014

NONRENEWABLE

PETROLEUM 34.9%
Uses: transportation, manufacturing

NATURAL GAS 27.5%
Uses: heating, manufacturing, electricity

COAL 18.0%
Uses: electricity, manufacturing

URANIUM 8.3%
Uses: electricity

PROPANE 1.6%
Uses: heating, manufacturing

RENEWABLE

BIOMASS 4.8%
Uses: heating, electricity, transportation

HYDROPOWER 2.5%
Uses: electricity

WIND 1.7%
Uses: electricity

SOLAR 0.4%
Uses: heating, electricity

GEOTHERMAL 0.2%
Uses: heating, electricity

*Total does not add to 100% due to independent rounding.
Data: Energy Information Administration

The Energy I Used Today

Circle the things you used or did in the left column. When you have completed the list, your teacher will show you how many Energy Bucks each activity or device uses. Write those numbers in the right column, then add them together to find your Total Energy Bucks Used.

What device woke me up this morning?	ENERGY BUCKS
Alarm Clock or Radio	________________

What devices were used to make my breakfast?

Microwave	________________
Stove/Oven	________________
Toaster Oven/Toaster	________________
Refrigerator	________________

What devices did I use as I got ready for school this morning?

Air Conditioning/Heating	________________
Radio/CD Player/MP3 Player/iPod	________________
Gaming System	________________
TV/DVD Player	________________
Shower/Bath	________________
Hair Dryer	________________
Curling Iron/Curlers/Flat Iron	________________
Telephone/Cell Phone	________________
Computer	________________
iPad/Tablet	________________

What rooms had lights turned on this morning?

Bedroom	________________
Bathroom	________________
Kitchen	________________
Family Room	________________
Other	________________

How did I get to school today?	ENERGY BUCKS
Walk	________
Bicycle	________
School Bus	________
Carpool	________
Family Vehicle	________

What devices did I use after school yesterday?	
Air Conditioning/Heating	________
Travel in Vehicle	________
Lights	________
Computer	________
iPad/Tablet	________
Gaming System	________
Radio/CD Player/MP3 Player/iPod	________
TV/DVD Player	________
Telephone/Cell phone	________
Snack Preparation	________

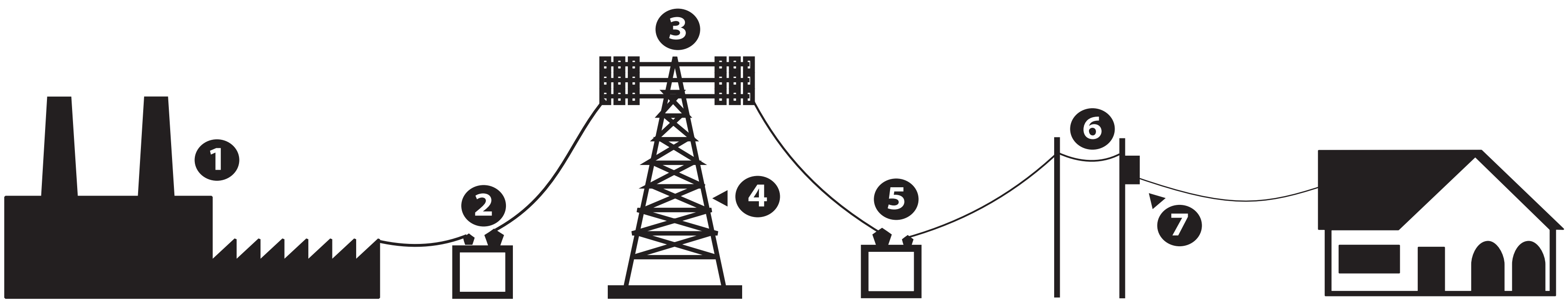
What devices were used at home last night?	
Air Conditioning/Heating	________
Microwave	________
Stove/Oven	________
Toaster Oven/Toaster	________
Refrigerator	________
Grill	________
Lights	________
TV/DVD Player	________
Gaming System	________
Shower/Bath	________
Hair Dryer	________
Telephone/Cell Phone	________
Computer	________
iPad/Tablet	________
Radio/CD Player/MP3 Player/iPod	________

Total Energy Bucks Used ________

LESSON 1

Transporting Electricity

Explain what each of the components numbered below does to get electricity from the generator to the consumer.



1. Power plant: ______________________

2. Step-up transformer: ______________________

3. Transmission line: ______________________

4. Power tower: ______________________

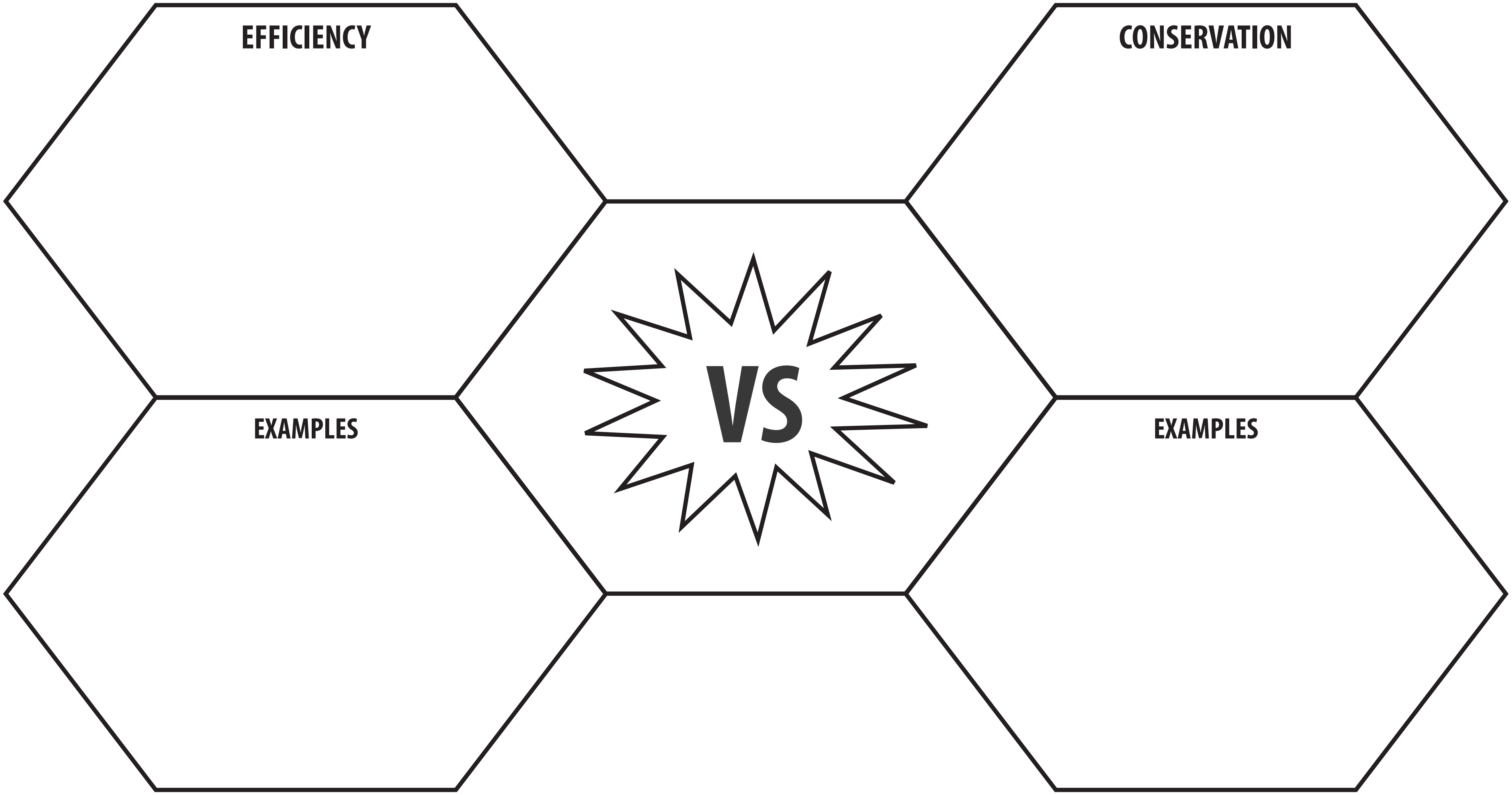
5. Step-down transformer: ______________________

6. Distribution line: ______________________

7. Neighborhood transformer: ______________________

LESSON 1

Efficiency vs. Conservation



Explain how energy efficiency and conservation work together.

Reflections

1. Define energy.

2. Define renewable.

3. Define nonrenewable.

4. List the ten major energy sources and categorize them as renewable (R) or nonrenewable (NR).

1. ____________________ **6.** ____________________

2. ____________________ **7.** ____________________

3. ____________________ **8.** ____________________

4. ____________________ **9.** ____________________

5. ____________________ **10**. ____________________

5. Make a list of the forms of energy and give an example of each.

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

6. Using *The Energy I Used Today* worksheet, add up the number of activities that used electricity.

LESSON 1

Connections

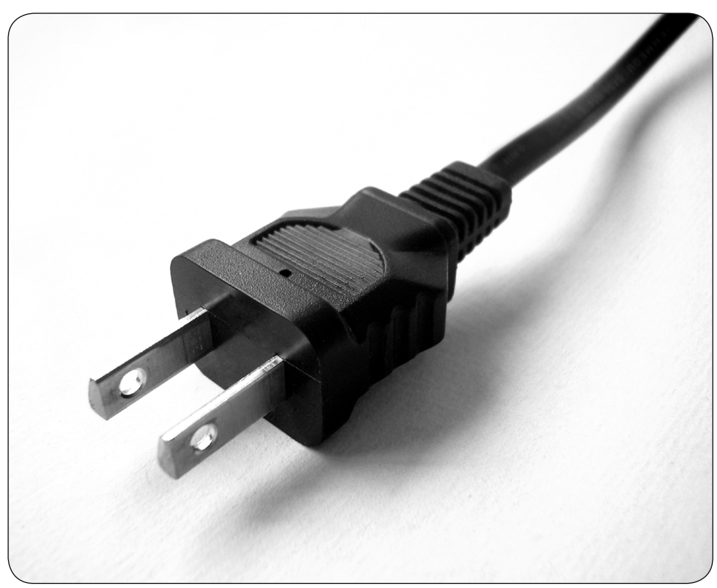
Choose a format such as a newspaper article, letter, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. Describe what you do on a typical weekend and how your weekend would be different if you had no electricity.

2. Describe the energy sources an early pioneer might have used for lighting, heating, cooking, and transportation.

3. Looking at *The Energy I Used Today* list, how would you change your behavior if you had to reduce your total energy expenses by 10 Energy Bucks?

4. Why is so much of the energy we use today in the form of electricity?



LESSON 2

Using Energy at School

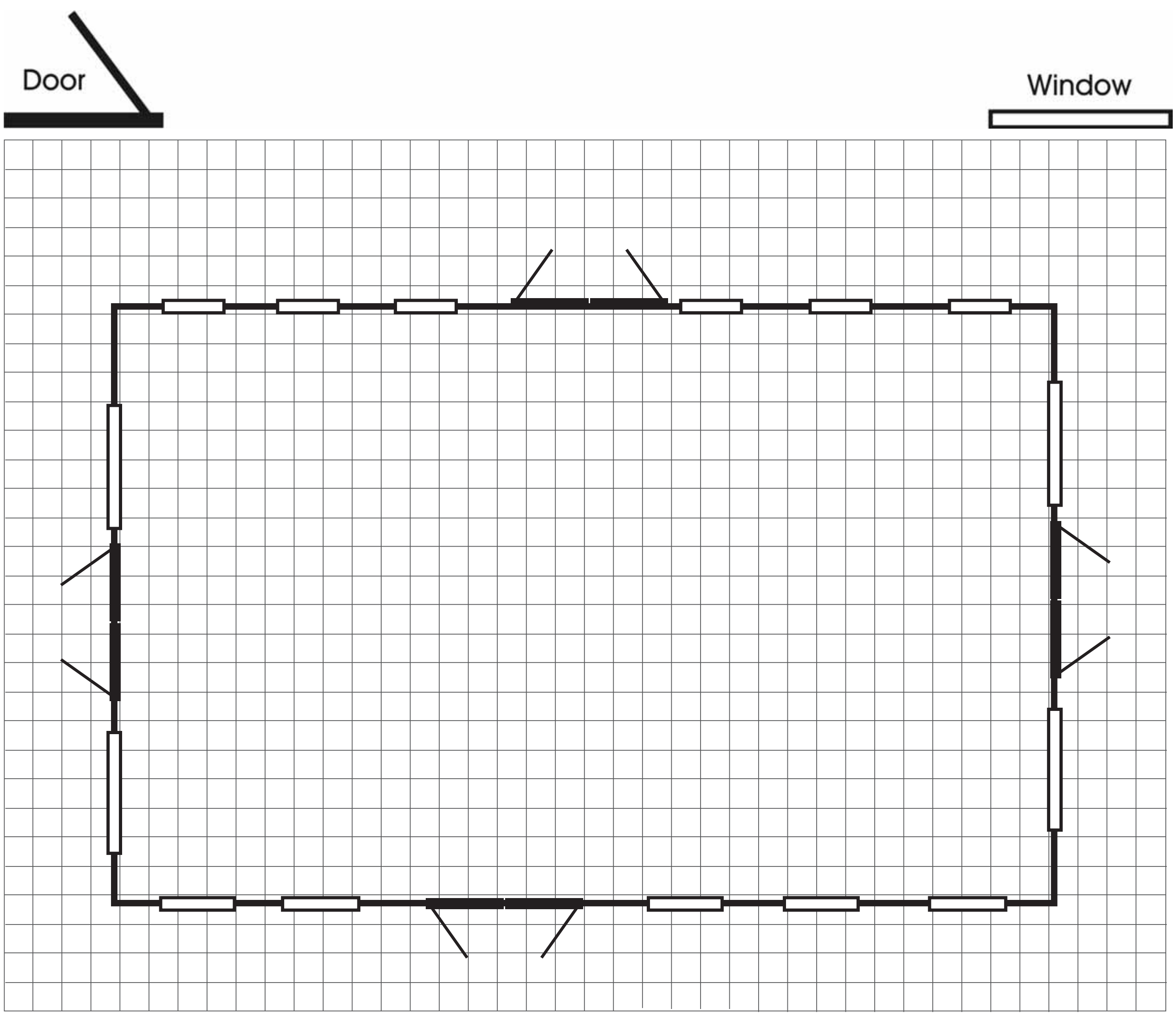
Energy Use at School Diagrams

Your assignment is to draw three diagrams—one of the entire school building, one of your classroom, and one of the work area your teacher assigns to you. Begin by making sketches of your school, classroom, and work area on notebook paper.

