

EPA ENERGY CONSERVATION

POLLUTION PREVENTION (P2) EDUCATION TOOLBOX
Tools for Helping Teachers Integrate P2 Concepts in the Classroom

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WHAT ARE THE USES OF ENERGY?

Energy is defined as "the ability to do work." In this sense, examples of work include moving something, lifting something, warming something, or lighting something. The following is an example of the transformation of different types of energy into heat and power.

Oil burns to make heat -->
Heat boils water -->
Water turns to steam -->
Steam pressure turns a turbine -->
Turbine turns an electric generator -->
Generator produces electricity -->
Electricity powers light bulbs -->
Light bulbs give off light and heat

It is difficult to imagine spending an entire day without using energy. We use energy to light our cities and homes, to power machinery in factories, cook our food, play music, and operate televisions. In a home where electricity supplies all of the energy requirements, the average energy consumption is shown below:

Air conditioner and heater	=	50%
Water heater	=	20%
Lighting and small appliances	=	10%
Refrigerator	=	8%
Other	=	5%
Ovens and stoves	=	4%
Clothes dryer	=	3%

Electricity is generated from both renewable and nonrenewable energy sources. These sources are defined below.

Renewable energy sources:

These sources are constantly renewed or restored and include wind (wind power), water (hydropower), sun (solar), vegetation (biomass), and internal heat of the earth (geothermal). About 9.0 percent of electricity in the U.S. is generated from renewable sources.

Nonrenewable energy sources:

These are natural resources that cannot be replenished (fossil fuels such as oil, gas, and coal). About 71.5 percent of electricity in the U.S. is generated from nonrenewable sources.

In addition to renewable and nonrenewable energy sources, about 19.5 percent of electric power in the U.S. is generated by nuclear power plants. However, operating such plants poses significant nuclear waste disposal problems; consequently, there are no current plans to build more. Most electricity in the United

States is generated by burning nonrenewable fossil fuels and there is a limited amount of these energy sources.

WHY IS ENERGY CONSERVATION IMPORTANT?

Because of the limited amount of nonrenewable energy sources on Earth, it is important to conserve our current supply or to use renewable sources so that our natural resources will be available for future generations.

Energy conservation is also important because consumption of nonrenewable sources impacts the environment. Specifically, our use of fossil fuels contributes to air and water pollution. For example, carbon dioxide is produced when oil, coal, and gas combust in power stations, heating systems, and car engines. Carbon dioxide in the atmosphere acts as a transparent blanket, that contributes to the global warming of the earth, or "greenhouse effect." It is possible that this warming trend could significantly alter our weather. Possible impacts include a threat to human health, environmental impacts such as rising sea levels that can damage coastal areas, and major changes in vegetation growth patterns that could cause some plant and animal species to become extinct.

Sulfur dioxide is also emitted into the air when coal is burned. The sulfur dioxide reacts with water and oxygen in the clouds to form precipitation known as "acid rain." Acid rain can kill fish and trees and damage limestone buildings and statues.

You can help solve these global problems. In the U.S., the average family's energy use generates over 11,200 pounds of air pollutants each year. Therefore, every unit (or kilowatt) of electricity conserved reduces the environmental impact of energy use.

HOW CAN POLLUTION PREVENTION HELP YOU?

The following four P2 concepts can help you evaluate your household energy use and identify ways to conserve energy. These concepts will significantly reduce a family utility bill and other energy costs over 1 year.

Changing What You Use

- ✓ Walk, ride a bicycle, or use mass transit instead of driving; automobile emissions account for about 60 percent of air pollution in our cities.
- ✓ Install compact fluorescent light bulbs that use less energy and last 10 times longer than incandescent light bulbs.
- ✓ Air-dry your clothes on a laundry line instead of using a clothes dryer.
- ✓ Install a programmable thermostat that automatically adjusts the temperature when you are in bed or away.
- ✓ Buy energy-efficient appliances. There are standard energy use tags attached to most new appliances that can help you determine which appliance will be the most efficient. These appliances may be more costly, but your utility bill savings will quickly make up for the extra cost.

Changing What You Do

- ✓ Set the thermostat to 68 °F in winter when you're home and down to 55° F when you go to bed or are away (programmable thermostats can do this automatically).

- ✓ Insulate the ceiling, walls, and floor of your home.
- ✓ Plant a tree next to a window for shade to reduce the need for air conditioning.
- ✓ Recycle items such as newspaper, aluminum cans, and plastic bottles; recycling these items requires less energy than producing them from brand new, raw materials.
- ✓ Wash clothes in cold water and only in full loads.
- ✓ Use energy-saving settings on washing machines, dishwashers, and clothes dryers.

