UNIT 7

Resources and the Environment

Chapter 24
Earth Resources
BIG Idea People and other organisms use Earth's resources for everyday living.

Chapter 25
Energy Resources
BIG Idea People use energy resources, most of which originate from the Sun, for everyday living.

Chapter 26
Human Impact on Resources
BIG Idea The use of natural resources can impact Earth's land, air, and water.

CAREERS IN EARTH SCIENCE

Environmental Technician: These **environmental technicians** are wearing protective suits as they collect water samples for environmental testing. Environmental technicians help monitor the air, land, and water to maintain a clean environment for all living things.

WRITING in Earth Science

Visit glencoe.com to learn more about environmental technicians. Then write a short essay about how environmental technicians cleaned up a bay after an oil spill.

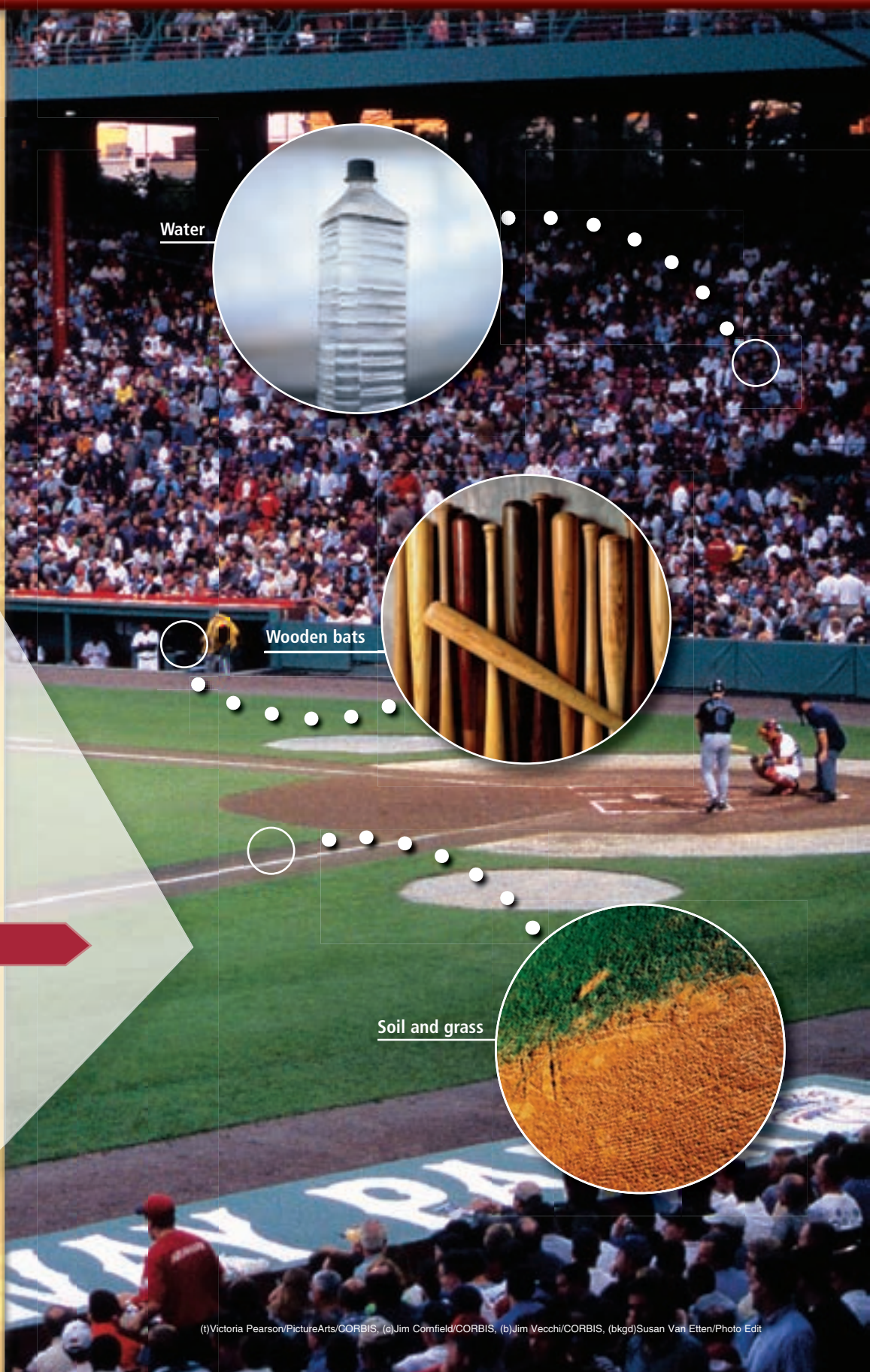
Gabe Palmer/CORBIS

Earth Science Online

To learn more about environmental technicians, visit glencoe.com.

CHAPTER 24

Earth Resources



BIG Idea **People and other organisms use Earth's resources for everyday living.**

24.1 Natural Resources

MAIN Idea Resources are materials that organisms need; once used, some resources can be replaced, whereas others cannot.

24.2 Resources from Earth's Crust

MAIN Idea Earth's crust provides a wide variety of resources to grow food, supply building materials, and provide metals and minerals.

