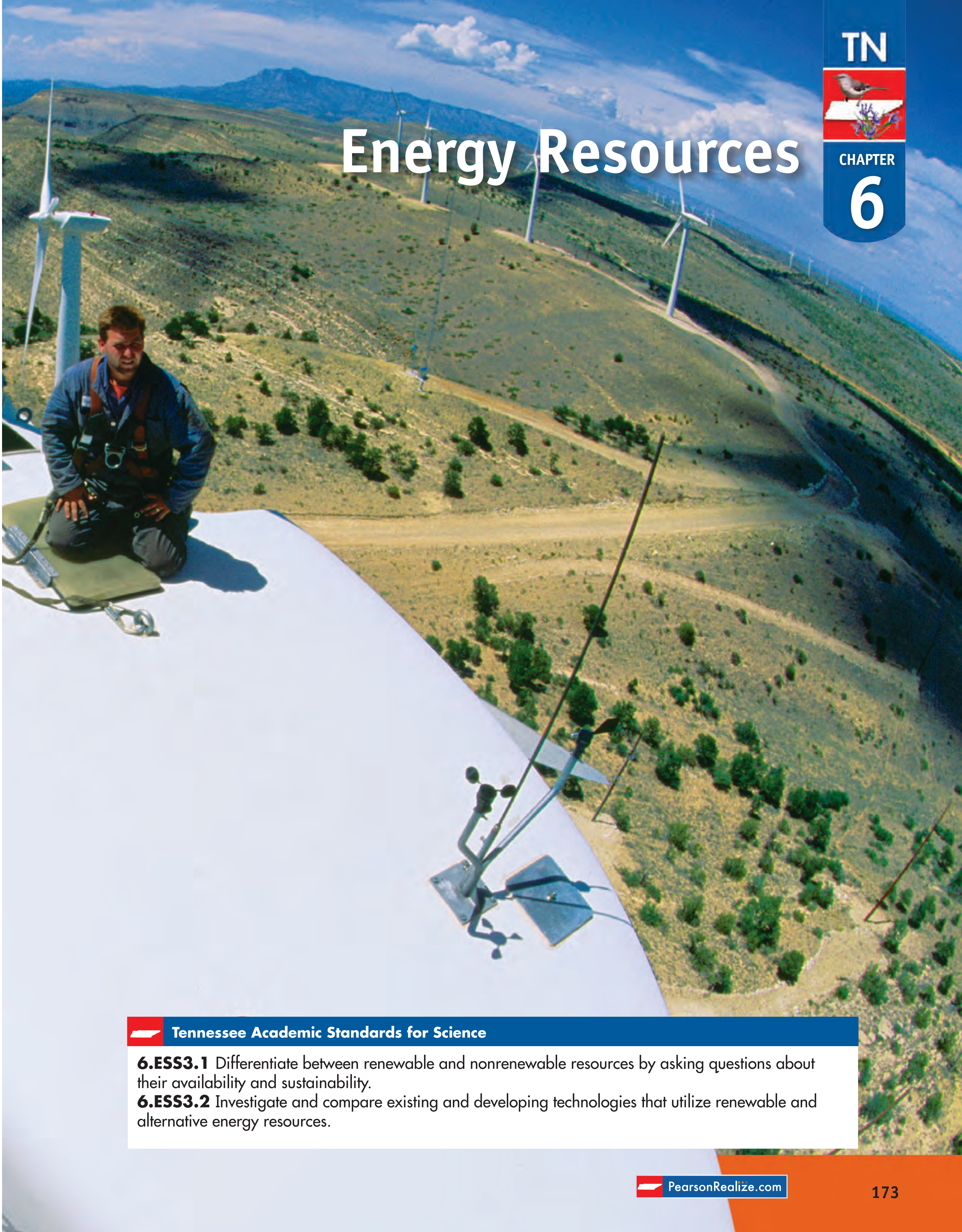
HOW CAN WIND KEEP YOUR LIGHTS ON?

What are some of Earth's energy sources?

This man is repairing a wind turbine at a wind farm in Texas. Most wind turbines are at least 30 meters off the ground where the winds are fast. Wind speed and blade length help determine the best way to capture the wind and turn it into power. Develop Hypotheses **Why do you think people are working to increase the amount of power we get from wind?**

Watch the **Untamed Science** video to learn more about energy resources.



TN

CHAPTER 6

Energy Resources

Tennessee Academic Standards for Science

6.ESS3.1 Differentiate between renewable and nonrenewable resources by asking questions about their availability and sustainability.
6.ESS3.2 Investigate and compare existing and developing technologies that utilize renewable and alternative energy resources.

CHAPTER 6

Getting Started

Check Your Understanding

1. **Background** Read the paragraph below and then answer the question.

Aisha loves visiting her grandmother at work. Her grandmother says that the building she works in was designed to help conserve **natural resources.** Most of the building's electricity comes from **renewable resources,** such as sunlight and wind, instead of from **nonrenewable resources,** such as oil or coal.

A **natural resource** is any material that occurs naturally in the environment and is used by people.

A **renewable resource** is either always available or is naturally replaced in a short time.

A **nonrenewable resource** is a resource that is not replaced within a useful time frame.

- What is one example of a natural resource?

____

____

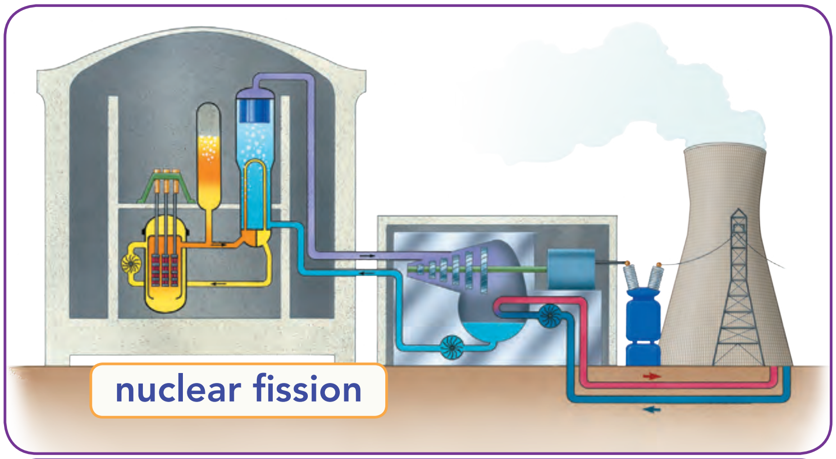
Vocabulary Skill

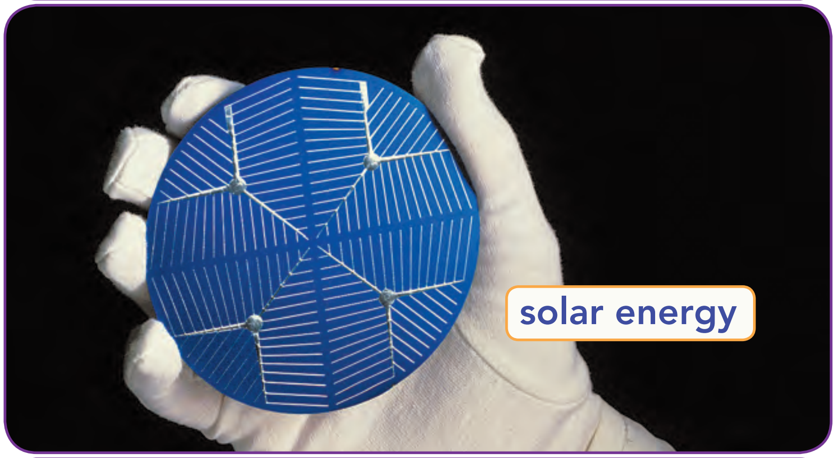
High-Use Academic Words High-use academic words are words that are used frequently in classrooms. Look for the words below as you read this chapter.

