UNIT OVERVIEW

We live in an energy-hungry culture. People's demand for electricity and fuel taxes Earth's supply of nonrenewable resources and forces us to find and use renewable and alternative sources. The Energy Resources unit acquaints students with the types of energy that people rely on and how these resources are generated and used. Various energy resources are compared: crude oil, coal, natural gas, nuclear power, biomass, solar, wind, hydroelectric, geothermal, and tidal power. Students will learn that there are benefits and drawbacks to using each resource.

Certain reading resources are provided at three reading levels within the unit to support differentiated instruction. Other resources are provided as a set, with different titles offered at each reading level. Dots on student resources indicate the reading level as follows:

- low reading level
- middle reading level
- high reading level

THE BIG IDEA

We use energy in everything we do. This reliance comes at a cost. Since the Industrial Revolution, people have burned increasingly larger amounts of fossil fuels to meet growing energy needs. While inexpensive and seemingly plentiful, coal and oil cause pollution and add to the problem of global warming. Today, these nonrenewable resources are in dwindling supply, especially oil. Other resources have shown promise, but each one also has drawbacks. Comparing and contrasting the costs versus the benefits of various energy resources helps people make personal, local, national, and global decisions about the use of those energy resources.

Other topics

This unit also addresses topics such as: using solar energy for cooking, fission versus fusion, and the harmful effects that oil spills have on the environment.

SPARK

The spark is designed to get students thinking about the unit's topics and to generate curiosity and discussion.

Materials

- computers with Internet access
- calculators (recommended)
- paper and pencils

Activity

Students may have heard that it's good to conserve electricity and other forms of energy, but they may not know why this is so. Ask students whether they know how much electricity they actually use and how their usage compares to the national average.

Demonstrate for students how to calculate one person's household energy consumption for a year. First, search the Internet for typical wattages of common appliances. For example, a dishwasher uses around 1200 watts.

Then use the recommended formula for calculating electricity usage:

wattage × hours used per day ÷ 1000 = daily kilowatt-hour (kWh) usage

Ask student volunteers to estimate the number of hours they use each device per day, week, or month, and then multiply accordingly (by 365, 52, or 12) to get the annual usage. Students may select an average or midrange wattage when a range is provided. Invite different students to reply for each device. Continue until the class has discussed all major devices. Compile these results into a displayed class list. Below is an example for a personal computer (laptop) that is used 3 hours per day.

50 watts/hour × 3 hours/day ÷ 1000 = 0.15 kWh per day

0.15 kWh per day × 365 days = 54.75 kWh per year

Once the class has calculated the annual usage for each device, have students add together all these usage figures to arrive at an annual total. Remind them that the list represents just one individual's annual usage.

To figure out the annual cost of using all these devices, multiply the total usage by the cost per kWh. Use the national (U.S.) average of 8.5 cents/kWh, or convert for local currency. Divide the total (which is in cents) by 100 to get the figure in dollars. Have students compare the resulting annual electricity usage and cost with the U.S. average of 11,040 kWh at a cost of about $938.

Below are questions to guide discussion.

If you had to pay for your yearly electricity use yourself, how would you do it? Would you try to get more money or try to reduce your usage?

How much electricity do you estimate is used each year by your whole household?

Where does the electricity you use come from? How does it get to your home or school?

What resources are used to produce electricity?

Use this activity to begin an introductory discussion about energy resources. Explain that all the energy students use comes at a cost, whether in terms of money, environmental impact, or even safety. Understanding how much electricity they use in a year may help students make judgments about their energy usage. Throughout the unit, students will learn more about energy resources.

Many of the unit's vocabulary terms are related to the spark activity and can be introduced during the spark. For vocabulary work, see the Vocabulary section in this *Unit Guide*.

PRIOR KNOWLEDGE

Invite students to explain their understanding of energy and where the power comes from to run our vehicles, machines, and gadgets.

Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about energy resources.

- What form of energy do you use most?
- Energy resources fall into two main categories. Can you name them?
- What do the terms *nonrenewable resources* and *renewable resources* mean? What are some examples of each?
- Why are coal, oil, and natural gas called *fossil fuels?*
- What might be some drawbacks to burning fossil fuels?
- What are some forms of energy that may be important in the future?
- What might be some drawbacks to using alternative energy resources?
- What would happen if we ran out of all energy resources? Could that ever happen?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

Resources are available for printing or projecting, and many student resources are also available for students to access digitally on Kids A–Z.

Selected unit resources are available in more than one language.

For a complete list of materials provided with the unit, see the Energy Resources unit page on the Science A–Z website.

