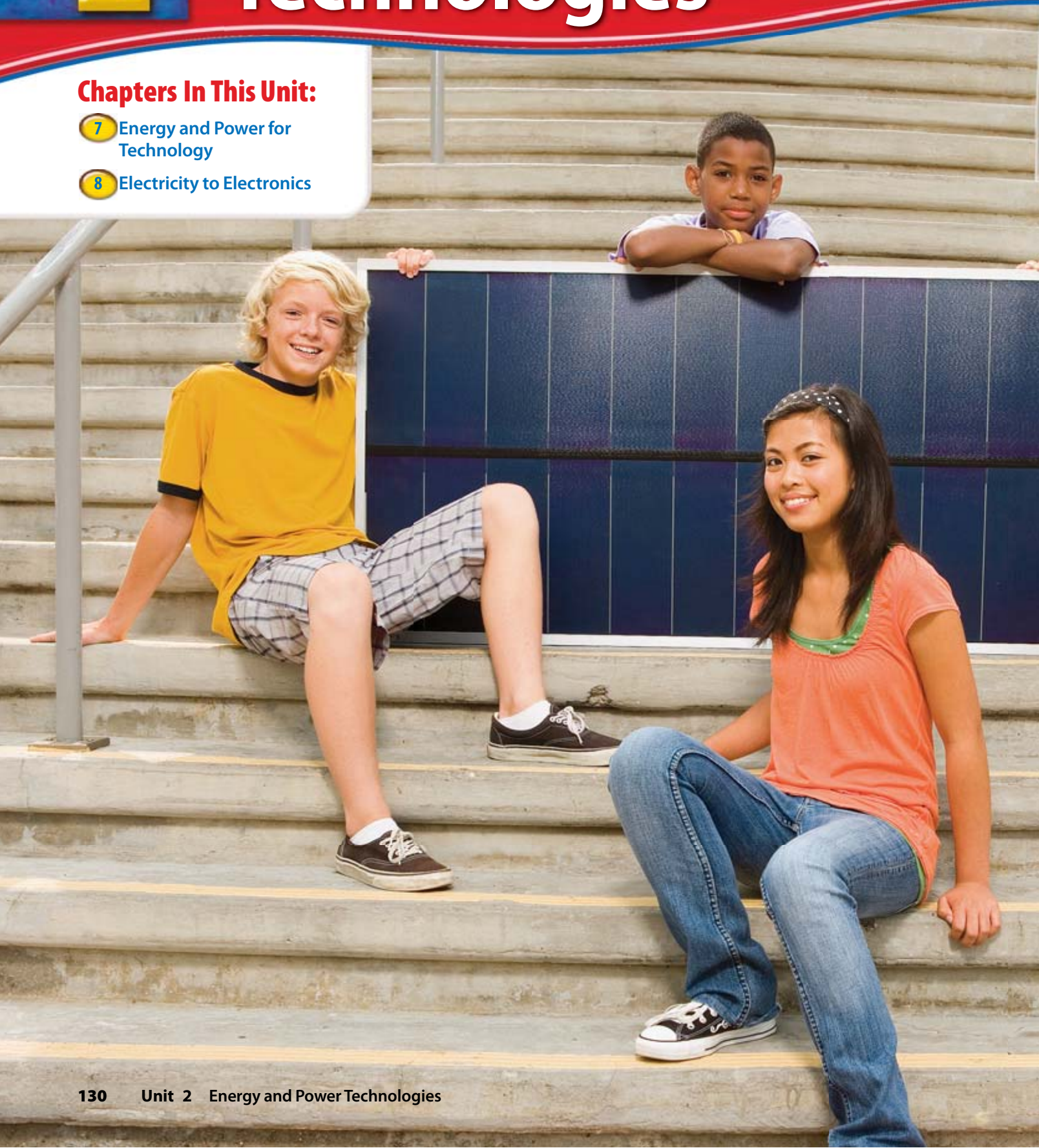
unit 2

Energy and Power Technologies

Chapters In This Unit:



Unit Thematic Project Preview

Designing Alternative Power Plants

As part of this unit, you will learn about different forms of energy. Electric companies can convert energy from many sources—water, the sun, wind, nuclear energy, or coal.

As you read this unit, use this checklist to prepare for the project at the end of this unit:

PROJECT CHECKLIST

- ✓ Make a list of alternative energy sources.
- ✓ Think about which one you would like to explore further.
- ✓ Do online research and find an example of this energy source being used today.

WebQuest Internet Project

Go to **glencoe.com** to this book's Online Learning Center (OLC) to find the WebQuest activity for Unit 2. Begin by reading the Task. This WebQuest activity will help you find out how alternative fuels can reduce air pollution and provide other benefits.

Explore the Photo

Power for Our World Since the beginning of the 20th century, people have depended on the power of electricity to operate everything from lighting to music. Recently alternative forms of energy to create electricity, such as solar power, have emerged. *Look around the classroom and make a list of everything that relies on electricity to function.*

chapter 7

Energy and Power for Technology

Sections

What You'll Learn

- **List** the different forms of energy.
- **Explain** renewable, nonrenewable, and unlimited energy resources.
- **Identify** the most common forms of power.
- **Describe** uses for each form of power.
- **Explain** how energy and power technologies are selected.
- **Identify** forms of pollution resulting from energy and power technologies.
- **Discuss** methods to slow depletion of energy resources.

Explore the Photo

The Power of Wind Large wind farms made up of wind turbines are a source of energy for many communities. *Where might be the best places for these wind farms?*

Launch the TECHNOLOGY LAB

Build a Solar Heating System

At the end of this chapter, you will be asked to create a model of a small solar heating system that might be used in a home. Get a head start by using this checklist to prepare for the Technology Lab.

PROJECT CHECKLIST

- ✓ Look up "solar heating systems" on the Internet and find one used for homes.
- ✓ Start collecting some materials you might need, such as black paper, clear plastic wrap, small-diameter plastic tubing, and thin wire.
- ✓ Ask your teacher to explain the safety procedures for this lab.

section 7.1

Energy Basics

Reading Guide

Before You Read **Preview** What is energy?

Content Vocabulary

- energy
- calorie
- fossil fuel
- solar heating system
- solar cell
- wind farm
- hydroelectric power
- geothermal energy

Academic Vocabulary

You will see these words in your reading and on your tests. Find their meanings at the back of this book.

- vehicle
- constant

Graphic Organizer

Draw the section diagram. Use it to organize and write down information as you read.

Sources of Energy

Renewable	Nonrenewable	Unlimited
Food	Oil	Solar energy

Go to **glencoe.com** to this book's OLC for a downloadable graphic organizer and more.

TECHNOLOGY STANDARDS

STL 3 Relationships & Connections
STL 5 Environmental Effects
STL 11 Design Process
STL 16 Energy & Power Technologies

ACADEMIC STANDARDS

Mathematics

NCTM Problem Solving Apply and adapt a variety of appropriate strategies to solve problems.

English Language Arts

NCTE 6 Apply knowledge of language structure and conventions to discuss texts.

STL *National Standards for Technological Literacy*
NCTM *National Council of Teachers of Mathematics*
NCTE *National Council of Teachers of English*
NSES *National Science Education Standards*
NCSS *National Council for the Social Studies*

Understanding Energy

Can we use energy directly from nature?