24.3 Air Resources

MAIN Idea The atmosphere contains gases required for life on Earth.

24.4 Water Resources

MAIN Idea Water is essential for all life, yet it is unevenly distributed on Earth's surface.

GeoFacts

- One ash tree can provide 60 baseball bats. The average major league player uses 100 bats per season.
- Safeco Field in Seattle, Washington, has 550 metric tons of clay in the infield alone.
- The retractable roof at Chase Field, in Phoenix, Arizona, was built with over 4 million kg of structural steel.

Start-Up Activities

LAUNCH Lab

What natural resources do you use in your classroom?

The materials that you use every day in your classroom, such as your paper, pencils or pens, and textbooks, all originate from multiple sources. You already know that paper comes from trees, but what about the ink? Where did other common classroom items originate?

Procedure

1. Read and complete the lab safety form.
2. Obtain a **classroom item** from your teacher.
3. Working with a partner, determine all the different components of your classroom item.
4. Next, determine where each of the components originated and classify the origin as either living or nonliving.
5. Within the living or nonliving groups, classify each as being either easily replaced or not replaceable.

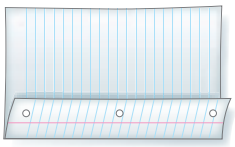
Analysis

1. **Compare and contrast** your results with those of several other groups.
2. **Explain** How many items on your list were not replaceable? Why?
3. **Determine** Are any of the items on either list recyclable? Explain.
4. **Analyze** How could you make this product with more replaceable items?

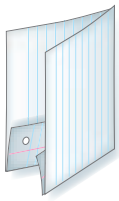
FOLDABLES™ Study Organizer

Renewable v. Nonrenewable Resources Make this Foldable to compare and contrast the two main types of resources.

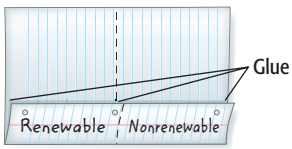
STEP 1 Fold up the bottom of a horizontal sheet of paper about 5 cm.



STEP 2 Fold the sheet in half.



STEP 3 Open the paper and glue or staple the bottom flap to make two compartments.



FOLDABLES **Use this Foldable with Section 24.1.** As you read about Earth's renewable and nonrenewable resources, record information on index cards or quarter-sheets of paper.

Earth Science online

Visit glencoe.com to

- study entire chapters online;
- explore Concepts in Motion animations:
  - Interactive Time Lines
  - Interactive Figures
  - Interactive Tables
- access Web Links for more information, projects, and activities;
- review content with the Interactive Tutor and take Self-Check Quizzes.

Section 24.1

Objectives

- **Distinguish** between renewable and nonrenewable resources.
- **Explain** sustainable yield.
- **Describe** how resources are unevenly distributed on Earth.

Review Vocabulary

biosphere: all of Earth's organisms and the environment in which they live

New Vocabulary

natural resource
renewable resource
sustainable yield
nonrenewable resource

Natural Resources

MAIN Idea **Resources are materials that organisms need; once used, some resources can be replaced, whereas others cannot.**

Real-World Reading Link Did you eat an apple or a banana for breakfast this morning? Every day, you eat food and drink water because these resources are necessary for you to live.

Resources

You and every other living thing on Earth must have certain resources to grow, develop, maintain life processes, and reproduce. The resources that Earth provides are known as **natural resources.** Natural resources include Earth's organisms, nutrients, rocks, and minerals. Natural resources might come from the soil, air, water, or deep in Earth's crust. All items that you use every day, like those shown in **Figure 24.1,** come from natural resources.

Renewable resources If you cut down a tree, you can replace that tree by planting a seedling. A tree is an example of a **renewable resource,** which is a natural resource that can be replaced by nature as quickly as it is used. Renewable resources include fresh air; fresh surface water in lakes, rivers, and streams; and most groundwater. When used properly, fertile soil is a renewable resource. However, if soil is exposed to wind and water erosion, the topsoil can be eroded. Renewable resources also include all living things and elements that cycle through Earth's systems, such as nitrogen, carbon, and phosphorus. Resources that exist in an inexhaustible supply, such as solar energy, are also renewable resources.

Figure 24.1 Most of the items in this photo originated as natural resources. **Identify** *three resources represented in this photo.*

Clive Helm/CORBIS

Figure 24.2 Bamboo can be grown as a sustainable yield crop because it grows fast and needs no replanting. Bamboo can be used to produce a variety of items including flooring, cooking utensils, and clothing.

Sustainable yield of organisms Humans can use natural resources responsibly by replacing resources as they are used. The replacement of renewable resources at the same rate at which they are consumed results in a **sustainable yield.**

Organisms in the biosphere are important renewable resources. Plants and animals reproduce; therefore, as long as some mature individuals of a species survive, they can be replaced. Crops can be planted every spring and harvested every fall from the same land as long as the Sun shines, the rain falls, and the required nutrients are provided by organic matter or fertilizers. Animals that are raised for food, such as chickens and cattle, can also be replaced in short periods of time. Forests that are cut down for the production of paper products can be replanted and ready for harvest again in 10 to 20 years. Trees that are cut down for timber can be replaced after a period of up to 60 years.