The next three pages are blank grids. Look at the diagram below to help you draw your school diagram. Look at the diagrams on pages 26 and 29 as inspiration to help you draw your classroom and work area diagrams. When you think your sketches are accurate, draw your diagrams on the grids. Use the symbols below to indicate windows and doors.

Make your diagram of the school large, but leave empty space around the building because you will be adding to the outside later.

Make the classroom and work area diagrams as large as possible.



LESSON 2

My School

My Classroom

My Work Area: ______________________________

Reflections

My Work Area: ____

Members of My Work Group: ____

1. How many exterior doors does your work area have? ______ Interior doors? ______

2. How many windows does your work area have? ______

3. How many electrical outlets does your work area have? ______

4. How many light fixtures does your work area have? ______

5. How many energy-consuming devices does your work area have? ______

6. How many heating/cooling devices or vents does your work area have? ______

Complete the chart below with data from your diagrams and the other work groups:

LOCATION	DOORS	WINDOWS	ELECTRICAL OUTLETS	LIGHTS	ELECTRICAL DEVICES	HEATING/ COOLING DEVICES/VENTS	OTHER
BUILDING							
CLASSROOM							
OFFICE							
LIBRARY							
CAFETERIA							
GYMNASIUM							

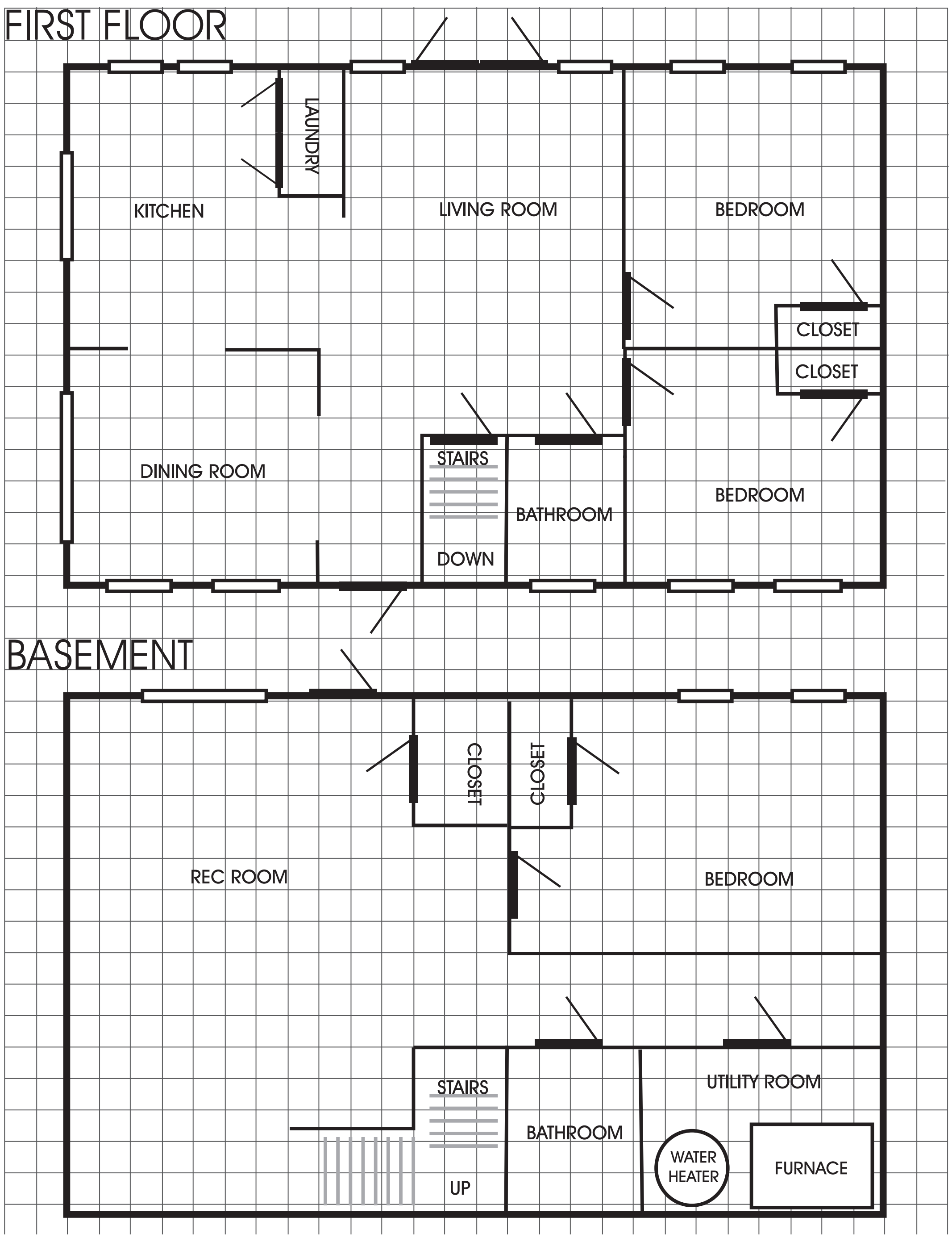
Notes:

Home Activity 1

LEGEND

Energy Use at Home Diagrams

Your assignment is to draw a diagram of your home like the example below. Begin by making sketches of your home on notebook paper. If your home has several floors, make a sketch of each floor. The next two pages are blank grids. When you think your sketches are accurate, draw your diagram on the grids. If you have several floors, use both pages. Use the symbols above to indicate windows and doors. Make your diagrams large because you will be adding to them throughout the unit.



My Home 1

LESSON 3

My Home 2

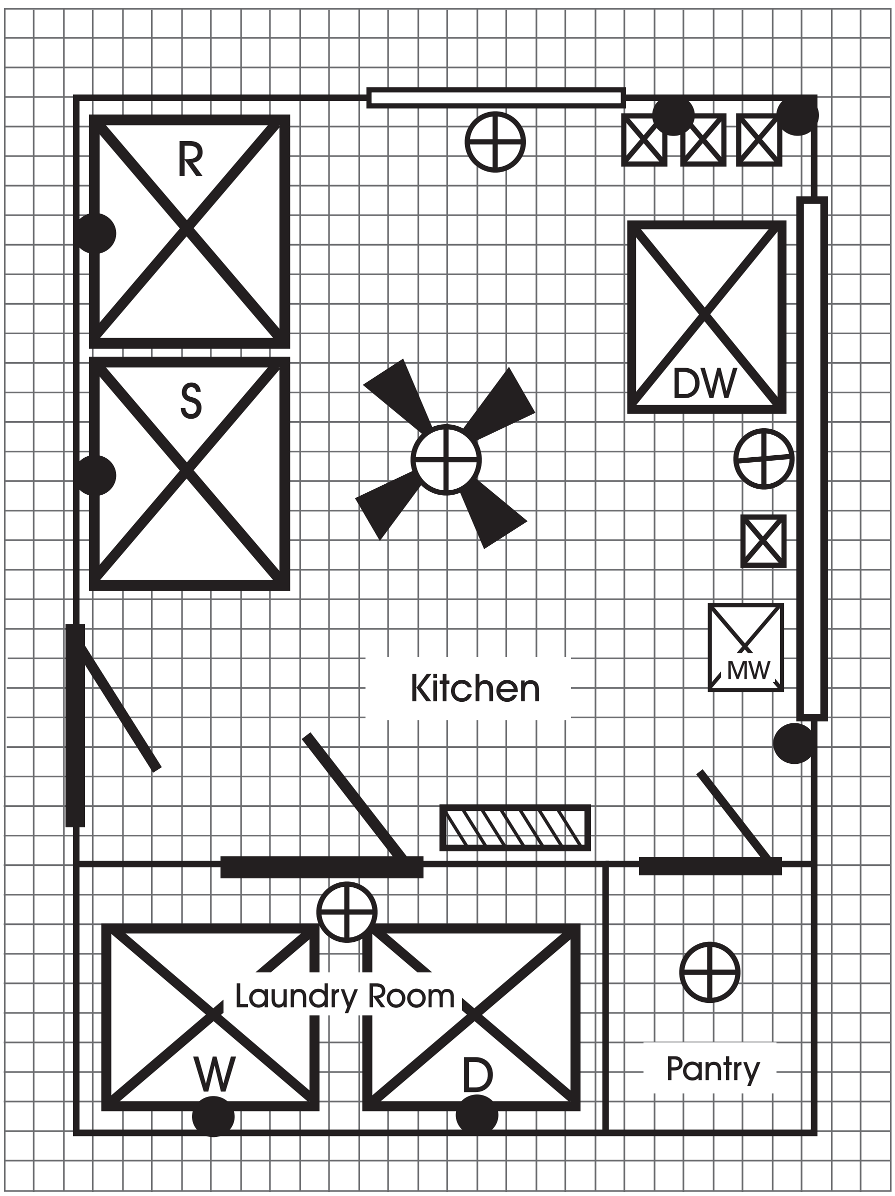
LESSON 3

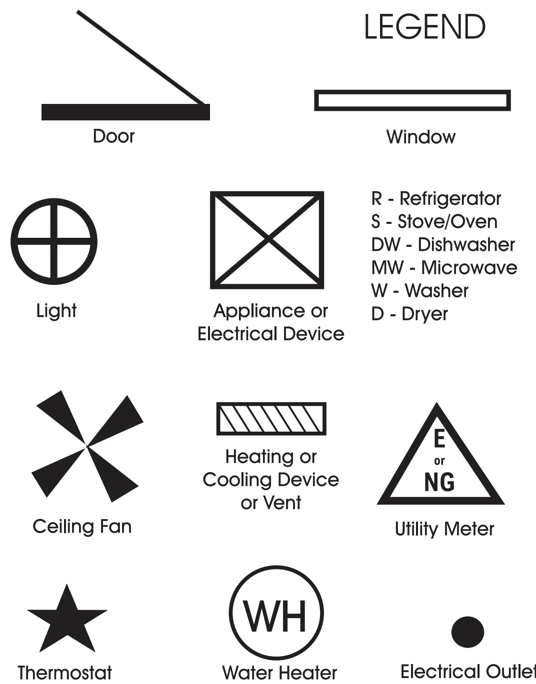
Home Activity 2

Energy Use at Home Diagrams

Your assignment is to draw diagrams of your kitchen and bedroom like the example below. Begin by making sketches of the rooms on notebook paper. When you think your sketches are accurate, draw your diagrams on the grids on the next two pages. Use the symbols below to indicate windows, doors, electrical outlets, lights, ceiling fans, appliances, and other electrical devices.

The sample diagram below is of a kitchen with a laundry room and pantry. It has three doors, two windows, and seven electrical outlets. There are two lights in the kitchen area and one ceiling fan with a light, one light in the pantry, and one light in the laundry room. There are two labeled appliances in the laundry room (washer and dryer) and four labeled appliances in the kitchen (refrigerator, stove, dishwasher, and microwave). There are also four smaller appliances in the kitchen that are not labeled. They are a garbage disposal, a coffee maker, a blender, and a toaster.





My Kitchen

My Bedroom

LESSON 3

Reflections

Investigating Home Energy Use

1. What tools and steps did you use to make accurate diagrams of your home?

2. How many exterior doors are in your home? _______

3. How many windows are in your home? _______

4. How many appliances did you find in your kitchen? _______

5. How many energy-consuming devices did you find in your bedroom? _______

6. How many light bulbs are in your home? _______

7. How many of these light bulbs are CFLs or LEDs? _______

LESSON 3

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. Describe the information that surprised you the most as you completed your Energy Use at Home Diagrams.