Word	Definition	Example
scarce	*adj.* rare; in limited supply	Tickets for the concert are becoming *scarce* because of the demand.
emit	*v.* to give off	When the oven is on, it *emits* heat, making the whole apartment warmer.

2. **Quick Check Choose the word from the table above that best completes each sentence.**

- Motor vehicles ______________ chemicals that contribute to air pollution.
- As people continue to use oil faster than it can be replaced, it will become ____________.





Chapter Preview

LESSON 1

- solar energy
- hydroelectric power
- biomass fuel
- gasohol
- geothermal energy
- nuclear fission
- reactor vessel
- fuel rod
- control rod

Relate Cause and Effect

Infer

LESSON 2

- efficiency
- insulation
- energy conservation

Identify the Main Idea

Observe

CCC: Cause and Effect

Scenario Investigation

Light Bulbs Can't Use Much Energy

SEP: Using Mathematics and Computational Thinking

Purpose To calculate the energy consumption of household light bulbs

Materials
- calculator
- index card (one for each student)

Scenario

Your mother is always getting on your case about something. If your shower lasts more than two minutes, she tells you to stop wasting water. If you leave the lights on in a room, she accuses you of wasting electricity. You defend yourself as best you can, but you wonder how much it really costs to leave the lights on. It can't cost very much, can it?

Believe it or not, incandescent light bulbs use a lot of energy. A single 100-watt bulb left on 24 hours a day for a whole year would cost about $100.00 to operate. That seems like too much, doesn't it? The average cost of electricity in the United States is $0.113 per kilowatt hour (kWh). See for yourself:

$$100 \text{ watts} \times \frac{24 \text{ hours}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} = \frac{876{,}000 \text{ watt-hours}}{\text{year}}$$

$$\frac{876{,}000 \text{ watt-hours}}{\text{year}} \times \frac{1 \text{ kWh}}{1000 \text{ watt-hours}} = \frac{876 \text{ kWh}}{\text{year}}$$

$$\frac{\$0.113}{\text{kWh}} \times \frac{876 \text{ kWh}}{\text{year}} = \$98.99/\text{year}$$

Today your science teacher issued a challenge: Count the number of incandescent light bulbs in your home and determine the total cost of leaving all the light bulbs on for one year.

Procedure

1. Counting Your Bulbs Use the chart below to record the number of incandescent light bulbs used in your home. Keep track of how many bulbs are of each wattage (the number should be on the light bulb).

Watts	Total Bulbs	Total Watts
25		
40		
60		
75		
100		
150		
Total		

Why Compact Fluorescent Bulbs?

Incandescent bulbs produce light by passing electricity through a thin filament. The filament is heated until it glows. Fluorescent bulbs (CFLs) use electricity to excite the atoms of mercury vapor that fill the tube. The excited mercury atoms cause the phosphorus coating on the inside of the CFL to give off visible light.

Fluorescent bulbs convert more of the electricity into visible light and less into heat. A fluorescent bulb can produce the same amount of light as an incandescent bulb for about half the cost.

Procedure *(continued)*

☐ **2. The Totals** Multiply the number of bulbs by the number of watts for each size bulb. Next, add the total number of watts of all bulbs in your home. Record your results in the table.

☐ **3. Kilowatt Hours** Now calculate the number of kilowatt-hours your light bulbs could possibly use in a year.

First multiply the total number of watts from your chart by 24 hours: ________________

Multiply this number by 365 days: ________________

Divide this number by 1,000: ________________ kWh in a year

☐ **4. Lighting 24/7** To determine what it would cost to have all of your lights burning 24 hours a day, seven days a week, for an entire year, you need to make one more calculation. Multiply the final number from Step 3 by the cost of a kilowatt hour in your

community. (Your teacher will tell you that number.) ____________________________

Conclusion

Let's see what you learned about the cost of operating incandescent light bulbs.

☐ **1.** How much would it cost to leave your incandescent lights on 24/7?

☐ **2.** How do incandescent and fluorescent light bulbs transform electrical energy into light energy?

____

____

☐ **3.** Why are fluorescent bulbs cheaper to operate?

____

____

The news anchor at your local TV station wants you to explain your findings on the evening news. Prepare an index card with your answers to the following questions:

- How many incandescent light bulbs do you use in your home?
- What is the wattage of the highest-wattage bulb?
- Do you have any compact fluorescent bulbs? If so, how many?
- How many kilowatts would your light bulbs draw per hour if they were all turned on?
- What would it cost to leave all of your incandescent lights on 24/7 for a whole year?

Since the news anchor wants more than one-word answers, try to think of ways to expand your answers. (For example, for the first question, you could also tell how many bulbs you have of each size.) Write your answers in complete sentences.

TN

LESSON 1

6.ESS3.1, 6.ESS3.2

Renewable Sources of Energy

UNLOCK THE BIG ?

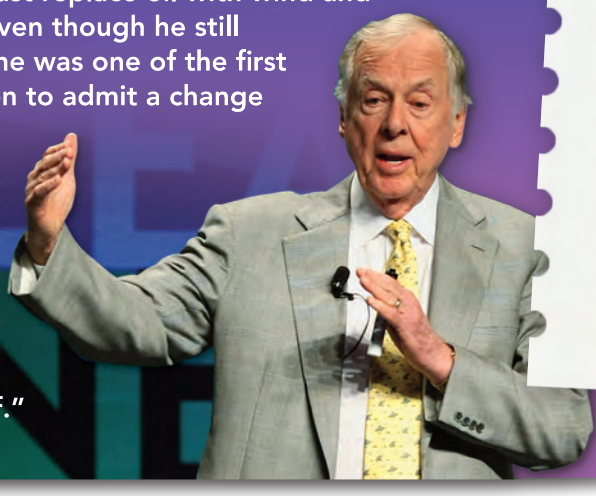
- What Are Some Renewable Sources of Energy?
- How Does a Nuclear Power Plant Produce Electricity?

my planet Diary

BIOGRAPHY

An Unlikely Decision

T. Boone Pickens's family taught him the value of hard work during the Great Depression of the 1930s. At 11, he delivered newspapers. By 26, he founded his own oil and gas company and became rich. In 2007, T. Boone Pickens surprised everyone by announcing plans to build the world's largest wind farm. He insisted the country must replace oil with wind and solar power. Even though he still promotes oil, he was one of the first oil businessmen to admit a change was needed. "I've been an oil man all my life," Pickens said, "but this is one emergency we can't drill our way out of."



Communicate Discuss these questions with a group of classmates. Write your answers below.

1. Why do you think Pickens's decision was so surprising?

____

____

2. Do you think more focus should be put on finding sources of energy other than oil? Why or why not?

____

____

Lab zone® Do the Inquiry Warm-Up Can You Capture Solar Energy?

What Are Some Renewable Sources of Energy?

Coal, oil, and natural gas are not the only energy options available on Earth. **Renewable sources of energy include sunlight, water, wind, biomass fuels, and geothermal energy.** Other energy options include nuclear power and hydrogen. Scientists are trying to put these energy resources to work.

Vocabulary

- solar energy
- hydroelectric power
- biomass fuel
- gasohol
- geothermal energy
- nuclear fission
- reactor vessel
- fuel rod
- control rod

Skills

- Reading: Relate Cause and Effect
- Inquiry: Infer

Solar Energy The warmth you feel on a sunny day is **solar energy,** or energy from the sun. The sun constantly gives off energy in the forms of light and heat. Solar energy is the source, directly or indirectly, of most other renewable energy resources. In one hour, Earth receives enough solar energy to meet the energy needs of the world for an entire year. Solar energy does not cause pollution. It will not run out for billions of years.

So why hasn't solar energy replaced energy from fossil fuels? One reason is that solar energy is only available when the sun is shining. Another problem is that the energy Earth receives from the sun is very spread out. To obtain a useful amount of power, it is necessary to collect solar energy from a large area.