Bamboo, shown in **Figure 24.2,** is one of Earth's most versatile renewable resources. Used by more than half the world's population for food, shelter, fuel, and clothing, bamboo is one of the world's fastest-growing plants. Because bamboo is a grass, it can be harvested without replanting. Bamboo grows without fertilizers or pesticides and is harvested in three to five years.

Reading Check **Identify** an example of sustainable yields.

Sunlight Some of Earth's renewable resources are not provided by Earth. The Sun provides an inexhaustible source of energy for all processes on Earth. Sunlight is considered a renewable resource because it will be available for at least the next five billion years.

VOCABULARY

ACADEMIC VOCABULARY

Technique
the systematic procedure by which a complex or scientific task is accomplished
The scientist's technique for gathering soil samples was flawless.

FOLDABLES
Incorporate information from this section into your Foldable.

Nonrenewable resources Many homes have copper pipes that transport water to the faucets. Today, copper costs about three times more than it did five years ago. Copper is expensive because there are a limited number of copper mines, and demand continues to increase. When all the resources in the operating mines have been exhausted, no more copper will be mined unless new sources can be located. Copper is an example of a **nonrenewable resource**—a resource that exists in a fixed amount in various places in Earth's crust and can be replaced only by geological, physical, and chemical processes that take millions of years. Resources such as fossil fuels, diamonds and other gemstones, and elements such as gold, copper, and silver are therefore considered to be nonrenewable. **Figure 24.3** shows some materials you use every day and the nonrenewable resources used to make them.

Reading Check **Explain** why gold, fossil fuels, and gemstones are nonrenewable resources.

Distribution of Resources

You have probably noticed that natural resources are not distributed evenly on Earth. Ohio, Pennsylvania, and West Virginia have an abundance of coal. California is known for its gold deposits. Georgia has large stands of trees used for paper and lumber. Some regions of the world, such as the United States, have an abundance of different types of natural resources. Other areas might have limited types of resources, but in abundant supply. For example, Saudi Arabia and Kuwait, in the Middle East, have more petroleum reserves than other areas of the world.

CAREERS IN EARTH SCIENCE

Materials Engineer Materials engineers work with metals, stone, plastics, and combinations of materials called composites to create materials used in everyday products, including computers, television screens, golf clubs, and snowboards. To learn more about Earth science careers, visit glencoe.com.