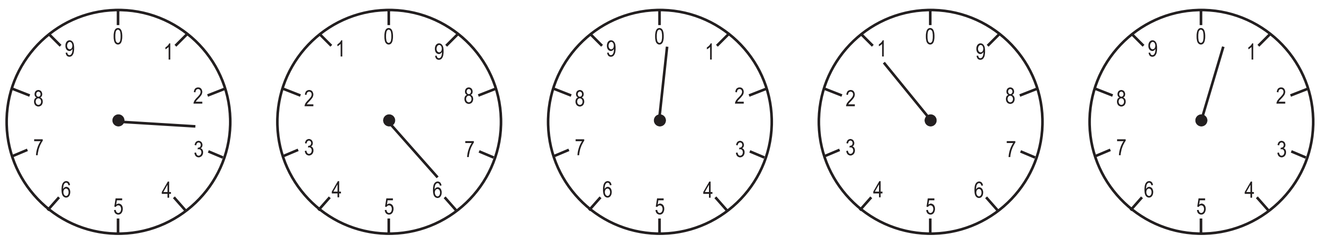
2. Describe one way your family wastes energy and what you could do to change that behavior.

3. Describe one way your family saves energy.

Reading an Electric Meter

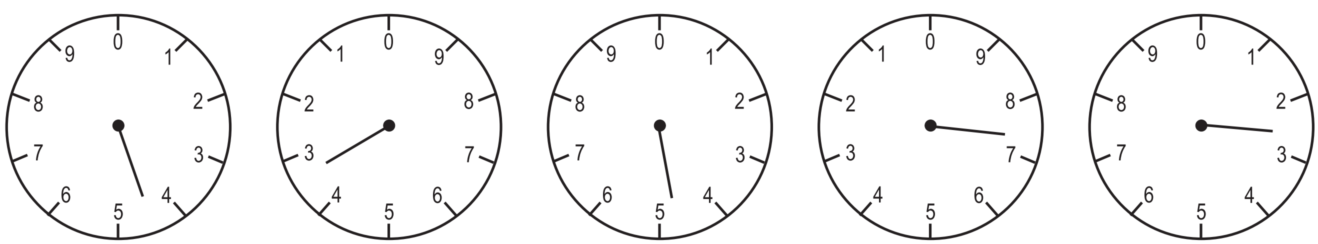
The meters below show the readings for the first and last days of January. See if you can determine how much electricity was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, **always record the smaller number**.

On January 1, the electric meter looked like this at school:



_____ _____ _____ _____ _____

On January 31, the electric meter looked like this at school:



_____ _____ _____ _____ _____

Electricity is measured in kilowatt-hours (kWh). One kWh is measured as one kilowatt (1,000 watts) of power consumed for one hour.

How much electricity was used in January at school? Let's find out. Subtract the January 1 reading from the January 31 reading to find the kilowatt-hours of electricity that were used during January.

January 31 reading = ____________________

January 1 reading = – ____________________

Electricity used = ____________________ **kWh**

If the power company charges $0.10 for every kilowatt-hour of electricity that is used (the national average for **commercial customers** in 2014), what is the cost of the electricity that was used in January? Let's find out. Multiply the kilowatt-hours of electricity used by the cost per kilowatt-hour.

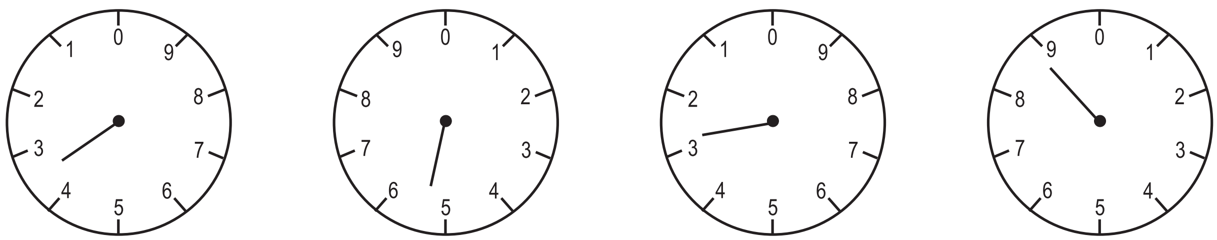
____________ **kWh** **X** **$0.10/kWh** **=** **$** ____________________

LESSON 4

Reading a Natural Gas Meter

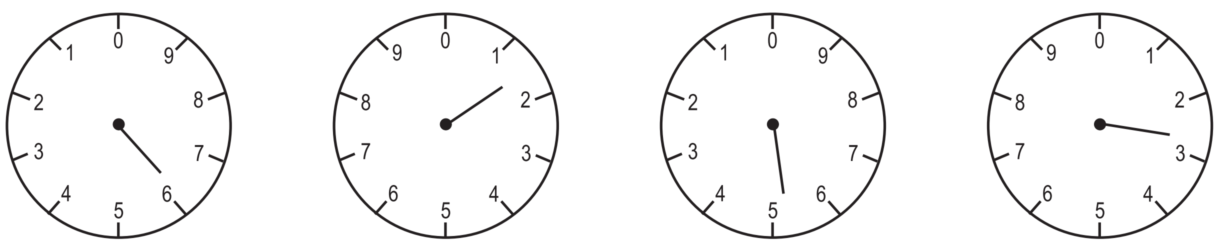
The natural gas meters below show the readings for the first and last days of January. See if you can determine how much natural gas was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, **always record the smaller number**.

On January 1, the natural gas meter looked like this at school:



_____ _____ _____ _____

On January 31, the natural gas meter looked like this at school:



_____ _____ _____ _____

Natural gas is measured in cf or cubic feet, a measure of its volume—how much space it occupies. A cubic foot of natural gas is a small amount of fuel, so most gas meters measure natural gas in hundreds of cubic feet—or Ccf. The first C means one hundred (from the Roman numbering system).

100 cubic feet = 100 cf = 1 Ccf

How much natural gas was used in January at school? Let's find out. Subtract the January 1 reading from the January 31 reading to find the volume of natural gas that was used during January.

January 31 reading = ______________

January 1 reading = –______________

Natural gas used = ______________ **Ccf**

The meter measures the natural gas in Ccf, but the natural gas company charges by the amount of heat energy the gas contains. Heat energy is measured in therms. One Ccf of natural gas contains about one therm of heat energy (1.030 therms). If the gas company charges $0.89 for a therm of gas (the national average for **commercial customers** in 2014), how much did the gas cost in January?

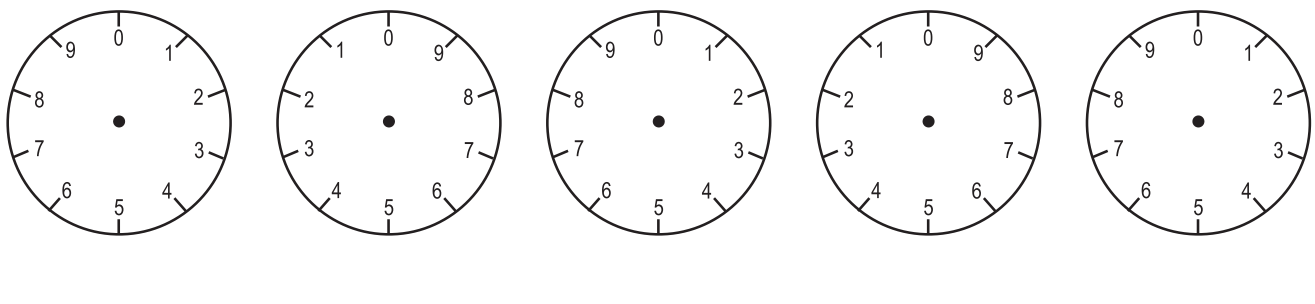
Usage Charge: ______________ **Ccf X $0.89/Ccf = $** ______________

LESSON 4

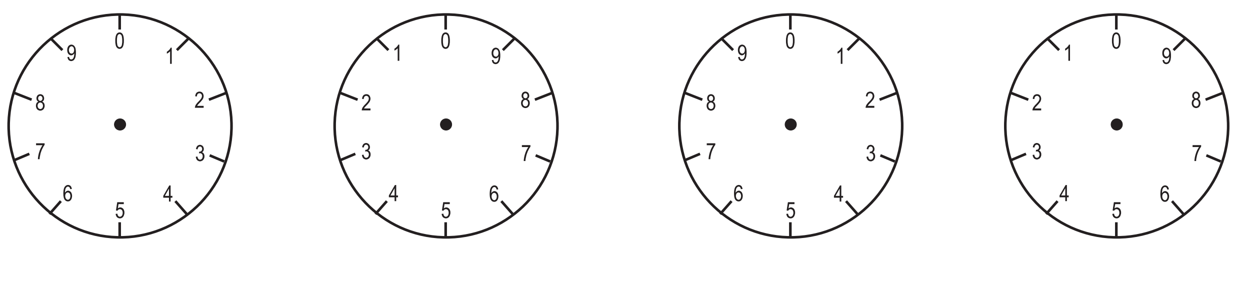
School Utility Meters

On the diagrams below, record the readings of the electric and natural gas meters at your school. If your school's meters do not have dials, draw pictures of the meters on the bottom of the page and record the readings.

SCHOOL ELECTRIC METER



SCHOOL NATURAL GAS METER

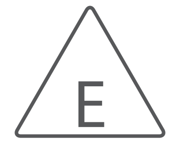


ELECTRIC METER

NATURAL GAS METER

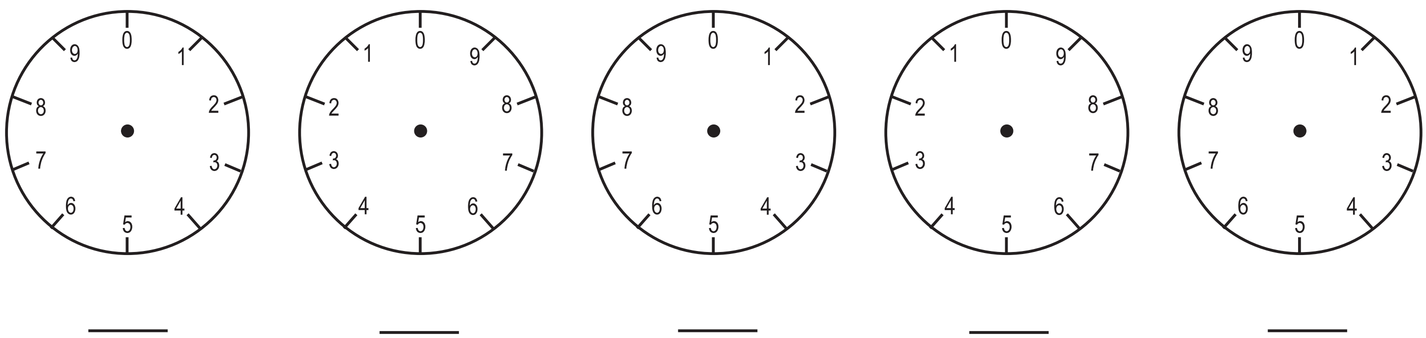
Home Activity 1

Reading Your Electric Meter at Home

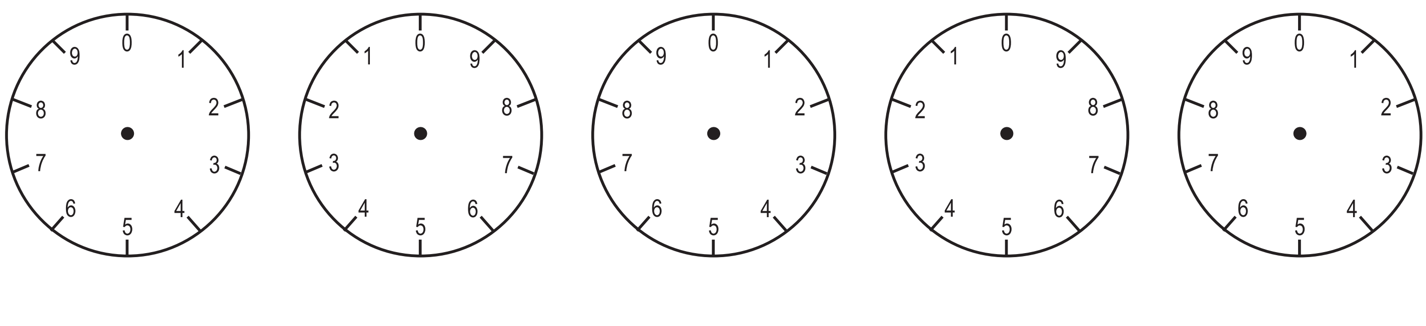


1. Your first assignment is to locate the electric meter at your home with the help of an adult, and add it to your home diagram using the symbol to the right.
2. Your second assignment is to read your electric meter at the same time on two consecutive days and record the readings on the meter faces below. Determine the amount of electricity used during the 24-hour period in kilowatt-hours, then calculate the cost of the electricity used if the rate for residential customers is $0.125 per kilowatt-hour. Finally, multiply the cost of electricity for one day by 30, to determine the cost of electricity for a month if you use the same amount of electricity each day.
3. If you do not have access to your electric meter, use the meter readings of someone in the class to calculate costs.