Solar Power Plants One way to capture the sun's energy involves using giant mirrors. In a solar power plant, rows of mirrors focus the sun's rays to heat a tank of water. The water boils. This creates steam. The steam can then be used to generate electricity.

Solar Cells Solar energy can be converted directly into electricity in a solar cell. When light hits the cell, an electric current is produced. Solar cells power some calculators, lights, and other small devices.

Relate Cause and Effect Underline one way solar energy is collected and circle the way it is used.

did you know?

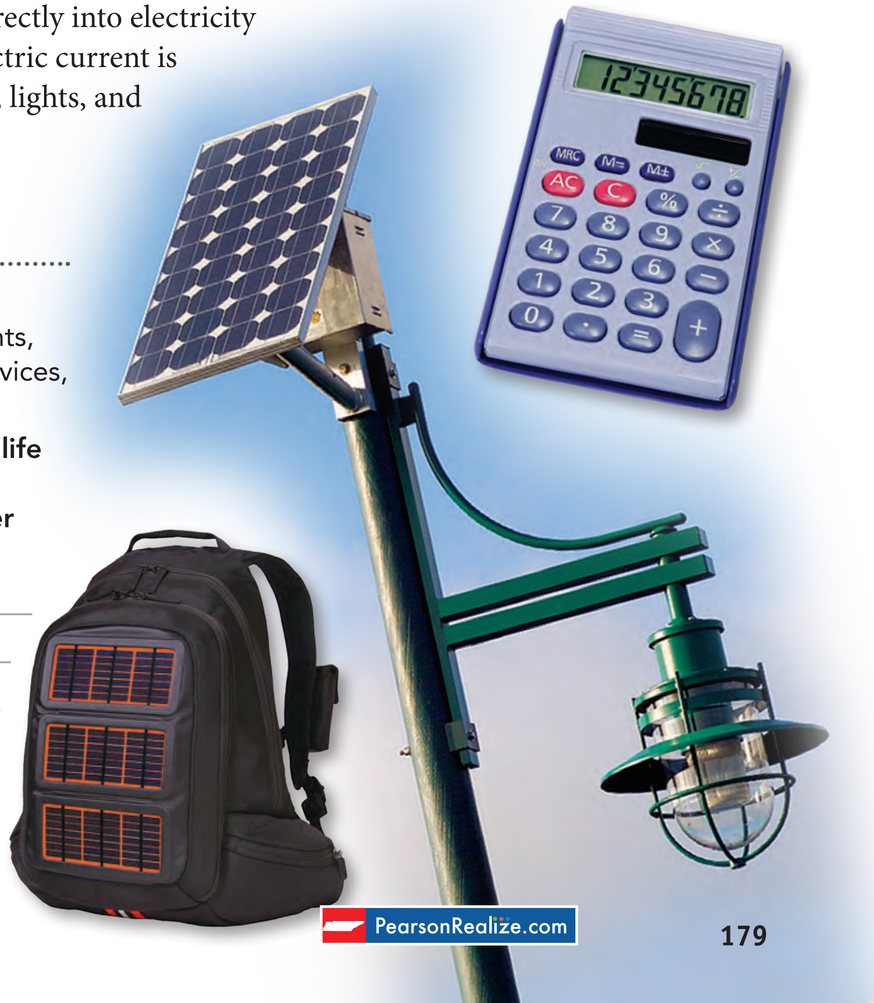
Photovoltaic cells, or solar cells, are named for the Greek word for light, *photo,* and electricity pioneer Alessandro Volta.

FIGURE 1

Everyday Solar Power

Many objects, including calculators, street lights, and even backpacks that charge electronic devices, can be powered by the sun.

Describe **What object in your everyday life would you like to run on solar power? Would you want the sun to be its only power source? Why?**



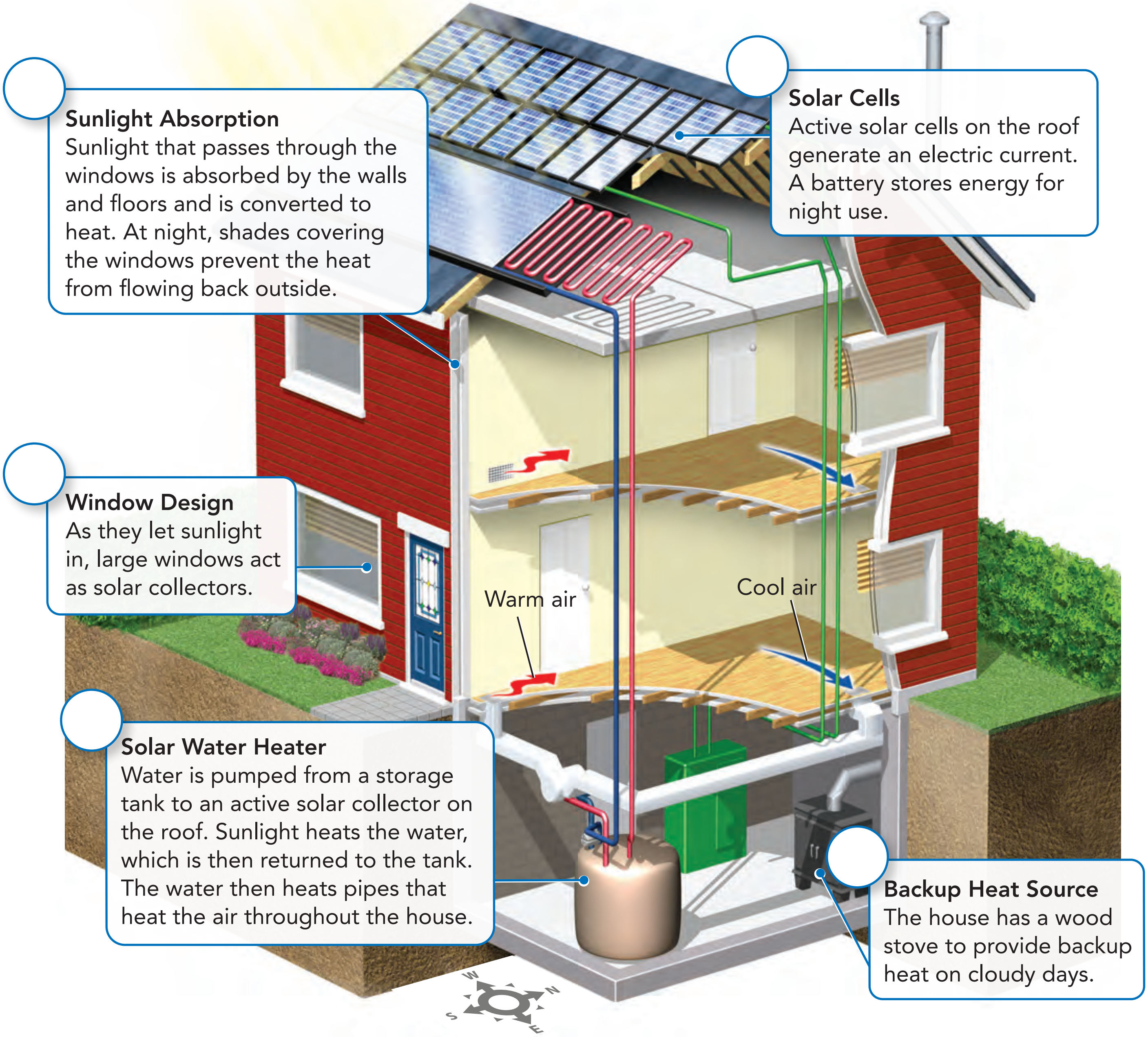


FIGURE 2

Solar-Powered House

This house takes advantage of active and passive solar heating.

Infer Draw a checkmark in the blank circles on the passive sources of solar energy. Draw a star in the blank circles on the active sources.