What is energy? Is it strength, speed, or motion? Actually, **energy** is the ability to do work. Nature does not usually give us energy in a form we can use directly. It is as if the energy were hiding—waiting for someone to find it. For example, coal is a source of energy, but it is just a black rock. Technology makes it possible to find and release the energy hidden in the rock, and then put that energy to work. Technologists are always looking for new and better ways to use nature's energy.

As You Read

Identify Think of some examples of the different forms of energy.

Forms of Energy

How many forms of energy are there?

As you go through an average day, you use many different forms of energy. Electrical energy powers light bulbs. Thermal, or heat, energy from your home's furnace keeps you warm. Mechanical energy, used by buses or cars, might get you to school.

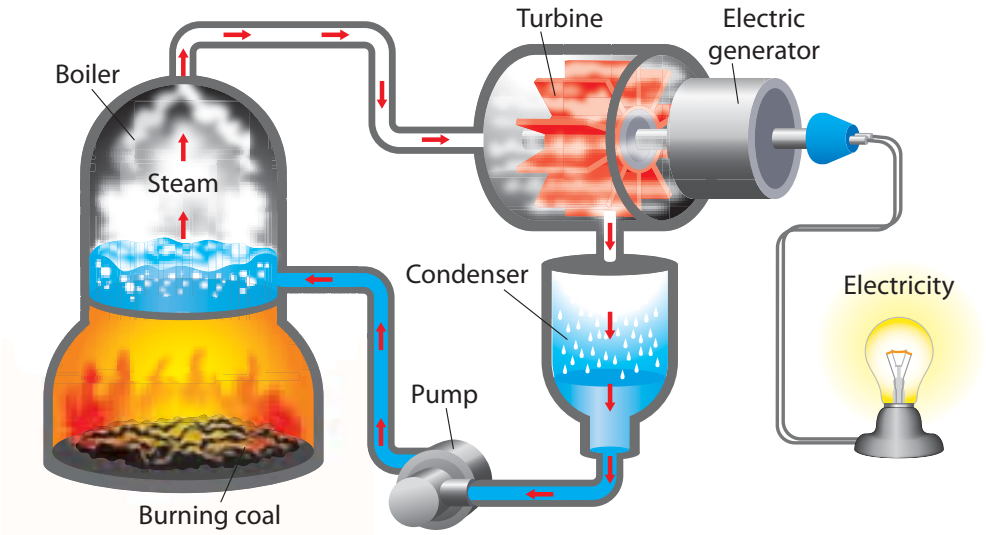
All energy in nature can be grouped into these six forms:

1. Mechanical energy, or energy of motion—pedaling a bicycle
2. Thermal, or heat, energy—a campfire for cooking marshmallows
3. Electrical energy—a bolt of lightning
4. Chemical energy—a battery in a cell phone
5. Nuclear energy—a submarine engine
6. Light, or radiant, energy—solar cells for a calculator or a house

Energy cannot be created or destroyed, but it can be changed from one form to another. For example, to use coal to produce useful electricity, the form of the energy must change many times before it becomes electricity. **Figure 7.1** Changing Forms of Energy shows the path from the black rock to electricity in these steps: Burning coal produces heat; heat changes water to steam; steam powers a turbine that spins a generator; and the generator produces electricity.

Reading Check **Recall** What are the six forms of energy in nature?

Figure 7.1 **Changing Forms of Energy**



Coal Power Raw energy sources can be converted into useful forms of energy. *What energy is created from coal?*

Energy Resources

Today's energy sources fall into what three groups?

Let's take a closer look at today's sources of energy. They can be divided into three groups: renewable, nonrenewable, and unlimited.

Renewable Sources

Renewable energy sources come from plants and animals. They can be replaced or renewed when we need more. Two examples include food and alcohol.

Food

Your body requires food for the energy you use in walking, blinking your eyes, thinking, and all your other activities. Food energy is measured in **calories**. Some foods contain more energy than others; more food energy means more calories.

Alcohol

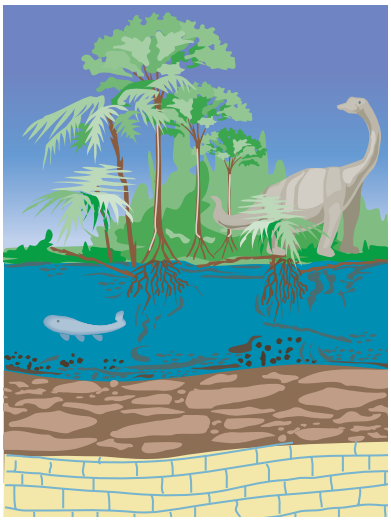
Alcohol is a liquid made from crops such as corn and sugar cane. It can be used as fuel in special automobile and truck engines. These engines can operate with regular gasoline, an alcohol-gasoline mixture, or pure alcohol. They are called "flexible-fuel" **vehicles**.

Automobiles that run on alcohol fuel produce less air pollution than those that use gasoline. When added to gasoline, an alcohol called "ethanol" can extend fuel supplies. A mixture of 10 percent ethanol and 90 percent gasoline is sold at some service stations. All ordinary car engines can run on this fuel.

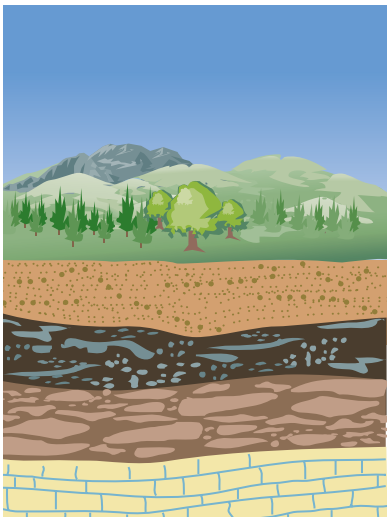
Reading Check **Recall** What might be some examples of renewable, nonrenewable, and unlimited energy sources used by your family every day?

Burning Fuel Swimming uses a lot of energy. *From what do we get that energy? What units are used to measure that kind of energy?*

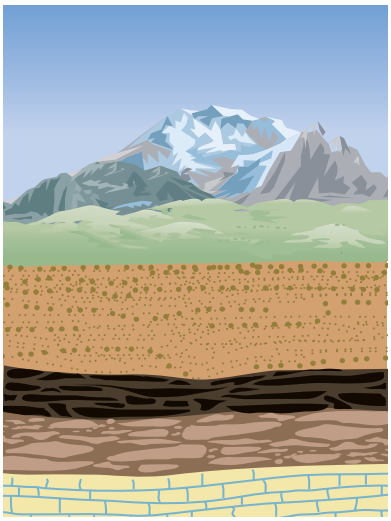
Figure 7.2 Forming Fossil Fuels



The formation of fossil fuels began when plants and animals died, and their remains formed thick layers on the bottom of swamps.



Eventually, the remains were covered by thick layers of earth.



Pressure and heat over millions of years slowly changed the remains into fossil fuels.

Ancient Energy Sources Coal, oil, and natural gas are fossil fuels that have formed over millions of years. *What type of source of energy are fossil fuels?*

Nonrenewable Sources

Nonrenewable sources of energy cannot be replaced once they are gone. Coal, oil, natural gas, and uranium are examples of these sources.

Coal, oil, and natural gas are **fossil fuels**, or fuels made from fossils. A fossil is what remains from a plant or animal that lived long ago. Coal, oil, and natural gas are formed from these once-living plants and animals. (See **Figure 7.2**.)