Day 1 Date: ______________________ **Time:** ______________________



Day 2 Date: ______________________ **Time:** ______________________



Electricity Used: **Day 2 Reading** _____________ **kWh**

Day 1 Reading – _____________ **kWh**

Electricity Used _____________ **kWh**

Cost for One Day: _______________ **kWh x $0.125/kWh = $** _________________

Cost for One Month: **$**_______________ **x 30 days = $** _________________

LESSON 4

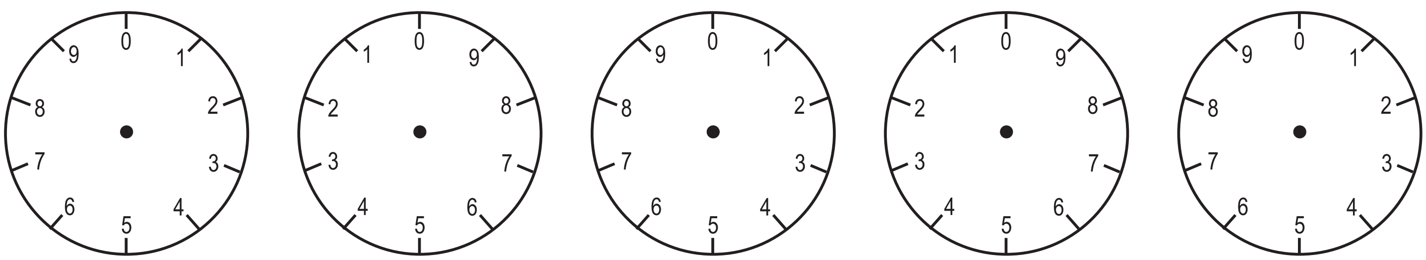
Home Activity 2

Reading Your Natural Gas Meter at Home

NG

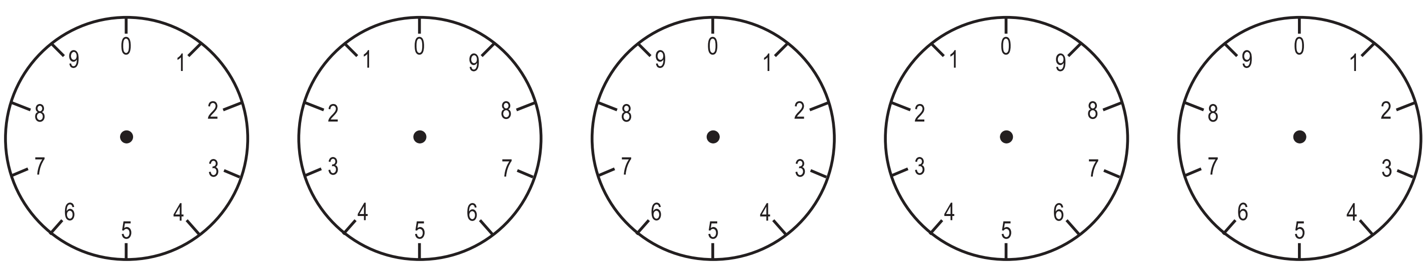
1. Your first assignment is to locate the natural gas meter at your home with the help of an adult, and add it to your home diagram using the symbol to the right.
2. Your second assignment is to read your natural gas meter at the same time on two consecutive days and record the readings on the meter faces below. Determine the volume of natural gas used during the 24-hour period (Ccf), and calculate the cost of the natural gas used if the rate for residential customers is $1.10 per Ccf. Finally, multiply the cost of natural gas for one day by 30, to determine the cost of natural gas for a month if you use the same amount of natural gas each day.
3. If you do not have access to your natural gas meter, use the meter readings of someone in the class to calculate costs.

Day 1 Date: ____________________ **Time:** ____________________



____ ____ ____ ____ ____

Day 2 Date: ____________________ **Time:** ____________________



____ ____ ____ ____ ____

Natural Gas Used:	**Day 2 Reading**		____________ **Ccf**
	Day 1 Reading	**–**	____________ **Ccf**
	Natural Gas Used		____________ **Ccf**

Cost for One Day:	____________ **Ccf**	**x**	**$1.10/Ccf**	**=**	**$** ______________
Cost for One Month:	**$**____________	**x**	**30 days**	**=**	**$** ______________

Reflections

Measuring Energy Use

1. How many electric meters are there at your school? ______ Natural gas meters? ______

2. Does your school pay more or less than residential customers for energy?

3. If your family uses about the same amount of electricity each month, how much electricity would your home use in a year? _______________ kWh

4. How much would you pay for electricity for a year at a cost of $0.125/kWh? $ ________________

5. If you reduced your electricity consumption by 10 kWh per day, how much money would you save in a year? $ ________________

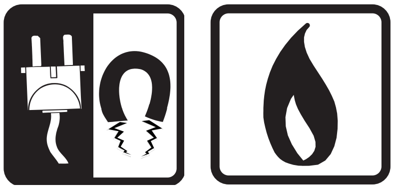
6. The average household in the U.S. paid around $1,369 for electricity in 2014. How does your predicted cost compare to the national average?

7. If your home used 75 Ccf of natural gas during the month of September, how would you expect this number to change if checking your meter in the month of December? March? June? Explain why you think the number of Ccf would be different.

8. How much would you pay for natural gas for a year at a cost of $1.10/Ccf? $ ________________

9. If you reduced your natural gas consumption by 2 Ccf per day, how much money would you save in a year? $ ________________

10. The average household in the U.S. paid about $730 for natural gas in 2014. Based on where you live, how do you think your home compares to the national average? Do you think it will be more, less, or the same? Explan your reasoning.



LESSON 4

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. Describe an easy way you and your family could reduce electricity consumption at home and how you might get everyone in your family to join in your plan.

2. Describe one way that your school uses more electricity than it needs and how you might reduce that consumption.

3. Explain how to read an electric meter.

4. Compare the cost of electricity and natural gas in your area to the national average costs.

LESSON 5

Insulation Investigation

Question

Are certain materials better for insulating than others?

Materials

- 2 Radiation cans
- 2 Thermometers
- Insulating material
- Masking tape
- 2 Rubber bands
- Hot water (provided by teacher)

Hypothesis

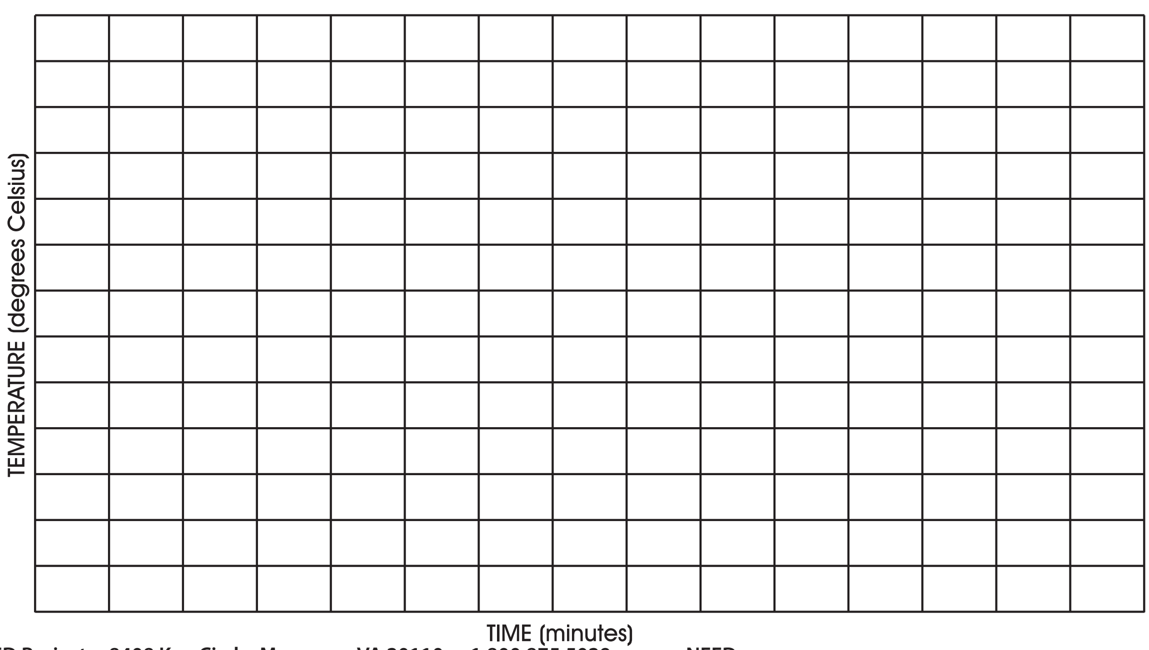
Procedure

1. Remove the tops from the cans.
2. Use the insulating material to insulate one can on the sides only.
3. Ask your teacher to fill both of your cans with hot water. Replace the tops.
4. Suspend a thermometer through the hole in each top, making sure it does not touch the bottom or the sides of the can.
5. In the chart below, record the temperature (°C) of the water in the cans at two-minute intervals for 20 minutes. Your teacher will keep track of the time with a timer. Calculate the overall change in temperature (ΔT) for both cans.
6. Graph the results on the graph below.

Data Table

TYPE OF INSULATION: ________________________________

TIME (MIN)	0	2	4	6	8	10	12	14	16	18	20	ΔT
Insulated temperature												
Uninsulated temperature												



Home Activity

Investigating Home Insulation and Infiltration

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 5, 7-11 of the *Energy Saver* guide

Materials

- Electrical outlet and switchplate gaskets
- Screwdriver
- Ruler

✔ Procedure

1. If you have access to your attic, measure the amount of insulation with the help of an adult.

   _____ < 5 inches 2 points

   _____ 5-10 inches 4 points

   _____ > 10 inches 6 points

2. Open your outside doors and check the condition of the weatherstripping between the doors and the door-frame.

   _____ none 0 points

   _____ poor 2 points

   _____ fair 4 points

   _____ good 6 points

3. Using the map on page 9 of the *Energy Saver* guide, determine in which Insulation Zone your home is located.

   Zone ____________________

4. According to the map, what are the recommended R ratings in your Insulation Zone for the following:

   Attic __________________________________

   Walls __________________________________

   Floors __________________________________

5. Using the graphic on page 7 of the *Energy Saver* guide, decide with your family the five areas of your home you will check for air leaks.

   1. ______________________________ 4. ______________________________

   2. ______________________________ 5. ______________________________

   3. ______________________________

6. Using the picture on page 5 of the *Energy Saver* guide, determine the top three ways air can escape from your home.

   1. ____

   2. ____

   3. ____

Actions

1. With an adult, check the wall switches and electrical sockets for air leaks.
2. With an adult, install the switchplate and electrical outlet gaskets where air leaks are found.

LESSON 5

Reflections

Insulation

1. In 20 minutes, how much did the temperature of the water in the uninsulated can change?

2. In 20 minutes, how much did the temperature of the water in the insulated can change?

3. After 20 minutes, what was the difference in temperature between the insulated and uninsulated cans?

4. Which material was the best insulator?

5. Which material was the worst insulator?

6. What variables in the experiment might make the results unreliable?

7. How might you change the experiment to get more reliable results?

LESSON 5

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. Describe what you learned from the insulation experiment and how it relates to saving energy at home.

2. Encourage homeowners to make sure they have adequate insulation in their homes.

Image courtesy of Owens Corning

LESSON 6

Temperature Investigation

Materials

- Digital thermometer
- Digital humidity/temperature pen

✔ Procedure

1. After viewing the school's heating and cooling system, add it to your school diagram, using the star symbol above.
2. Find out the answers to the following questions:

   Which system is in operation? ________________________________

   What energy source fuels the heating system? ______________________

   What energy source fuels the cooling system? ______________________

3. Locate the thermostat in the classroom. Add the thermostat to your classroom diagram, using the star symbol above.
4. Record the temperature setting of the thermostat. ______________________
5. Using the thermometer, record the actual temperature of the classroom. ______________________
6. Using the *Thermostat Temperature Guide* below, determine whether your classroom is saving or wasting energy and by how much.

   ____

7. Using the humidity/temperature pen, measure the humidity in your classroom. ______________________
8. Using the information in the *Student Informational Text*, is your humidity level within a healthy range? ______________________
9. With your team, locate the thermostat in your work area and add it to your work area diagram using the star symbol above.
10. Record the temperature setting of the thermostat. ______________________
11. Using the thermometer, record the actual temperature of the area. ______________________
12. Using the *Thermostat Temperature Guide* below, determine whether your area is saving or wasting energy and by how much.

    ____

Thermostat Temperature Guide *IN FAHRENHEIT*

HEATING

ENERGY SAVING | **ENERGY WASTING**

-20%	-10%	0%	+10%	+20%	+30%	+40%	+50%	+ + + +	+ + + + +
64^0	66^0	68^0	70^0	72^0	74^0	76^0	78^0	80^0	82^0
+ + + +	+ + + +	+ + + +	+ +	+30%	+20%	+10%	0	-10%	-20%

ENERGY WASTING | **ENERGY SAVING**

COOLING

Home Activity

Investigating Thermostats

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 12-18 of the *Energy Saver* guide

Materials

- *Thermostat Temperature Guide*, page 45

✔ Procedure

1. Locate the thermostat(s) in your home and add them to your home diagram using the star symbol above.
2. With the help of an adult, record the thermostat settings for your home:

Cooling Season:

______ < 74°	0 points
______ 74°-75°	2 points
______ 76°-77°	4 points
______ > 77°	6 points

Heating Season:

______ >74°	0 points
______ 72°-74°	2 points
______ 69°-71°	4 points
______ < 69°	6 points

3. We change our heating and/or cooling system filters this many times a year:

______ Never	0 points
______ Once	2 points
______ 2-3 times	4 points
______ > 3 times	6 points

4. Are there any heat-emitting devices located near the thermostat(s)? How would this affect the operation of the thermostat?

