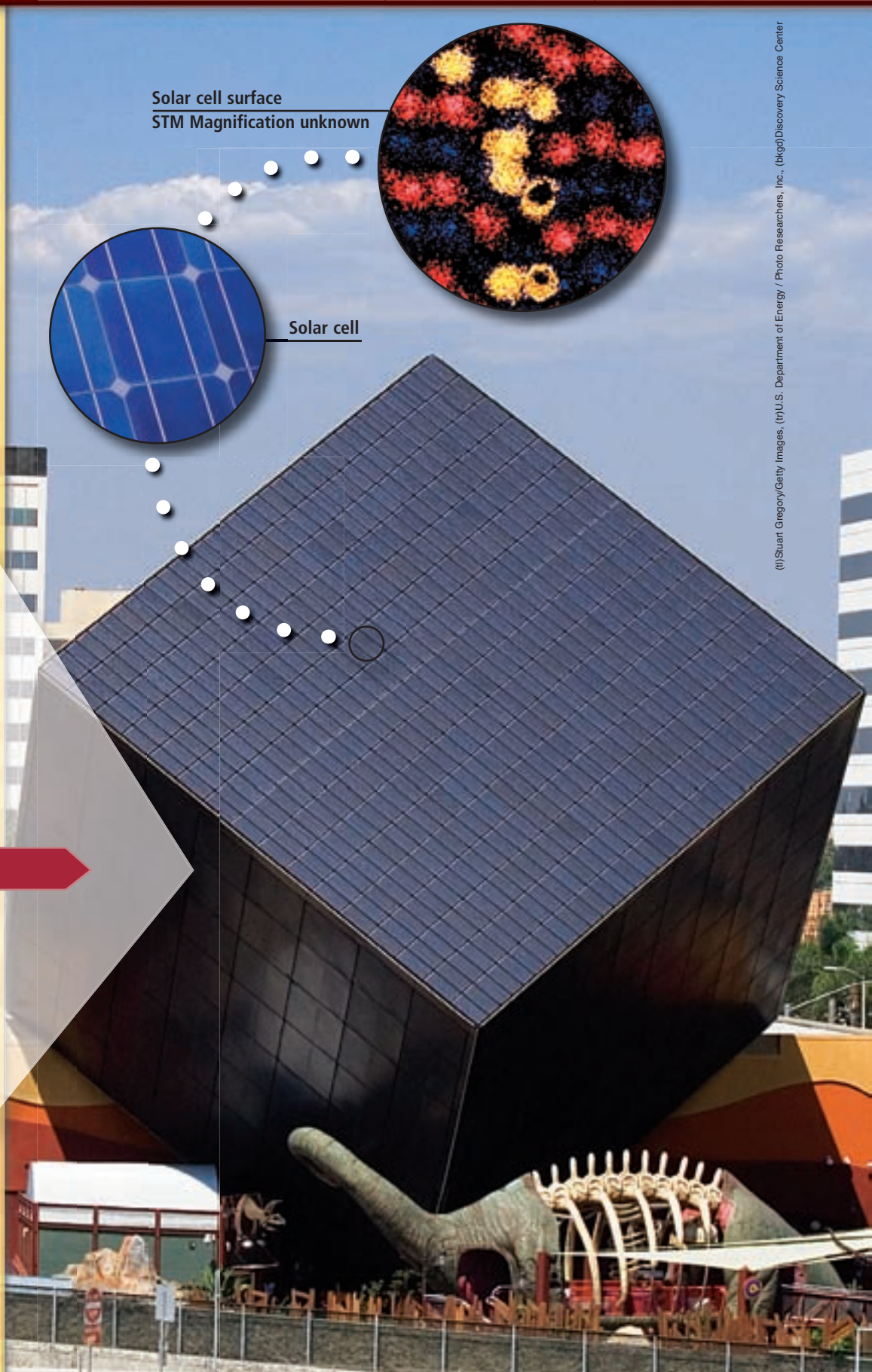
CHAPTER 25

Energy Resources



(tl)Stuart Gregory/Getty Images, (tr)U.S. Department of Energy / Photo Researchers, Inc., (bkgd)Discovery Science Center

BIG Idea **People use energy resources, most of which originate from the Sun, for everyday living.**

25.1 Conventional Energy Resources
MAIN Idea Biomass and fossil fuels store energy from the Sun.

25.2 Alternative Energy Resources
MAIN Idea Many resources other than fossil fuels can be developed to meet the energy needs of people on Earth.

25.3 Conservation of Energy Resources
MAIN Idea Using energy efficiently reduces the consumption of nonrenewable resources.

GeoFacts

- The solar cube at the Discovery Science Center in Santa Ana, California, is 10 stories high and provides a percentage of energy used to run the center.
- Enough sunlight falls on Earth's surface each minute to meet the world's energy demands for an entire year.
- Silicon from one metric ton of sand, used in solar cells, produces as much electricity as burning 500,000 metric tons of coal.

Start-Up Activities

LAUNCH Lab

Can you identify sources of energy?

Energy cannot be created or destroyed, but it can change form and be transferred. Thus, the same energy can be used repeatedly.

Procedure

WARNING: ***Allow the beaker to cool before moving it at the end of the activity.***

1. Read and complete the lab safety form.
2. Add 200 mL of **water** to a **250-mL glass beaker.**
3. Place the beaker on a **hot plate.**
4. Turn the hot plate on high. Observe what happens to the water as it heats up and begins to boil.

Analysis

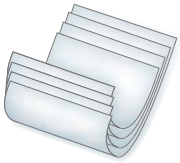
1. **Describe** what happened to the energy as it was used to heat and boil the water.
2. **Infer** where the energy went when the water began to boil.
3. **Determine** Where did the energy to boil the water come from? Trace the electricity from your school to its source.

FOLDABLES™ Study Organizer

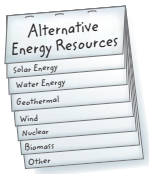
Alternative Energy Resources
Make the following Foldable to explain some important alternatives to traditional energy resources.

STEP 1 Collect four sheets of paper and layer them 2 cm apart vertically. Keep the left and right edges even.

STEP 2 Fold up the bottom edges of the sheets to form seven equal tabs. Crease the fold to hold the tabs in place.



STEP 3 Staple along the fold. Label the tabs *Solar Energy, Water Energy, Geothermal, Wind, Nuclear, Biomass,* and *Other.*



FOLDABLES **Use this Foldable with Section 25.2.**
As you read this section, describe the types of resources available and explain how they differ from traditional resources.

Earth Science Online

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Section 25.1

Objectives

- **Explain** why the Sun is the source of most energy on Earth.
- **Identify** materials that are used as fuels.
- **Illustrate** how coal forms.

Review Vocabulary

fault: fracture in Earth's crust along which movement occurs

New Vocabulary

fuel
biomass fuel
hydrocarbon
peat
fossil fuel

Conventional Energy Resources

MAIN Idea **Biomass and fossil fuels store energy from the Sun.**

Real-World Reading Link What kinds of activities do you engage in each morning? In the kitchen, you might toast bread or use a microwave oven to heat up your breakfast. You might ride a bus to school or drive a car. All of these activities require energy, and the food you eat, such as toast, provides your body with the energy it needs to function.

Earth's Main Energy Source

The energy that humans and all other organisms use comes mostly from the Sun. How is solar energy used by organisms? Plants are producers—they capture the Sun's light energy in the process of photosynthesis. The light energy is converted into a form that can be used for maintenance, growth, and reproduction by the plant. When other organisms called consumers eat producers, they use that stored energy for their own life processes. For example, when a rabbit eats grass, it consumes the energy stored by the plant. The rabbit stores energy as well, and this energy can be transferred to other organisms when the rabbit is eaten, when the rabbit produces waste, or when it dies and decomposes back into the ground. **Figure 25.1** shows how trapped light energy can be transferred from plants to humans.

Humans use energy to keep them warm in cold climates, to cook food, to pump water, and to provide light. There are many different fuel sources available to humans to provide this energy. Most of these fuels also store energy that originated from the Sun.

Figure 25.1 Humans need energy to live. When you eat a bowl of cereal, you use energy derived from the Sun. The wheat plant harnessed the Sun's light energy through photosynthesis. Some of this energy was stored in the seed of the wheat which humans can consume to get energy they need to survive.

David Young-Wolff/PhotoEdit

Biomass Fuels

Fuels are materials that are consumed to produce energy. The total amount of living matter in an ecosystem is its biomass. Therefore, fuels derived from living things are called **biomass fuels.** Biomass fuels, shown in **Figure 25.2,** are renewable resources.