Improving Your Housekeeping

- ✓ Turn down the water heater thermostat to 120° F.
- ✓ Turn off lights when leaving a room.
- ✓ Close heating vents and close doors to unused rooms.
- ✓ Close drapes and windows during sunny summer days and after sunset in cooler weather.
- ✓ Stop air leaks around windows and doors with caulk or weather stripping. Air leaks can rob your house of heat in the winter or make it too humid in the summer. As much as 40 percent of your heating and cooling costs can be due to air leaks.
- ✓ Clean or change air filters on your air heating system in the winter and on air conditioning units in the summer so that they work more efficiently.

Educating Yourself and Others

- ✓ Commonwealth Edison, Chicago's electric utility company, sends free information on how to evaluate energy efficiency in your house. To receive this home audit guide, call 1-800-334-7661.
- ✓ Share knowledge and ideas with family, friends, and neighbors.

LESSON PLAN

This lesson plan provides guidance and activities to help you meet the following goals:

- ✓ Define energy and its uses
- ✓ Explain renewable and nonrenewable energy sources
- ✓ Explain how P2 concepts can be used to conserve energy.

The preceding pages of the fact sheet contain background information and the definitions necessary to implement this lesson plan, which meets the requirements for the following Chicago Academic Standards and Frameworks: 6th grade -state goal 11 CAS A. CFS 4, state goal 12 CAS C., state goal 13 CAS B. CFS 1; 7th grade - state goal 12 CAS D. CFS 3 and CAS E. CFS 5, state goal 13 CAS B. CFS 2; 8th grade - state goal 12 CAS E. CFS 3, state goal 13 CAS A. CFS 7 and 9 and CAS B. CFS 2.

WHAT ARE THE USES OF ENERGY?

Begin the lesson by asking the students to define energy.

- ✓ Ask the students to name all of the activities they enjoy doing during the week. Could they do these activities without electricity?
- ✓ Point out that there are many types of energy and electricity is a common type that we use daily. Use the example of the transformation of energy into heat and power shown on the fact sheet.

Based on the information provided, explain renewable and nonrenewable energy sources.

- ✓ Describe the sources from which energy can be derived, such as the sun, wind, water, vegetation, and internal heat of the earth (renewable sources), and fossil fuels (nonrenewable sources).
- ✓ Emphasize that nonrenewable sources are finite, which means there is a limited supply of these sources on earth. Explain that currently, the United States uses mostly nonrenewable energy sources.
- ✓ Explain that electricity is also generated from nuclear energy, but nuclear power plants are no longer being built because of the environmental threats from disposing of nuclear waste.

Activity No. 1 - Sources of Energy

Objective: Students will survey, research, and report on how fossil fuels impact the environment.

Time Length: About 45 minutes if the teacher brings in resource books; about 90 minutes if students need to go to the library to obtain resources

Materials: Paper and pencil for each student and encyclopedias and resource books on energy sources

Activity:

- ✓ Have the students imagine that all electricity in their community comes from only one source and that because of an increase in population in their neighborhood, demand for electricity is growing.
- ✓ Divide the class into groups and assign each group a different energy source: wind power, hydropower, solar power biomass, geothermal, oil, gas, coal and nuclear power.

- ✓ Instruct the students to research their energy source using the encyclopedia and resource books available in class or at the library.
- ✓ Have each group find out how the energy source is supplied, its costs relative to other sources, and the advantages and disadvantages of using the source.
- ✓ Have each group discuss their findings with the class. The class as a whole should find the best new energy source to use in their community.

WHY IS ENERGY CONSERVATION IMPORTANT?

Energy conservation helps endure resources for the future and also helps prevent pollution.

- ✓ Explain that if we continue to consume nonrenewable sources at an increasing rate, these sources will be depleted.
- ✓ Explain that not only are we depleting our nonrenewable sources, but that use of fossil fuels has negative environmental impacts, such as global warming and acid rain.

Activity No. 2 - The Greenhouse Effect

Objective: Students should understand how gases such as carbon dioxide can get trapped in the atmosphere, contributing to the "greenhouse effect."

Time Length: About 10 minutes to set up; start the activity at the beginning of class because the experiment must sit for 30 minutes, followed by about 10 minutes of discussion

Materials Needed: Two thermometers, two plastic bags (one large and one small), and twist ties

Activity:

- ✓ Lay one thermometer inside the small bag.
- ✓ Inflate the bag by blowing into it, then close the end with the twist tie.
- ✓ Put the inflated bag inside the larger plastic bag.
- ✓ Inflate the large bag with air and close the end with the twist tie.
- ✓ Place the bag in direct sunlight, and lay the second thermometer next to the bag.
- ✓ Observe the temperature reading of both thermometers after 30 minutes.
- ✓ Explain to the students that the temperature reading inside the bag should be higher because the double layer of air inside the bag acts as a greenhouse, just like the atmosphere around the earth.
- ✓ Explain to the students that both layers of air allow radiant energy from the sun to enter, and this radiation energy is absorbed and trapped when it is reflected back from the earth. As a result, the temperature near the earth increases, as it does in a greenhouse. Similarly, in this demonstration, when sunlight enters the outer bag (or the earth's atmosphere), the inner bag (or gases in the atmosphere such as carbon dioxide) absorbs and reradiates the heat back toward the thermometer (or earth), thereby raising the temperature. This situation represents global warming.
- ✓ Emphasize to the students that as more gases are released into the atmosphere through the use of fossil fuels, the more heat is absorbed and trapped in our atmosphere.