5. Show your family the *Thermostat Temperature Guide* and explain how it can help your family save money and energy.

   Decide with your family two ways you can save energy on heating and cooling:

   1. ____
   2. ____

➲ Actions

1. Post the *Thermostat Temperature Guide* in a prominent place as a reminder to you and your family.

LESSON 6

Reflections

Home Heating and Cooling

1. What is the main source of heat for your home?

2. Does your home have a fireplace, wood-burning stove, or other space heater to provide additional heat?

3. How is your home cooled (central air conditioning/window air conditioners)?

4. Does your family use ceiling fans or other fans to circulate air?

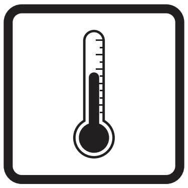
5. Does your home have a programmable thermostat to control the temperature?

6. Does your family use blinds and drapes to help control temperature in your home?

7. Does your home have storm windows and doors?

8. Does your home have an attic fan?

9. Do you use a humidifier or dehumidifier to control moisture?



LESSON 6

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. What area of your house stays the warmest, what area stays the coolest, and why?

2. What are some ways you can be comfortable in your home without adjusting the temperature and using more energy?

3. List four ways your family could save energy when heating and cooling your home and explain.

LESSON 7

Water Heating Investigation

WH

Question

Is water temperature constant throughout the school and is it set correctly?

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 19-20 of the *Energy Saver* guide

Materials

- 1 Flow meter bag
- 1 Hot water gauge
- Digital thermometer

Hypothesis

____

____

✔ Procedure

1. Add the water heating system symbol above to your school diagram.
2. What energy source fuels the water heating system? ______________________ What is the efficiency rating? ______________________
3. Record the temperature setting of the thermostat. ___________________

With the help of an adult:

4. Locate all hot water sources in your assigned work area and list them below.
   - With the flow meter bag, measure the water flow of all sources and record on the chart below. **FOR YOUR SAFETY: Measure ONLY COLD water with the flow meter bag.**
   - With the hot water gauge or digital thermometer, measure the temperature of the hot water at all sources and record on the chart. **FOR YOUR SAFETY: BE CAREFUL not to touch the water.**
5. Determine and record the recommended temperature setting from pages 19-20 of the *Energy Saver* guide.
6. Gather data from the other teams and add below.

LOCATION	WATER FLOW	ACTUAL TEMPERATURE	RECOMMENDED TEMPERATURE

Home Activity 1

Investigating Home Water Heating and Usage

WH

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 19-20 of the *Energy Saver* guide

Materials

- Hot water gauge
- Flow meter bag
- Kitchen sink aerator
- Bathroom sink aerator
- Low flow showerhead
- Teflon tape

✔ Procedure

With the help of an adult:

1. Locate the water heater and add it to your home diagram using the symbol above.
2. Read and record the temperature setting of the water heater. __________________
3. Locate the EnergyGuide label and record the efficiency rating. _________________

_____ uses the most energy	0 points
_____ uses more than average energy	2 points
_____ uses average energy	3 points
_____ uses less than average energy	4 points
_____ uses the least energy	6 points

4. Use the hot water gauge to measure the temperature of the hot water in your bathroom sink. ___________

Actions

1. Use the flow meter bag to measure how much COLD water your main shower uses. If the showerhead is NOT efficient, install the low flow showerhead and measure again.
2. Use the flow meter bag to measure how much COLD water your main bathroom sink and kitchen sink use. If they are NOT efficient, install the energy efficient aerators and measure again.

WATER FLOW	BEFORE INSTALLATION	AFTER INSTALLATION
Main Shower		
Main Bathroom Sink		
Kitchen Sink		

The Tools

Hot Water Gauge: Measures the temperature of your hot water. See instructions on plastic card.

Flow Meter Bag: Measures the amount of water flow. Instructions are on the bag.

Aerators and Showerheads: Reduce the water flow without reducing pressure. The smaller aerator is for the main bathroom sink; the larger aerator is for kitchen sink. Install using instructions for showerhead.

Teflon Tape: Ensures a tight seal for showerhead and aerators.

LESSON 7

Home Activity 2

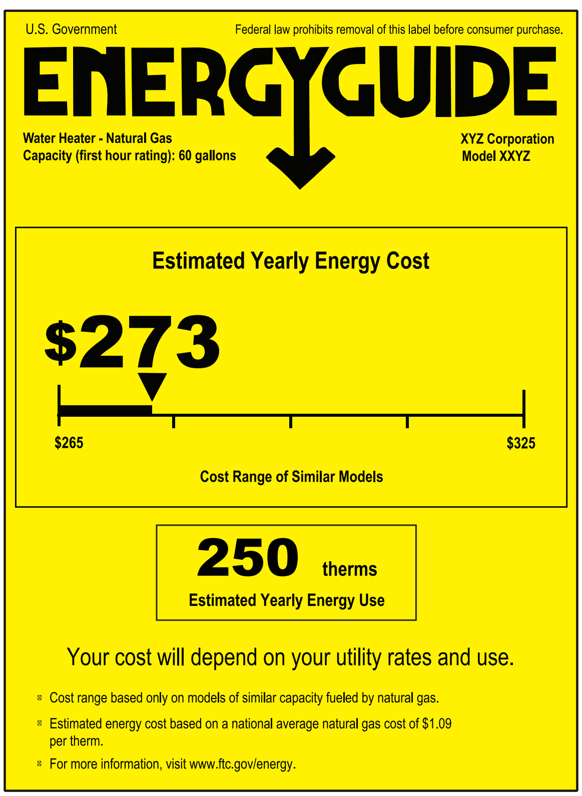
Comparing EnergyGuide Labels

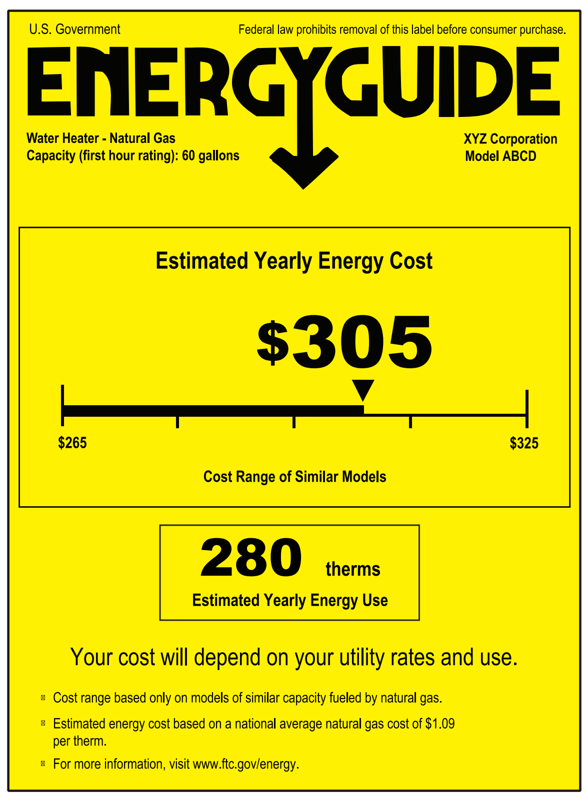
Your family needs to buy a new water heater. Water heaters usually last a long time—10 years or more—so you can save a lot of money on an energy efficient one. Use the chart below to figure out which water heater to buy, comparing the information on the EnergyGuide labels.

- **How many years will it take before you begin to save money?**
- **How much money will you have saved after seven years?**

Water Heater 1: Purchase Price: $375.00 **Water Heater 2: Purchase Price: $250.00**

WATER HEATER 1	EXPENSES	COST TO DATE	WATER HEATER 2	EXPENSES	COST TO DATE
Purchase Price			Purchase Price		
Year One			Year One		
Year Two			Year Two		
Year Three			Year Three		
Year Four			Year Four		
Year Five			Year Five		
Year Six			Year Six		
Year Seven			Year Seven		





LESSON 7

Reflections

Water Heating and Usage

1. Do you have an electric or natural gas water heater?

2. How old is your water heater?

3. Is your water heater wrapped with an insulating blanket?

4. Is your water heater set at the recommended temperature? If not, what is the setting? _________

5. How efficient is your water heater according to the EnergyGuide label?

6. Did you install the low flow showerhead and aerators? Why or why not?

7. Use the chart on page 20 of the *Energy Saver* guide to determine the top uses of hot water in your home:

1. ____

2. ____

LESSON 7

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

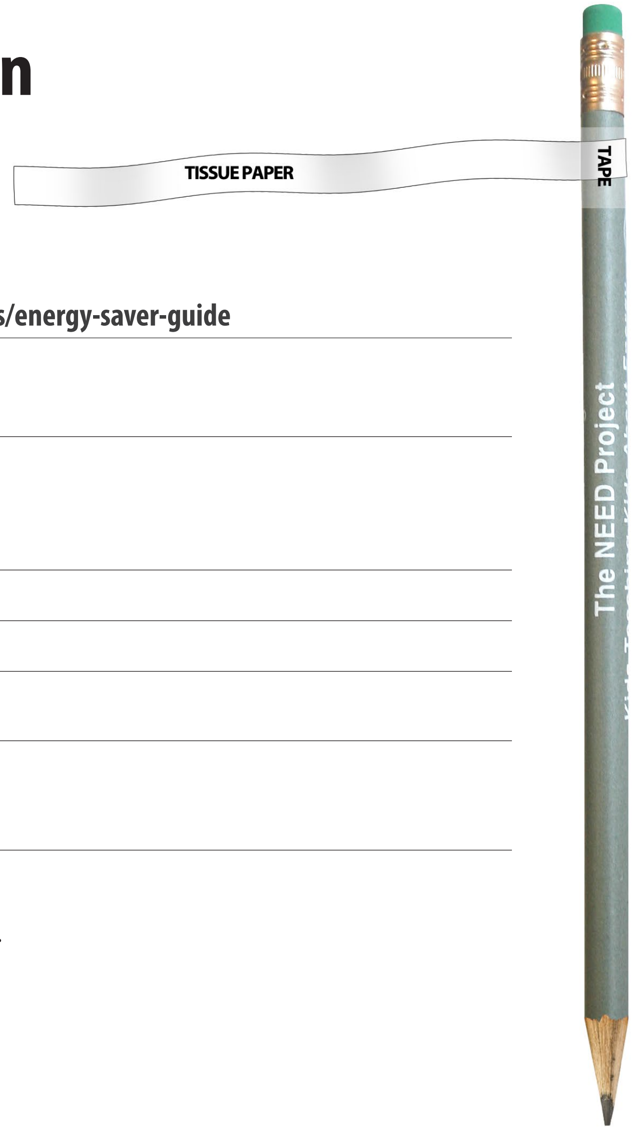
1. What can you and your family do to reduce your hot water use?

2. What did you learn using the hot water gauge and the flow meter bag?

3. Explain how buying an energy efficient appliance can save money, even if it costs more to buy.

LESSON 8

Windows Investigation



Question

Are the windows in the building efficient at stopping air infiltration?

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 21-22 of the *Energy Saver* guide

Materials

- 1 Pencil
- 1 Piece of tape
- 1 Piece of tissue paper (1” x 12”)

Hypothesis

____

____

Preparation

- Tape a piece of tissue paper to the end of a pencil as shown in the picture.

Procedure

IN THE CLASSROOM

1. Examine the window(s) in your classroom and record your observations.
   - Direction windows face ______________________
   - Single or double pane ______________________
   - Special coating ______________________
   - Blinds or shades ______________________
   - Locking mechanism ______________________
   - Caulking and weatherstripping ______________________
   - Other observations ______________________
2. Use the pencil with the tissue paper to check for air infiltration around the windows when they are closed. The tissue paper will flutter if any air is infiltrating. Record your observations.

   ____

   ____

IN THE WORK AREA

1. Examine the window(s) in your work area and record your observations.
   - Direction windows face ______________________
   - Single or double pane ______________________
   - Special coating ______________________
   - Blinds or shades ______________________
   - Locking mechanism ______________________
   - Caulking and weatherstripping ______________________
   - Other observations ______________________
2. Use the pencil with the tissue paper to check for air infiltration around the windows when they are closed. The tissue paper will flutter if any air is infiltrating. Record your observations.

   ____

   ____

LESSON 8

Home Activity

Investigating Windows and Air Infiltration

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 21-22 of the *Energy Saver* guide

Materials

- Pencil with tissue paper

✔Procedure

1. Examine the windows in your home and record your observations.

   Number of windows ________________

   Age of windows ________________

   _____ single pane - no storm windows 0 points

   _____ single pane with plastic sheeting 2 points

   _____ single pane with storm windows 4 points

   _____ double pane 6 points

   _____ double pane with gas fill 8 points

   Special coating _____ yes _____ no

   Heavy blinds or shades _____ yes _____ no

   Awnings over south or west facing _____ yes _____ no

   Locking mechanism _____ yes _____ no

   Caulking and weatherstripping _____ yes _____ no

   Other observations ____

2. Use the pencil with the tissue paper to check for air infiltration around the windows when they are closed. The tissue paper will flutter if any air is infiltrating. Record your observations.