Passive Solar Heating Solar energy can be used to heat buildings with passive solar systems. A passive solar system converts sunlight into heat, or thermal energy. The heat is then distributed without using pumps or fans. Passive solar heating is what occurs in a parked car on a sunny day. Solar energy passes through the car's windows and heats the seats and other car parts. These parts transfer heat to the air, warming the inside of the car. The same principle can be used to heat a home.

Active Solar Heating An active solar system captures the sun's energy, and then uses pumps and fans to distribute the heat. First, light strikes the dark metal surface of a solar collector. There, it is converted to thermal energy. Water is pumped through pipes in the solar collector to absorb the thermal energy. The heated water then flows to a storage tank. Finally, pumps and fans distribute the heat throughout the building. Refer to **Figure 2.**

Hydroelectric Power

Hydroelectric Power Solar energy is the indirect source of water power. In the water cycle, energy from the sun heats water on Earth's surface. The heat turns the water into water vapor. The vapor condenses and falls back to Earth as rain, sleet, hail, or snow. As the water flows over land, it provides another source of energy.

Hydroelectric power is electricity produced by flowing water. A dam across a river blocks the flow of water, creating a body of water called a reservoir. When a dam's gates are opened, water flows through tunnels at the bottom of the dam. As the water moves through the tunnels, it turns turbines (like a fan's blades). The turbines are connected to a generator. Once a dam is built, generating electricity is inexpensive. But dams can prevent some fish species from breeding. They can also damage aquatic habitats.

Capturing the Wind Like water power, wind energy is also an indirect form of solar energy. The sun heats Earth's surface unevenly. As a result, different areas of the atmosphere have different temperatures and air pressures. The differences in pressure cause winds to form as air moves from one area to another.

Wind can be used to turn a turbine and generate electricity. Wind farms consist of many wind turbines. Together, the wind turbines generate large amounts of power. Wind is the fastest-growing energy source in the world. Wind energy does not cause pollution. In places where fuels are difficult to transport, wind energy is the major source of power if it is available.

Nuclear Power Like water and wind power, nuclear power does not produce air pollution since no fuel is burned. Instead, the energy released from the splitting of atoms is used to create steam that turns turbines. This process can be dangerous and even cause explosions if too much energy is released. Wastes generated by nuclear plants can be dangerous if disposed of improperly.

FIGURE 3

Hydroelectric and Wind Power

Hydroelectric and wind power do not rely on fossil fuels.

Compare and Contrast **List similarities and differences between water and wind power in the Venn diagram.**

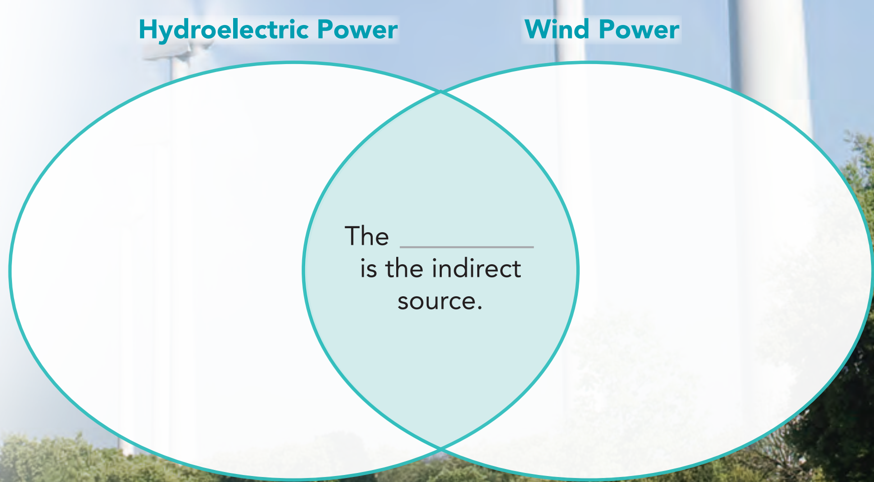


FIGURE 4

Corn Power

Biomass fuels come from living things, such as corn. It takes about 11.84 kilograms of corn to make one gallon of fuel!

Biomass Fuels Wood was probably the first fuel ever used for heat and light. Wood belongs to a group of fuels called **biomass fuels.** Biomass fuels are made from living things. Other biomass fuels include leaves, food wastes, and even manure. As fossil fuel supplies shrink, people are taking a closer look at biomass fuels. For example, when oil prices rose in the early 1970s, Hawaiian farmers began burning sugar cane wastes to generate electricity.

In addition to being burned as fuel, biomass materials can be converted into other fuels. For example, corn, sugar cane, and other crops can be used to make alcohol. Adding alcohol to gasoline forms **gasohol.** Gasohol can be used as fuel for cars. Bacteria can produce methane gas by decomposing biomass materials in landfills. That methane can be used to heat buildings. And some crops, such as soybeans, can produce oil. The oil can be used as fuel, which is called biodiesel fuel.

Biomass fuels are renewable resources. But it takes time for new trees to replace those that have been cut down. And it is expensive to produce alcohol and methane in large quantities. As a result, biomass fuels are not widely used today in the United States. But as fossil fuels become scarcer, biomass fuels may provide another source for meeting energy needs.

apply it!

What can happen when a food crop is used for fuel? The relationship is plotted with two curves on the graph.

1 **Interpret Graphs** According to the graph, as demand for corn increases, what happens to the supply?

____

2 CHALLENGE How would the price of corn change as demand for fuel increases? Why?

____

____

____

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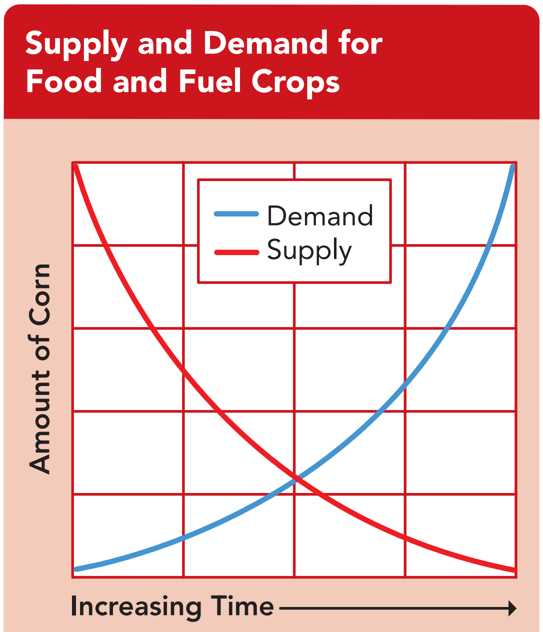


Tapping Earth's Energy Below Earth's surface are pockets of very hot liquid rock called magma. In some places, magma is very close to the surface. The intense heat from Earth's interior that warms the magma is called **geothermal energy.**

In certain regions, such as Iceland and New Zealand, magma heats underground water to the boiling point. In these places, the hot water and steam can be valuable sources of energy. For example, in Reykjavík, Iceland, 90 percent of the homes are heated by water warmed underground in this way. Geothermal energy can also be used to generate electricity, as shown in **Figure 5.**

Geothermal energy does have disadvantages. There are only a few places where Earth's crust is thin enough for magma to come close to the surface. Elsewhere, very deep wells would be needed to tap this energy. Drilling deep wells is very expensive. Even so, geothermal energy is likely to become a good method for meeting energy needs for some locations in the future.