- ✓ Have the students think of the negative effects of global warming. Examples include droughts in continental interiors that can destroy crops, extreme climatic events such as hurricanes and floods, rising sea levels because of melting glaciers, and species loss due to changing vegetation growth patterns.

HOW CAN POLLUTION PREVENTION HELP YOU?

Based on information provided, discuss how the four P2 concepts described earlier can be used to conserve energy thereby reducing air and water pollution.

- ✓ Ask students to think of alternatives to using energy and actions to conserve energy.
- ✓ Emphasize that renewable sources do not contribute to air pollution.

Activity No. 3 - Household Appliance Energy Quiz

Objectives: Students should understand how energy is used by common household appliances and which appliances use the most energy, and develop ideas to conserve energy

Time Length: About 25 minutes

Materials Needed: One Copy of the attached "Household Appliance Energy Quiz," and a pencil for each student

Activity:

- ✓ Ask students to name all of the household appliances they have at home that they believe consume energy.
- ✓ Distribute the "Household Appliance Energy Quiz" and allow students 10 minutes to rank common household appliances by the amount of energy they use.
- ✓ Have students match each common household appliance with the letter in the right column of the quiz that best describes how the appliance uses energy.
- ✓ Provide the answers to the students and ask students if the ranking is affected by method of energy use.
- ✓ Discuss how energy is used by appliances mentioned by the students at the beginning of the activity, not covered by the quiz. Examples include a clock and VCR.
- ✓ Ask the students which appliances they could live comfortably without and alternatives to using the appliances listed and named earlier by the students.
- ✓ Discuss conservation methods. Examples include reducing appliance use whenever possible, using appliances appropriate to the size of the job, keeping thermostats and refrigerators out of direct sunlight, and maintaining appliances.

METHOD OF EVALUATION/ASSIGNMENT

Have students write the following questions in their journals:

- ✓ How is energy used in your home?
- ✓ Are you using the conservation ideas discussed during class?
- ✓ What alternatives and energy conservation actions can you practice at home to save money?

Using these questions, students should conduct a "home energy audit" with their families and write the results in their journals.

ATTACHMENT 1

HOUSEHOLD APPLIANCE ENERGY QUIZ

Below is a list of common household appliances. Rank the appliances from 1 (lowest) to 10 (highest) according to the amount of energy you think they use. For example, if you think the refrigerator uses the most energy, rank it 10.

Next, figure out how each household appliance uses energy by filling in letters in the column "What Am I" for each appliance from the letters in the column "How Do I Use Energy?"

	Ranking:	What Am I?	How Do I Use Energy?
Television			A. I use energy to spin and keep you cool.
Stereo			B. Even though I am always plugged into an outlet, energy is consumed only when I am turned on to heat food.
Refrigerator			C. I use energy to produce pictures on a screen.
Washing machine			D. I use energy to rinse and spin.
Water heater			E. I use energy when I am plugged in and turned to a certain temperature.
Range top (stove)			F. I use a large amount of energy derived from electricity or gas to cook food.
Ceiling fan			G. I use energy to receive radio waves in your home.
Toaster			H. I use a lot of energy because I am always cooling and freezing.
Iron			I. I use a large amount of energy so that you can take warm showers and have hot water.
Microwave			J. I use energy to heat coils that cook your food.

ATTACHMENT 2

HOUSEHOLD APPLIANCE ENERGY QUIZ

(Answer Key)

Below is a list of common household appliances. Rank the appliances from 1 (lowest) to 10 (highest) according to the amount of energy you think they use. For example, if you think the refrigerator uses the most energy, rank it 10.

Next, figure out how each household appliance uses energy by filling in letters in the column "What Am I" for each appliance from the letters in the column "How Do I Use Energy?"

	Ranking:	What Am I?	How Do I Use Energy?
Television	3	C	A. I use energy to spin and keep you cool.
Stereo	1	G	B. Even though I am always plugged into an outlet, energy is consumed only when I am turned on to heat food.
Refrigerator	8	H	C. I use energy to produce pictures on a screen.
Washing machine	4	D	D. I use energy to rinse and spin.
Water heater	10	I	E. I use energy when I am plugged in and turned to a certain temperature.
Range top (stove)	9	F	F. I use a large amount of energy derived from electricity or gas to cook food.
Ceiling fan	2	A	G. I use energy to receive radio waves in your home.
Toaster	7	J	H. I use a lot of energy because I am always cooling and freezing.
Iron	5	E	I. I use a large amount of energy so that you can take warm showers and have hot water.
Microwave	6	B	J. I use energy to heat coils that cook your food.