LESSON 8

Reflections

Windows and Air Infiltration

1. Was there air infiltration from any of the windows in your classroom or work area?

2. Are any of the windows in your classroom or work area cracked or broken?

3. How would you rate the overall energy efficiency of your school's windows?

4. What could you do besides replacing the windows to make your school's windows more energy efficient?

5. Was there air infiltration from any of the windows in your home?

6. Are any of the windows in your home cracked or broken?

7. How would you rate the overall energy efficiency of your home's windows?

8. What could you do besides replacing the windows to make your home's windows more energy efficient?

LESSON 8

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

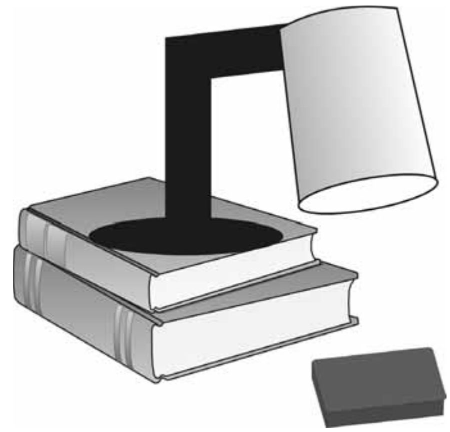
1. What can you and your family do to make your windows more energy efficient?

2. What did you learn by examining your windows and investigating air infiltration through your windows?

3. List "Energy Saving Tips" for windows.

LESSON 9

Light Bulb Investigation



Question

Can different types of bulbs with similar lumen ratings have different light output?

Materials

- 3 Lamps
- 1 Incandescent light bulb
- 1 Compact fluorescent light bulb (CFL)
- 1 Light emitting diode bulb (LED)
- 1 Light meter
- Textbooks

Hypothesis

Preparation

- Read all of the steps in the procedure.

✔ Procedure

1. Place the incandescent bulb in one lamp, the CFL in another, and the LED bulb in the third lamp. (If you do not have three lamps, conduct three trials, one for each bulb.)
2. Place the lamps on a table on identical stacks of books.
3. Plug the lamps into an outlet and turn them on.
4. Use the light meter to measure the light output of the lamps.
5. Record your measurements and calculations in the table below.
6. Compare the output measured by the light meter to the stated output of the bulbs.

Data

BULBS	FOOT-CANDLES FROM LIGHT METER	STATED LUMEN OUTPUT
Incandescent		
CFL		
LED		

Conclusion

What did you learn about the light output of the three bulbs? Use data to support your answer.

LESSON 9

Flicker Checker Investigation

An incandescent bulb produces light by passing electricity through a wire inside the bulb. This wire is called a filament. When electricity flows through the wire, it gets very hot and glows, producing light. Incandescent bulbs use 90 percent of the electricity to produce heat and only ten percent to produce light. They are very inefficient in their use of energy.

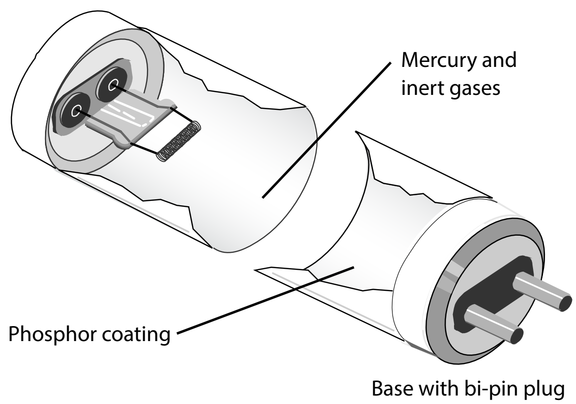
A fluorescent bulb produces light by passing electricity through a gas inside the bulb. The electrons in the gas molecules become more energetic and some escape. They bounce around and crash into the walls of the bulb. The walls of the bulb are painted with a special material that gives off light when hit by electrons.

Fluorescent lights have ballasts that help move the electricity through the gas inside the bulb. A ballast is an electromagnet that produces a large voltage between the two ends of the bulb so the electricity will flow between them.

There are two types of ballasts, magnetic and electronic. Magnetic ballasts produce a frequency of 60 Hertz (Hz), which means the light is flickering on and off 60 times a second. Electronic ballasts produce a frequency of 10,000-20,000 Hz. Fluorescent lights with electronic ballasts are more energy efficient than those with magnetic ballasts.

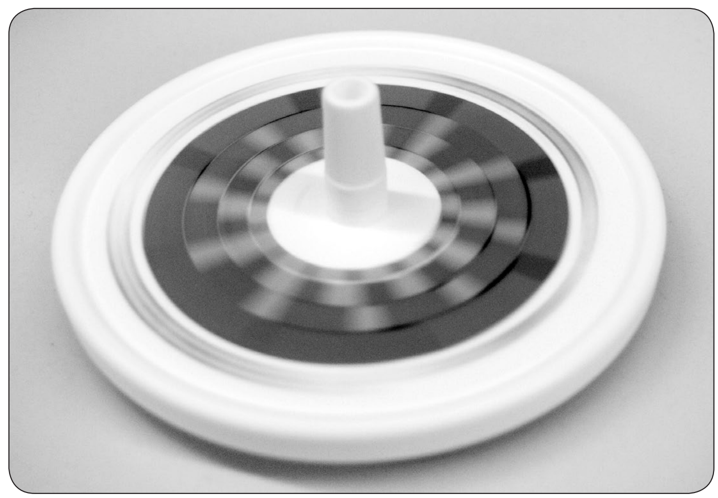
To determine which type of ballast a fluorescent light contains, spin the Flicker Checker under it. If you see smooth circles, as shown in the lower picture, the fluorescent light contains an electronic ballast. If you see a checkered pattern that moves from ring to ring, the light contains a magnetic ballast.

Fluorescent Tube Lamp

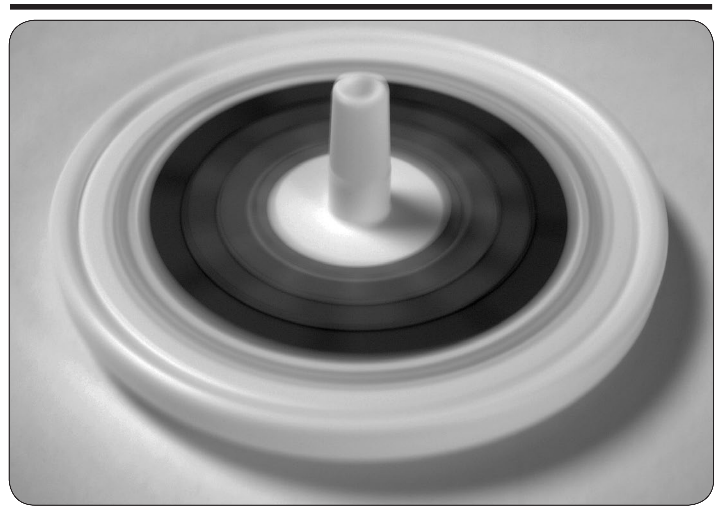


In fluorescent tubes, a very small amount of mercury mixes with inert gases to conduct the electric current. This allows the phosphor coating on the glass tube to emit light.

FLICKER CHECKER SHOWING A MAGNETIC BALLAST



FLICKER CHECKER SHOWING AN ELECTRONIC BALLAST



✔ Procedure

Use the Flicker Checker to determine the type of lighting in different areas of your school.

AREA	TYPE OF BALLAST
Classroom	
Cafeteria	
Gym	
Hallway	
Office	
Restroom	

Home Activity

Comparing Light Bulbs

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 23-26 of the *Energy Saver* guide

Materials

- Compact fluorescent light bulb (CFL)
- Light emitting diode bulbs (LED)

✔ Procedure

1. With your family, examine the pictures and the data of the incandescent, halogen, CFL, and LED bulbs below.
2. Notice that the amount of light produced by the bulbs is the same, but the wattage, the cost, and the life of the bulbs are different.
3. With your family, use the *Facts of Light Worksheet* on the next page to determine the amount of money you can save by using CFLs or LEDs instead of incandescent light bulbs.

Action

1. Replace incandescent light bulbs in your home with energy efficient lighting. **FOR YOUR SAFETY:** Replace bulbs only after allowing the bulb to cool. Incandescent or halogen bulbs can be VERY hot if illuminated.

	INCANDESCENT BULB	HALOGEN	COMPACT FLUORESCENT (CFL)	LIGHT EMITTING DIODE (LED)
Brightness	850 lumens	850 lumens	850 lumens	850 lumens
Life of Bulb	1,000 hours	3,000 hours	10,000 hours	25,000 hours
Energy Used	60 watts = 0.06 kW	43 watts = 0.043 kW	13 watts = 0.013 kW	12 watts = 0.012 kW
Price per Bulb	$0.50	$3.00	$3.00	$8.00

LESSON 9

Facts of Light Worksheet

How Much Can You Save With Energy Efficient Bulbs?

The graphic on the previous page shows four light bulbs that produce the same amount of light. You might put bulbs like these into a bright overhead light. One bulb is an incandescent light bulb, one is a halogen (an energy efficient incandescent), one is a compact fluorescent light bulb (CFL), and another is a light emitting diode (LED). Which one is the better bargain? Let's do the math and compare the four light bulbs using the residential cost of electricity at $0.125/kWh.

1. Determine how many bulbs you will need to produce 25,000 hours of light by dividing 25,000 by the number of hours each bulb produces light.
2. The price of each bulb has been given to you in the chart below.
3. Multiply the number of bulbs you will need by the cost of each bulb to determine the cost of bulbs to produce 25,000 hours of light.
4. Multiply the wattage of the bulbs (using the kW number given) by 25,000 hours to determine kilowatt-hours (kWh).
5. Multiply the number of kilowatt-hours by the cost per kilowatt-hour to determine the cost of electricity to produce 25,000 hours of light.
6. Add the cost of the bulbs plus the cost of electricity to determine the life cycle cost for each bulb.
7. Compare the environmental impact of using each type of bulb. Multiply the total kWh consumption by the average amount of carbon dioxide produced by a power plant. This will give you the pounds of carbon dioxide produced over the life of each bulb.




All bulbs provide about 850 lumens of light.

	COST OF BULB	INCANDESCENT BULB	HALOGEN	COMPACT FLUORESCENT (CFL)	LIGHT EMITTING DIODE (LED)
	Life of bulb (how long it will light)	1,000 hours	3,000 hours	10,000 hours	25,000 hours
	Number of bulbs to get 25,000 hours				
x	Price per bulb	$0.50	$3.00	$3.00	$8.00
=	**Cost of bulbs for 25,000 hours of light**				
	COST OF ELECTRICITY	**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Total Hours	25,000 hours	25,000 hours	25,000 hours	25,000 hours
x	Wattage	60 watts = 0.060 kW	43 watts = 0.043 kW	13 watts = 0.013 kW	12 watts = 0.012 kW
=	Total kWh consumption				
x	Price of electricity per kWh	$0.125	$0.125	$0.125	$0.125
=	**Cost of Electricity**				
	LIFE CYCLE COST	**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Cost of bulbs				
+	Cost of electricity				
=	**Life cycle cost**				
	ENVIRONMENTAL IMPACT	**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Total kWh consumption				
x	Pounds (lbs) of carbon dioxide per kWh	1.23 lb/kWh	1.23 lb/kWh	1.23 lb/kWh	1.23 lb/kWh
=	**Pounds of carbon dioxide produced**				

LESSON 9

Reflections

Lighting

1. What types of lights are used in your school? Do any of them have magnetic ballasts?

2. How many total light bulbs are in your home? ______

3. How many compact fluorescent light bulbs or LEDs are in your home?

_____ No CFLs or LEDs	0 points
_____ 1-2 CFLs or LEDs	2 points
_____ 3-4 CFLs or LEDs	4 points
_____ > 4 CFLs or LEDs	6 points

4. How much money did you and your family calculate you could save by replacing one incandescent bulb with a CFL? How much would you save by using an LED?

5. If you replaced five incandescent bulbs with CFLs, how much money could you save? What would you save if using LEDs?

6. Did you install the bulbs from your kit in your home?

7. When you replace an incandescent bulb with a CFL or LED, what measurement should you use to make sure you are getting a comparable light bulb?

8. If a nightlight uses only $0.02 of electricity per year and lasts a lifetime, how much would you pay for electricity if you used the nightlight for 80 years?

LESSON 9

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. What factors make some people reluctant to use CFLs? What about LEDs?

2. Convince someone to replace incandescent bulbs with CFLs or LEDs.

3. Inform someone about the benefits of efficient light bulbs.

DID YOU KNOW?
Only 10 percent of the energy used by an incandescent bulb produces light.

The rest is given off as heat.

LESSON 10

Measuring Electricity Use

Appliances and Machines

Background

Electricity consumption is measured in killowatt-hours (kWh). A killowatt is equal to 1,000 watts. A Kill A Watt™ monitor can measure the electrical consumption of machines and electrical appliances. The average cost of a kWh of electricity for schools is $0.10 per kWh.

Question

Which items are the largest energy consumers in your school?