One type of fuel available for human use is derived directly from plant material. Plant materials burn readily because of the presence of **hydrocarbons**—molecules with hydrogen and carbon bonds only. Hydrocarbons are the result of the combination of carbon dioxide and water during photosynthesis. When plant materials burn, oxygen is released as a waste product.

Wood Humans have been using wood for fuel for thousands of years. Billions of people, mostly in developing countries of the world, use wood as their primary source of fuel for heating and cooking. Unfortunately, the need to use wood as a fuel has resulted in deforestation of many areas of the world. As forests near villages are cut down for fuel, people travel farther to gather the wood they need. In some parts of the world, this demand for wood has led to the complete removal of forests, which can result in erosion and the loss of topsoil.

Field crops Another biomass fuel commonly used in developing countries is field crops. The simplest way to use field crops, such as corn, hay, and straw, as fuel is to burn them. Crop residues left after harvest, including the stalks, hulls, pits, and shells from corn, grains, and nuts, are other sources of energy.

Fecal material Feces are the solid wastes of animals. In many cases, dried feces contain undigested pieces of grass that help the material to burn. Feces from cows often meet the energy needs of people in developing countries with limited forest resources. Some people collect animal fecal matter for fuel and dry it on the outside walls of their stables or compounds as shown in **Figure 25.2.**

Reading Check **Explain** how field crops, fecal material, and wood are all examples of biomass fuels.

VOCABULARY

SCIENCE USAGE V. COMMON USAGE

Consume

Science usage: to use up completely

Common usage: to eat

Figure 25.2 Biomass fuel, such as wood, field crops, and fecal material, is the primary source of fuel for people in many countries. The fecal matter in the image below has been hung on the side of this home to dry before it is burned.

Wood

Fecal material

Figure 25.3 Peat has been harvested for fuel for centuries from bogs like this one in Ireland.

Dr. John D. Cunningham/Visuals Unlimited

Peat Bogs are poorly drained areas with spongy, wet ground that is composed mainly of dead and decaying plant matter. When plants in a bog die, they fall into the water. Bog water is acidic and has low levels of oxygen; these conditions slow down or stop the growth of the bacteria that decompose dead organic matter, including plants. As a result, dead and partially decayed plant material accumulates on the bottom of the bog. Over time, as the plant material is compressed by the weight of water and by other sediments that accumulate, it becomes a light, spongy material called **peat,** shown in **Figure 25.3.** Most of the peat used as fuel today is thousands of years old.

Peat has been used as a low-cost fuel for centuries because it can be cut easily out of a bog, dried in sunlight, and then burned in a stove or furnace to produce heat. Highly decomposed peat burns with greater fuel efficiency than wood. Today, peat is used to heat many homes in Ireland, England, parts of northern Europe, and the United States.

Fossil Fuels

Energy sources that formed over geologic time as a result of the compression and incomplete decomposition of plants and other organic matter are called **fossil fuels.** Although coal, oil, and natural gas originally formed from once-living things, these energy sources are considered nonrenewable. Recall from Chapter 24 that nonrenewable resources are used at a rate faster than they can be replaced. Fossil fuels are nonrenewable resources because their formation occurs over thousands or even millions of years, but we are using them at a much faster rate.

Fossil fuels mainly consist of hydrocarbons and can be transported wherever energy is needed and used on demand. This is why most industrialized countries, including the United States, depend primarily on coal, natural gas, and petroleum to fuel electric power plants and vehicles. Although fossil fuels are diverse in their appearance and composition, all of them originated from organic matter trapped in sedimentary rock.

Coal Coal is the most abundant of all the fossil fuels. Recall from Chapter 6 that coal forms from peat over millions of years. As compression continues, the hydrogen and oxygen in peat are lost and only carbon remains. The greater the carbon concentrations in coal, the hotter it burns. Most coal reserves in the United States are bituminous coal, therefore, many of the electricity-generating plants in the United States burn this type of coal. Study **Figure 25.4** to learn how the different types of coal form.

VOCABULARY

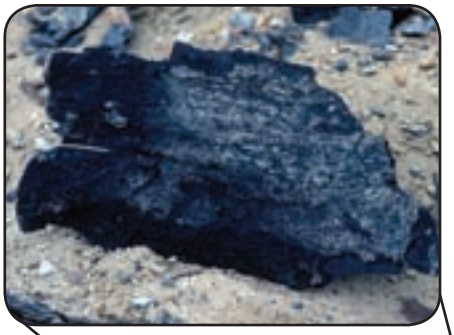
ACADEMIC VOCABULARY

Diverse
made up of distinct characteristics, qualities, or elements
The United States has diverse weather—the Northwest is cool and wet, while the Southwest is hot and dry.

Visualizing Coal

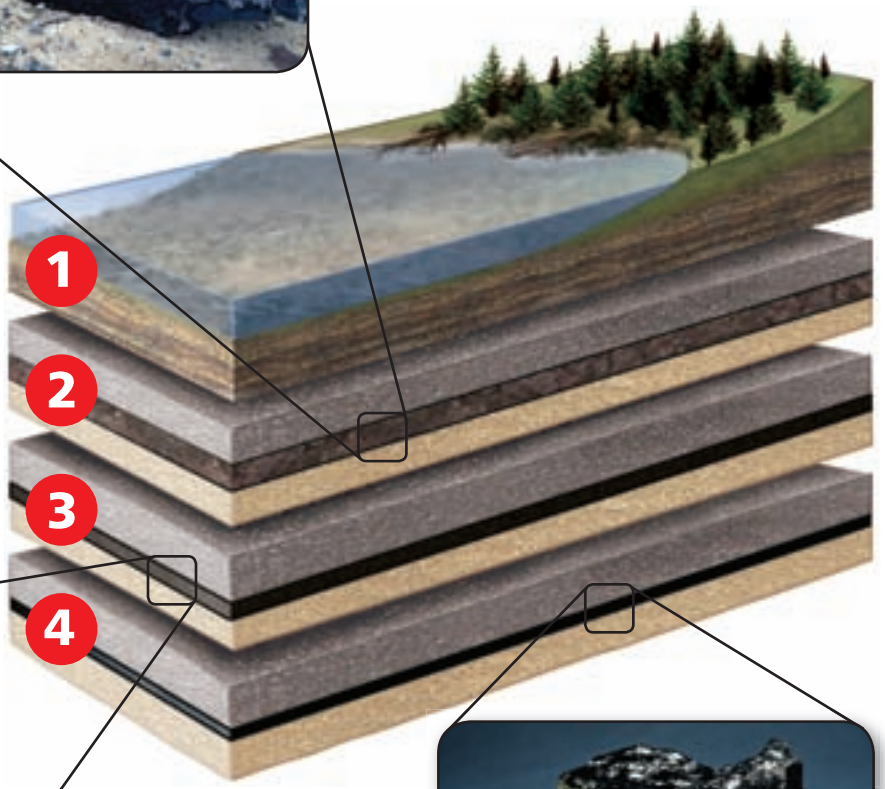
NATIONAL GEOGRAPHIC

Figure 25.4 Coal forms from the compression of organic material over time.

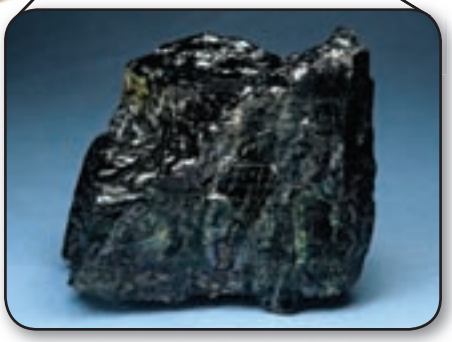


Lignite is a soft, brown, low-grade coal with low sulfur content—less than 1 percent. Because the carbon concentration in lignite is generally around 40 percent, it is inefficient as a fuel. More lignite must be burned than other types of coal to provide the same amount of energy.

1. Incomplete decay of plants forms peat.
2. Peat is compressed to form lignite.
3. After further compression, bituminous coal forms.
4. More heat and pressure are applied to form anthracite.



Bituminous coal can have carbon concentrations as high as 85 percent. When bituminous coal burns, it releases carbon dioxide and gases containing sulfur and nitrogen into the air, causing air pollution.



Anthracite can have a carbon concentration as high as 90 to 95 percent, and it stores more energy and burns cleaner than other types of coal. However, less than 1 percent of the coal reserves in the United States are anthracite.

Concepts in Motion

To explore more about coal, visit glencoe.com.