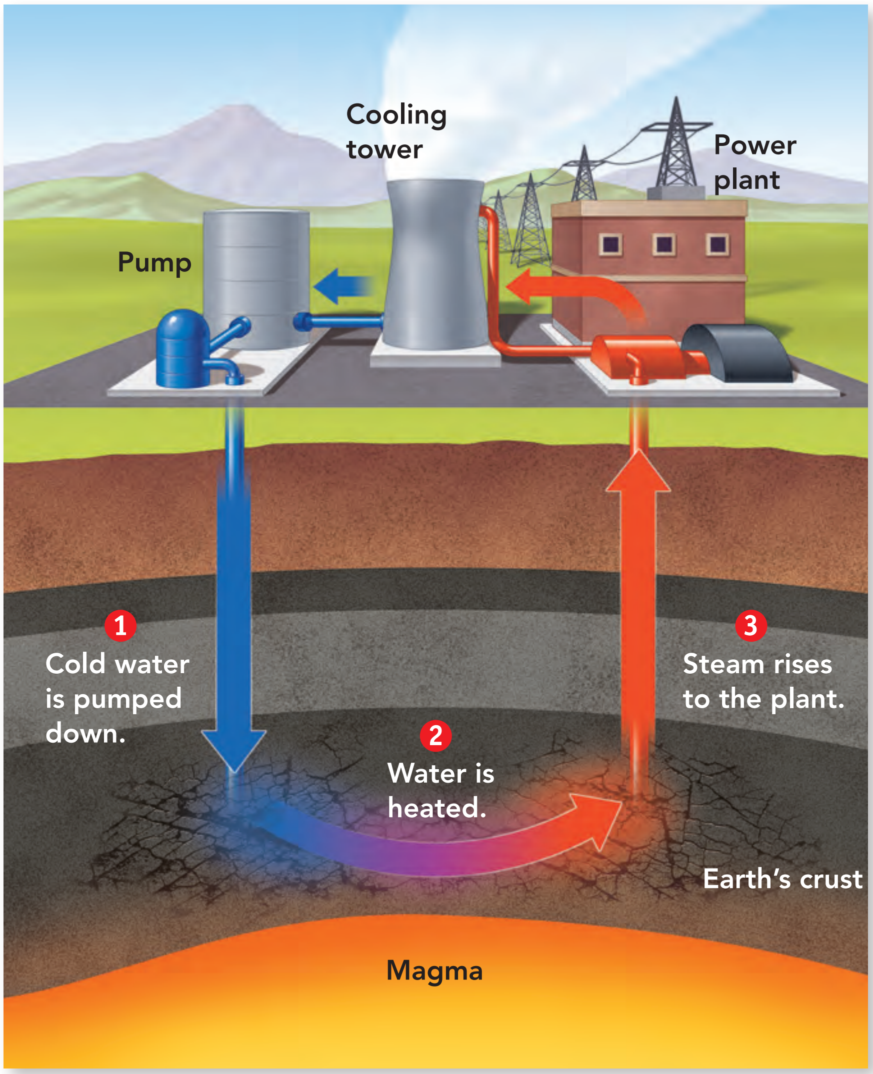
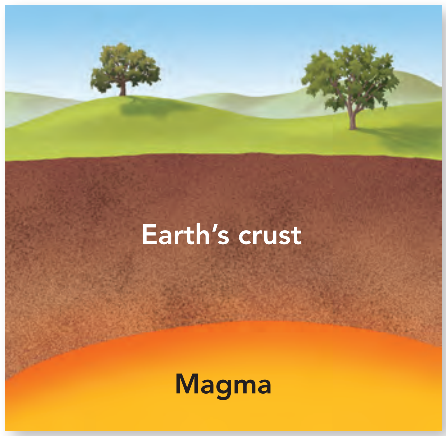


FIGURE 5

Geothermal Power in Iceland

Geothermal power plants like the one shown here use heat from Earth's interior to generate electricity.

Infer On the diagram below, draw Earth's crust and show where magma might be located in relation to Iceland's surface.



EXPLORE THE BIG ?

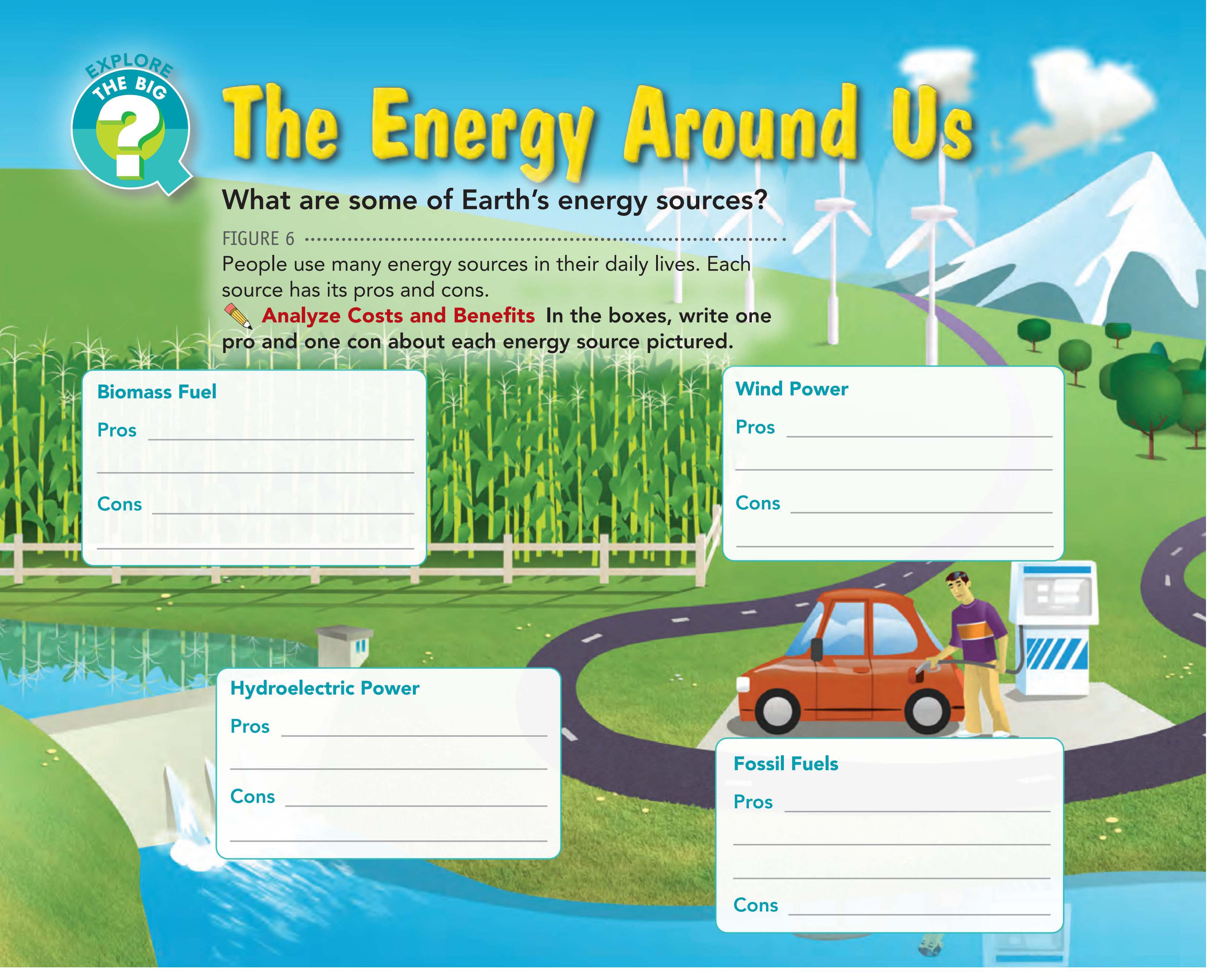
The Energy Around Us

What are some of Earth's energy sources?

FIGURE 6

People use many energy sources in their daily lives. Each source has its pros and cons.

Analyze Costs and Benefits In the boxes, write one pro and one con about each energy source pictured.



Biomass Fuel

Pros ______________________

____

Cons ______________________

____

Wind Power

Pros ______________________

____

Cons ______________________

____

Hydroelectric Power

Pros ______________________

____

Cons ______________________

____

Fossil Fuels

Pros ______________________

____

____

Cons ______________________

Vocabulary High-Use Academic Words The word *emit* means "to give off." What do vehicles that run on hydrogen fuel cells emit?