Coal

Millions of years ago, as plants died, their remains fell to the ground. Over time and under pressure, these plants formed thick layers, which became coal seams. A seam is a strip of coal between other rock layers. It can be close to the surface or deep underground. Many seams are only two or three feet thick. Power companies use coal to generate electricity.

Oil

You can thank animals that lived millions of years ago for the gasoline used in today's cars. When these animals died, their remains combined with the remains from plants to form crude oil. The fuels for cars, trucks, locomotives, airplanes, and ships come from oil. More of our energy comes from oil than from any other source. Oil is also turned into products, such as plastics, paint, and asphalt.

Natural Gas

The slow transformation of plant and animal matter into oil also produces natural gas. As a result, natural gas is often near oil deposits. It is a flammable gas, which means that it burns easily.

The United States produces more natural gas than any other country. Many industrial processes use natural gas. It is mostly used as a fuel for home heating and cooking. What kind of energy heats your home?

Uranium

Uranium is not a fossil fuel, but it is also a nonrenewable source of energy. Unlike fossil fuels, uranium does not come from plants and animals. It is a radioactive, rocklike mineral that comes from the ground. Uranium is used for fuel in nuclear power plants, which produce electricity. It is also used to power some U.S. Navy ships. Most of our supply of uranium comes from the states of New Mexico and Wyoming.

Uranium develops a large amount of heat during a controlled nuclear reaction. For example, in power plants, the heat changes water into steam, and the steam operates generators that produce electricity.

The amount of energy in uranium is amazingly high. One pound of uranium can produce as much electricity as 3 million pounds of coal could produce. There are more than 400 nuclear reactors in the world. The United States has more than 100, which is more than in any other country. These nuclear reactors produce about 17 percent of all electricity in the United States.

Academic Connections
Science

Your Carbon Footprint
A carbon footprint is a measure of how much carbon dioxide enters the atmosphere as a result of your daily activities. Carbon dioxide is a major greenhouse gas that comes from burning fossil fuels. What you do has an effect on your carbon footprint. That includes turning on a light switch, riding in a car, and buying food. The average U.S. carbon footprint is about 3,500 pounds per person each month.

Apply Determine your own carbon footprint. Use a search engine and the keywords *carbon footprint calculator.*

STEM

SuperStock Royalty Free (2)

On Land and Sea
One picture is a drilling rig for extracting crude oil from the ground. The other is an offshore oil rig, which resembles a community where workers can stay for weeks. *Where do the offshore oil rigs find oil?*

SuperStock Royalty Free

Energy Conversion Nuclear power plants convert nuclear energy into electrical energy. *What is the white cloud coming from one of the cooling towers?*

Unlimited Sources

Although we are using up our nonrenewable sources of energy, there are several other sources of energy that will never run out. They are known as *unlimited sources*. We will never use up all the solar energy, the energy from wind, the energy from flowing water, or the geothermal energy on our planet.

Solar Energy

Solar energy comes from the sun. Unlike coal, oil, wood, or many other sources of energy, solar energy is available all over the world. We use the sunlight, or sun's rays, for light, electricity, and heat. Many homes today are practicing energy conservation by using **solar heating systems**.

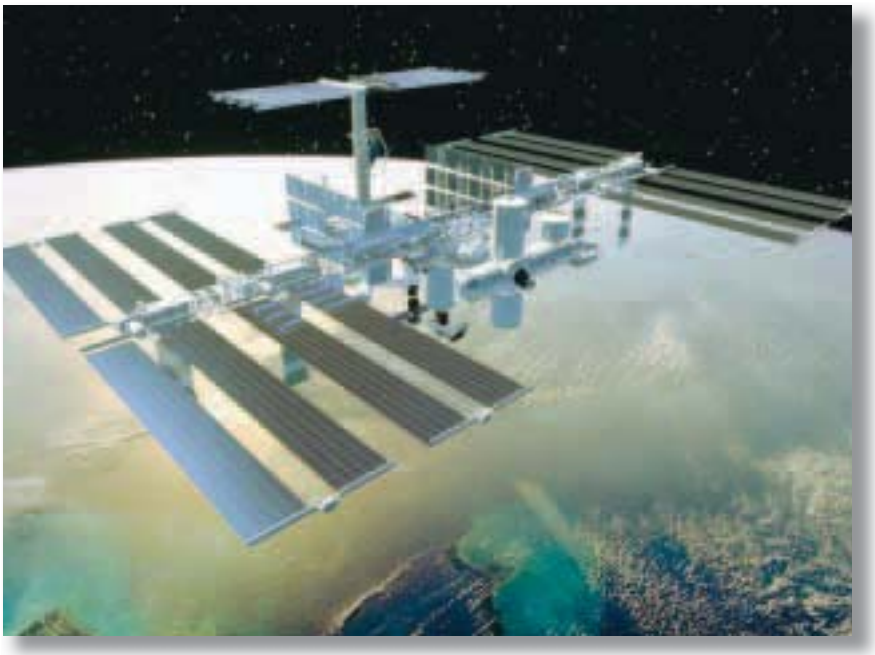
One type of system uses large flat panels called "solar collectors," which are mounted on a roof. Water flows through tubes in the solar collectors and is warmed by the sun. The heated water continues moving into the building and heats the home's interior. Another type of system uses only special windows and walls to take advantage of the sun's warming rays. Sunlight streams in and warms the interior. Some of the warmth is absorbed by the walls. Then the walls radiate the heat back into the room at night.

Solar energy can also produce electricity. This happens when sunlight strikes wafer-thin **solar cells**. These cells are also known as *photovoltaic* (foh-toh-vohl-TAY-ik) *cells*, or photocells. Orbiting satellites above Earth get their electricity from solar cells built on the satellites. Solar cells are not used as much because their electricity costs much more to produce than electricity from a power plant.

Wind

The motion of air across the earth has filled the sails of ships and turned windmills for centuries. More recently wind has been used to turn propellers connected to generators that produce electricity. The wind spins the bladed rotors of large wind turbines at about 15–17 revolutions per minute. The blades capture the energy of the wind, which is channeled to a gearbox in the "nacelle" (the turbine housing). From there, the energy flows to a generator, where it is converted into electricity. The wind turbine is controlled by advanced computers.

Wind farms consist of a group of many wind turbines. They exist in many states and countries. Wind farms are located in areas known to have fairly **constant** winds. Certain regions of the country provide enough wind for wind turbines to operate regularly. Wind turbines and other necessary equipment (like large batteries for storing electricity) can be expensive. It is not usually practical for one house to have its own wind turbine, although in earlier days, people used simple windmills for pumping water.



SuperStock Royalty Free

Energy in Space Solar cells on the International Space Station produce electricity from sunlight. They generate the same amount of electricity that 55 U.S. homes might use. *Why might this space station use solar cells?*

Imagine This...