Earth Science online

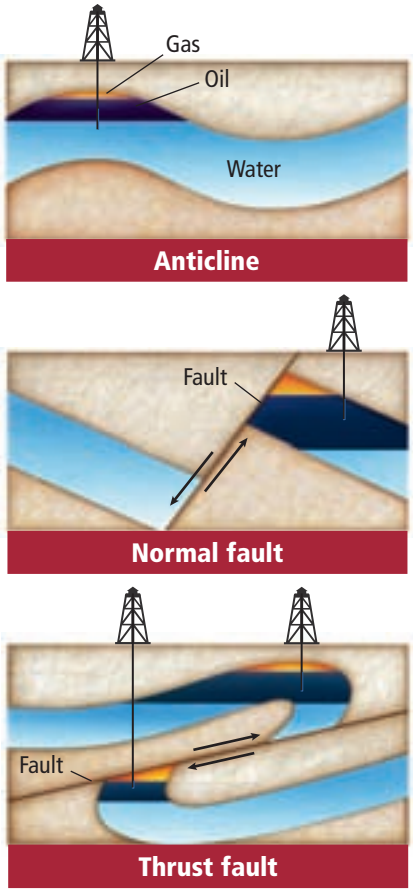


Figure 25.5 These diagrams show typical structural traps for oil and gas deposits.

Petroleum and natural gas Most petroleum deposits formed from microscopic organisms in oceans. Dead and decaying organisms were buried beneath layers of clay and mud. Many layers of clay and mud increased the pressure and temperature, forming liquid oil, also called crude oil. Crude oil that is collected on Earth's surface or pumped out of the ground is refined into a wide variety of petroleum products, such as gasoline, diesel fuel, and kerosene.

Natural gas forms along with oil and is found beneath layers of solid rock. The rock prevents the gas from escaping to Earth's surface.

Migration Rock containing pores or spaces that liquid can move through is called permeable rock. Crude oil and natural gas migrate sideways and upward from their place of formation. As they migrate, they accumulate in permeable sedimentary rocks such as limestone and sandstone. Because petroleum is less dense than water, oil and gas continue to rise until they reach a barrier of impermeable rock, such as slate or shale, that prevents their continued upward movement. This barrier effectively seals the reservoir and creates a trap for the petroleum. Geologic formations such as faults and anticlines—folds of rock—can trap petroleum deposits, as shown in **Figure 25.5.**

Reading Check **Describe** how oil migrates upward through sedimentary rock.

MiniLab

Model Oil Migration

How does oil move through layers of porous rocks?

Procedure

1. Read and complete the lab safety form.
2. Pour 20 mL of **cooking oil** into a **100-mL graduated cylinder.**
3. Pour **sand** into the graduated cylinder until the sand-oil mixture reaches the 40-mL mark.
4. Add a layer of **colored aquarium gravel** above the sand until the gravel reaches the 70-mL mark.
5. Pour **tap water** into the graduated cylinder until the water reaches the 100-mL mark.
6. Observe the graduated cylinder for 5 min. Record your observations.

Analysis

1. **Identify** what the cooking oil, sand, and aquarium gravel represent.
2. **Explain** what happened when you added water to the mixture in the graduated cylinder. Why does adding water cause this change?
3. **Predict** what might occur in the graduated cylinder if you added a carbonated soft drink to the mixture instead of water. What would the bubbles represent?

Oil shale Some petroleum resources are trapped in different types of rocks. For example, oil shale is a fine-grained rock that contains a solid, waxy mixture of hydrocarbon compounds called kerogen. Oil shale can be mined, then crushed and heated until the kerogen vaporizes. The kerogen vapor can then be condensed to form a heavy, slow-flowing, dark-brown oil known as shale oil. Shale oil is processed to remove nitrogen, sulfur, and other impurities before it can be sent through the pipelines to a refinery.

The largest deposits of oil shale in the world are found in the Green River Formation, shown in **Figure 25.6.** This geologic formation contains an estimated 800 billion barrels of recoverable oil, which is three times greater than the proven oil reserves of Saudi Arabia. People in the United States use about 20 million barrels of oil per day. If oil shale could be used to meet a quarter of that demand, the estimated 800 billion barrels of recoverable oil from the Green River Formation would last for more than 400 years.

Historically, the cost of oil derived from oil shale has been significantly higher than pumped oil. Recently, prices for crude oil have again risen to levels that might make oil-shale-based oil production commercially viable, and both governments and industries are interested in pursuing the development of oil shale.

Figure 25.6 Oil shale is found primarily in sedimentary rocks. One of the most abundant sources of oil shale known is the Green River Formation in Utah, shown on the map as the dark green regions.

Section 25.1 Assessment

Section Summary

- The Sun is the source of most energy on Earth.
- Humans have used materials derived from living things, such as wood, as renewable fuels for thousands of years.
- Fossil fuels formed from organisms that lived millions of years ago.

Understand Main Ideas

1. MAIN Idea **Explain** how energy stored in coal was obtained from the Sun.
2. **List** four types of biomass fuels.
3. **Illustrate** how coal forms.
4. **Discuss** how two uses of energy in your home can be traced back to the Sun.

Think Critically

5. **Evaluate** this statement: Anthracite is usually found deeper in Earth's crust than lignite.
6. **Debate** whether scientists should research the prospect of obtaining oil from the Green River Formation.

MATH in Earth Science

7. Research different ways coal can be mined and write a report on the positive and negative effects of mining.

Section 25.2

Objectives

- **Identify** alternative energy resources.
- **Identify** various ways to harness the Sun's energy.
- **Describe** how water, wind, nuclear, and thermal energy can be used to generate electricity.
- **Explain** why nuclear energy might be controversial.

Review Vocabulary

electron: subatomic partical that has little mass, but has a negative electric charge that is exactly the same magnitude as the positive charge of a proton

New Vocabulary

photovoltaic cell
hydroelectric power
geothermal energy
nuclear fission

Alternative Energy Resources

MAIN Idea **Many resources other than fossil fuels can be developed to meet the energy needs of people on Earth.**

Real-World Reading Link Have you ever walked barefoot across dark-colored pavement on a hot day? The thermal energy from the Sun caused the pavement to heat up and might have burned your feet. Scientists are working to find the most efficient ways to convert this thermal energy from the Sun into electricity for human use.

Solar Energy

Have you ever used a calculator with a solar collector? These solar-powered calculators use the Sun's energy to provide power. As you learned in Section 25.1, the Sun is the source of most of the energy on Earth. The main advantages of solar energy are that it is free and it doesn't cause pollution.

As you also learned in Section 25.1, many of the fuels used today are renewable resources, including wood. Most people, however, rely heavily on nonrenewable fossil fuels for their energy needs. Nonrenewable fossil fuels (oil, coal, and natural gas) are used to generate approximately 85 percent of the total energy consumed for electricity, heat, and transportation in the United States.

However, the supply of fossil fuels on Earth is limited. **Figure 25.7** shows that at the present rate of consumption, scientists estimate that oil and natural gas reserves might last only another 50 years. Although coal will last longer, burning coal releases harmful gases into the atmosphere, as you will learn in Chapter 26. Scientists, private companies, and government agencies are all studying renewable resources, such as solar energy, as alternatives to traditional energy resources, including fossil fuels.

You have learned that plants transfer the energy provided by the Sun to other organisms through food webs. Solar energy can also be used directly to meet human energy needs through passive and active solar heating.

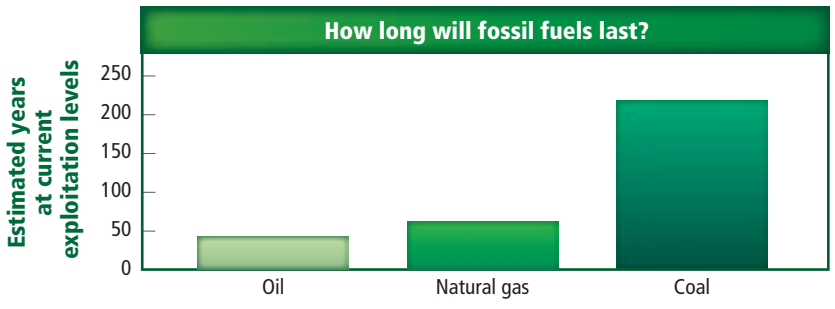


Figure 25.7 At current consumption rates, available oil reserves might last only 50 years.

Passive solar heating If you have ever sat in a car that has been in the sunlight, you know that the Sun can heat up the inside of a car just by shining through the windows and on the surface of the car. In the same way, the Sun's energy can be captured in homes. Thermal energy from the Sun enters through windows, as shown in **Figure 25.8.** Floors and walls made of concrete, adobe, brick, stone, or tile have heat-storing capacities and can help to hold the thermal energy inside the home. These materials collect solar energy during the daytime and slowly release it during the evening as the surroundings cool.

In some warm climates, these materials alone can provide enough energy to keep a house warm. Solar energy that is trapped in materials and slowly released is called passive solar heating. Passive solar designs can provide up to 70 percent of the energy needed to heat a house. Although a passive solar house can be slightly more expensive to build than a traditional home, the cost of operating such a house is 30 to 40 percent lower.