VOCABULARY

Use the terms below for vocabulary development throughout the unit. They can be found in boldface in the *Nonfiction Book*, the *Quick Reads*, and/or other unit resources. These terms and definitions are available on *Vocabulary Cards* for student practice. Additional vocabulary lists are provided in the teaching tips for *Investigation Packs* and *FOCUS Books*.

Core Science Terms

These terms are crucial to understanding the unit.

biomass	organic matter from present-day living things—such as wood, garbage, or plant parts—that is used as an energy source
coal	a dark-colored rock made of prehistoric plant and animal remains that is burned as a fuel
conserve	to prevent something important from being wasted, overused, or harmed
crude oil	a liquid found under Earth's surface that is used to make fuels and many other products; also called petroleum
electricity	energy created by moving charged particles
energy resource	a supply of something that can be used by people to do work and to provide power
energy	the power to do work, make a change, or move objects
fossil fuel	an energy source—such as coal, oil, or natural gas—formed from living things that died long ago and changed while in the ground
generator	a machine that turns motion into electricity
geothermal energy	heat from inside Earth, which can be used as a power source
hydroelectric power	electricity produced when moving water turns turbines that are connected to generators
natural gas	an odorless, colorless, clean-burning fossil fuel
nonrenewable resource	a supply of something that cannot be replaced after it has been used
nuclear energy	energy that is released when atoms, usually those of radioactive materials, are split or joined
renewable resource	a supply of something that can be replaced and is not depleted after it has been used
solar energy	the energy of the Sun, which can be used as a power source
wind energy	the energy of moving air, which can be used as a power source

Other Key Science Terms

The following vocabulary is not essential for comprehending the unit but may enrich students' vocabulary.

atom	the smallest unit of a chemical element, made up of protons, neutrons, and electrons
biofuel	any fuel that comes directly from organic matter found in present-day living things
electron	a particle that is part of an atom and orbits the nucleus; it has a negative electrical charge
global warming	an increase in the average temperature of Earth's atmosphere and oceans, especially one great enough to change the climate
greenhouse effect	the process by which heat is trapped inside Earth's atmosphere by gases
helium	the second lightest chemical element, often occurring as a gas
hydrogen	the lightest chemical element, often occurring as a gas; the gas commonly used in fuel cells
methane	an odorless, colorless, flammable gas; also called natural gas
neutron	a particle in the nucleus of an atom; it has no electrical charge
nuclear fission	a process by which the nuclei of atoms are split apart to create energy
nuclear fusion	a process by which the nuclei of atoms are joined together to create energy
nucleus	the positively charged center of an atom, consisting of protons and neutrons and containing most of the atom's mass; (plural: nuclei)
oil spill	the accidental release of crude oil into the environment
pollution	harmful substances put into the air, water, or soil
proton	a particle that is part of the nucleus of an atom; it has a positive electrical charge
tanker	an air, water, or land vessel that carries large amounts of a liquid, especially crude oil
turbine	a fan-shaped machine that captures the motion of water, wind, or steam to create an electric current

Vocabulary Activities

You may choose to introduce all the terms that will be encountered in the unit before assigning any of the reading components. *Vocabulary Cards* with the key science terms and definitions are provided. Dots on the cards indicate the reading levels of the *Nonfiction Book* or the *Quick Reads* in which each term can be found. If all level dots appear, the term may come from another resource in the unit. Students can use these cards to review and practice the terms in small groups or pairs. The cards can also be used for center activity games such as Concentration.

The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see Vocabulary A-Z.

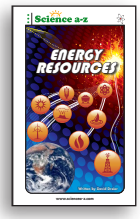
Students can use the *Word Smart* vocabulary *Graphic Organizer* to organize information on the science terms. You may want to assign each student one to three words to share his or her *Word Smart* knowledge with classmates. Students who have the same word should first compare their *Word Smart* sheets with each other and then report to the larger group.

The science terms can be used in oral practice. Have students use each term in a spoken sentence.

As students read, encourage them to create a science dictionary by recording new vocabulary terms and definitions in their *SAZ Journal*.

BACKGROUND AND MISCONCEPTIONS

Use this section as a resource for more background knowledge on unit content and to clarify the content for students if misconceptions arise. Refer to Using the Internet below for more ways to extend the learning.



Q: *Isn't energy something in a body that helps it grow or move?*

A: Yes, but it is more than that. A body does require energy from food to live, move, and grow. This kind of energy, which is chemical energy, comes from the breakdown of nutrients inside the body. But energy can come from many other sources, too, and can be used to power things besides humans and other animals. Energy is a characteristic of matter that makes it possible to do work (move things). An important law of physics is the conservation of energy, which explains that energy can't be created or destroyed but can only be converted from one form to another. For example, coal contains chemical energy that gets converted into mechanical energy and heat when it is burned in a power plant, making electrical energy. In this unit, the focus is on energy sources other than consumable chemical energy.