Driving on Air

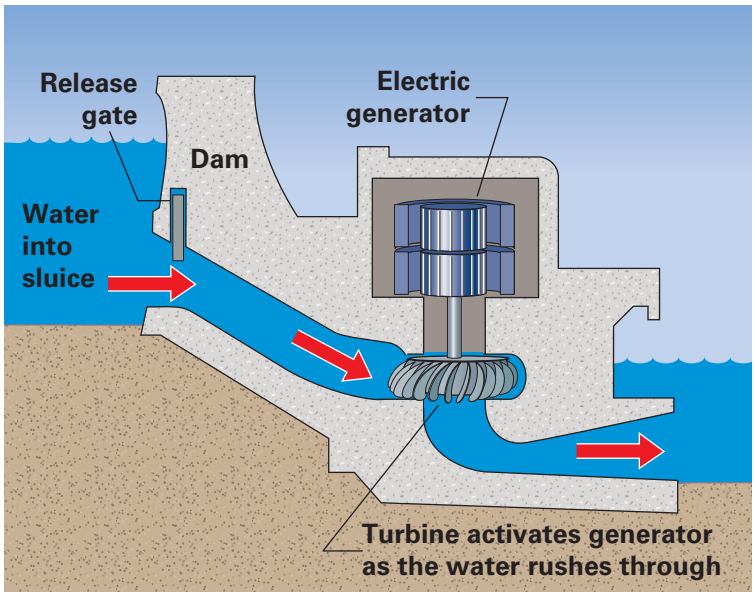
Imagine driving a car that runs on air! A French company is experimenting with a three-passenger car that runs on compressed air. The *Air Car* travels 125 miles on one charge of compressed air at a top speed of 68 mph. It would take a few minutes to refill the air tanks at special stations. The company plans to make the car in India and 12 other countries. *What might be the advantages and disadvantages of this air car?*

Go to **glencoe.com** to this book's OLC for answers and to learn more about several alternative engines.

Flowing Water

We use flowing water to generate **hydroelectric power**. *Hydro* means "water." A controlled amount of water flows through pipes in a dam and into a turbine. A turbine resembles a pinwheel. A spinning turbine, connected to a generator, creates electricity. About 7 percent of our electricity comes from hydroelectric dams. The Grand Coulee Dam in Spokane, WA, is the largest source of U.S. water power. See **Figure 7.3**.

Figure 7.3 Water Power



Going with the Flow Water flowing through the dam spins a turbine connected to a generator. *What is another term for water power?*

Geothermal Energy

Molten rock lies far beneath the earth's crust. This is where we get **geothermal energy**—heat produced under the earth. Hot water or steam is created when underground water comes in contact with hot materials and surfaces as a spring. The steam can be used to produce electricity. Some geothermal electric power plants are located along the west coast of the United States.

section 7.1 assessment

After You Read Self-Check

1. List the six forms of energy. Give an example of each form.
2. Explain how fossil fuels are formed.
3. Tell where a house's solar collectors would be located.

Think

4. Some solar houses have no windows on one side. Explain why you think this is so.

Practice Academic Skills

English Language Arts

5. Build a model of an offshore oil-drilling rig. Put it on display. Write a one-page description of how the rig operates.

STEM Mathematics

6. The local electric company has a unique way of billing. They charge a monthly minimum of $4.75, which includes the first 50 kilowatt hours (kwh). They charge $0.0822 for the next 450 kwh, $0.0536 for the next 1,500 kwh, and above that they charge $0.0514 for every kwh. How much would a bill be for 2,650 kwh?

Math Concept Multi-Step Problems Most multi-step problems require extra attention to solve.

1. Make notes to help you organize the steps that you need to take.
2. Eliminate any information that is given but not needed.

For help, go to **glencoe.com** to this book's OLC and find the Math Handbook.

section 7.2

Converting Energy to Power

Reading Guide

Before You Read **Preview** What is the difference between energy and power?

Content Vocabulary

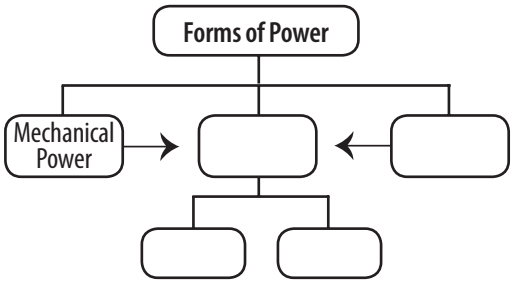
- power
- horsepower
- pneumatic power
- hydraulic power
- load
- efficiency

Academic Vocabulary

- goal
- technical

Graphic Organizer

Draw the section diagram. Use it to organize and write down information as you read.



Go to **glencoe.com** to this book's OLC for a downloadable graphic organizer and more.

TECHNOLOGY STANDARDS

STL 4 Cultural, Social, Economic & Political Effects

STL 5 Environmental Effects

STL 16 Energy & Power Technologies

ACADEMIC STANDARDS

Science

NSES Content Standard E Abilities of technological design

English Language Arts

NCTE 7 Conduct research and gather, evaluate, and synthesize data to communicate discoveries.

STL *National Standards for Technological Literacy*

NCTM *National Council of Teachers of Mathematics*

NCTE *National Council of Teachers of English*

NSES *National Science Education Standards*

NCSS *National Council for the Social Studies*

Power and Work

Is energy different from power?

As You Read

Question What are different types of power?

Although the words *energy* and *power* are related to each other, the two words have different meanings. Power is a measure of the work done over a certain period of time. It is a way of rating how quickly the work is done. You can cut grass more quickly by using a riding lawn mower than you can using a push-type lawn mower. In both cases, the goal of the work is the same: cutting the same area of grass. However, the engine in the riding mower allows you to do it more quickly, so it is more powerful.

One common measure of power is **horsepower**. A three-horsepower lawn mower engine produces as much power as three horses. If you are in very good physical condition, you might be able to develop about 0.2 horsepower for several minutes.

Recall What is the definition of power?

Forms of Power

What are the most common forms of power?

We commonly use three forms of power: mechanical, electrical, and fluid. The photo below illustrates these forms of power as they are used every day.

Mechanical Power

Mechanical energy is the energy that is involved in motion. When you pedal a bicycle, you convert mechanical energy to power. You use the up-and-down motion of your leg muscles to provide the mechanical power that moves the bicycle.

Electrical Power

We convert fossil fuel energy into electrical power in power plants. That power is then used for things such as lighting our homes, operating air conditioners, and running electric motors.

Three Forms of Power The three most commonly used forms of power are mechanical, electrical, and fluid power. *What form of power is used for a refrigerator?*

Fluid Power

When gases or fluids, such as air or water, are put under pressure, they can control and transmit fluid power. An electric motor is often used to pressurize the fluid. The greater the pressure they are under, the greater the force they exert.

Fluid power that is produced by using pressurized gases is called **pneumatic power**. Pneumatic (noo-MAT-ik) power operates tools in some automobile repair shops and factories. Compressors are used to pressurize air for power tools and paint sprayers, and to inflate tires. Putting liquids under pressure results in **hydraulic power**. Hydraulic power is popular for heavy construction equipment and factories because it provides more force than pneumatic power can produce.

Power Systems

Power systems drive and provide propulsion (motion or force) to other technological products and systems. Power systems must have a source of energy, a process, and a load. The energy source is part of the input in a power system. The process converts the energy into a form that can do work. The **load** is the output force. For example, your uncle might use a small pickup truck to carry 500 pounds of mulch for a flower garden. The load is the force that the truck must exert to carry that much mulch.

Power systems have been important to the development and growth of our culture. For example, 100 years ago, it took months to travel around the world. Ideas, customs, and products moved slowly to reach people. Today, thanks to machines (airplanes) that fly very fast, almost every city on our planet is only hours away from every other city. As a result, ideas, customs, and products spread quickly.