Reading Check **Explain** the process of heating a home using passive solar heating.

Active solar heating Even in areas that do not receive consistent sunlight, the Sun's energy can still be used for heating. Active solar-heating systems include collectors such as solar panels that absorb solar energy, and fans or pumps that distribute that energy throughout the house.

If kept away from trees, solar panels mounted on the roof can have unobstructed exposure to the Sun. Energy collected by these solar panels can be used to heat a house directly, or it can be stored for later use in insulated tanks that contain rocks, water, or a heat-absorbing chemical. Solar panels, shown in **Figure 25.8,** mounted on a roof can heat water up to 65°C, which is hot enough to wash dishes and clothing.

Passive and active solar heating rely on direct sunlight. Using direct sunlight is relatively easy, but energy is also needed during hours of darkness, or in areas that are often overcast. Solar energy is difficult to store for later use. An economical and practical method of storing large amounts of solar energy for long periods of time has not yet been developed.

Passive solar heating

Active solar heating

Figure 25.8 Solar heating is considered a good alternative to conventional energy resources because it is clean and readily available in some areas. However, sunlight is available during limited hours each day and it is difficult to store for later use. More research needs to be done to make solar power a reasonable alternative for more people.

FOLDABLES
Incorporate information from this section into your Foldable.

Photovoltaic cells Solar energy can be converted into electric energy by using a **photovoltaic cell,** a structure that is made of two layers of two types of silicon. The cell absorbs energy from the sunlight that strikes it. The electricity produced by photovoltaic cells can be stored in batteries. Photovoltaic cells are reliable, quiet, and typically last more than 30 years. Large-scale groups of panels can be set up in deserts and in other land areas that are not useful for other human purposes.

One example of this is a solar power tower. The solar power tower generates electricity by harnessing the solar heating of the desert surface. A glass canopy surrounds the tower and acts as a greenhouse to heat the earth beneath it. The heat creates a self-contained wind field, driving a network of 32 turbines, which generate electricity. Other advances in technology, such as those shown in **Figure 25.9,** might make renewable energy sources more accessible for future generations.

Energy from Water

Hydroelectric power is generated by converting the energy of free-falling water to electricity. When a dam is built across a large river to create a reservoir, the water stored in the reservoir can flow through pipes at controlled rates and cause turbines to spin to produce electricity. Hydroelectric power can also be generated from free-flowing water, such as the Niagara River. Today, hydroelectric power provides about 20 percent of the world's electricity and 6 percent of its total energy. Approximately 10 percent of the electricity used in the United States is generated by water, while Canada obtains more than 70 percent of its electricity from this source. Many of the hydroelectric power resources of North America and Europe have been developed, but sites have not yet been developed in Africa, South America, and Asia.

Figure 25.9

Development of Alternative Energy Sources

Countries develop new sources of energy to meet their growing needs.

1933–1935 The United States builds the Hoover Dam and the Grand Coulee Dam to produce hydroelectric power, the country's main energy source, second to coal, until 1984.

1800 1900 1925 1950

1800 Holland boasts 9000 windmills that are used chiefly for land drainage and grinding grain.

1919 Ethanol, used as fuel for early automobiles, is banned during Prohibition in the United States. Gasoline becomes the primary source of motor fuel.

1952 Coal, which had replaced wood in much of Europe due to deforestation, causes a smog that kills 4000 Londoners. England enacts new antipollution laws.

Energy from the oceans Ocean water is another potential source of energy. The energy of motion in waves, which is created primarily by wind, can be used to generate electricity. Barriers built across estuaries or inlets can capture the energy associated with the ebb and flow of tides for use in tidal power plants.

Geothermal Energy

Geothermal energy doesn't come from the Sun. Instead, it originates from Earth's internal heat. Steam produced when water is heated by hot magma beneath Earth's surface can be used to turn turbines and generate electricity. A geothermal power plant is shown in **Figure 25.10.** Energy produced by naturally occurring heat, steam, and hot water is called **geothermal energy.** While some geothermal energy escapes from Earth in small amounts that are barely noticeable, large amounts of geothermal energy are released at other surface locations. In these areas, which usually coincide with plate boundaries, geothermal energy can be used to produce electricity.

Wind Energy

Windmills in the Netherlands have been capturing wind power for human use for more than 2000 years. The windmills used today are more accurately called wind turbines because they convert the energy of the wind into electrical energy. Wind turbines currently provide 3 percent of the electricity used in Denmark. Experts suggest that wind power could supply more than 10 percent of the world's electricity by the year 2050.

Figure 25.10 Geothermal energy plants produce clean energy by harnessing the naturally occurring heat often found at plate boundaries.
Analyze ***Is geothermal energy a renewable resource? Explain.***

Concepts in Motion

Interactive Figure To see an animation of geothermal power, visit glencoe.com.

1969 Iceland builds its first geothermal power plant. Today, geothermal energy heats 87 percent of the country's homes and supplies 17 percent of its energy needs.

1995 The United States' program uses landfill gas to make electricity, reducing certain greenhouse gas emissions.

2005 Ninety percent of all homes in Israel use solar panels to heat water. Other countries have adopted this technology in recent decades.

1960 1980 2000

1957 The first large-scale commercial nuclear power plant in the country begins operating in Shippingport, Pennsylvania.

1997 The first hybrid car to run on a gasoline engine and an electrical motor is mass-produced and released in Japan.

Concepts in Motion

Interactive Time Line To learn more about these discoveries and others, visit glencoe.com. Earth Science Online

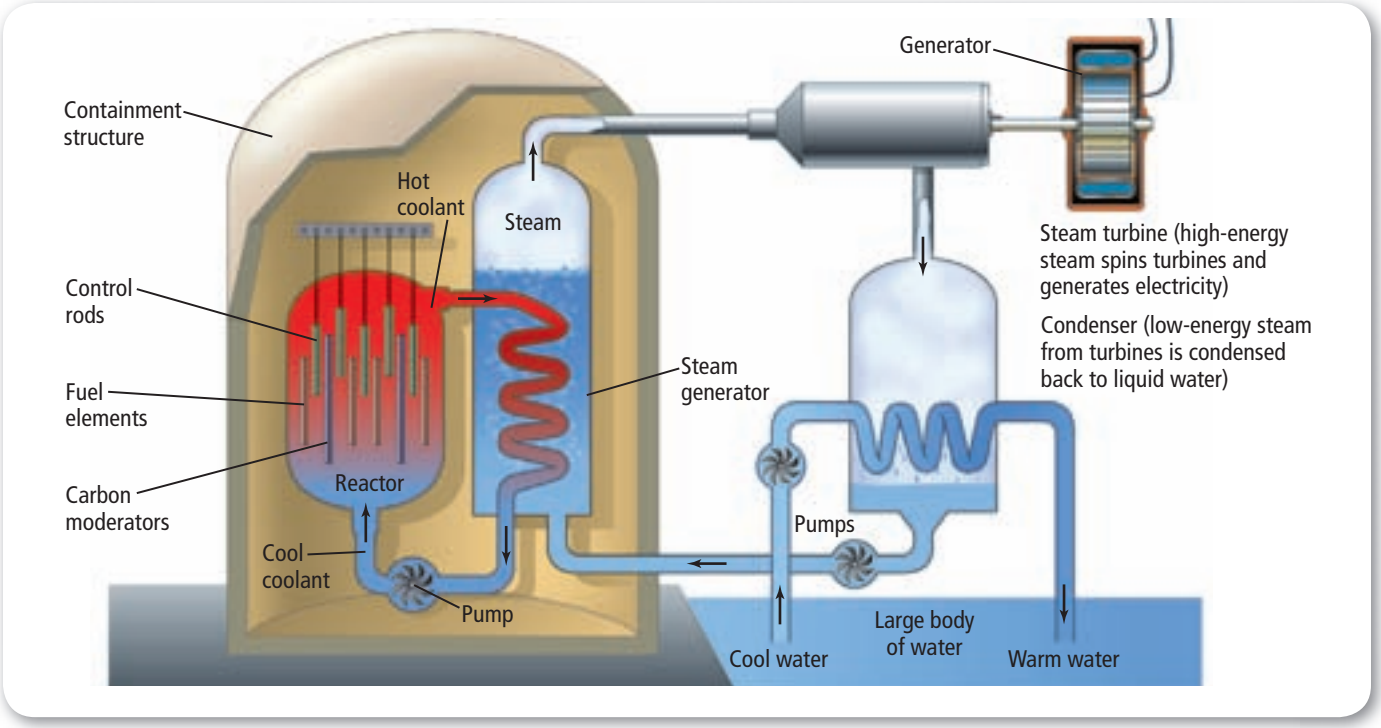


Figure 25.11 Nuclear reactors rely on fission to generate heat. Heated water is converted to steam which turns a turbine to generate electricity.
Identify *how many separate systems are in this reactor.*

concepts in MOtion
Interactive Figure To see an animation of a nuclear fission reactor, visit glencoe.com.