Materials

- Kill A Watt™ monitor

Hypothesis

✔Procedure

Calculate how much it costs to operate the machines in your classroom. You need to know the wattage, the cost of electricity, and the number of hours a week each machine is used.

You can estimate the number of hours the machine is used each week, then multiply by 40 to get the yearly use. We are using 40 weeks for schools, because school buildings aren't used every week of the year. Using the copier as an example, if it is used for ten hours each week, we can find the yearly use like this:

Yearly use = 10 hours/week x 40 weeks/year = 400 hours/year

Remember that electricity is measured in kilowatt-hours. You will need to change the watts to kilowatts. One kilowatt is equal to 1,000 watts. To get kilowatts, you must divide the watts by 1,000. Using the copier as an example, divide like this:

kW = W/1,000
kW = 1,265/1,000 = 1.265

The average **cost of electricity for schools in the U.S. is about ten cents ($0.10)** a kilowatt-hour. You can use this rate or find out the actual rate from your school's electric bill. Using the average cost of electricity, we can figure out how much it costs to run the copier for a year by using this formula:

Yearly cost	**=**	**Hours used**	**x**	**Kilowatts**	**x**	**Cost of electricity (kWh)**			
Yearly cost	**=**	**400 hours/year**	**x**	**1.265 kW**	**x**	**$0.10/kWh**			
Yearly cost	**=**	**400**	**x**	**1.265**	**x**	**$0.10/kWh**	**=**	**$50.60**	

MACHINE OR APPLIANCE	HOURS PER WEEK	HOURS PER YEAR	WATTS (W)	KILOWATTS (kW)	RATE ($/kWh)	ANNUAL COST
Copier	*10*	*400 hours*	*1,265 W*	*1.265 kW*	*$0.10*	*$50.60*

The Environment and You

When we breathe, we produce carbon dioxide. When we burn fuels, we produce carbon dioxide, too. Carbon dioxide (CO_2) is a greenhouse gas. Greenhouse gases hold heat in the atmosphere. They keep our planet warm enough for us to live, but since the Industrial Revolution, we have been producing more carbon dioxide than ever before. Since 1850, the level of CO_2 in the atmosphere has increased by over 40 percent.

Research shows that greenhouse gases are trapping more heat in the atmosphere. Scientists believe this is causing the average temperature of the Earth's atmosphere to rise. They call this global climate change or global warming. Global warming refers to an average increase in the temperature of the atmosphere, which in turn causes changes in climate. A warmer atmosphere may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife, and humans. When scientists talk about the issue of climate change, their concern is about global warming caused by human activities.

Driving cars and trucks produces carbon dioxide because fuel is burned. Heating homes by burning natural gas, wood, heating oil, or propane produces carbon dioxide, too.

Making electricity can also produce carbon dioxide. Some energy sources—such as hydropower, solar, wind, geothermal, and nuclear—do not produce carbon dioxide, because no fuel is burned. About 38.6 percent of our electricity, however, comes from burning coal. Another 30.1 percent comes from burning natural gas, petroleum, and biomass.

The general rule is that, on average, every kilowatt-hour of electricity produces 1.23 pounds of carbon dioxide. Let's use this rule to figure out how much carbon dioxide is produced by the machines in your classroom. You can put the figures from the earlier worksheets in the boxes below. Here are the figures for the copier:

CO_2 a year = wattage x hours of use x rate of CO_2/kWh

CO_2 a year = 1.265 kW x 400 hr/yr x 1.23 lb/kWh = 622.38 lbs

MACHINE OR APPLIANCE	KILOWATTS (kW)	RATE OF CO_2/kWh (LBS)	HOURS PER YEAR	CO_2/YEAR (LBS)
Copier	*1.265 kW*	*1.23*	*400 hours*	*622.38*

LESSON 10

Home Activity 1

MEASURING ELECTRICITY USE

Let's figure out how much it costs to operate the machines and appliances on your list from home. Fill in the chart with the name of the machine and its wattage. Change the watts to kilowatts by dividing the number of watts by 1,000.

Estimate the number of hours that the machine is used each week. This time, multiply by 52, since there are 52 weeks in a year and you use machines all through the year at home.

The average **residential cost of electricity in the U.S. is about twelve and a half cents ($0.125**) a kilowatt-hour. You can use this rate or find out the actual rate for your home from your family's electric bill.

Yearly cost = Hours used x Kilowatts x Rate

MACHINE OR APPLIANCE	HOURS PER WEEK	HOURS PER YEAR	WATTS (W)	KILOWATTS (kW)	RATE ($/kW)	YEARLY COST

LESSON 10

Home Activity 1

THE ENVIRONMENT AND YOU

Let's calculate how much carbon dioxide is produced by the machines and appliances on your list from home. Fill in the chart with the name of the machine, its wattage in kilowatts, and the number of hours it is used. These figures are on an earlier worksheet.

Multiply the wattage by the number of hours used by the rate per kilowatt-hour of carbon dioxide, using the following formula:

wattage x **hours of use per year** x **rate of CO_2/kWh** = **CO_2 a year**

MACHINE OR APPLIANCE	KILOWATTS (kW)	HOURS PER YEAR	CO_2/kWh	CO_2/YEAR (LBS)

LESSON 10

Home Activity 2

APPLIANCES AND ENERGYGUIDE LABELS

Reading: Download from www.energy.gov/energysaver/downloads/energy-saver-guide

- Pages 27-34 of the *Energy Saver* guide

Materials

- Refrigerator thermometer
- Dollar bill

✔ Procedure

1. With the help of an adult, test the seal on the door of your refrigerator. To do this, you will need a dollar bill. Close the door over the dollar bill so that it is half in and half out of the refrigerator. Grasp the end of the bill with both hands by the corners and pull slowly and steadily. Do not try to jerk it; it might tear.

   _____ comes out easily 0 points

   _____ comes out fairly easily 2 points

   _____ comes out with difficulty 4 points

   _____ does not move 6 points

2. Use the refrigerator thermometer to measure the temperature of your refrigerator and freezer and record in the chart below.

APPLIANCE	TEMPERATURE	SAFE ZONE (°F)
Refrigerator		37°-40°
Freezer Section		0°-5°
Separate Freezer (if applicable)		0° or Colder

3. Look around your house for large or small appliances that have ENERGY STAR® logos on them. Explain to your family that the ENERGY STAR® means the appliances meet strict energy efficiency standards. What ENERGY STAR® appliances did you find?

4. Take a trip with your family to a store that sells large appliances, such as refrigerators. Using the blank EnergyGuide labels on the next two pages, record information from the EnergyGuide labels on two models of different appliances, such as refrigerators and dishwashers. Make sure that one appliance of each set is an energy efficient model. Make sure you also record the price of each appliance. You may also "shop" for these items online and download their labels for comparing.

5. Use the charts at the bottom of the pages to calculate the payback periods of the energy efficient models of each set of appliances.

energy

CHANGE FOR THE BETTER WITH ENERGY STAR

Home Activity 3

PAYBACK PERIODS

Based on standard U.S. Government tests

ENERGYGUIDE

Appliance: Brand:

Size: Model:

Compare the Energy Use of this Appliance with Others Before You Buy.

This Model Uses

Energy Use range of all similar models

Uses Least Energy **Uses Most Energy**

Based on standard U.S. Government tests

ENERGYGUIDE

Appliance: Brand:

Size: Model:

Compare the Energy Use of this Appliance with Others Before You Buy.

This Model Uses

Energy Use range of all similar models

Uses Least Energy **Uses Most Energy**

APPLIANCE 1	EXPENSES	COST TO DATE		APPLIANCE 2	EXPENSES	COST TO DATE
Purchase Price				Purchase Price		
Year One				Year One		
Year Two				Year Two		
Year Three				Year Three		
Year Four				Year Four		
Year Five				Year Five		
Year Six				Year Six		
Year Seven				Year Seven		
Year Eight				Year Eight		
Year Nine				Year Nine		
Year Ten				Year Ten		

Home Activity 3

PAYBACK PERIODS

Based on standard U.S. Government tests

ENERGYGUIDE

Appliance: Brand:

Size: Model:

Compare the Energy Use of this Appliance with Others Before You Buy.

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Purchase Price			Purchase Price		
Year One			Year One		
Year Two			Year Two		
Year Three			Year Three		
Year Four			Year Four		
Year Five			Year Five		
Year Six			Year Six		
Year Seven			Year Seven		
Year Eight			Year Eight		
Year Nine			Year Nine		
Year Ten			Year Ten		

LESSON 10

Reflections

1. How many machines in your classroom or assigned area are ENERGY STAR® rated? How many are not?

ENERGY STAR®	Not ENERGY STAR®
1. ______________________	1. ______________________
2. ______________________	2. ______________________
3. ______________________	3. ______________________
4. ______________________	4. ______________________
5. ______________________	5. ______________________
6. ______________________	6. ______________________

2. What machines did your team measure with the Kill A Watt™ monitor?

3. How energy efficient was the seal on your refrigerator?

4. Were the temperatures of your refrigerator and freezer within the Safe Zones?

5. If not within the Safe Zones, did you and your family adjust the temperature?

6. What kinds of appliances did you compare and what were the payback periods for the more efficient models?

LESSON 10

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. Describe a Kill A Watt® monitor and explain how it can be used to help save energy.

2. Describe the concept of payback period and how it applies to energy efficient appliances.

3. Encourage someone to purchase energy efficient appliances.

LESSON 11

Your Family Rating

In many of the activities, you and your family rated your energy consumption and efficiency. Now you will add all of those points together to determine your family's overall rating. Share this information with your family.

Your Ratings

Page 42:	Insulation Points:	______
	Weatherstripping Points:	______
Page 46:	Cooling Points:	______
	Heating Points:	______
	Furnace Filter Points:	______
Page 50:	Water Heater Points:	______
Page 55:	Windows Points:	______
Page 62:	Lighting Points:	______
Page 68:	Refrigerator Points:	______
	TOTAL Points	______

Rating Guide

40 or more points	EXCELLENT
30–39 points	GOOD START but there's more we can do
29 or fewer points	Make a commitment today to save energy at home and at school

Savings Plan

Make a list of things your family can do to save energy and money.

LESSON 11

Connections

Choose a format such as a newspaper article, postcard, bookmark, brochure, or flyer to complete one of the activities listed below.

1. What are the most important things you have learned about energy and how to save it?

2. What about energy would you like to know more about?

3. What things do you think you and your family will do to save energy at home?

Saving Energy Glossary

appliance	any piece of equipment, usually powered by electricity, that is used to perform a particular function; examples of common appliances are refrigerators, clothes washers, microwaves, and dishwashers
compact fluorescent	a light bulb consisting of a gas-filled tube and a magnetic or electronic ballast; electricity flows from the ballast through the gas, causing it to give off ultraviolet light; the ultraviolet light excites a white phosphor coating on the inside of the tube, which emits visible light; compact fluorescent light bulbs use less energy and produce less heat than a comparable incandescent bulb
depletion zone	a barrier region in a semiconductor that interferes with electron movement because it lacks excess electrons and spaces or holes for electrons (see semiconductor)
energy	the ability to do work or make a change
energy conservation	saving energy through behavior changes and installing energy efficient devices
energy efficiency	the ratio of the energy delivered by a machine to the energy supplied for its operation; often refers to reducing energy consumption by using technologically advanced equipment without affecting the service provided
ENERGY STAR®	a Federal Government program that recognizes the most energy efficient machines with a logo
energy sustainability	meeting energy demands without affecting the needs of others for the future
EnergyGuide label	the label on an appliance that shows how much energy the appliance uses in comparison to similar appliances
gasket	a material used to make a joint or seal airtight
gauge	an instrument for or a means of measuring or testing
halogen	a type of incandescent light bulb that uses a small amount of a halogen gas and a filament; slightly more efficient than traditional incandescent bulbs
hygrometer	a tool used to measure humidity
incandescent	a type of electric light in which light is produced by a filament heated by electric current; the most common example is the type you find in table and floor lamps
infiltration	to pass into or through
insulation	a material used to separate surfaces to prevent the transfer of electricity, heat, or sound
Kill A Watt™ monitor	a device that measures the amount of electrical energy used by a machine
kilowatt	a unit of power, used to measure electric power or consumption; a kilowatt equals 1,000 watts
kilowatt-hour (kWh)	a measure of electricity, measured as one kilowatt (1,000 watts) of power expended over one hour
kinetic	the energy of motion
landscaping	the use of plants to modify or ornament a natural landscape
light emitting diodes	energy saving bulb that generates light through the use of a semiconductor
lumen	a measure of the amount of light produced by a bulb
nonrenewables	fuels that cannot be renewed or made again in a short period of time, such as petroleum, natural gas, coal, propane, and uranium
payback period	the length of time you must use a more expensive, energy efficient appliance before it begins to save you money in excess of the additional upfront cost
R-value	a measure of a material's resistance to heat flow in units of Fahrenheit degrees x hours x square feet per Btu; the higher the R-value of a material, the greater its insulating capability
renewables	fuels that can be made or used again in a short period of time, such as solar, wind, biomass, geothermal, and hydrometer
semiconductor	a material that has a conductivity level between an insulator and a conductor

therm	a measure of the amount of thermal energy (or heat) that can be produced by natural gas
thermostat	a device that controls the amount of heating and cooling produced and/or distributed
watt	a unit of measure of power
weatherization	to make a house better protected against the effects of weather

BLANK PAGE

Post-Assessment

Circle the correct answer. If you do not know the answer, leave the question blank. Do not guess.