Analyze What kind of power has affected cultures around the world? Why?

Selecting Energy and Power Technologies

How would you decide which energy type is best for a specific purpose?

You are faced with many choices and decisions every day. Some are technical decisions. Selecting a wristwatch is an example. You can buy a digital watch that displays numbers. However, you may want an analog model that has hands. Your decision is based on each item's advantages and disadvantages. Engineers and designers select specific energy and power technologies by considering their advantages and disadvantages.

Tech Stars

Lewis Latimer

Inventor of Carbon Filaments for Light Bulbs

Lewis Latimer was born in Massachusetts in 1848. He was the son of escaped slaves from Virginia. Latimer studied Thomas Edison's work on the light bulb and improved its design. In 1881, he invented the Latimer electric lamp, which used inexpensive carbon filaments instead of paper filaments. This bulb could burn longer. A few years later, Latimer became the only black member of Thomas Edison's 24-member engineering division at the Edison Company.

In addition to the Latimer lamp, he invented the water closet for railroad cars and a threaded wooden socket for light bulbs. Latimer also drafted the patent drawings for Alexander Graham Bell's patent application for the telephone.

Jack-of-All-Trades Lewis Latimer had many interests. He was an inventor, draftsman, engineer, author, poet, musician, a devoted family man—and a philanthropist.

English Language Arts/Writing Research and write a brief history of the light bulb from Thomas Edison's original design to today's energy-saving, compact fluorescent light bulbs.

Go to **glencoe.com** to this book's OLC to learn about young innovators in technology.

Factors to Consider

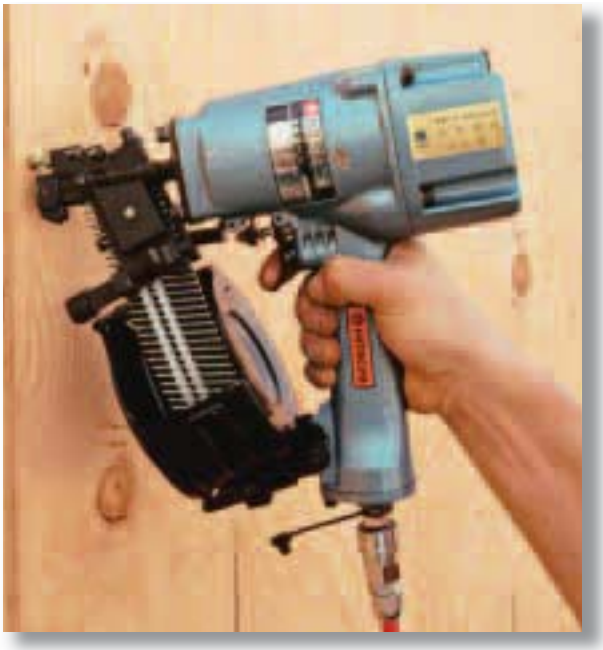
What kinds of things must be considered when selecting energy and power technologies? Engineers consider efficiency when designing products and systems. **Efficiency** is the ability to achieve a desired result with as little effort and waste as possible. An efficient machine, for example, does a lot of work compared to the amount of energy it uses. A bicycle is a very efficient machine. Pedaling a bike at 12 miles per hour requires only 0.10 horsepower.

However, much of the energy we use is not used efficiently. Have you ever felt the hood of a car that has been running? It probably felt hot. All engines that perform work release heat energy into the environment. Overall, only about 20 percent of the energy content of gasoline is actually converted into mechanical power in an ordinary car engine. The rest is wasted, mostly in the form of heat.

Other factors that must be considered include cost, availability, ease of use, environmental and social impacts, and time required. Many trade-offs may be involved.

Consider these common situations:

- Face-to-face speech works very well when you are near another person. A telephone is better when you are farther apart. At what distance do we change from face-to-face speech to using a phone?



Bob Rowan/Progressive Image/Corbis

The Best Tool? A traditional hammer does not require electricity. Most carpenters prefer to use a pneumatic nailer for many nails. *If a carpenter used a hammer instead of a nailer to build a house, how might the cost of the project be affected?*

- Most cars use gasoline engines. They do not use jet engines. Why not?
- Some carpenters use ordinary hammers and nails. Some use pneumatic nailers. What would be some advantages and disadvantages of each method in terms of power?

section 7.2 assessment

After You Read Self-Check

1. Explain the difference between energy and power.
2. Name the three forms of power.
3. Define the word *efficiency*.

Think

4. Identify the energy source, the process, and the load for a biker riding down the street. For a power saw cutting wood.

Practice Academic Skills

English Language Arts

5. Write a script for a 60-second radio commercial advertising and promoting one form of power. Talk about its advantages and the ways it is used.

STEM Mathematics

6. Erich built an internal combustion engine. His calculations show that it is capable of producing 65 horsepower. If the engine only produces 70 percent of its total horsepower, how much would it produce?

Math Concept Percents Percents can be thought of as parts of the whole.

1. Divide the percent by 100 to convert it to a decimal.
2. Find the value by multiplying by the decimal.

For help, go to **glencoe.com** to this book's OLC and find the Math Handbook.

section 7.3

Impacts of Energy and Power Technology

Reading Guide

Before You Read **Connect** What could be a positive and a negative effect of using energy?

Content Vocabulary

- acid rain
- greenhouse effect
- energy conservation
- recycle

Academic Vocabulary

- percent
- aware

Graphic Organizer

Draw the section diagram. Use it to organize and write down information as you read.

Ways to Protect the Environment

1. Reduce energy use.
2. _____
3. _____
4. _____
5. _____
6. _____

Go to **glencoe.com** to this book's OLC for a downloadable graphic organizer and more.

TECHNOLOGY STANDARDS

STL 3 Relationships & Connections
STL 4 Cultural, Social, Economic & Political Effects
STL 5 Environmental Effects
STL 6 Role of Society

ACADEMIC STANDARDS

Science

NSES Content Standard F Science and technology in society

English Language Arts

NCTE 12 Use language to accomplish individual purposes.

STL *National Standards for Technological Literacy*
NCTM *National Council of Teachers of Mathematics*
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The Effects of Using Energy

Besides air pollution, what other negative effects are caused by misusing technology?

The use of technology can have unintended consequences. For example, Americans have good transportation systems, countless electrical devices, good housing, and food. This way of life and a successful economy have been the result in part of advancements in technology. The use of energy has made technology possible. Unfortunately, not all results have been good. Our energy consumption has created some serious problems. People are striving to find ways to balance financial needs with protecting the earth's environment.

As You Read

List Think of things people can do to offset the negative effects of technology.

Pollution

What are some different causes of pollution?

Pollution results when contaminants—unwanted elements—get into our environment, whether in our air, our water, or our land.

Fossil Fuels

More than 90 percent of our energy comes from burning fossil fuels. You may already know that burning produces a great many pollutants. Burning fills the air with haze and sometimes makes your eyes burn. It can also be a serious health threat. Each fuel produces many pollutants, but there is usually one pollutant that is particularly serious in each case.

Acid Rain

All coal has a small amount of sulfur. When coal burns, it creates sulfur dioxide (SO_2). The sulfur dioxide combines with water vapor and oxygen in the air to form a weak sulfuric acid. This acid mixes with nitric acid (NO_2), another pollutant, and falls to the earth as **acid rain**. See **Figure 7.4**. It can kill fish, crops, and trees. Acid rain also damages monuments and statues.