Nuclear Energy

As you learned in Chapter 3, atoms lose particles in the process of radioactive decay. One process by which atomic particles are emitted is called nuclear fission. **Nuclear fission** is the process in which a heavy nucleus (mass number greater than 200) divides to form smaller nuclei and one or two neutrons. This process releases a large amount of energy. Radioactive elements consist of atoms that have a natural tendency to undergo nuclear fission. Uranium is one such radioactive element that is commonly used in the production of nuclear energy. Nuclear energy is one other energy source that does not come directly from the Sun.

In the late 1950s, power companies in the United States began developing nuclear power plants similar to the one shown in **Figure 25.11.** Scientists suggested that nuclear power could produce electricity at a much lower cost than coal and other types of fossil fuels. Another advantage is that nuclear power plants do not produce carbon dioxide or any other greenhouse gases. After 50 years of development, however, 445 nuclear reactors are currently producing only 17 percent of the world's electricity. Construction of new nuclear power plants in Europe has come to a halt, and new nuclear plants have not been built in the United States since 1978.

What happened to using nuclear energy as a new source of power? High operating costs, poor reactor designs, and public concerns about radioactive wastes contributed to the decline of nuclear power. In addition, nuclear accidents, such as those at Three Mile Island in Pennsylvania, in 1979, and at Chernobyl, Ukraine, in 1986, alerted people to the hazards of nuclear power plants. Because of its hazards, nuclear power has not been developed further in the United States as an alternative energy source.

Jim Richardson/CORBIS

Biofuels

You learned in Section 25.1 that biomass fuels include wood, dried field crops, and fecal materials from animals. Biomass is a renewable energy resource as long as the organisms that provide the biomass are replaced. Scientists are developing ways to produce fuels similar to gasoline from crops such as corn and soybeans. These fuels are called biofuels.

Ethanol Ethanol is a liquid produced by fermenting crops such as barley, wheat, and corn, which is shown in **Figure 25.12.** Ethanol can be blended with gasoline to reduce consumption of fossil fuels. Ethanol fuels burn more cleanly than pure gasoline. Most cars today can use fuels with up to 10 percent ethanol. Some vehicles, called flexible fuel vehicles, can run on mixtures containing 85 percent ethanol.

Biodiesel Biodiesel can be manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is safe, biodegradable, and reduces air pollution. Blends of 20 percent biodiesel with 80 percent petroleum diesel (B20) can generally be used in unmodified diesel engines; however, it is currently more expensive than regular diesel.

Figure 25.12 Biofuels, like biomass fuels, are derived from renewable resources. Crops like corn can be processed to create ethanol, a cleaner burning fuel than gasoline.

Section 25.2 Assessment

Section Summary

- Alternative energy resources can supplement dwindling fossil fuel reserves.
- Solar energy is unlimited, but technological advances are needed to find solutions to collect and store it.
- Nuclear energy is produced when atoms of radioactive elements emit particles in the process known as nuclear fission.
- Biofuels can help reduce consumption of fossil fuels.

Understand Main Ideas

1. MAIN Idea **Identify** one alternative energy resource that is associated with each of Earth's systems: the atmosphere, hydrosphere, biosphere, and geosphere.
2. **Compare** passive solar energy and active solar energy.
3. **Infer** which alternative energy source would have the least impact on the environment if the required technology could be developed to harness and use it. Explain.

Think Critically

4. **Analyze** In theory, solar energy could supply all of the world's energy needs. Why isn't it used to do so?
5. **Evaluate** the advantages and disadvantages of nuclear energy.

WRITING in Earth Science

6. Write a newspaper article that describes how alternative energy resources can be used where you live.

Section 25.3

Objectives

- **Identify** ways to conserve energy resources.
- **Discuss** how increasing energy efficiency can help preserve fossil fuels.
- **Describe** ways to use energy more efficiently.

Review Vocabulary

renewable resource: a resource that is replaced through natural processes at a rate equal to or greater than the rate at which it is used

New Vocabulary

energy efficiency
cogeneration
sustainable energy

Conservation of Energy Resources

MAIN Idea **Using energy efficiently reduces the consumption of nonrenewable resources.**

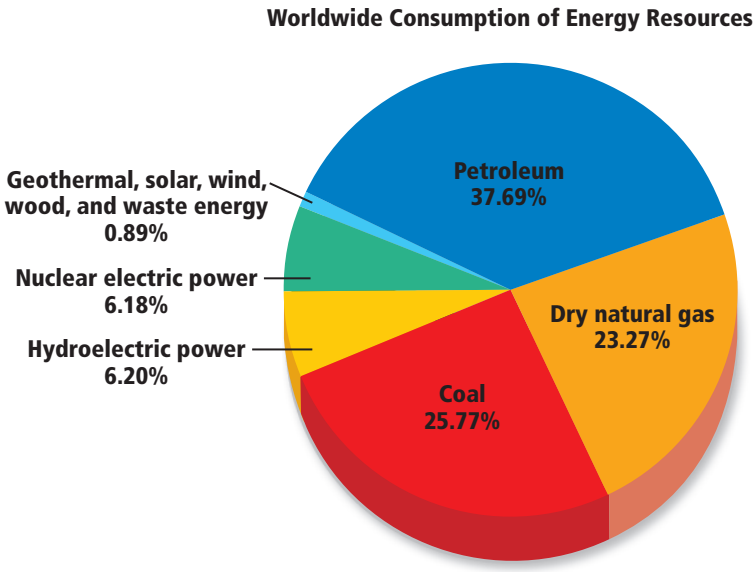
Real-World Reading Link Think of runners on a cross-country team or a swimmer in a 400-m event. They don't sprint to start, instead they pace themselves so they have enough energy to finish the race. Energy resources can be used in this way, too.

Global Use of Energy Resources

As you learned in Chapter 24, fossil fuels are nonrenewable and are in limited supply. Yet people on Earth consume these resources at increasing rates. **Figure 25.13** shows global consumption of natural resources, both renewable and nonrenewable. However, consumption is not equal in all parts of the world. Developing countries, for example, obtain 41 percent of their energy from a renewable resource, compared to industrialized countries where renewable resources account for only about 10 percent of the energy used.

Using renewable energy resources that are locally available conserves the fuel that would be used to transport and process resources at a different location. Using a variety of energy resources rather than a single, nonrenewable energy resource, such as fossil fuels, can also help conserve resources. For example, a community that has hydroelectric energy resources might also use solar energy to generate electricity during months when water levels are low.

Figure 25.13 Petroleum is the most widely used energy resource worldwide, followed closely by coal and natural gas.
Explain *Why do you think nonrenewable resources account for almost 87 percent of the world energy consumption?*



Energy Efficiency

Energy is the ability to do work. The amount of work produced compared to the amount of energy used is called **energy efficiency.** Energy resources do not produce 100 percent of the potential work that is stored in the energy source.

When a car uses gasoline, some of the energy stored in the gasoline is converted to mechanical energy that moves the car, while some of the energy is used to power accessories, like the car's air conditioner. Most of the energy in the gasoline is lost as heat. Decreasing heat loss is one way that more of the stored energy can be converted to do work. To find ways to use resources more efficiently, scientists study exactly how energy resources are used and where improvements are needed. Using resources more efficiently is a type of conservation. For example, adding insulation to a house reduces heat loss, so less energy is needed to heat the air inside.

Reading Check **Explain** energy efficiency.

Improving efficiency in industry Most of the electricity in the United States is generated by burning fossil fuels—predominantly coal—to heat water, forming steam. Recall that increasing the temperature of a gas also increases pressure. It is the steam pressure that spins the turbines that drive the generators to create electricity. Unfortunately, this is an inefficient process. Approximately one-third of the energy potential within the original fuel source can be converted into steam pressure.

Improving efficiency in transportation Transportation is necessary to move people, food, and other goods from one place to another. Although most transportation currently relies on oil, conservation practices can help reduce dependency on oil resources used for transportation. **Table 25.1** lists some of the advantages of public transportation, which is one way people can improve energy efficiency in transportation.

CAREERS IN EARTH SCIENCE

Environmental Consultant An environmental consultant interprets environmental data, conducts field surveys, and conducts environmental impact assessments. From this information, they make suggestions to businesses of how to limit their environmental impacts and meet governmental regulations. To learn more about Earth science careers, visit glencoe.com.