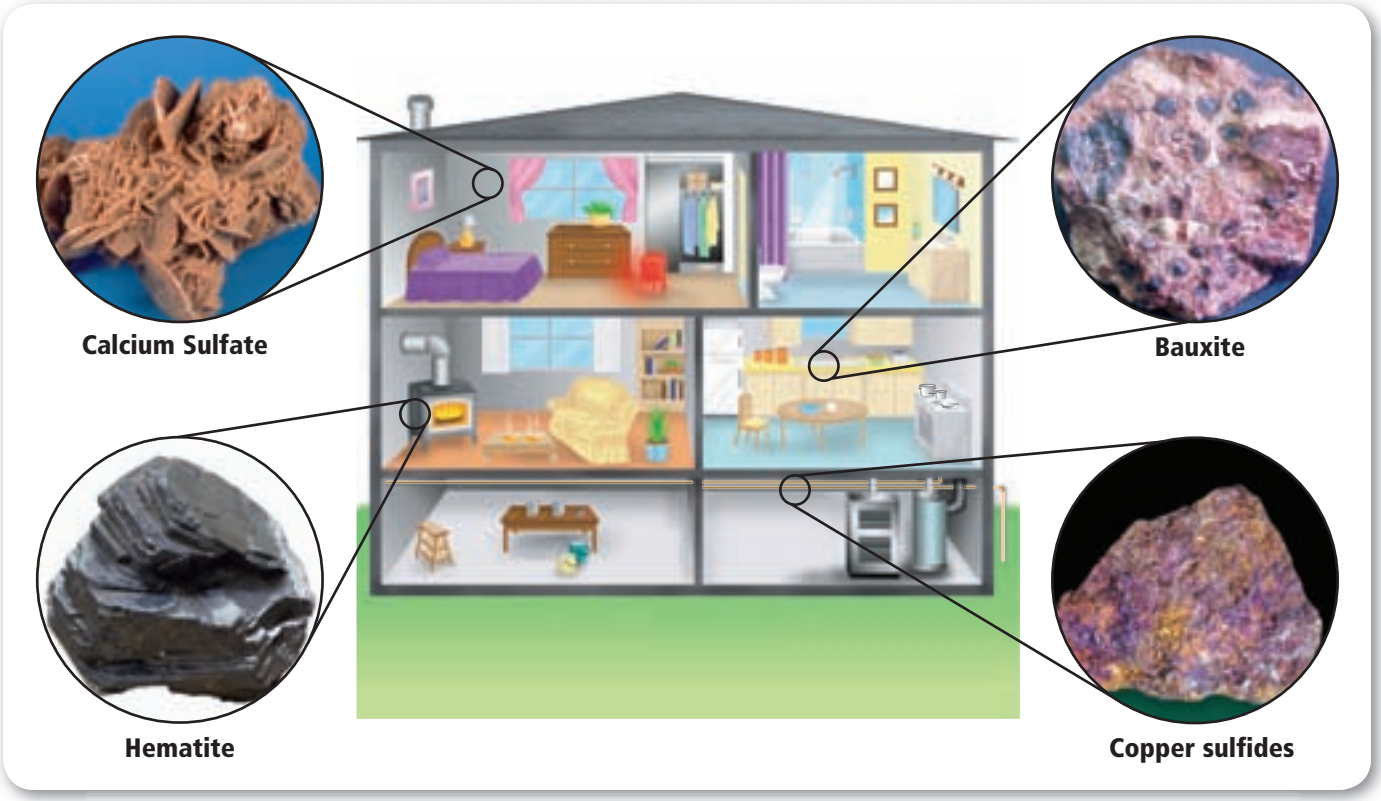


Figure 24.3 Nonrenewable resources are all around us. Aluminum from bauxite is used to make pots and pans, copper sulfides are used in copper plumbing, calcium sulfate is used to make drywall for houses and buildings, and iron from hematite is used to make appliances such as wood stoves.

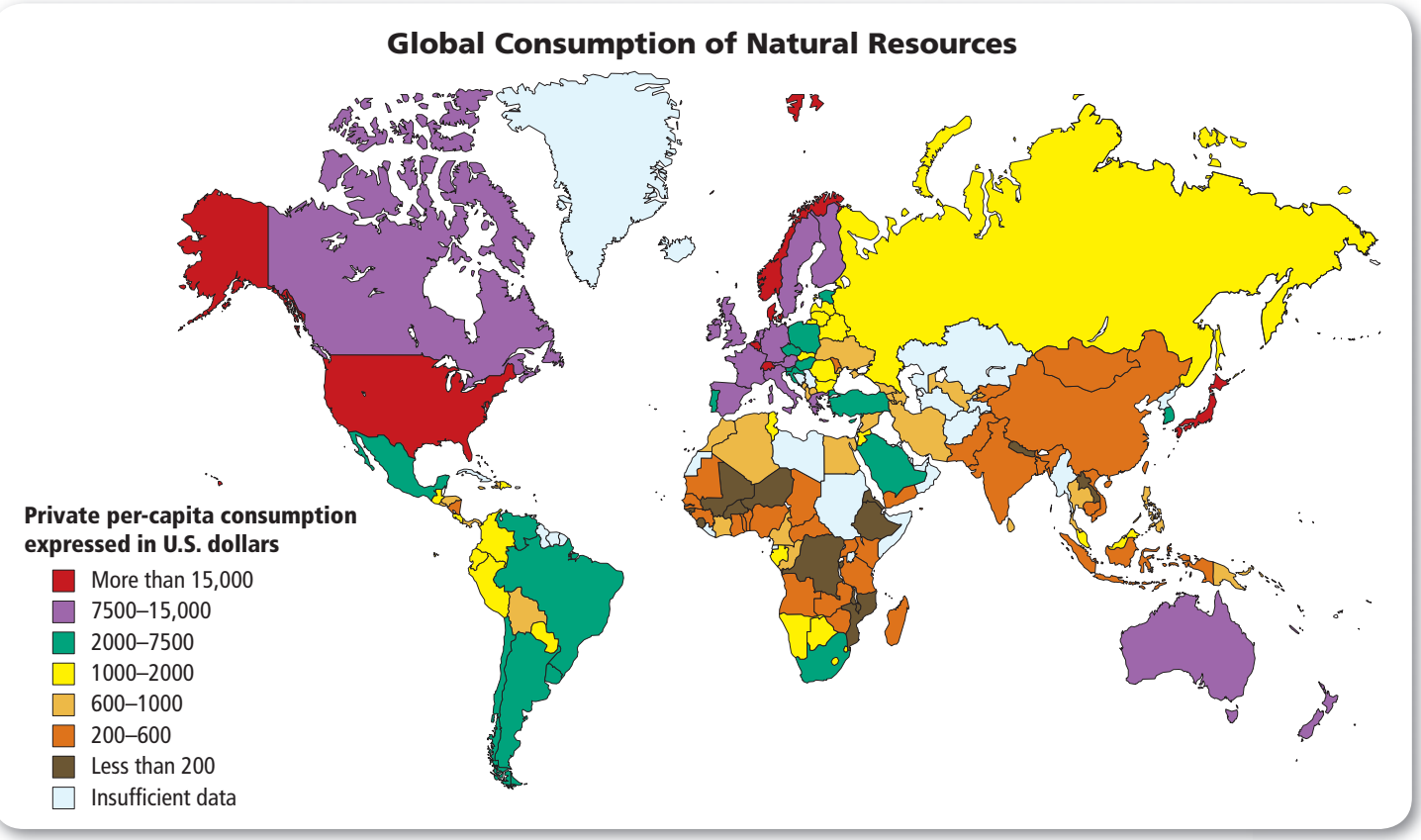


Figure 24.4 Across the globe, consumption of natural resources varies from country to country. Notice the average person in the United States consumes more than $15,000 a year in natural resources.
Determine *How does this compare with Canada or India?*

Consumption of resources Billions of people throughout the world use natural resources every day. Not only are natural resources distributed unevenly on Earth, they are likewise consumed unevenly. Although people in the United States make up only 6 percent of the world's population, they consume approximately 30 percent of Earth's mineral and energy resources each year, as shown in **Figure 24.4.** As a result, even more energy and resources are required to transport many resources from their point of origin to the places where they are being consumed.