1. The energy in petroleum, natural gas, coal, and biomass is stored as ___________________.

a. thermal energy **b.** chemical energy **c.** kinetic energy

2. About 39% of all electricity in the U.S. is generated by ___________________.

a. uranium **b.** hydropower **c.** coal

3. Renewable energy sources account for what percent of total energy consumption in the U.S.?

a. 9 % **b.** 91 % **c.** 25 %

4. Electric meters in homes measure electricity use in ___________________.

a. volts **b.** watts **c.** kilowatt-hours

5. The amount of heat energy in natural gas is measured in ___________________.

a. cubic centimeters **b.** therms **c.** degrees Fahrenheit

6. The average cost of a kilowatt-hour of electricity for homes in the U.S. is ___________________.

a. $1.05 **b.** $0.55 **c.** $0.125

7. A material that slows the movement of heat is called ___________________.

a. insulation **b.** conduction **c.** barrier

8. The biggest cost in the American home is ___________________.

a. lighting **b.** controlling indoor temperature **c.** operating appliances

9. A device that controls temperature is called a/an ___________________.

a. thermometer **b.** insulator **c.** thermostat

10. Most appliances are powered by ___________________.

a. natural gas **b.** electricity **c.** propane

11. Energy efficient CFLs and LEDs reduce lighting energy use in your home by how much compared to incandescent bulbs?

a. 10 – 20 % **b.** 25 – 50 % **c.** 75 – 80 %

12. Which household appliance uses the most energy?

a. refrigerator **b.** television **c.** dishwasher

13. A water heater should be set at ___________________.

a. 120°F **b.** 150°F **c.** 180°F

14. Most heat moves in and out of a house through the ___________________.

a. windows and doors **b.** walls and ceiling **c.** air ducts

15. The average yearly electric bill in the U.S. is about ___________________.

a. $1,400 **b.** $2,400 **c.** $3,400

BLANK PAGE

Pre-Assessment

Circle the correct answer. If you do not know the answer, leave the question blank. Do not guess.

1. The energy in petroleum, natural gas, coal, and biomass is stored as ____________.

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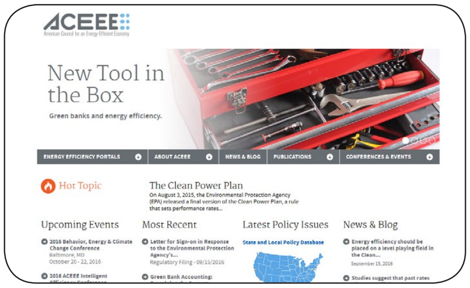
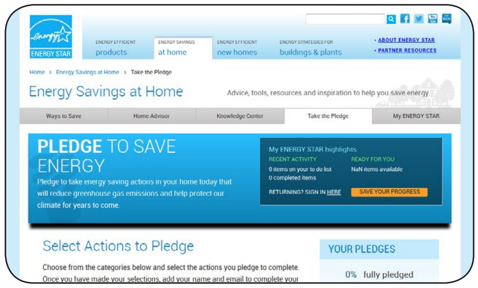
Internet Resources



American Council for an Energy-Efficient Economy

Promoting economic prosperity, energy security, and environmental protection through energy efficiency.

www.aceee.org



Energy Savings at Home

Take the ENERGY STAR® Pledge and do your part to save energy and reduce emissions.

www.energystar.gov/campaign/takeThePledge

Green Button Data Initiative

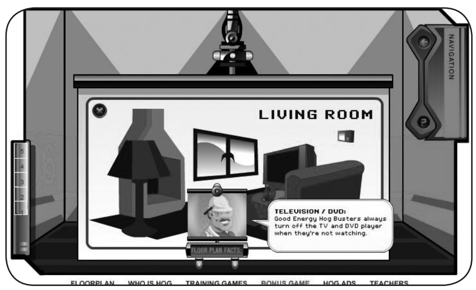
Utility customers are able to access energy usage information on a daily and hourly basis through an app. Learn how to get started with your participating provider.

www.energy.gov/data/green-button

Energy Efficiency and Renewable Energy (EERE)

EERE invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil.

www.energy.gov/eere/office-energy-efficiency-renewable-energy



Energy Hog

This interactive video game is full of sound effects, cartoon characters, and activities that teach students about energy efficiency.

www.energyhog.org

Energy Kid's Page

Energy Ant hosts this site containing energy facts, fun and games, classroom activities, and more.

www.eia.gov/kids

Find Your Efficiency Zone

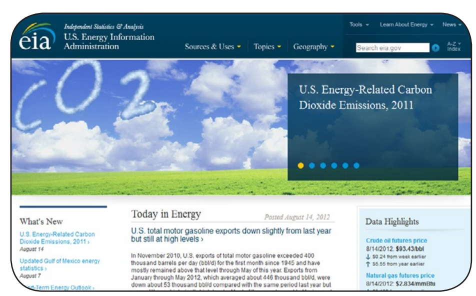
Based on the zip code entered, it will provide a comparison of the energy costs of an average home and an energy-efficient home in your area.

http://homeenergysaver.lbl.gov/consumer

Ask A Scientist

This online question-and-answer service for K-12 teachers and students was launched in 1991. Today Ask A Scientist is in several formats including YouTube™, AMA, and on Twitter.

www.anl.gov/education/learning-center/classroom-resources



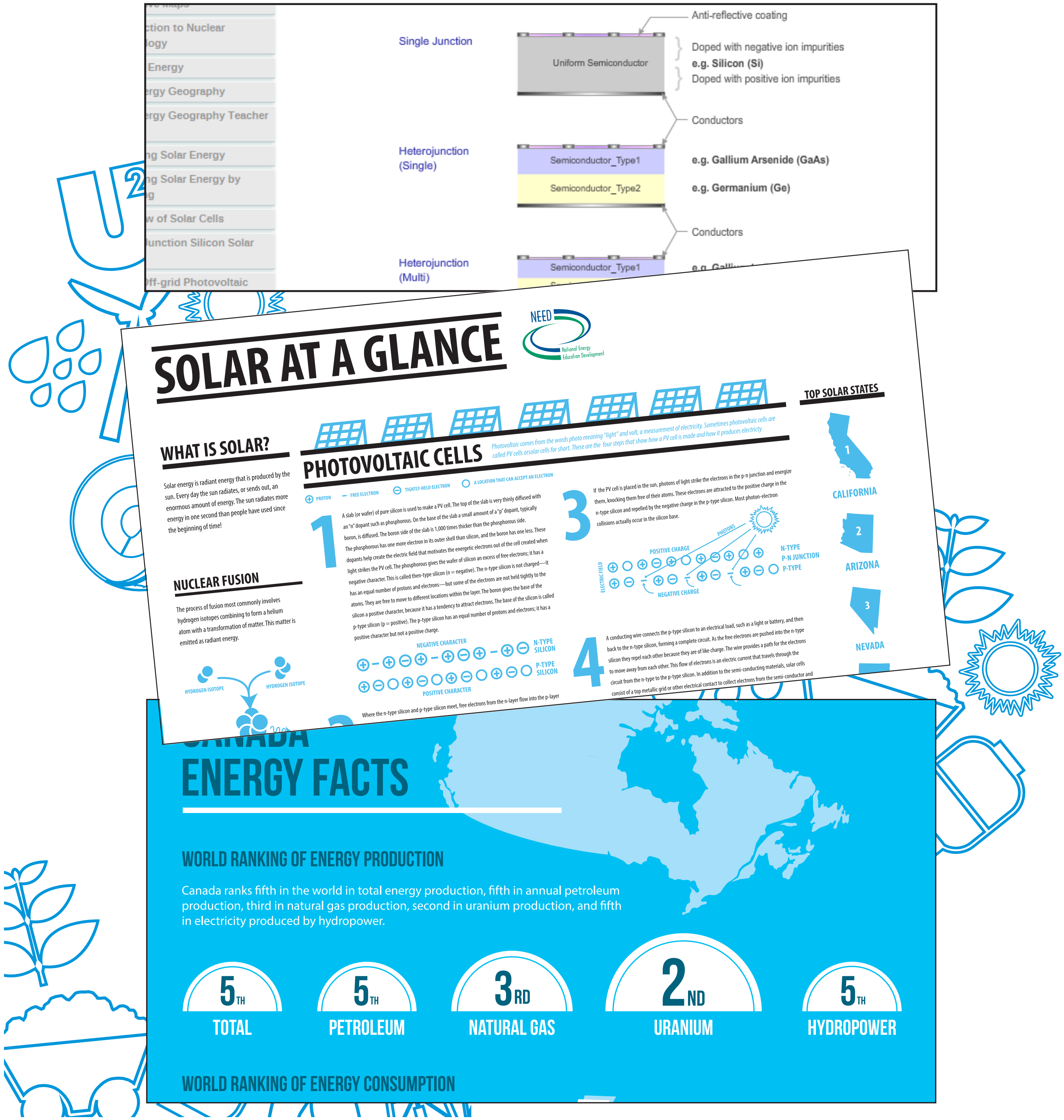
U.S. Energy Information Administration

The Energy Information Administration of the U.S. Department of Energy has up-to-date and historical information on energy consumption in many formats.

www.eia.gov

Looking For More Resources?

Our supplemental materials page contains PowerPoints, animations, and other great resources to compliment what you are teaching!
This page is available at www.NEED.org/educators.



Youth Awards Program for Energy Achievement

All NEED schools have outstanding classroom-based programs in which students learn about energy. Does your school have student leaders who extend these activities into their communities? To recognize outstanding achievement and reward student leadership, The NEED Project conducts the National Youth Awards Program for Energy Achievement.

This program combines academic competition with recognition to acknowledge everyone involved in NEED during the year—and to recognize those who achieve excellence in energy education in their schools and communities.

What's involved?

Students and teachers set goals and objectives, and keep a record of their activities. Students create a digital project to submit for judging. In April, digital projects should be uploaded to the online submission site.

Want more info? Check out **www.NEED.org/Youth-Awards** for more application and program information, previous winners, and photos of past events.

National Sponsors and Partners

Air Equipment Company
Albuquerque Public Schools
American Electric Power
Arizona Public Service
Armstrong Energy Corporation
Barnstable County, Massachusetts
Robert L. Bayless, Producer, LLC
BP America Inc.
Bellefonte Area School District
Blue Grass Energy
Boys and Girls Club of Palm Beach County
Cape Light Compact–Massachusetts
Central Falls School District
Chugach Electric Association, Inc.
Citgo
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ComEd
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David Petroleum Corporation
Desk and Derrick of Roswell, NM
Direct Energy
Dominion
Dominion Nuclear
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East Kentucky Power
Elba Liquifaction Company
E.M.G. Oil Properties
Encana Cares Foundation
Energy Future Holdings
Energy Market Authority – Singapore
Escambia County Public School Foundation
Eversource
Exelon Foundation
First Roswell Company
Foundation for Environmental Education
FPL
The Franklin Institute
Government of Thailand–Energy Ministry
Green Power EMC
Guilford County Schools – North Carolina
Gulf Power
Gerald Harrington, Geologist
Harvard Petroleum
Hawaii Energy
Houston Museum of Natural Science
Idaho National Laboratory
Illinois Clean Energy Community Foundation
Independent Petroleum Association of New Mexico
James Madison University
Kentucky Department of Energy Development and Independence
Kentucky Power – An AEP Company
Kentucky Utilities Company
Kinder Morgan
Leidos
Linn County Rural Electric Cooperative
Llano Land and Exploration
Louisville Gas and Electric Company
Massachusetts Division of Energy Resources
Mississippi Development Authority–Energy Division
Mojave Environmental Education Consortium
Mojave Unified School District
Montana Energy Education Council
The Mountain Institute
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NextEra Energy Resources
New Mexico Oil Corporation
New Mexico Landman's Association
Nicor Gas
Nisource Charitable Foundation
Noble Energy
Nolin Rural Electric Cooperative
Northern Rivers Family Services
North Carolina Department of Environmental Quality
North Shore Gas
NRG Energy, Inc.
NRG Battle of the Regions Donors
Offshore Technology Conference
Ohio Energy Project
Opterra Energy
Pacific Gas and Electric Company
PECO
Pecos Valley Energy Committee
Peoples Gas
Petroleum Equipment and Services Association
Phillips 66
PNM
Providence Public Schools
Read & Stevens, Inc.
Renewable Energy Alaska Project
Rhode Island Office of Energy Resources
Robert Armstrong
Roswell Geological Society
Salt River Project
Salt River Rural Electric Cooperative
Saudi Aramco
Schlumberger
C.T. Seaver Trust
Shell
Shell Chemicals
Sigora Solar
Society of Petroleum Engineers
Society of Petroleum Engineers – Middle East, North Africa and South Asia
Solar City
David Sorenson
Tennessee Department of Economic and Community Development–Energy Division
Tesoro Foundation
Tri-State Generation and Transmission
TXU Energy
United Way of Greater Philadelphia and Southern New Jersey
University of North Carolina
University of Tennessee
U.S. Department of Energy
U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy–Wind for Schools
U.S. Energy Information Administration
Yates Petroleum Corporation