____

____

____

____

Electric Cars and Hydrogen Fuel Cells You may have heard about or even seen battery-powered electric cars. But what about cars that use hydrogen fuel cells? Both technologies, battery-powered electric cars and hydrogen fuel cells, have been developed to use renewable energy. See **Figure 6.**

Electric cars run entirely on batteries, and you plug them into an outlet to recharge them. The electricity used can be generated by power plants that use hydroelectric or solar energy. Some electric cars have adaptors that let you recharge them in minutes.

Some cars can run on hydrogen. They have tanks called hydrogen fuel cells that hold hydrogen instead of gasoline. Many power plants can use excess energy to break water molecules apart to make hydrogen. This hydrogen can then be pumped into cars. Cars that run on hydrogen fuel cells emit water vapor, not exhaust.

Geothermal Energy

Pros ______________________

____

Cons ______________________

____

Solar Power

Pros ______________________

____

Cons ______________________

____

Hydrogen Power

Pros ______________________

____

Cons ______________________

____

____

Nuclear Power

Pros ______________________

____

Cons ______________________

____

Lab zone® Do the Lab Investigation *Design and Build a Solar Cooker.*

Assess Your Understanding

1a. Review What forms of energy are provided by the sun?______________________

b. Explain Are biomass fuels renewable? Why?______________________

____

c. ANSWER THE BIG ? What are some of Earth's energy sources?

____

____

____

____

____

got it?

O **I get it!** Now I know that alternative energy sources include______________________

____

O I need extra help with ______________________

____

How Does a Nuclear Power Plant Produce Electricity?

Nuclear power plants generate much of the world's electricity. They generate about 20 percent of the electricity in the United States and more than 70 percent in France. Controlled nuclear fission reactions take place inside nuclear power plants. **Nuclear fission** is the splitting of an atom's nucleus into two nuclei. The splitting releases a lot of energy. **In a nuclear power plant, the heat released from fission reactions is used to turn water into steam. The steam then turns the blades of a turbine to generate electricity.** Look at the diagram of a nuclear power plant in **Figure 7.** In addition to the generator, it has two main parts: the reactor vessel and the heat exchanger.

FIGURE 7

Nuclear Power Plants

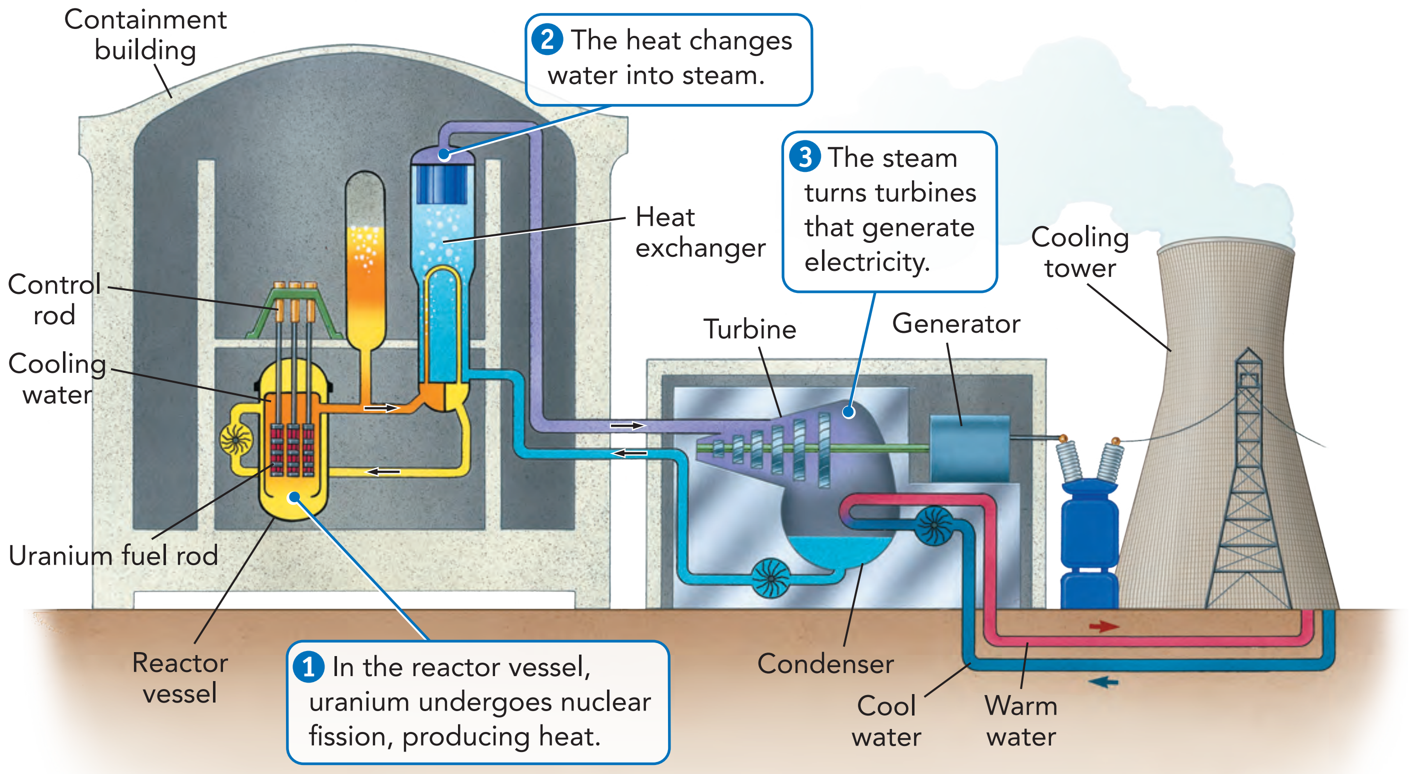
Nuclear power plants are designed to turn the energy from nuclear fission reactions into electricity.

Interpret Diagrams Where does nuclear fission occur in the plant?

Reactor Vessel

The **reactor vessel** is the part of the nuclear reactor in which nuclear fission occurs. The reactor contains rods of radioactive uranium called **fuel rods.** When several fuel rods are placed close together, a series of fission reactions occurs.

If the reactor vessel gets too hot, control rods are used to slow down the chain reactions. **Control rods,** made of the elements cadmium, boron or hafnium, are inserted near the fuel rods. The elements absorb particles released during fission and slow the speed of the chain reactions. The control rods can then be removed to speed up the chain reactions again.



Heat Exchanger Heat is removed from the reactor vessel by water or another fluid that is pumped through the reactor. This fluid passes through a heat exchanger. There, the fluid boils water to produce steam. The steam runs the electrical generator. The steam is condensed again and pumped back to the heat exchanger.

The Risks of Nuclear Power At first, people thought that nuclear fission would provide an almost unlimited source of clean, safe energy. But accidents at nuclear power plants have led to safety concerns. In 1986, the reactor vessel in a nuclear power plant in Chernobyl, Ukraine, overheated. The fuel rods generated so much heat that they started to melt. This condition is called a meltdown. The excess heat caused a series of explosions, which injured or killed dozens of people immediately. In addition, radioactive materials escaped into the environment and killed many more people.

Plant operators can avoid accidents at nuclear facilities through careful planning and by improving safety features. A more difficult problem is the disposal of radioactive wastes. Radioactive wastes remain dangerous for many thousands of years. Scientists must find ways to store these wastes safely for very long periods of time.

FIGURE 8
Nuclear France
France uses nuclear power to generate much of its electricity, including the power for the lights on the Eiffel Tower. However, there are several risks to using nuclear power.
Identify In the text, underline these risks.

Lab zone Do the Quick Lab *Producing Electricity.*

Assess Your Understanding

got it?