Q: *Isn't energy used up or lost once the fuel is gone?*

A: No. Fuel may run out, but the energy it provides is never really lost. Once again, energy gets converted from one form into another. Energy can also be stored for later use. In the case of a car, stored gasoline (chemical energy) is burned and converted into mechanical energy. Burning gas to move the car (motion energy) gives off heat, another form of energy, which goes into the air. Energy is often on the move, but it is never lost. (Students may draw a comparison to water in the water cycle.)

Q: *How can conserving electricity help reduce the use of fossil fuels?*

A: Students may think that electricity starts and stops with the flick of a switch. But a lot had to happen before electricity could reach that switch. In order to generate electricity, fuel (usually coal) is often burned to create steam to move the turbines, magnets, and coils that generate the flow of electric current. Then that current must travel from the generating source to the end user. Whether coal, solar energy, nuclear fission, or moving water provides the power, some sort of resource was needed to crank turbines before those lights could be turned on or that video game would work. So conserving electricity means there is a smaller demand for the resources (often fossil fuels) needed to produce that electricity. When many people conserve even a little energy, it can preserve nonrenewable resources and reduce pollution.

Q: *If fossil fuels have so many drawbacks, why have people used them for so long?*

A: Fossils fuels were abundant and quite inexpensive when they first became widely used. They can be found in most parts of the world and are generally less expensive to obtain than newer, alternative sources. It has only been through scientific research and public education that people have begun to reduce their use of fossil fuels because of the drawbacks, especially air pollution and global warming. At the same time, some individuals and organizations minimize or refute concerns about fossil fuels. Around the world, people must weigh many important factors when choosing which energy resources to use. Cost and protection of existing jobs sometimes win out over concerns about the drawbacks, such as environmental impact and dwindling supplies.

Q: *How can experts say the oil supplies will run out in 40 years? Isn't there a large amount of oil that hasn't been tapped?*

A: The world does have large, untapped oil deposits, but even if people were to find them, that oil would eventually run out, too. To plan for the long term, we will most likely need to find alternative energy resources.

Q: *Are all renewable resources good?*

A: Every renewable resource has drawbacks, just as do nonrenewable ones. As addressed in the *Nonfiction Book Energy Resources*, even resources in limitless supply—such as sunlight and wind—aren't always available. They may also require large areas of land or ocean surface. Some renewable resources, such as wood and biofuels, do cause pollution, albeit less than from burning fossil fuels. In some cases, using new resources would require changes to the existing infrastructure that we use to deliver energy. And some emerging sources—such as nuclear power—present concerns over accidents and safe storage. The biggest barrier of all may be that technologies to harness alternative energy sources are often costly. But experts are addressing all these drawbacks to make alternative energy resources more appealing options.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when the term *energy* or *energy resources* is entered. You can also search for individual types of energy resources, such as natural gas or solar energy. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- renewable and nonrenewable energy resources
- fossil fuels vs. alternative energy sources
- nuclear fission and fusion (or nuclear power generation)
- biomass/biofuels
- solar panel diagram
- future energy sources
- wind farm maps
- hydrogen fuel cells
- How does a power plant work?
- conserving energy

Projects and Activities

- **Project/Community Service:** Challenge students to develop an energy conservation program for your school. They should research ways to save energy and promote them through posters, flyers, school Web or newspaper articles, daily announcements, and other means. Consider setting a goal to achieve, such as X fewer kilowatt-hours of electricity used, to help students monitor how their program is working.
- **Math:** Ask students to produce a graph that shows the local usage of renewable resources compared to nonrenewable resources. Help students conduct research to find out what percentage of overall usage each resource comprises. Then have them use that data to make a pie chart or bar graph.

- **Arts:** Ask students to write a song, prepare a skit, or design a mural in which they compare and contrast various energy resources. The pro-con charts in the *Nonfiction Book Energy Resources* might help students organize their thoughts before creating their presentation.
- **Inquiry Science:** Have students work in groups to learn more about and become experts on one alternative or future energy resource. Ask them to prepare a report to share with the class. Provide research time in the library/media center and online.
- **Literature:** Recommended titles include: *Energy in Crisis* by Catherine Chambers, *Energy Sources: The Impact of Science and Technology* by Rob Bowden, and *Renewable Energy: Sources and Methods* by Anne Maczulak.
- **Writing/Research:** Ask students to report on a newspaper or online news story, or a news item on television or radio, related to energy resources. Have them explain how the story relates to what they learned in this unit. For extensive writing resources, visit Writing A-Z.
- **Guest:** Invite a speaker from a power plant or other utility to talk to the class about how power is generated and distributed.
- **Field Trip:** Visit a power plant or other utility to see firsthand how generating and delivering energy works.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.