Section 24.1 Assessment

Section Summary

- Natural resources are the resources that Earth provides, including organisms, nutrients, rocks, minerals, air, and water.
- Renewable resources are replaced at a rate equal to or greater than the rate at which they are being used.
- Nonrenewable resources exist in a fixed amount and take millions of years to replace.

Understand Main Ideas

1. MAIN Idea **Explain** how organisms, including humans, use natural resources.
2. **Explain** why costs of copper and other materials continue to increase.
3. **Categorize** the following as a renewable or nonrenewable resource: trees, aluminum, cotton, gemstones, and corn. Which are produced by sustainable yield?

Think Critically

4. **Propose** why consumption of natural resources is higher in the United States. Why is it important to be aware of this?

MATH in Earth Science

5. Aluminum production from bauxite ore costs $2000 per ton, whereas aluminum recycling costs $800 per ton. What is the percent saved by recycling?

Section 24.2

Objectives

- **Describe** materials from Earth's crust that are considered natural resources.
- **Recognize** the need to protect Earth's land surface as a resource.
- **Explain** the uneven distribution of resources worldwide.

Review Vocabulary

igneous rock: intrusive or extrusive rock formed from the cooling and crystallization of magma

New Vocabulary

desertification
aggregate
bedrock
ore
tailings

Resources from Earth's Crust

MAIN Idea **Earth's crust provides a wide variety of resources to grow food, supply building materials, and provide metals and minerals.**

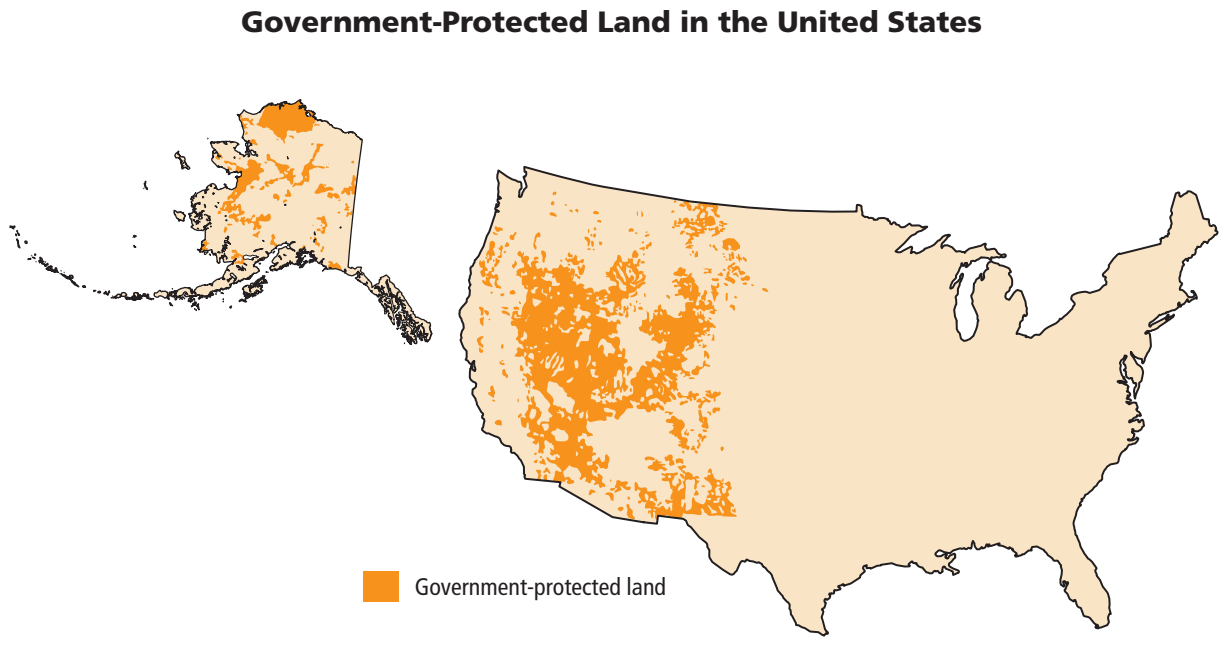
Real-World Reading Link Imagine going to a store where you can buy food, clothes, electronics, and whatever else you need. Earth's crust is like a store—it supplies most materials needed and used by humans.

Land Resources

In the springtime, many people visit garden centers and buy sand, mulch, peat moss, topsoil, and different kinds of rocks for landscaping purposes. These items are all land resources. Land provides places for humans and other organisms to live and interact. Land also provides spaces for the growth of crops, forests, grasslands, and wilderness areas.

Protected land Of all the land in the United States, 42 percent is protected land, which mostly consists of forests, parks, wildlife refuges, and grazing areas, shown in **Figure 24.5.** These land areas are federally administered to protect timber, grazing areas, minerals, and energy resources. Some public land areas, such as national forests, are managed for sustainable yield and provide recreational spaces. Some remote areas are designated as wilderness areas—places that are maintained in their natural state and protected from development.