○ **I get it!** Now I know that nuclear power plants produce energy by ______________________

○ I need extra help with ______________________

TN

LESSON 2

6.ESS3.1, 6.ESS3.2

Energy Use and Conservation

UNLOCK THE BIG ?

- How Has Energy Use Changed Over Time?
- How Can We Ensure There Will Be Enough Energy for the Future?

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TECHNOLOGY

House of Straw

What was that first little pig thinking? Was he just lazy—building a house of straw as quickly as he could without much thought? Or was he helping the environment? It turns out that straw is one of the best materials for keeping warm air inside in cold weather and keeping hot air outside in hot weather. Builders place stacks of straw along the exterior walls of a building and then seal the straw with mud. Bales of straw are natural and cheap, since straw is left over after grain is harvested. It's no wonder that more and more people are using straw to insulate their homes!

Communicate Write your answers below.

1. How does using straw for insulation save energy?

2. Why is using straw for insulation good for the environment?

Lab zone® Do the Inquiry Warm-Up *Which Bulb Is More Efficient?*

Vocabulary

- efficiency
- insulation
- energy conservation

Skills

- Reading: Identify the Main Idea
- Inquiry: Observe

How Has Energy Use Changed Over Time?

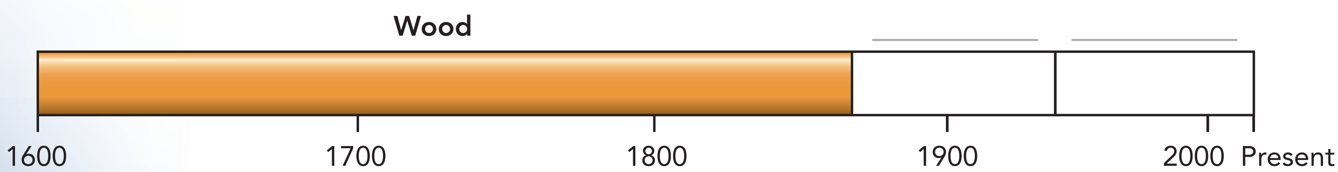
Energy, beyond using your own muscle power, is essential to the way most people live. The methods people use to obtain energy have changed, especially in the last 200 years. **For most of human history, people burned wood for energy. Only recently have fossil fuels become the main energy source.**

Eventually, people harnessed the power of other renewable resources. Ships used tall sails to capture wind energy. Flowing water turned wheels connected to stones that ground grain into flour.

Wood, wind, and water were also the main sources of energy in the United States until the nineteenth century. Coal gained in popularity as a fuel during the westward expansion of the railroads. Coal remained the dominant fuel until 1951, when it was replaced by oil and natural gas.

Today, scientists are continually looking for new and better fuels to meet the world's energy needs. As fossil fuel supplies continue to decrease, the interest in renewable energy sources has increased. With more focus on protecting the environment, scientists are working to meet our energy needs while reducing and eliminating many sources of pollution.

Identify the Main Idea Energy use has changed over time. On the timeline, label and shade the periods in which coal and oil were the dominant fuel sources in the United States.



Lab zone Do the Quick Lab *Human Energy Use.*

Assess Your Understanding

got it?

- **I get it!** Now I know that human energy use has ____________________
- I need extra help with ____________________

How Can We Ensure There Will Be Enough Energy for the Future?

What would happen if the world ran out of fossil fuels today? The heating and cooling systems in most buildings would stop functioning. Forests would disappear as people began to burn wood for heating and cooking. Cars, buses, and trains would be stranded wherever they ran out of fuel. About 70 percent of the world's electric power would disappear. Since televisions, computers, and telephones depend on electricity, communication would be greatly reduced. Lights and most home appliances would no longer work.

Although fossil fuels won't run out immediately, they also won't last forever. Most people think that it makes sense to use fuels more wisely now to avoid fuel shortages in the future. **One way to preserve our current energy resources is to increase the efficiency of our energy use. Another way is to conserve energy whenever possible.** Refer to **Figure 1.**

FIGURE 1

Wasting Energy

Many things, such as lights and appliances, use energy. If people do not use these things properly, energy can be wasted.

Observe **Circle everything in this scene that is wasting energy.**

Energy Efficiency One way to make energy resources last longer is to use fuels more efficiently. **Efficiency** is the percentage of energy that is actually used to perform work. The rest of the energy is "lost" to the surroundings, usually as heat. People have developed many ways to increase energy efficiency.

Heating and Cooling One method of increasing the efficiency of heating and cooling systems is insulation. **Insulation** is a layer of material that traps air. This helps block the transfer of heat between the air inside and outside a building. You have probably seen insulation made of fiberglass. It looks like pink cotton candy. A layer of fiberglass 15 centimeters thick insulates a room as well as a brick wall 2 meters thick!

Trapped air can act as insulation in windows too. Many windows consist of two panes of glass with space in between them. The air between the panes of glass acts as insulation.

Lighting Much of the electricity used for home lighting is wasted. For example, less than 10 percent of the electricity that an incandescent light bulb uses is converted into light. The rest is given off as heat. In contrast, compact fluorescent bulbs use about one fourth as much energy to provide the same amount of light.

FIGURE 2

Solutions to Wasting Energy

There are many ways to save energy in a home.

Explain **Pick at least three of the things you circled in the scene and explain what people could do to stop wasting energy.**

Ways to Conserve Energy

Transportation Engineers have improved the energy efficiency of cars by designing better engines and batteries. For instance, many new cars use high-efficiency hybrid engines that go twice as far on a tank of fuel than other cars. Buses in some cities are now entirely electric, running on high-power rechargeable batteries. New kinds of batteries allow some electric cars to drive hundreds of kilometers before recharging.

Another way to save energy is to reduce the number of cars on the road. In many communities, public transit systems provide an alternative to driving. Other cities encourage carpooling and bicycling. Many cities now set aside lanes for cars containing two or more people.

apply it!

1 You have been put in charge of designing an ad campaign for your area to get more people to use public transportation. Design a poster that will get people's attention and inform them about their choices. On your poster, list at least three reasons why people should use public transportation. Give your poster a title.

2 **Describe** Where would you want to display your poster? Why?

____

____

3 CHALLENGE How else could you increase awareness about public transportation?

____

____

____

Energy Conservation Another approach to making energy resources last longer is conservation. **Energy conservation** means reducing energy use.

You can reduce your personal energy use by changing your behavior in some simple ways. For example, if you walk to the store instead of getting a ride, you are conserving the gasoline it would take to drive to the store.

While these suggestions seem like small things, multiplied by millions of people they add up to a lot of energy saved for the future.

FIGURE 3

Energy Conservation in Your Everyday Life

Even students like you can conserve energy.

Communicate **With a partner, think of ways you can conserve energy in your daily life. Write your answers in the notebook.**

Lab zone® Do the Quick Lab *Future Energy Use.*

Assess Your Understanding

1a. Define What does it mean to say that something is "energy efficient"?

____

b. Solve Problems What are some strategies a city could use to increase energy conservation?

____

got it?

○ **I get it!** Now I know that ensuring that the future has enough energy requires ______________________________

○ I need extra help with ______________________________

CHAPTER 6

Study Guide

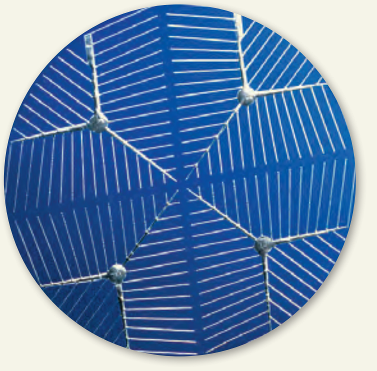
REVIEW THE BIG ?

Earth has many energy sources, including wind used for wind power; the sun, which can be used for ________________; and flowing water, which can be used for ____________________________.

LESSON 1 Renewable Sources of Energy

Renewable sources of energy include sunlight, water, wind, biomass fuels, and geothermal energy.