Table 25.1 **Advantages of Public Transportation**

Concepts in Motion
Interactive Table To explore more about public transportation, visit glencoe.com.

Using public transportation to get to work can save a person between $300 and $3000 in fuel costs per year.
Using public transportation saves more than 3 billion liters of gasoline every year—equal to all U.S. manufacturers of computers and electronic equipment.
If Americans used public transportation for roughly 10 percent of daily travel needs, the United States would reduce its dependence on imported oil from the Persian Gulf by more than 40 percent.
During the past ten years, U.S. public transportation use has grown by 25.1 percent—a faster rate than highway travel (22.5 percent).

Commuting efficiently People who live in metropolitan areas can improve energy efficiency by using public transportation. Major U.S. cities, such as New York, use subways or elevated trains to move people. In Europe, mass transportation includes long-distance rail systems, as well as electric trams and trolleys. When it is necessary to drive private automobiles, carpooling can reduce the number of vehicles on the highways. Some metropolitan areas encourage carpooling by providing express lanes for cars with multiple passengers.

Automobiles The use of fuel-efficient vehicles is another way to reduce the amount of petroleum resources consumed. Automobile manufacturers can build vehicles that achieve high rates of fuel efficiency without sacrificing performance. The future of this industry is promising as hybrid, fuel cell, and electric technologies begin to reach the consumer market. Also, less energy is needed to move something that weighs less. Smaller cars use less gasoline. Another way to conserve gasoline is to drive slower than 100 km/h (62 mph) on the freeway and use alternate forms of transportation.

Getting more for less Increased demand for fuels requires a greater supply and results in higher costs. Electricity is costly to produce, and it is not usually used efficiently in homes or industry. In the United States, approximately 43 percent of the energy used to fuel motor vehicles and to heat homes and businesses is lost as thermal energy. If energy were used more efficiently, less energy would be needed, thus decreasing the total cost of energy.

VOCABULARY

ACADEMIC VOCABULARY

Efficient
productive without waste
The automobile was more efficient when the proper tune-ups had been done.

DATA ANALYSIS LAB

Based on Real Data*

Make and Use Graphs

What proportion of energy resource types are used to heat homes? Natural gas, electricity, heating oil, propane, and kerosene are used to heat American homes. The table shows percentages used to heat different types of homes.

Think Critically

1. **Compare** the sources of energy used by plotting the data on a graph. Be sure to use different colors for the different types of energy. Place the percentages on the *y*-axis and the source on the *x*-axis.
2. **Infer** why single-family homes use natural gas more than other types of dwellings.
3. **Infer** why heating oil, propane, and kerosene are not widely used as energy sources for homes.

Data and Observations

Energy Sources for American Homes (%)

Energy Source	Single-Family Dwellings	Multi-Family Dwellings	Mobile Homes
Natural gas	60	48	32
Electricity	23	42	43
Heating oil	8	7	3
Propane	5	0	15
Kerosene	1	0	4
Other	3	3	3

*Data obtained from: The National Energy Education Development Project. 2004. *Secondary Energy Infobook*.

Harnessing waste thermal energy Generating electricity produces waste thermal energy that can be recovered. The simultaneous production of two usable forms of energy is called **cogeneration.** Cogeneration captures the excess thermal energy (steam) for domestic or industrial heating. It can also be used in a large air-conditioner unit. It turns a turbine connected to a compressor that chills water sent to an air handler unit in a different building. Excess thermal energy can also be used to generate electricity that operates electrical devices within the power plant, such as sulfur-removing scrubbers on smokestacks. While industries use one-third of all energy produced in the United States, cogeneration has allowed some industries to increase production while reducing energy use. Cogeneration has enabled central Florida to operate the nation's cleanest coal-powered electric facility. The power station shown in **Figure 25.14** utilizes cogeneration for an oil refinery and chemical plant.

Figure 25.14 This cogeneration power station helps reduce energy use at an oil refinery and chemical plant in Hampshire, UK.

Sustainable Energy

Energy resources on Earth are interrelated, and they affect one another. **Sustainable energy** involves the global management of Earth's natural resources to meet current and future energy needs. A good management plan incorporates both conservation and energy efficiency. New technology that extends the supply of fossil fuels is a vital part of such a plan. Global cooperation can help maintain the necessary balance between protection of the environment and economic growth. The achievement of these goals will depend on the commitment made by all so that future generations have access to the energy resources required to maintain a high quality of life on Earth.

Section 25.3 Assessment

Section Summary

- Energy resources will last longer if conservation and energy-efficiency measures are developed and used.
- Energy efficiency results in the use of fewer resources to provide more usable energy.
- Cogeneration, in which two usable forms of energy are produced at the same time from the same process, can help save resources.
- Sustainable energy can help meet current and future energy needs.

Understand Main Ideas

1. MAIN Idea **Summarize** why the conservation and efficient use of energy resources is important.
2. **List** three ways in which you could conserve electric energy in your home.
3. **Compare** energy consumption between developing and industrialized countries.
4. **Analyze** Why is it important to conserve resources instead of seeking new sources of fossil fuels for energy?

Think Critically

5. **Illustrate** how cogeneration can save energy resources.

MATH in Earth Science

6. If the global consumption of coal were reduced by 25 percent, what would the percentage consumption of coal be? Refer to **Figure 25.13** for more information.

Earth Science and the Environment

Bacteria Power!

Bacteria are all around us—some are helpful while others cause disease. Without bacteria, life would be very different. Humans have bacteria that live in the stomach and intestines to help digest food. Other bacteria cause illnesses such as strep throat and tuberculosis.

Pollution-eating bacteria Through research, scientists have discovered bacteria that can eat pollution, and other bacteria that can produce energy that can be harnessed for human use. Bacteria in the genus *Desulfitobacterium* have long been studied for their unique appetites. They eat pollution, such as toxic waste, and change it into less toxic or even nontoxic products. Recently, scientists worked with *Desulfitobacterium* successfully to find a species of bacteria that could break down freshwater pollution.

Microbial power plants Not only are *Desulfitobacterium* able to consume toxic waste, they are also able to produce energy at a constant rate. While scientists have known of the bacteria's ability to break down different toxins and produce energy as a by-product, this was the first time it was discovered that bacteria could do both at once. The energy that the bacteria produced could be harnessed to run small electrical devices.

Desulfitobacterium are able to survive extreme heat, radiation, and other environments that would easily wipe out other bacterial populations. Imagine that a fuel cell containing *Desulfitobacterium* is placed in an area where it will not be used for many years, and where it is exposed to harsh environments. If *Disulfitobacterium* was used as the power source for the fuel cell, it could exist in a stage similar to hibernation until it was needed or until conditions improved.

In the future, *Desulfitobacterium* might be used to power a wastewater treatment plant, such as this one, while helping to reclaim the wastewater being processed.

Diverse diets The metabolic capabilities of *Desulfitobacterium* bacteria are unique. The bacteria have a diverse diet, so they can use many different sources, including wastewater, chemical pollutants, and pesticides, to produce electricity.

While this biotechnology is still in the early stages of discovery and development, there are many exciting opportunities to be explored. It is possible that a bacterial colony could be used to reclaim wastewater while producing electricity to power the water treatment plant at the same time.

WRITING in Earth Science

Brochure You are marketing a fuel cell that uses these bacteria. Create a brochure explaining the potential uses of these fuel cells and why this biotechnology is important in today's world.

GEOLAB

DESIGN YOUR OWN: DESIGN AN ENERGY-EFFICIENT BUILDING

Background: **Buildings can be designed to conserve heat. Some considerations involved in the design of a building that conserves heat include the materials that will be used in construction, the materials that will store heat, and the overall layout of the building. By using a more energy-efficient design and more energy-efficient materials, consumers can decrease their monthly gas or electric bills and conserve natural resources.**

Question: *How can a building be designed to conserve heat?*

Possible Materials

glass or clear plastic squares
sturdy cardboard boxes
scissors
tape
glue
thermometers
paint
paper
aluminum foil
polystyrene
stone
mirrors
fabric
light source

Safety Precautions

Procedure

1. Read and complete the lab safety form.
2. Working in groups of three to four, brainstorm a list of design features that might contribute to the heat efficiency of a building and consider how you might incorporate some of these features into your building.
3. Design your building.
4. Make a list of heat-conserving issues that you addressed.
5. Decide which materials you will use to build your house. Collect those materials.
6. Construct the building and a control building for comparison.
7. Devise a way to test the heat-holding ability of each building.
8. Perform the test on each building. To test the buildings' heat efficiency, it may be necessary to heat the buildings and determine how long heat is conserved within each one. **WARNING:** ***Make sure the heat source is far enough away from the building materials so that they do not burn or melt.***
9. Record your data in a table. Then, make a graph of your data.
10. Make modifications to the design to improve the building's efficiency.

Analyze and Conclude

1. **Conclude** Was the building you designed more energy-efficient than the control building?
2. **Analyze** What problems did you encounter, and how did you solve them?
3. **Analyze** How did your observations affect decisions that you might make if you were to repeat this lab? Why do you think your design worked or did not work?
4. **Predict** Would your design work in a home in your community? In a community with a different climate? Why or Why not?
5. **Compare and contrast** the building you designed and the control building.
6. **Compare and contrast** your design and the designs of your classmates.
7. **Determine** how your design could be improved.
8. **Predict** how using different energy sources might affect your results.

TRY AT HOME

Apply How could you incorporate some of your design elements into your own home? Discuss your lab with an adult at home and make suggestions to conserve heat. Visit glencoe.com for more information on heat-efficient designs.

CHAPTER 25

Study Guide

Download quizzes, key terms, and flash cards from glencoe.com.

BIG Idea People use energy resources, most of which originate from the Sun, for everyday living.

Section 25.1 Conventional Energy Resources

Vocabulary

- biomass fuel (p. 709)
- fossil fuel (p. 710)
- fuel (p. 709)
- hydrocarbon (p. 709)
- peat (p. 710)

Key Concepts

MAIN Idea Biomass and fossil fuels store energy from the Sun.

- The Sun is the source of most energy on Earth.
- Humans have used materials derived from living things, such as wood, as renewable fuels for thousands of years.
- Fossil fuels formed from organisms that lived millions of years ago.

Lignite

Bituminous

Anthracite

Section 25.2 Alternative Energy Resources

Vocabulary

- geothermal energy (p. 717)
- hydroelectric power (p. 716)
- nuclear fission (p. 718)
- photovoltaic cell (p. 716)

Key Concepts

MAIN Idea Many resources other than fossil fuels can be developed to meet the energy needs of people on Earth.

- Alternative energy resources can supplement dwindling fossil fuel reserves.
- Solar energy is unlimited, but technological advances are needed to find solutions to collect and store it.
- Nuclear energy is produced when atoms of radioactive elements emit particles in the process known as nuclear fission.
- Biofuels can help reduce consumption of fossil fuels.

Section 25.3 Conservation of Energy Resources

Vocabulary

- cogeneration (p. 723)
- energy efficiency (p. 721)
- sustainable energy (p. 723)

Key Concepts

MAIN Idea Using energy efficiently reduces the consumption of nonrenewable resources.

- Energy resources will last longer if conservation and energy-efficiency measures are developed and used.
- Energy efficiency results in the use of fewer resources to provide more usable energy.
- Cogeneration, in which two usable forms of energy are produced at the same time from the same process, can help save resources.
- Sustainable energy can help meet current and future energy needs.

CHAPTER 25 Assessment

Vocabulary Review

Write a sentence defining each of the following vocabulary terms.

1. fuel
2. peat
3. fossil fuel
4. energy efficiency
5. geothermal energy
6. cogeneration

Fill in the blanks with an appropriate vocabulary term from the Study Guide.

7. _____ is a form of energy generated by the conversion of free-falling water to electricity.
8. Solar energy is converted into electric energy through the use of _____.
9. Molecules with hydrogen and carbon bonds are called _____.

Replace the underlined words with the correct vocabulary term from the Study Guide.

10. The process in which a heavy nucleus divides to form smaller nuclei results in a release of a large amount of energy.
11. Global management of Earth's natural resources to meet human needs will allow people to have all the energy they need to live.
12. Fuels formed from organic matter are burned in developing countries as a source of heat.

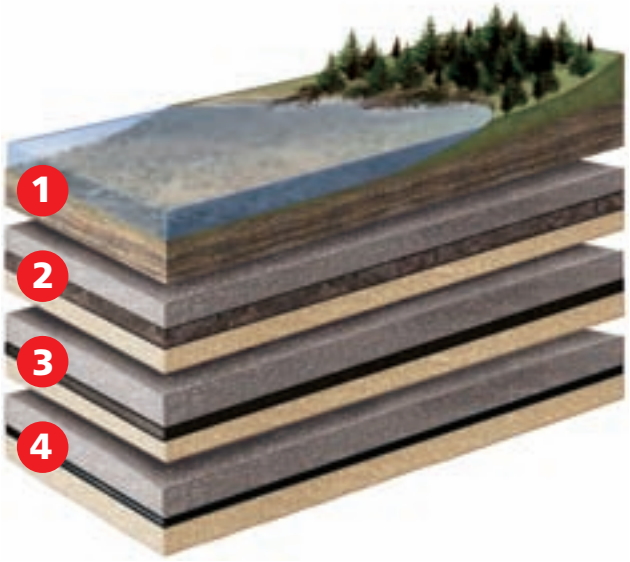
Understand Key Concepts

13. Which is the primary source of energy on Earth?
    A. oil
    B. coal
    C. the Sun
    D. wood
14. When a consumer eats a producer, from where are they gaining energy?
    A. Earth
    B. the plant
    C. the Sun
    D. the ground

Use the figure below to answer Questions 15 and 16.

15. Which best describes the type of resource illustrated in the figure?
    A. biomass
    B. biofuel
    C. solar heating
    D. fossil fuel
16. What type of resource is shown?
    A. fossil fuel
    B. renewable resource
    C. nonrenewable resource
    D. cogeneration
17. Which is not derived from living things?
    A. petroleum
    B. coal
    C. peat
    D. nuclear power
18. Which form of energy commonly coincides with tectonic plate boundaries?
    A. fossil fuels
    B. geothermal energy
    C. wind energy
    D. biomass fuels

Use the diagram below to answer Questions 19 and 20.



19. Which process happens in Layer 1?
- **A.** Vegetation accumulates and forms peat.
- **B.** Bituminous coal forms from lignite.
- **C.** Lignite forms from accumulated vegetation.
- **D.** Anthracite forms from bituminous coal.

20. Which is formed in Layer 4?
- **A.** anthracite
- **B.** bituminous coal
- **C.** lignite
- **D.** peat

21. Which is one reason nuclear power plants are not widespread?
- **A.** Nuclear power is not energy efficient.
- **B.** Nuclear reactors emit greenhouse gases.
- **C.** Nuclear reactions occur only on the Sun.
- **D.** Negative public perception of nuclear power.

Constructed Response

22. **Describe** three ways fossil fuels are used for energy.

23. **Draw and label** a diagram to explain passive solar heating.

24. **Identify** one form of energy not derived from the Sun.

25. **Describe** the formation of lignite.

26. **Explain** how organisms living on Earth in this era could become fossil fuels.

27. **Analyze** why a substance such as water is good to use in passive heating situations.

28. **List** three ways to conserve oil.

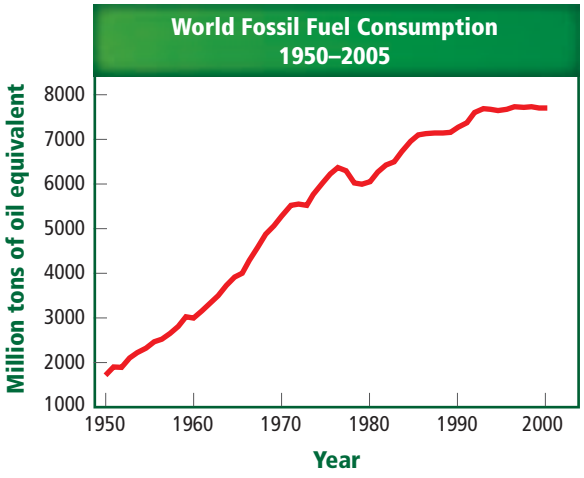
Think Critically

29. **Explain** why lignite, which has a carbon concentration of 40 percent, burns less efficiently than anthracite, which has a carbon concentration of 90 to 95 percent.

30. **Distinguish** What characteristics of water allow it to be used to produce energy as well as store energy?

31. **Explain** why biomass fuels are more widely used than oil for fuel in developing countries.

Use the graph below to answer Questions 32 and 33.



32. **Calculate** how many more tons of fossil fuels were used in 2000 compared to 1960.

33. **Predict** Do you think the trend shown on the graph would be the same for developing and industrialized countries if they were shown separately? Why?

34. **Explain** why not all organic resources are considered renewable. Give an example of a renewable and nonrenewable organic resource.

35. **Predict** What might be some negative consequences of a nation being dependent on foreign energy resources?

Earth Science online Chapter Test glencoe.com

36. **Compare and Contrast** How might the fuel-use by people living in the northeastern United States differ from fuel-use by people who live in the southern and southwestern United States?

37. **Imagine** that you and your friends took a trip to a deserted island that had no plants larger than small shrubs. Describe how you would seek a fuel source from the island.

38. **Evaluate** the potential for using more solar energy in your community. Which type of solar energy collection would work best? Is solar energy an effective energy source for your community? Why or why not?

39. **Analyze** why biomass fuels are not widely used in the United States.

40. **Compare and contrast** nuclear energy with energy that comes from petroleum.

41. **Imagine** you are eating a cheeseburger. Explain all the ways you are gaining energy derived from the Sun.

42. **Predict** what might happen to gas prices, assuming oil continues to be used at the current rate and an alternative fuel source is not discovered. Explain.

43. **Explain** why a wood-burning stove is not an efficient way to heat a home.

Concept Mapping

44. Make a concept map to organize information about alternative energy resources using the following terms: *geothermal energy, hydroelectric power, solar energy, wind power, tidal power,* and *biomass fuels.* For more help, refer to the *Skillbuilder Handbook.*

Challenge Question

45. **Apply** If a standard home costs $150,000 to build and costs $2300 per year to heat, and the same home, built with materials designed to use passive solar heat, costs $180,000 to build, but $400 per year to heat, how long will it take to make up the price difference between the two houses?

Additional Assessment

46. WRITING in Earth Science Write a letter to the editor for a local newspaper to convince others to recycle. Include specific examples and how those actions will assist in extending the limited supply of a particular natural resource.

DBQ Document–Based Questions

Data obtained from: Annual Energy Review 2005. July 2006. *Energy Information Administration* (EIA-0384).

Energy Consumption (quadrillion btu)				
Year	Fossil Fuels	Nuclear	Renewable	Total
2000	84.96	7.86	6.17	98.99
2001	83.18	8.03	5.35	96.56
2002	83.99	8.14	5.93	98.06
2003	84.39	7.96	6.14	98.49
2004	86.23	8.22	6.22	100.67
2005	85.96	8.13	6.06	100.15

47. Compare and contrast the consumption of renewable energy resources with the consumption of other energy resources.

48. In 2001, what percentage of the total energy consumed in the United States was fossil fuels? Based on the data, has that percentage changed significantly in the first part of this decade?

49. What percentage of the total energy consumption for 2005 was comprised of fossil fuels?

Cumulative Review

50. Name the molecule that is necessary for life that was absent from Earth's early atmosphere. **(Chapter 22)**

51. Bedrock is found everywhere in Earth's crust. Explain whether or not an abundance of bedrock would diminish the concern over availability as a resource. **(Chapter 24)**

Standardized Test Practice

Multiple Choice

1. Which is the most expensive and least used method of providing water to areas in the United States?

A. tapping groundwater
B. aqueducts
C. desalination
D. dams

Use the illustration to answer Questions 2 and 3.

2. How could this kitchen be made more energy efficient?

A. by maintaining older appliances instead of replacing them with newer ones
B. by replacing the kitchen cabinets
C. by washing the dishes in the dishwasher instead of the sink
D. by replacing the old windows with newer ones

3. If this kitchen were located in a home in Arizona, which alternative energy source could be used?

A. peat
B. solar energy
C. ethanol
D. hydroelectric power

4. Which relationship between geologic structures and plate boundaries is most accurate?

A. Explosive volcanoes most often occur near convergent boundaries.
B. Folded mountains commonly develop at divergent boundaries.
C. Rift valleys are usually produced at convergent boundaries.
D. Volcanic arcs are usually found along transform boundaries.

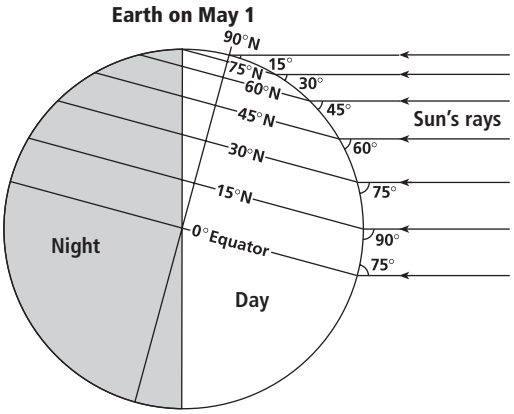
5. Besides being a requirement for respiration, why else is oxygen important in the atmosphere?

A. It provides protection from ultraviolet rays emitted by the Sun.
B. It regulates climate and weather patterns on Earth.
C. It is the major component of wind to cool Earth.
D. It allows rays from the Sun to filter in and warm Earth.

6. What was the goal of Stanley Miller's research?

A. to refute the belief that life could have existed on early Earth
B. to explain the formation of oxygen on early Earth
C. to test the primordial soup hypothesis
D. to do an analysis of the atmosphere present on early Earth

Use the illustration below to answer Questions 7 and 8.



7. Which change can be expected to occur at 45° N over the next 30 days?

A. The duration of solar radiation will decrease and the temperature will decrease.
B. The duration of solar radiation will decrease and the temperature will increase.
C. The duration of solar radiation will increase and the temperature will decrease.
D. The duration of solar radiation will increase and the temperature will increase.

8. Where would the risk of sunburn be highest?

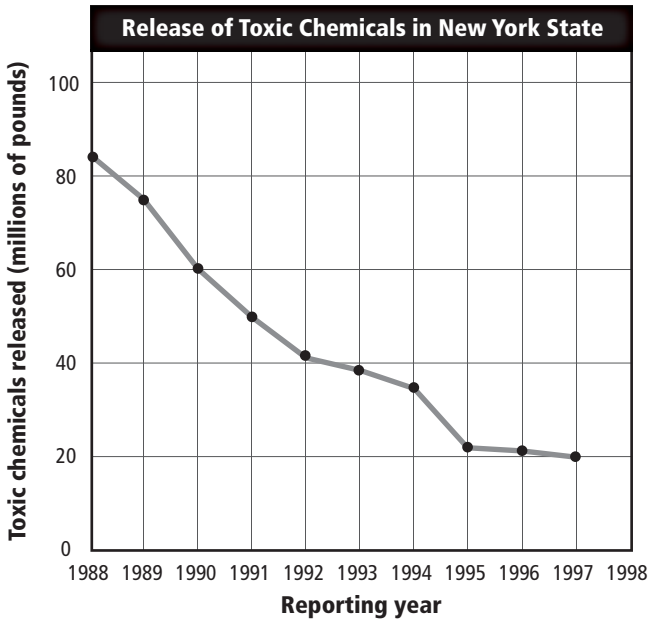
A. the equator
B. 15° N
C. 45° N
D. 75° N

9. Besides the formation of Pangaea, what other major event occurred during the Paleozoic?

A. the first major volcanic eruption
B. the first appearance of life
C. the appearance of complex life
D. the mass extinction of all life

Short Answer

Use the illustration below to answer Questions 10 to 12.



10. About how much change has occurred in the amount of toxic chemical released from 1988 to 1997?

11. During what four-year period was the greatest drop in toxic chemicals released? What is one possible explanation for this major drop?

12. State one possible explanation for why the amount of toxic chemicals released remained relatively constant between 1995 and 1997.

13. How were coral reefs formed?

14. How does the process of relative-age dating differ from the process of absolute-age dating?

15. What do scientists hypothesize as the cause of the cooling trend during the Cenozoic Era?

Reading for Comprehension

Vegetable Oil Fuels

Chemists and advocates for alternative energy technologies are training their sights on the grease used to cook french fries. Unlike petroleum-based products, vegetable oils are biodegradable, non-toxic, and are derived from a renewable resource. One problem, however, is the high development cost of vegetable-derived motor oils relative to petroleum-based products. Advocates for the use of vegetable oils say they are easier on the environment because they are much more biodegradable than conventional, petroleum-based oils. When spilled or disposed of on the ground, vegetable oil will decompose by upward of 98 percent. Petroleum based products only decompose 20 to 40 percent. Additionally, vegetable oils are a renewable resource.

Article obtained from: Roach, J. Vegetable oil—the new fuel? *National Geographic News*. April 22, 2003. (Online resource accessed October 7, 2006.)

16. What can be inferred from this passage?

A. Petroleum-based oils are better than vegetable oils as energy sources.

B. Vegetable oils will not be able to be used in car engines.

C. Although vegetable oils are better for the environment, it will be some time before they replace the use of petroleum-based oils.

D. Even though vegetable oils are better for the environment than petroleum-based oils, it is still better not to use them for energy sources.

17. When spilled or disposed of, what percent of vegetable oils will decompose?

A. 3 percent **C.** 98 percent

B. 75 percent **D.** 100 percent

NEED EXTRA HELP?															
If You Missed Question . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Review Section . . .	24.4	25.3	25.2	18.1	22.3	22.4	12.1	12.1	23.1	24.3	24.3	24.3	23.1	21.3	23.3