Carbon Monoxide

Gasoline forms carbon monoxide when it burns. Carbon monoxide is an odorless, colorless, and poisonous gas. When you breathe it into your lungs, it reduces the ability of your blood to carry oxygen. If a person has a lung problem, too much carbon monoxide can make the problem worse.

Reducing Acid Rain

There is no complete solution to the problem. However, acid rain can be reduced if power companies and industries use coal containing less sulfur. They can also install special equipment to remove up to 90 percent of the sulfur dioxide from their smoke.

Effects of a Warmer Climate Global warming increases the temperature of air and water, causing glaciers to melt. *What are some causes of global warming?*

Getty Images Royalty Free, Momatiuk-Eastcott/Corbis

BusinessWeek Tech NEWS

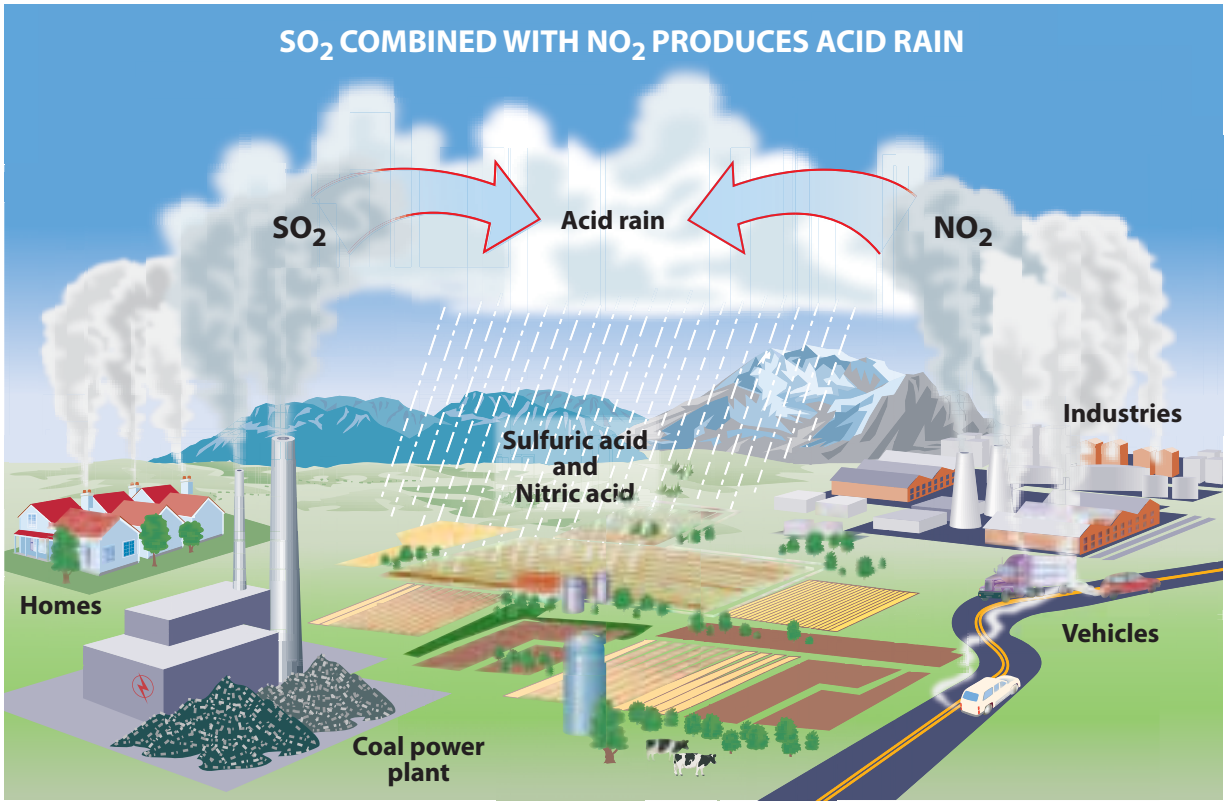
Green Fuel for Jet Liners

Aviation giant Boeing teamed up with a handful of airlines to find an efficient and environmentally friendly way to power jets. Among the resources being considered is algae, the green gunk found in stagnant ponds and unkempt aquariums. Algae-based fuels hold up better in extreme conditions and cost less to harvest than crop-based fuels.

Critical Thinking *What are some extreme conditions at which a jet operates?*

Go to **glencoe.com** to this book's OLC to read more about this news.

Figure 7.4 Effects of Fossil Fuels



Acid Rain Acid rain is created when sulfur dioxide and nitric acid in the air mix with water vapor and fall to earth. *What is the greenhouse effect?*

The Greenhouse Effect

Burning fossil fuels also contributes to the greenhouse effect—the heating of the earth's atmosphere. This occurs when too much carbon dioxide builds up in the air. The carbon dioxide prevents heat from escaping. If we produce too much heat, and it cannot escape, the temperature of the earth's atmosphere may increase, creating the greenhouse effect.

Warmer temperatures might mean longer growing seasons for crops. More food could possibly be produced for the world's increasing population.

However, the polar ice caps would melt significantly. That melted ice would raise the ocean level and cause flooding of some seacoast cities. The changing climate also affects ecosystems and plant and animal life. These effects of "global warming" have already occurred in some areas of the world.

Waste Heat

Waste heat is also a water pollutant. Heat produced by power plants is discharged into lakes, rivers, and oceans. Water plants and animals can be harmed.

David R. Frazier/Photo Edit

A Different Kind of Waste Nuclear waste is transferred to sites like this one under very strict safety guidelines. *What problems can be caused by nuclear waste?*

Nuclear Waste

Nuclear pollution may be the most threatening pollution of all. Nuclear, or radioactive, waste is a solid left over after nuclear fuel is used up. The waste remains dangerous for many years and can cause serious health problems. Proper disposal of this material is difficult and is an important social issue.

The waste is placed in special concrete containers. The area where they are stored is constantly checked for radioactive leakage. Some people think that nuclear waste should be sent into space with rockets. What do you think? Future generations may be able to figure out how to use this waste in a positive way.

Depletion of Resources

What can we do to maintain a supply of energy for our future needs?

Our earth has a limited supply of some energy sources like fossil fuels. However, people need more and more energy as the world's population grows. Also, each person uses more energy now than in the past, partly because there are so many technological conveniences available for us to use.

We have to be sure that there is enough energy to provide for human needs. One way to do that is to develop alternate sources, such as solar energy. Another way is through **energy conservation**. Energy conservation is the management and efficient use of energy sources.

Ethics in Action

Emissions Trading

To reduce pollution, governments in the European Union have developed a system called "emissions trading." They give businesses credits in exchange for reducing pollution. One credit allows a business to release a certain amount of pollutants. If the business pollutes too much, it must buy more credits.

Fair Trade Critics say this policy is hard to enforce. They say it is too easy to cheat. Also, richer businesses can pay more to pollute more.

English Language Arts/Writing

Go Local Emissions trading focuses on individual responsibility. Critics say we need to reduce pollution as a community.

1. In a small group, brainstorm ways you can reduce pollution at your school.
2. Compare your list with other groups. As a class, pick the top three things you would do to reduce pollution and write a class statement.

David Young-Wolff/Photo Edit

Energy can be conserved if we recycle the materials and products we use. To **recycle** means to use again. Metal, glass, paper, and some plastics can be recycled. Reusing aluminum cans is one of the best ways to save energy. Recycled cans require 80 percent less energy to produce than cans made from raw materials. All glass can be recycled. Paper is usually recycled into bags, paper towels, and packaging materials. Materials that can be recycled have a special triangular symbol on them.

Recycling reduces our use of natural resources. It also reduces the amount of solid waste sent to landfills. Most cities and towns have a recycling center or a civic organization that arranges routine collections. Check to see how recycling is handled in your own community.

What You Can Do

How can you help?

Energy is used by our hospitals, fire fighters, schools, and in our homes. We cannot completely stop using energy even though it causes pollution and some sources are limited. It is also true that we cannot ignore these things just because we want energy. We have to find a proper balance between the two.

We can reduce our energy use. We can pass laws and obtain publicity in the media. This can make everyone **aware** of the problems and what is being done by our political leaders. We can control how much pollution enters the environment from each energy source. We can reduce the amount of pollution. Less pollution is created when we use solar, wind, water, or geothermal energy. We can develop more and better ways to use these unlimited energy sources.

Recycling Counts Everyone can help our environment by recycling certain kinds of waste materials. *What types of materials can be easily recycled?*

EcoTech

Downsize Your Computer

Desktop computers use twice as much energy as laptop computers use. Unlike a desktop computer, a laptop can be unplugged after its battery is charged. You can use it for a few hours. A laptop computer does not need a separate monitor.

Try This Do research at stores or online to compare the estimated costs of laptops with desktop computers. Consider the costs of purchasing the computer, monitor, and any other equipment, as well as the cost of energy usage. What is the difference?

What can you do? You might think that since you cannot vote, your opinion and ideas do not count. That is not true. You can influence the adults around you. They may listen to you and even follow your advice if they think that you are sincere and you know what you are talking about.

Here are some things to do to conserve energy and resources:

1. Keep informed. Know what is happening in your community, state, country, and world. Read newspapers, Web sites, and magazines; watch the news; and communicate with others in your community. Talk to knowledgeable adults. Have discussions with your friends.
2. Set your home thermostat at or below 65 degrees (Fahrenheit) in the winter. You will use less energy because the heating system will operate for less time.
3. If your home is air-conditioned, set the thermostat at or above 78 degrees in the summer. You will use less energy because the air conditioner will operate for less time.
4. Use less hot water by spending less time in the shower.
5. Replace light bulbs with low-energy fluorescent ones and turn off all unnecessary lights.
6. Walk or ride a bike. Use buses, trains, or subways instead of automobiles.
7. Practice recycling metal, glass, paper, and plastics at school and at home. Start with aluminum cans and paper.
8. Use renewable or unlimited energy sources whenever possible.

section 7.3 assessment

After You Read — Self-Check

1. Explain how energy is saved by setting a home thermostat at 65 degrees or lower in the winter.
2. Define the term *greenhouse effect*.
3. Identify the type of pollution that may be the most threatening.

Think

4. Discuss some possible ways to save energy that are not included in this section.

Practice Academic Skills

English Language Arts

5. See how difficult it can be to clean up an oil spill. Place a small amount of cooking oil in a large bowl of water. Try and soak up the oil with paper towels, tissue, or a sponge. Add a few drops of liquid detergent. Present your observations and conclusions to the class in a written report.

STEM Science

6. Research and write a few paragraphs on the dangers of nuclear waste and the problems involved with its disposal. Discuss alternate ways to deal with nuclear waste. Generate your own ideas about what to do with the waste.

Exploring Careers in Technology

Jason Lewis

MECHANICAL ENGINEER

Q: *What do you do?*
A: I work in the technology department of Vestas, the world's leading supplier of wind power technology. My job involves improving wind turbine reliability and performance by resolving mechanical issues.

Q: *What do you do on a typical day?*
A: I travel to wind farms to conduct inspections and gather data to performing analysis of technical solutions. I also communicate the progress of an investigation to a customer.

Q: *What kind of training and education did you need?*
A: Getting my job started with a basic education in mechanical engineering. The job also requires an ability to solve problems, experience related to wind energy, and strong communication skills.

Q: *What do you like most about your job?*
A: I really enjoy being part of the development of a clean and renewable energy source. Wind power can help meet modern energy demands while reducing dependence on fossil fuels.

Q: *How did you get interested in your job?*
A: I knew I wanted to be an engineer in an industry where my work made a difference. A year after college, I attended the Global Wind Energy Conference. I returned home later that week committed to finding a job in wind energy.

English Language Arts/Writing

The Evolution of Wind Power Wind power has been used for centuries. Find out how people have harnessed the power of the wind from the past to the present.

1. Research the history of wind power. Find out how it was first used and where.
2. Find some images or photographs of machines that have used wind power to operate.

Go to **glencoe.com** to this book's OLC to learn more about this career.

Real-World Skills
Analytical thinking, communication

Academics and Education
Physics, mathematics, writing, mechanical engineering

Career Outlook
Growth as fast as average for the next ten years
Source: *Occupational Outlook Handbook*

chapter 7

Review and Assessment

Chapter Summary

Section 7.1 Energy is the ability to do work, and power is the measurement of work done. Renewable energy sources come from plants and animals. Nonrenewable sources of energy cannot be replaced. Unlimited sources of energy include solar, wind, hydro, and geothermal energy.

Section 7.2 Power is measured when energy is converted from one form to another. All power systems include a source of energy, a process, and an output load.

Section 7.3 Burning fuels produces serious threats to our health and environment, including the greenhouse effect, global warming, acid rain, and carbon monoxide. We can help control pollution by making everyone aware of the problems. We can reduce the amount of pollution that enters our environment, and we can develop more and better ways of conserving energy.

Review Content Vocabulary and Academic Vocabulary

1. On a sheet of paper, use each of these terms and words in a written sentence.

Content Vocabulary

- energy
- calorie
- fossil fuel
- solar heating system
- solar cell
- wind farm
- hydroelectric power
- geothermal energy
- power
- horsepower
- pneumatic power
- hydraulic power
- load
- efficiency
- acid rain
- greenhouse effect
- energy conservation
- recycle

Academic Vocabulary

- vehicle
- constant
- goal
- technical
- percent
- aware

Review Key Concepts

2. **List** the different forms of energy.
3. **Identify** renewable, nonrenewable, and unlimited energy resources.
4. **Explain** how fossil fuels are formed.
5. **Identify** the most common forms of power.
6. **Describe** uses for each form of power.
7. **Explain** how to select energy and power technologies.
8. **Identify** forms of pollution.
9. **Describe** ways to slow depletion of energy resources.
10. **Discuss** the disposal of nuclear waste.

chapter 7

TECHNOLOGY LAB

Build a Solar Heating System

Most solar collectors are black because dark colors absorb the sun's rays. The simplest kind of solar collector has a black heating plate and a glass or plastic cover. Sunlight strikes the plate, and the plate becomes hot. The heat is trapped by the glass or plastic cover. The trapped heat is transferred to water flowing through tubing. The warmed water is sent where heat can be used.