Figure 24.5 Certain areas in the United States are protected from development. In this map, you can see that the majority of the protected lands in the United States are located in the western portion of the country.



National parks The national park system in the United States preserves scenic and unique natural landscapes, preserves and interprets the country's historic and cultural heritage, protects wildlife habitats and wilderness areas, and provides areas for various types of recreation. About 49 percent of the land in the national park system is designated as wilderness.

National wildlife refuges National wildlife refuges provide protection of habitats and breeding areas for wildlife, and some provide protection for endangered species. Other uses of the land in wildlife refuges, such as fishing, trapping, farming, and logging, are permitted as long as they are compatible with the purpose of the refuge.

Soil You learned in Chapter 7 how soil forms. In some parts of Earth's crust, it can take up to 1000 years to form just a few centimeters of topsoil, yet it can be lost in a matter of minutes as a result of erosion by wind or water. Plowing and leaving the ground without plant cover can increase topsoil loss.

The loss of topsoil makes soil less fertile and less able to hold water, which results in loss of crops. Today, topsoil is eroding more quickly than it forms on about one-third of Earth's croplands. Each decade, Earth loses about 7 percent of its topsoil, yet the eroded croplands must feed an ever-increasing human population.

In arid and semiarid areas of the world, the loss of topsoil leads to **desertification,** which is the process whereby productive land becomes desert. Desertification can occur when too many grazing animals are kept on arid lands, or when trees and shrubs are cut down for use as fuel in areas with few energy resources.

Desertification is a growing problem in Africa, as shown in **Figure 24.6.** It is also a growing problem in the Middle East, in the western half of the United States, and in Australia. Desertification can be prevented by reducing overgrazing and by planting trees and shrubs to anchor soil and retain water.

Reading Check **Describe** activities that can lead to erosion of topsoil.

VOCABULARY

ACADEMIC VOCABULARY

Compatible
capable of existing or performing in harmonious, agreeable, or congenial combination with another or others
My sister and her roommate are not compatible; they argue all the time.

Figure 24.6 Desertification is a growing concern in many areas. Clearcutting and over-farming have led some parts of Africa to be considered in great risk of desertification.

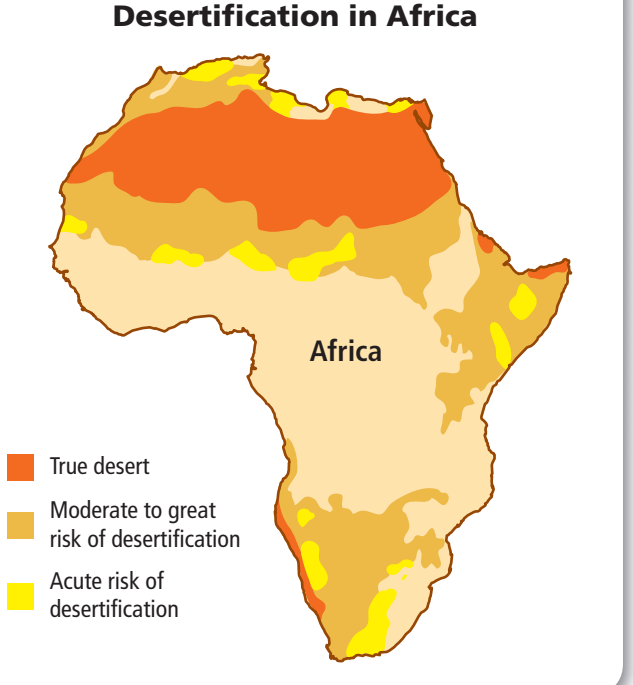


Figure 24.7 Different layers of Earth's surface have value as resources. Topsoil provides nutrients for crop production, aggregate can be used to help construct roads and sidewalks, and bedrock houses valuable ores that can be mined for profit.

Aggregates

Have you ever observed the construction of a highway? You might have seen workers place layers of materials on the ground before they began to build the highway surface. In some instances, the materials used for this first layer come from **aggregate,** which is a mixture of gravel, sand, and crushed stone that can naturally accumulate on or near Earth's surface.

You learned in Unit 3 how Earth processes transport materials. Some aggregates are transported by water and are found on floodplains in river valleys and in alluvial fans in mountainous areas. Other aggregates were deposited by glacial activity in moraines, eskers, kames, and outwash plains. Aggregates used in construction are often mixed with cement, lime, or other materials to form concrete or mortar.

Reading Check **Define** aggregate.

Bedrock

In Chapter 7, you learned that underneath topsoil is a layer of soil consisting of inorganic matter, including broken-down rock, sand, silt, clay, and gravel, as shown in **Figure 24.7.** This deeper soil layer lies on a base of unweathered parent rock called bedrock. **Bedrock** is solid rock, and it can consist of limestone, granite, marble, or other rocks that can be mined in quarries. Slabs of bedrock are often cut from quarry faces. Large pieces of bedrock are used in the construction of buildings, monuments, flooring, and fireplaces.