In a nuclear power plant, the heat released from fission reactions is used to change water into steam. The steam then turns the blades of a turbine to generate electricity.



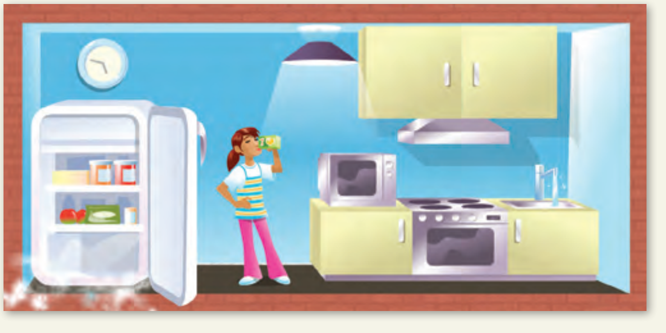
Vocabulary

- solar energy
- hydroelectric power
- biomass fuel
- gasohol
- geothermal energy
- nuclear fission
- reactor vessel
- fuel rod
- control rod

LESSON 2 Energy Use and Conservation

For most of human history, the main fuel source was wood. Only recently have fossil fuels become the main energy source.

One way to preserve our current energy resources is to increase the efficiency of our energy use. Another way is to conserve energy whenever possible.



Vocabulary

- efficiency
- insulation
- energy conservation

Review and Assessment

LESSON 1 Renewable Sources of Energy

1. Which of the following is not a biomass fuel?

a. gasohol   **b.** methane from landfills
c. hydrogen   **d.** sugar cane wastes

2. Running water can be used as an energy source to produce ____________________ power.

3. **Apply Concepts** Fill in the boxes with two benefits and two costs of hydrogen power.

Benefits	Costs

4. **Interpret Photos** Explain how a nuclear power plant, like the one pictured below, produces energy.

LESSON 2 Energy Use and Conservation

5. What is efficiency?

a. the percentage of energy that is lost to the environment as heat
b. the percentage of energy that is used to perform work
c. the percentage of energy that is conserved when work is done
d. the percentage of energy that is wasted when electronics are left on

6. ____________________ involves using less energy, helping energy resources last longer.

7. **Draw Conclusions** How is energy use today different from energy use 200 years ago?

8. **Solve Problems** Describe three actions a person can take to conserve energy.

CHAPTER 6

Review and Assessment

APPLY THE BIG ?

What are some of Earth's energy sources?

9. Earth's energy sources include many different resources. Name at least three sources of energy that could be used in a classroom like the one below. Then describe the ideal energy source for generating most of your school's electricity and explain why you chose this source.

TNReady Prep

6.ESS3.1, 6.ESS3.2

Read each question and choose the best answer.

1. Which statement is best supported by the table below?

2015 Solar Power Capacity

Country	Total Solar Capacity Global Rank	Total Solar Capacity per Person Global Rank
China	1	9
United States	4	8
Germany	2	1
Japan	3	4

A Germany produces the most solar power.
B The United States produces the least solar power per person.
C Japan produces less solar power per person than China.
D Germany produces the most solar power per person.

2. Which of the following is a renewable source of energy?

A oil
B coal
C wind
D wood

3. The interior of a car heats up on a sunny day because of

A solar cells.
B active solar heating.
C passive solar heating.
D direct solar heating.

4. Which explains why systems that transform energy are not completely efficient?

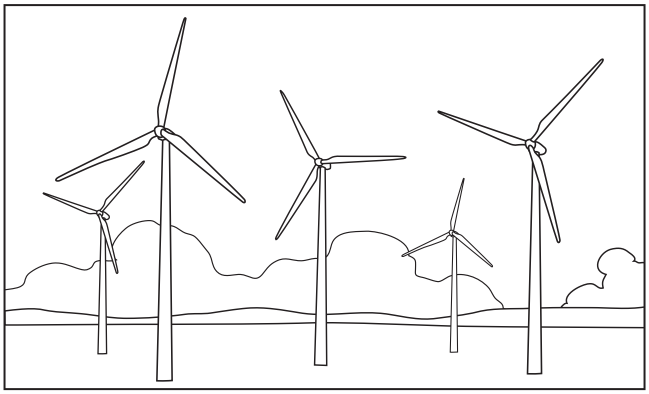
A Increasing energy resources increases efficiency.
B Doing less work gives off more heat.
C Some energy is converted to heat that flows to surrounding material.
D An increase in the amount of energy is needed to generate electricity.

5. How does a nuclear power plant produce energy?

A with solar panels
B through nuclear fission reactions
C with geothermal heat
D through nuclear meltdown reactions

Constructed Response

Use the diagram below and your knowledge of science to help you answer Question 6. Write your answer on a separate sheet of paper.



6. Describe how energy is produced in the diagram above. Then, describe one advantage and one disadvantage of this source.

How Low Is Low Impact?

▲ This electric car is charged by attaching an electric cord to an outlet. However, the source of the electricity may be a fossil fuel-based power plant.

Hybrid engines, windmills, low-impact this, alternative-energy that—everywhere you look, people are trying to find ways to create energy by using renewable resources. Sometimes, a technology seems to conserve energy, but in reality it has hidden costs. For example, electric cars do not release air pollutants during use, but the method that is used to generate the electricity for the car may cause pollution. Is the electricity really "clean"?

Evaluating the costs and benefits of different technologies is an important scientific skill. Use the following questions to sharpen your decision-making skills.

What is the source? What materials are used to create or power the technology? How are they obtained?

What are the products? What is produced when the technology is created or used? How do these products affect the environment? How are these products stored, recycled, or disposed of?

How does it affect our lives? Does using a technology encourage people to use more energy? If it does, do the benefits of the technology outweigh the environmental costs?

Every technology has costs and benefits. However, it is important to be able to evaluate new technologies to find out if the benefits outweigh the costs!

Write About It In a group, discuss the questions listed above. Can you think of ways to add to them or to change them? Then, create an Environmental Decision-Making Guide and use it to evaluate two of the energy technologies described in this chapter.

OFFSHORE PETROLEUM ENGINEER

Life on an Oil Rig

This professional's office is on a huge steel platform that is half the area of a football field, surrounded by water. With much of Earth's oil located under the ocean floor, petroleum engineers must go where the oil is. Many of them work on offshore oil rigs—large drilling platforms that extract oil from under the ocean floor.

Conditions far out in the the ocean can be harsh or dangerous. Large equipment, fires, and even hurricanes threaten workers' safety. However, far out in the ocean, workers on oil rigs can see sharks, manta rays, and other marine life.

Petroleum engineers study geology, physics, and chemistry to understand the properties of rock formations that contain oil. They use high-tech remote sensing equipment to find oil and computer modeling software to figure out how to get the oil out of the ocean's floor.

Write About It Find out more about life on an offshore oil rig. Then, write a diary or blog entry that describes a week in the life of an offshore petroleum engineer.

▲ The Petronius platform is located in the Gulf of Mexico.

Hydrokinetic Energy

Whirlpool! Maelstrom! Vortex! Do these words make you think of a rushing spiral of water, sucking fish and boats into its center? Not all vortexes sink ships. Fish and whales cause little vortexes when they swim. As the animals move, they create turbulence in the water. Turbulent water moves away from the animal and gives it a little push.

An engineer named Michael Bernitsas has developed a device that uses this effect to generate electricity. As currents push water around a cylindrical device, a vortex forms. As the vortex moves away from the device, the cylinder moves up and down. The device then converts that mechanical energy into electrical energy. Bernitsas has even improved the device by adding mechanical "fish tails" to the generators! Bernitsas is still testing his system, but he hopes that it can someday be used to help meet society's needs for a renewable source of energy.

Design It Find out more about how fish swim. Then, design a model that shows how the body of a fish moves in the water. In your model, show where a vortex would form as the fish swims.