Tools and Materials

- ✓ Two 8 × 12-inch sheets of poly-styrene foam (Styrofoam®)
- ✓ 6 × 10-inch sheet of corrugated cardboard
- ✓ 6 × 10-inch sheet of black paper
- ✓ Clear plastic wrap
- ✓ 5 feet of small-diameter flexible plastic tubing
- ✓ Small plastic bottle and bowl
- ✓ Thin wire & cutters
- ✓ Drill
- ✓ Razor knife
- ✓ Rubber bands
- ✓ Tape
- ✓ Red food dye
- ✓ Thermometer
- ✓ Clothespin
- ✓ Wristwatch
- ✓ Gloves

Set Your Goal

Your goal is to make a small solar heating system similar to those used in houses. Then you will test it to see how well it works.

Know the Criteria and Constraints

In this lab, you will:

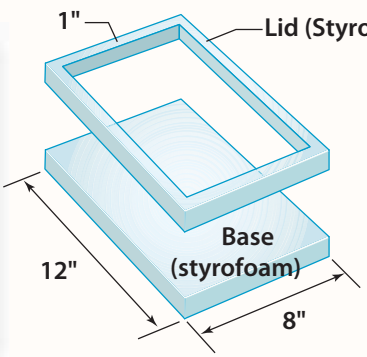
1. Make your solar collector from Styrofoam, plastic tubing, and other materials.
2. Keep your water supply in a plastic bottle.
3. Make your system as watertight as possible.
4. Compare the efficiency of your system with others.

Design Your Project

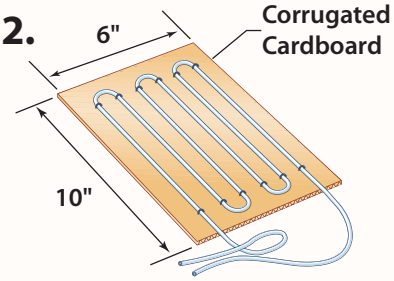
Follow these steps to complete this lab.

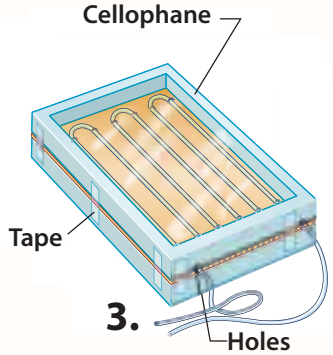
1. Look at the illustrations to become familiar with the procedure.
2. Use the razor knife to cut the Styrofoam to the sizes shown. Save the center cut.
3. Make the solar heating plate:
   - Place the black paper on top of the corrugated cardboard.
   - Arrange plastic tubing in S-shaped curves on black paper.

1.



2.





SAFETY

Heat Caution!

Be sure to follow all safety precautions for preventing burns. Wear gloves when handling hot items.

Real-World Skills

11. Understanding Energy Costs Look at the monthly bills your family has received over the past year for electricity. Write a paragraph or two describing the differences in electricity usage and the rates you were charged from season to season.

STEM Technology Skill

12. Generate Your Own Power There are several ways to make a small power generator you can use for simple tasks such as lighting a light bulb.

a. Research the topic of creating a power generator using the Internet. If possible, build a power generator.

b. Write an explanation of how and why your power generator works.

Academic Skills

Social Studies

13. Some communities charge for recycling, while others include it with trash disposal. Write about local recycling services and their prices.

STEM Mathematics

14. Amy is a waitress. She made $33.50 in tips. Amber only made $12.25 in tips. Julia, a coworker, made 1.5 times as much as Amy made, minus what Amber made. How much did Julia make?

Math Concept Algebra

Some problems are easier to solve if you write an equation. Think of an equation as a sentence that explains what you are trying to solve for. The unknowns are represented by letters such as x or y.

TSA WINNING EVENTS

Inventor

Situation Your team is to design a device to reduce energy consumption, increase recycling, or both. It may be as simple as a container to deposit aluminum cans or as complex as an electronic switch for home lighting.

Activity Working as a team, design a device that meets the criteria below. You are required to complete the following:

- Brainstorm and choose the best idea.
- Develop a series of sketches.
- Build a model or working prototype.
- Present your invention to the class.

Evaluation You will be evaluated on how well you meet the following criteria:

- Proposal is well thought-out.
- Sketches communicate the team's ideas.
- Model clearly demonstrates your invention.
- Presentation is well organized and clear.

Go to **glencoe.com** to this book's OLC for information about TSA events.

Standardized Test Practice

Directions Choose the letter of the best answer. Write the letter on a separate piece of paper.

1. What is 38 percent of $212.34, rounded to the nearest cent?

A $80.70
B $80.69
C $81.68
D $81.69

2. Hydraulic power is fluid power produced by putting a gas under pressure.

T

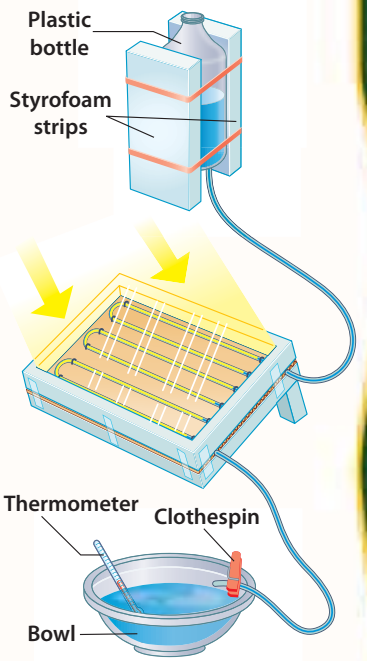
F

Test-Taking Tip When taking a multiple choice test, read the question before you look at the answer choices. If you come up with the answer in your head before looking at the possible answers, the choices given on the test will not throw you off or trick you.

- Make as many S curves as will fit. Leave about 18 inches of extra tubing at each end.
- Fasten the tubing to the black paper and cardboard using wire.
- Poke wire through the cardboard. Twist ends together underneath.
- Tape the clear plastic wrap over the opening in the Styrofoam lid.
- Place the heating plate on the Styrofoam base. Notch holes in the lid for the tubing and place the lid over the base. Tape together.

4. Now complete the solar heating system as depicted:
- Drill a hole in the bottom of the plastic bottle so the tubing fits.
- Force one of the free ends of the tubing into the hole.
- If necessary, seal the connection with waterproof glue.
- Make a bottle stand with Styrofoam.
- Place the solar collector where the sun's rays will hit the heating plate. Place it at a 45° angle.
- Put the end of the tubing in bowl. Clamp it with a clothespin.
- Add red food dye to the bottle of water.
- Place the bottle at least six inches above the collector.

5. Your system is complete. Now test it.
- Open the clothespin to allow the water to flow through the tubing.
- Measure the water's temperature. Close the clothespin.
- Allow the water to remain in the collector for 2 to 5 minutes.
- Open the clothespin and measure the water's temperature again.



Evaluate Your Results

After you complete this lab, answer these questions on a separate piece of paper.

1. What was the highest water temperature you measured?

2. Cover up half the collector. That is like creating 50 percent cloud cover. Does the water reach only half the maximum temperature?

3. What could you do to improve your solar collector?

Academic Skills Required to Complete Lab

Tasks	English Language Arts	Math	Science	Social Studies
Build heating plate.	✓	✓	✓	
Build the solar heating system.	✓	✓	✓	
Heat water in the sun.		✓	✓	
Measure water temperatures before and after heating.	✓	✓	✓	
Compare your results with the results of other students.	✓	✓	✓	