Ores

An **ore** is a natural resource that can be mined for a profit; that is, it can be mined as long as its value on the market is greater than the cost of its extraction. For example, the mineral hematite is an iron ore because it contains 70 percent iron by weight. Other minerals such as limonite also contain iron, but they are not considered ores because the percentage of iron contained in them is too low to make extraction profitable. Ores can be classified by the manner in which they formed. Some ores are associated with igneous rocks, and other ores are formed from processes that occur at Earth's surface.

Settling of crystals Iron, chromium, and platinum are examples of metals that are extracted from ores associated with igneous rocks. Chromium and platinum come from ores that form when minerals crystallize and settle to the bottom of a cooling body of magma. Chromite ore deposits are often found near the bases of igneous intrusions. One of the largest deposits of chromite is found in the Bushveldt Complex in South Africa.

Hydrothermal fluids The most important sources of metallic ore deposits are hydrothermal fluids. Hot water and other fluids might be part of the magma that is injected into surrounding rock during the last stages of magma crystallization. Because atoms of metals such as copper and gold do not fit into the crystals of minerals during the cooling process, they become concentrated in the remaining magma. Eventually, a solution rich in metals and silica moves into the surrounding rocks to create ore deposits known as hydrothermal veins, shown in **Figure 24.8.** Hydrothermal veins commonly form along faults and joints.

Chemical precipitation Ores of manganese and iron most commonly originate in layers formed through chemical precipitation. Iron ores in sedimentary rocks are often found in bands made up of alternating layers of iron-bearing minerals and chert shown in **Figure 24.8.** The origin of these ores, called banded iron formations, is not fully understood. Banded iron formations might have resulted from volcanic activity or weathering and microbial activity.

Placer deposits Some sediments, such as grains of gold and silver, are more dense than other sediments. When stream velocity decreases, as, for example, when a stream flows around a bend, heavy sediments are sometimes dropped by the water and deposited in bars of sand and gravel. Sand and gravel bars that contain heavier sediments, such as gold nuggets, gold dust, diamonds, platinum, gemstones, and rounded pebbles of tin and titanium oxides, are known as placer deposits. Some of the gold found during the Gold Rush in California during the late 1840s was located in placer deposits.


Chromite bands


Hydrothermal vein


Banded iron


Placer deposits

Figure 24.8 The chromite bands in the Bushvelt Complex are up to 0.5 m thick. Ores are also found in hydrothermal veins, banded formations, and placer deposits.

(t)JULIA CHENG/AP Images

Figure 24.9 Waste rock, such as this tailings pile in New Mexico, is discarded after minerals are extracted.

Effects of Mining

Although many of the resources that you have learned about in this section can be extracted with little impact on the surrounding environment, the extraction of others can have lasting impacts. Mines that are used to remove materials from the ground surface destroy the original ground contours. Open-pit mines can leave behind waste rock, shown in **Figure 24.9,** that can weather over time. The extraction of mineral ores often involves grinding parent rock to separate the ore. The material left after the ore is extracted, called **tailings,** might release harmful chemicals into groundwater or surface water.

Mining sometimes exposes other materials, such as mercury and arsenic, that can form acids as they weather and pollute groundwater. In addition to causing environmental problems, mining itself is a dangerous activity. In fact, the National Safety Council has identified mining as the most dangerous occupation in the United States: it has one of the highest yearly death rates of all occupations.

Section 24.2 Assessment

Section Summary

- Loss of topsoil can lead to desertification.
- Aggregates, composed of sand, gravel, and crushed stone, can be found in glacial deposits.
- An ore is a resource that can be mined at a profit. Ores can be associated with igneous rocks or formed by processes on Earth's surface.

Understand Main Ideas

1. MAIN Idea **Describe** three natural resources derived from Earth's crust.
2. **Explain** why topsoil loss is considered a worldwide problem.
3. **Identify** three reasons it is important to protect Earth's land resources.
4. **Explain** the relationship between ore and tailings.
5. **Determine** where placer materials might have originated.

Think Critically

6. **Predict** what would happen if a land resource, such as aluminum, was depleted.

WRITING in Earth Science

7. Create a three-fold pamphlet explaining the purposes and use of national parks and National Wildlife Refuge lands.

Earth Science online Self-Check Quiz glencoe.com

Section 24.3

Objectives

- **Recognize** that the atmosphere is a resource.
- **Illustrate** carbon and nitrogen cycles.
- **Describe** natural sources of air pollution.

Review Vocabulary

photosynthesis: a process used by certain organisms to make food using energy from the Sun and carbon dioxide from the air

New Vocabulary

nitrogen-fixing bacteria
pollutant

Air Resources

MAIN Idea **The atmosphere contains gases required for life on Earth.**

Real-World Reading Link Fish and other aquatic organisms have gills, which are specialized structures used to extract dissolved oxygen from the water. Humans, however, need to breathe air to get the oxygen their cells need. Scuba divers carry tanks with compressed air when they swim under water.

Origin of Oxygen

Most organisms on Earth require oxygen or carbon dioxide to maintain their life processes, but oxygen has not always been a part of Earth's atmosphere. As you recall from Chapter 22, scientists think that 4.6 to 4.5 bya Earth's atmosphere was similar to the mixture of gases released by erupting volcanoes. These gases included carbon dioxide, nitrogen, and water vapor. As Earth's crust cooled and became more solid, rains washed most of the carbon dioxide out of the atmosphere and into the oceans. Early life-forms in the seas used carbon dioxide during photosynthesis and released oxygen. Over time, oxygen in the atmosphere built up to levels that allowed the evolution of more complex organisms that required oxygen for life processes, as shown in **Figure 24.10.**

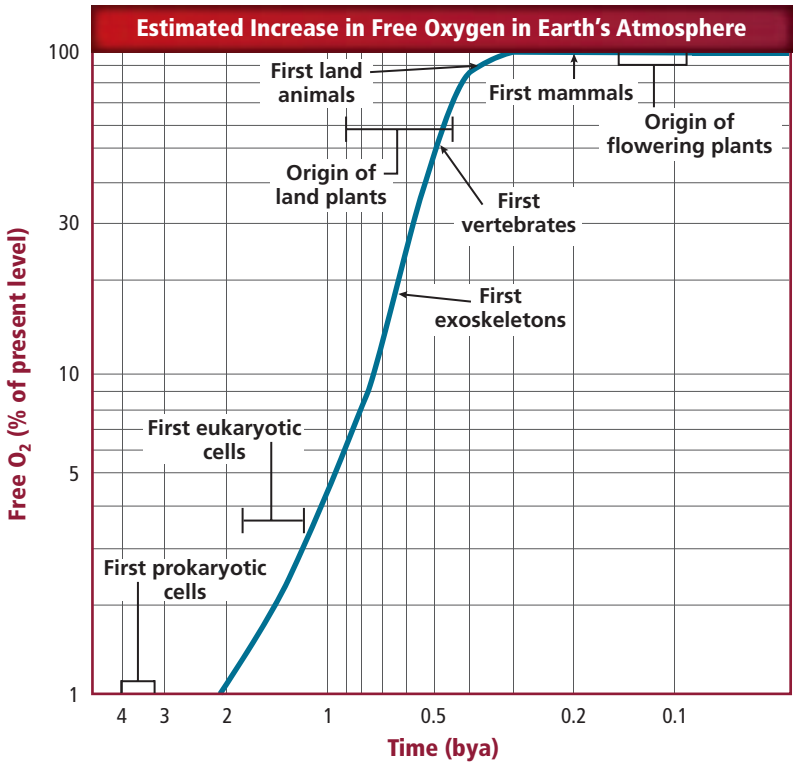


Figure 24.10 Scientists think that prokaryotes first appeared about 4 bya. It was not until 2 bya that eukaryotes appeared on Earth. Notice the difference in oxygen (O_2) gas levels between when prokaryotes and eukaryotes appeared.
Determine *When did land plants first appear?*

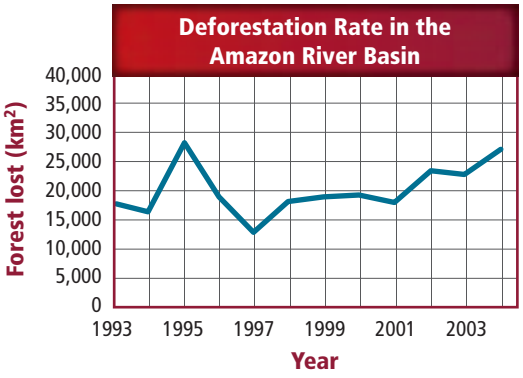
DATA ANALYSIS LAB

Based on Real Data*

Interpret Graphs

What is the rate of deforestation in the Amazon? Many experts are concerned about the loss of the forest cover in tropical rain forests worldwide. In the Amazon River Basin, scientists estimate that one hectare (ha, about 2.47 acres) of forest is cut down each hour.

Data and Observations



Analysis

1. How many square kilometers of the Amazon River Basin have been deforested since 2002?
2. According to the graph, what year was the peak in deforestation of the Amazon River Basin?

Think Critically

3. **Calculate** the rates of deforestation for the periods 1993 to 1998 and 1999 to 2004.
4. **Compare** the rates of deforestation for the periods from 1993 to 1998 and 1999 to 2004.
5. **Predict** what will happen to the Amazon Rain Forest over the next 30 years.
6. **Explain** how loss of rainforest could affect the carbon cycle.

*Data obtained from: Estimated Annual Deforestation Rate After 1988. *The National Institute for Space Sciences.*

Cycles of Matter

The law of conservation of mass states that the amount of matter on Earth never changes. Earth's elements cycle among organisms and the nonliving environment. In Chapter 11, you learned about how water cycles on Earth. Earth's atmosphere plays a significant role in other cycles, such as the nitrogen and carbon cycles.

Earth's cycles are in delicate balance. When fossil fuels burn, the carbon that was stored in them for millions of years is released into Earth's atmosphere. Clearing forests results in fewer trees to take in carbon and release oxygen.

Carbon cycle Life on Earth would not exist without carbon because carbon is the key element in the sugars, starches, proteins, and other compounds that make up living things. The carbon cycle is illustrated in **Figure 24.11.** During photosynthesis, green plants and algae convert carbon dioxide and water into carbohydrates and release oxygen back into the air. These carbohydrates are used as a source of energy for all organisms in a food web. