SECTION 1

Natural Resources

What does the water you drink, the paper you write on, the gasoline used in the cars you ride in, and the air you breathe have in common?

Water, trees used to make paper, crude oil used to make gasoline, and air are just a few examples of Earth's resources. Can you think of other examples of Earth's resources?

What You Will Learn

- Describe how humans use natural resources.
- Compare renewable resources with nonrenewable resources.
- Explain three ways that humans can conserve natural resources.

Vocabulary

natural resource
renewable resource
nonrenewable resource
recycling

READING STRATEGY

Reading Organizer As you read this section, make a concept map by using the terms above.

Earth's Resources

The Earth provides almost everything needed for life. For example, the Earth's atmosphere provides the air you breathe, maintains air temperatures, and produces rain. The oceans and other waters of the Earth give you food and needed water. The solid part of the Earth gives nutrients, such as potassium, to the plants you eat. These resources that the Earth provides for you are called natural resources.

A **natural resource** is any natural material that is used by humans. Examples of natural resources are water, petroleum, minerals, forests, and animals. Most resources are changed and made into products that make people's lives more comfortable and convenient, as shown in **Figure 1.** The energy we get from many of these resources, such as gasoline and wind, ultimately comes from the sun's energy.

Figure 1 **Natural Resources**

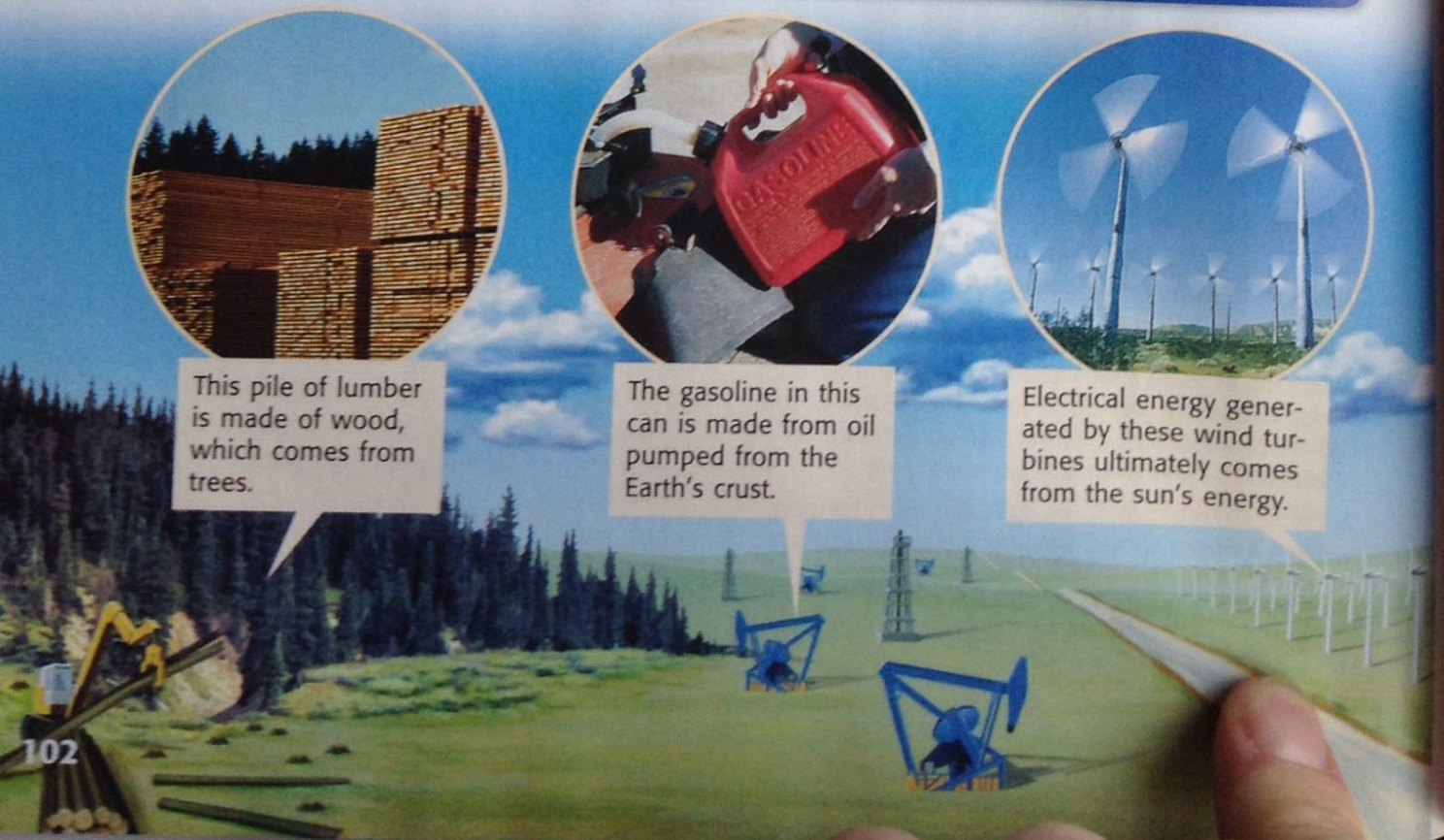


Figure 2 *Trees and fresh water are just a few of the renewable resources available on Earth.*

Renewable Resources

Some natural resources can be renewed. A **renewable resource** is a natural resource that can be replaced at the same rate at which the resource is used. **Figure 2** shows two examples of renewable resources. Although many resources are renewable, they still can be used up before they can be renewed. Trees, for example, are renewable. However, some forests are being cut down faster than new forests can grow to replace them.

Reading Check **What is a renewable resource?** (*See the Appendix for answers to Reading Checks.*)

Nonrenewable Resources

Not all of Earth's natural resources are renewable. A **nonrenewable resource** is a resource that forms at a rate that is much slower than the rate at which it is consumed. Coal, shown in **Figure 3,** is an example of a nonrenewable resource. It takes millions of years for coal to form. Once coal is used up, it is no longer available. Petroleum and natural gas are other examples of nonrenewable resources. When these resources become scarce, humans will have to find other resources to replace them.

natural resource any natural material that is used by humans, such as water, petroleum, minerals, forests, and animals

renewable resource a natural resource that can be replaced at the same rate at which the resource is consumed

nonrenewable resource a resource that forms at a rate that is much slower than the rate at which it is consumed

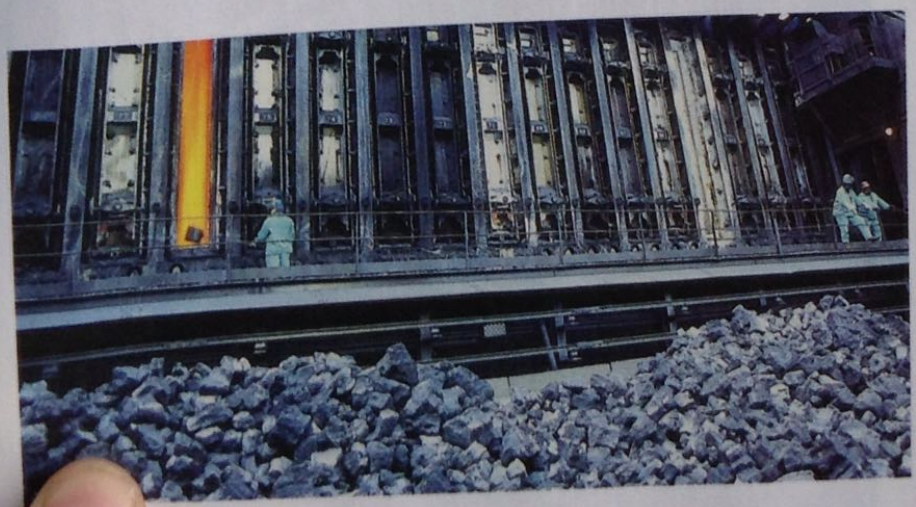


Figure 3 *The coal used in the industrial process shown here is not quickly replaced by natural processes.*

SCHOOL to HOME

Renewable?

WRITING SKILL With a parent or guardian, find five products in your home that were made from natural resources. List the resource or resources from which each product was made. Label each resource as renewable or nonrenewable. What can you do to help conserve the resources you listed? In your **science journal,** describe a personal action plan to conserve some of the resources you rely on every day.

ACTIVITY

Conserving Natural Resources

Whether the natural resources you use are renewable or nonrenewable, you should be careful how you use them. To conserve natural resources, you should try to use them only when necessary. For example, leaving the faucet on while brushing your teeth wastes clean water. Turning the faucet on only to rinse your brush saves water that you may need for other uses.

Conserving resources also means taking care of the resources even when you are not using them. For example, it is important to keep lakes, rivers, and other water resources free of pollution. Polluted lakes and rivers can affect the water you drink. Also, polluted water resources can harm the plants and animals, including humans, that depend on them to survive.

Energy Conservation

The energy we use to heat our homes, drive our cars, and run our computers comes from natural resources. The way in which we choose to use energy on a daily basis affects the availability of the natural resources. Most of the natural resources that provide us energy are nonrenewable resources. So, if we don't limit our use of energy now, the resources may not be available in the future.

As with all natural resources, conserving energy is important. You can conserve energy by being careful to use only the resources that you need. For example, turn lights off when you are not using them. And make sure the washing machine is full before you start it, as shown in **Figure 4.** You can also ride a bike, walk, or take a bus because these methods use fewer resources than a car does.

Figure 4 *Making sure the washing machine is full before running it is one way you can avoid wasting natural resources.*

Reduce, Reuse, Recycle

Another way to conserve natural resources is to recycle, as shown in **Figure 5.** **Recycling** is the process of reusing materials from waste or scrap. Recycling reduces the amount of natural resources that must be obtained from the Earth. For example, recycling paper reduces the number of trees that must be cut down to make new paper products. Recycling also conserves energy. Though energy is required to recycle materials, it takes less energy to recycle an aluminum can than it does to make a new one!

Newspaper, aluminum cans, most plastic containers, and cardboard boxes can be recycled. Most plastic containers have a number on them. This number informs you whether the item can be recycled. Plastic products with the numbers 1 and 2 can be recycled in most communities. Check with your community's recycling center to see what kinds of materials the center recycles.

Reading Check **What are some kinds of products that can be recycled?**

recycling the process of recovering valuable or useful materials from waste or scrap; the process of reusing some items

Figure 5 *You can recycle many household items to help conserve natural resources.*

SECTION Review

Summary

- We use natural resources such as water, petroleum, and lumber to make our lives more comfortable and convenient.
- Renewable resources can be replaced within a relatively short period of time, but nonrenewable resources may take thousands or even millions of years to form.
- Natural resources can be conserved by using only what is needed, taking care of resources, and recycling.

Using Key Terms

1. Use each of the following terms in a separate sentence: *natural resource*, *renewable resource*, *nonrenewable resource*, and *recycling*.

Understanding Key Ideas

2. How do humans use most natural resources?
3. Which of the following is a renewable resource?
   - **a.** oil
   - **b.** water
   - **c.** coal
   - **d.** natural gas
4. Describe three ways to conserve natural resources.

Math Skills

5. If a faucet dripped for 8.6 h and 3.3 L of water dripped out every hour, how many liters of water dripped out altogether?

Critical Thinking

6. **Making Inferences** How does human activity affect Earth's renewable and nonrenewable resources?
7. **Applying Concepts** List five products you regularly use that can be recycled.
8. **Making Inferences** Why is the availability of some renewable resources more of a concern now than it was 100 years ago?

SECTION 2

Fossil Fuels

How does a sunny day 200 million years ago relate to your life today?

Chances are that if you traveled to school today or used a product made of plastic, you used some of the energy from sunlight that fell on Earth several hundred million years ago. Life as you know it would be very different without the fuels or products formed from plants and animals that lived alongside the dinosaurs.

What You Will Learn

- Describe what energy resources are.
- Identify three different forms of fossil fuels.
- Explain how fossil fuels form.
- Describe how fossil fuels are found and obtained.
- Identify four problems with fossil fuels.

Vocabulary

fossil fuel
petroleum
natural gas
coal
acid precipitation
smog

READING STRATEGY

Brainstorming The key idea of this section is fossil fuels. Brainstorm words and phrases related to fossil fuels.

fossil fuel a nonrenewable energy resource formed from the remains of organisms that lived long ago; examples include oil, coal, and natural gas

Energy Resources

The fuels we use to run cars, ships, planes, and factories and to generate electrical energy, shown in **Figure 1,** are energy resources. *Energy resources* are natural resources that humans use to generate energy. Most of the energy we use comes from a group of natural resources called fossil fuels. A **fossil fuel** is a nonrenewable energy resource formed from the remains of plants and animals that lived long ago. Examples of fossil fuels include petroleum, coal, and natural gas.

Energy is released from fossil fuels when they are burned. For example, the energy from burning coal in a power plant is used to produce electrical energy. However, because fossil fuels are a nonrenewable resource, once they are burned, they are gone. Therefore, like other resources, fossil fuels need to be conserved. In the 21st century, societies will continue to explore alternatives to fossil fuels. But they will also focus on developing more-efficient ways to use these fuels.

Figure 1 *Light produced from electrical energy can be seen in this satellite image taken from space.*

Figure 2 *Some refineries use a process called* distillation *to separate petroleum into various types of petroleum products.*

Types of Fossil Fuels

All living things are made up of the element carbon. Because fossil fuels are formed from the remains of plants and animals, all fossil fuels are made of carbon, too. Most of the carbon in fossil fuels exists as hydrogen-carbon compounds called *hydrocarbons*. But different fossil fuels have different forms. Fossil fuels may exist as liquids, gases, or solids.

Liquid Fossil Fuels: Petroleum

A liquid mixture of complex hydrocarbon compounds is called **petroleum.** Petroleum is also commonly known as *crude oil*. Petroleum is separated into several kinds of products in refineries, such as the one shown in **Figure 2.** Examples of fossil fuels separated from petroleum are gasoline, jet fuel, kerosene, diesel fuel, and fuel oil.

More than 40% of the world's energy comes from petroleum products. Petroleum products are the main fuel for forms of transportation, such as airplanes, trains, boats, and ships. Crude oil is so valuable that it is often called *black gold*.

petroleum a liquid mixture of complex hydrocarbon compounds; used widely as a fuel source

natural gas a mixture of gaseous hydrocarbons located under the surface of the Earth, often near petroleum deposits; used as a fuel

Gaseous Fossil Fuels: Natural Gas

A gaseous mixture of hydrocarbons is called **natural gas.** Most natural gas is used for heating, but it is also used for generating electrical energy. Your kitchen stove may be powered by natural gas. Some motor vehicles, such as the van in **Figure 3,** use natural gas as fuel. An advantage of using natural gas is that using it causes less air pollution than using oil does. However, natural gas is very flammable. Gas leaks can lead to fires or deadly explosions.

Methane, CH_4, is the main component of natural gas. But other components, such as butane and propane, can be separated from natural gas, too. Butane and propane are often used as fuel for camp stoves and outdoor grills.

Reading Check **What is natural gas most often used for?**
(See the Appendix for answers to Reading Checks.)

Figure 3 *Vehicles powered by natural gas are becoming more common.*

Figure 4 *This coal is being gathered so that it may be burned in the power plant shown in the background.*

coal a fossil fuel that forms underground from partially decomposed plant material

Solid Fossil Fuels: Coal

The solid fossil fuel that humans use most is coal. **Coal** is a fossil fuel that is formed underground from partially decomposed plant material. Coal was once the major source of energy in the United States. People burned coal in stoves to heat their homes. They also used coal in transportation. Many trains in the 1800s and early 1900s were powered by coal-burning steam locomotives.

As cleaner energy resources became available, people reduced their use of coal. People began to use coal less because burning coal produces large amounts of air pollution. Now, people use forms of transportation that use oil instead of coal as fuel. In the United States, coal is now rarely used as a fuel for heating. However, many power plants, such as the one shown in **Figure 4,** burn coal to generate electrical energy.

INTERNET ACTIVITY

For another activity related to this chapter, go to **go.hrw.com** and type in the keyword **HZ5ENRW.**

Reading Check In the 1800s and early 1900s, what was coal most commonly used for?

CONNECTION TO Chemistry

Hydrocarbons Both petroleum and natural gas are made of compounds called *hydrocarbons*. A hydrocarbon is an organic pound that contains only carbon and hydrogen. A molecule of pane, C_3H_8, a gaseous fossil fuel, contains three carbons and eig hydrogens. Using a molecular model set, create a model of a propane molecule. (Hint: Each carbon atom should have four bonds, and each hydrogen atom should have one bond.)

ACTIVITY

How Do Fossil Fuels Form?

All fossil fuels form from the buried remains of ancient organisms. But different kinds of fossil fuels form in different ways and from different kinds of organisms.

Petroleum and Natural Gas Formation

Petroleum and natural gas form mainly from the remains of microscopic sea organisms. When these organisms die, their remains settle on the ocean floor. There, the remains are buried in sediment. Over time, the sediment is compacted and slowly becomes rock. Through physical and chemical changes over millions of years, the remains of the organisms become petroleum and gas. Gradually, more rocks form above the rocks that contain the fossil fuels. Under the pressure of overlying rocks and sediments, the fossil fuels can move through permeable rocks. *Permeable rocks* are rocks through which fluids, such as petroleum and gas, can move. As shown in **Figure 5,** these permeable rocks become reservoirs that hold petroleum and natural gas.

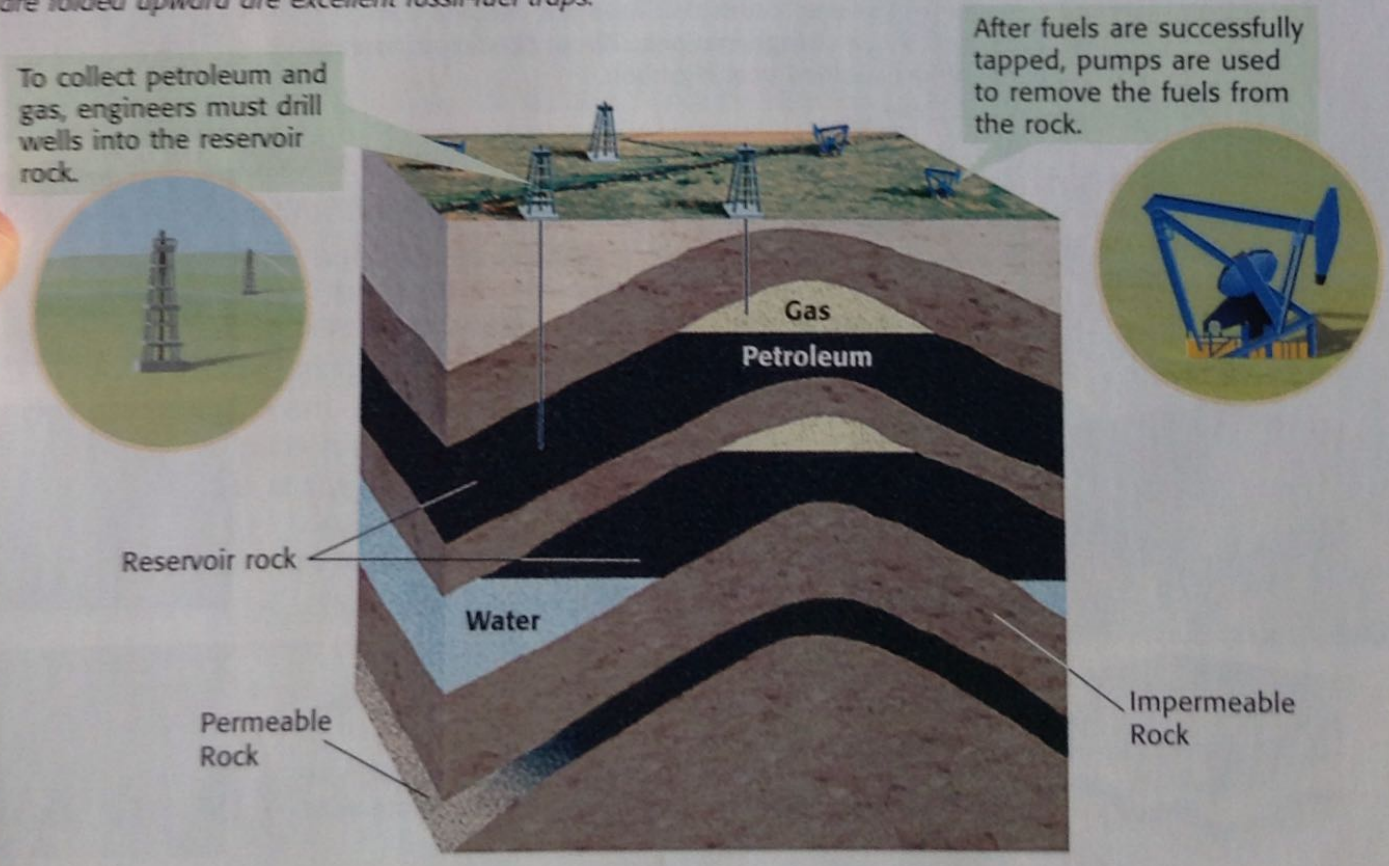
The formation of petroleum and natural gas is an ongoing process. Part of the remains of today's sea life will become petroleum and natural gas millions of years from now.

QUICK LAB

Rock Sponge

1. Place **samples of sandstone, limestone,** and **shale** in separate **Petri dishes.**
2. Place **five drops of light machine oil** on each rock sample.
3. Observe and record the time required for the oil to be absorbed by each of the rock samples.
4. Which rock sample absorbed the oil fastest? Why?
5. Based on your findings, describe a property that allows fossil fuels to be easily removed from reservoir rock.

Figure 5 *Petroleum and gas move through permeable rock. Eventually, these fuels are collected in reservoirs. Rocks that are folded upward are excellent fossil-fuel traps.*



Coal Formation

Coal forms underground over millions of years when pressure and heat cause changes in the remains of swamp plants. When these plants die, they sink to the bottom of the swamp. If they do not decay completely, coal formation may begin. The stages of coal formation are shown in **Figure 6.**

The first step of the process is the change of plant remains into peat. Peat is brown, crumbly matter made mostly of plant material and water. Peat is not coal. But, in some parts of the world, peat is dried and burned for heat or as fuel. If the peat is buried by sediment, pressure and heat are applied to the peat, and coal begins to form. The pressure and heat force water and gases out of the coal. As a result, the coal becomes harder, and its carbon content increases. The amount of heat and pressure determines the type of coal that forms. Lignite forms first, followed by bituminous coal, and, finally, anthracite. Coal formation can stop during any part of this process. Today, all three types of coal are mined throughout the world. The greater the carbon content of the coal is, the more cleanly the coal burns. But when burned, all types of coal pollute the air.

Figure 6 **Coal Formation**

Stage 1: Peat Forms
Sunken swamp plants that have not decayed completely can change into peat. About 60% of an average sample of dried peat is carbon.

Stage 2: Lignite Forms
If sediment buries the peat, pressure and temperature increase. The peat slowly changes into a type of coal called *lignite*. Lignite is harder than peat is, and about 70% of an average sample of lignite is carbon.

Stage 3: Bituminous Coal Forms
If more sediment is added, pressure and temperature force more water and gases out of the lignite. Lignite slowly changes into bituminous coal. About 80% of an average sample of bituminous coal is carbon.

Stage 4: Anthracite Forms
If more sediment accumulates, temperature and pressure continue to increase. Bituminous coal slowly changes into anthracite. Anthracite is the hardest type of coal. About 90% of an average sample of anthracite is carbon.

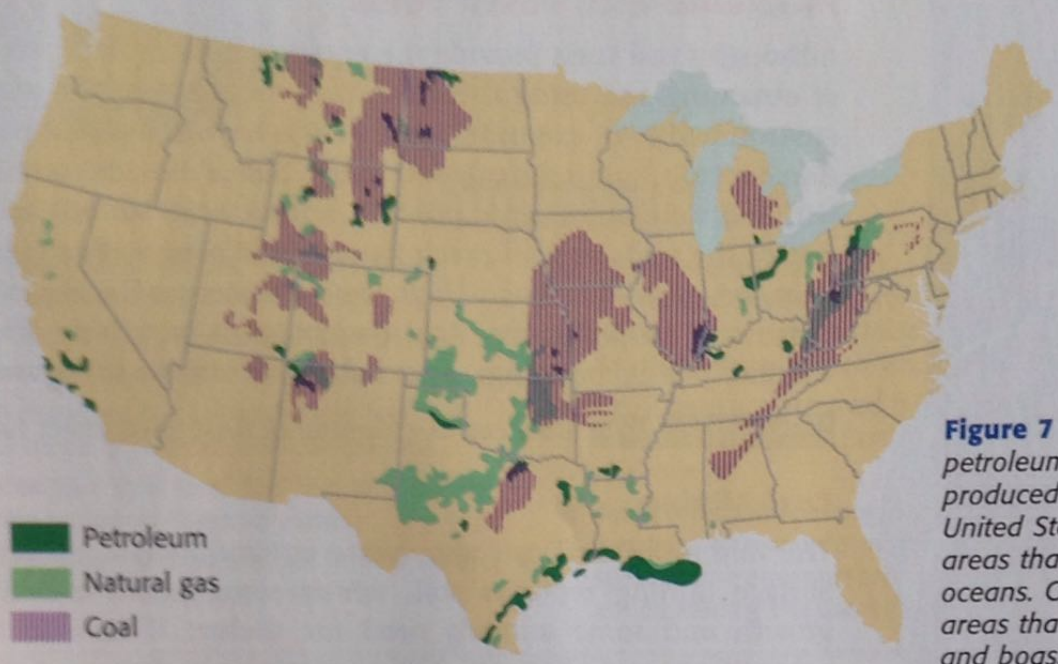


Figure 7 *Most of the petroleum and natural gas produced in the continental United States comes from areas that were prehistoric oceans. Coal comes from areas that were swamps and bogs.*

Where Are Fossil Fuels Found?

Fossil fuels are found in many parts of the world. Some fossil fuels are found on land, while other fossil fuels are found beneath the ocean. As shown in **Figure 7,** the United States has large reserves of petroleum, natural gas, and coal. Despite its large reserves of petroleum, the United States imports petroleum as well. About one-half of the petroleum used by the United States is imported from the Middle East, South America, Africa, Canada, and Mexico.

How Do We Obtain Fossil Fuels?

Humans use several methods to remove fossil fuels from the Earth's crust. The kind and location of fuel determine the method used to remove the fuel. People remove petroleum and natural gas from Earth by drilling wells into rock that contains these resources. Oil wells exist on land and in the ocean. For offshore drilling, engineers mount drills on platforms that are secured to the ocean floor or that float at the ocean's surface. **Figure 8** shows an offshore oil rig.

People obtain coal either by mining deep beneath Earth's surface or by surface mining. Surface mining, also known as *strip mining,* is the process by which soil and rock are stripped from the Earth's surface to expose the underlying coal that is to be mined.

Reading Check How are natural gas and petroleum removed from Earth?

Figure 8 *Large oil rigs, some of which are more than 300 m tall, operate offshore in many places, such as the Gulf of Mexico and the North Sea.*

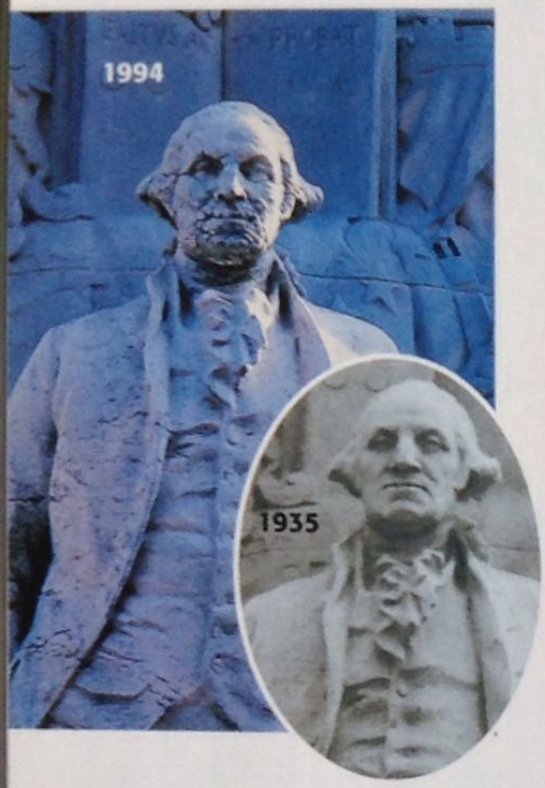


Figure 9 *Notice how this statue looked before the effects of acid precipitation.*

Problems with Fossil Fuels

Although fossil fuels provide the energy we need, the methods of obtaining and using them can have negative effects on the environment. For example, when coal is burned without pollution controls, sulfur dioxide is released. Sulfur dioxide combines with moisture in the air to produce sulfuric acid. Sulfuric acid is one of the acids in acid precipitation. **Acid precipitation** is rain, sleet, or snow that has a high concentration of acids, often because of air pollutants. Acid precipitation negatively affects wildlife, plants, buildings, and statues, as shown in **Figure 9.**

Reading Check **How can the burning of fossil fuels affect rain?**

Coal Mining

The mining of coal can also create environmental problems. Surface mining removes soil, which some plants need for growth and some animals need for shelter. If land is not properly restored afterward, surface mining can destroy wildlife habitats. Coal mining can also lower water tables and pollute water supplies. The potential for underground mines to collapse endangers the lives of miners.

Petroleum Problems

Producing, transporting, and using petroleum can cause environmental problems and endanger wildlife. In June 2000, the carrier, *Treasure,* sank off the coast of South Africa and spilled more than 400 tons of oil. The toxic oil coated thousands of blackfooted penguins, as shown in **Figure 10.** The oil hindered the penguins from swimming and catching fish for food.

Smog

Burning petroleum products causes an environmental problem called smog. **Smog** is photochemical haze that forms when sunlight acts on industrial pollutants and burning fuels. Smog is particularly serious in cities such as Houston and Los Angeles as a result of millions of automobiles that burn gasoline. Also, mountains that surround Los Angeles prevent the wind from blowing pollutants away.

acid precipitation precipitation, such as rain, sleet, or snow, that contains a high concentration of acids, often because of the pollution of the atmosphere

smog photochemical haze that forms when sunlight acts on industrial pollutants and burning fuels

Figure 10 *The oil spilled from the carrier,* Treasure, *endangered the lives of many animals including the blackfooted penguins.*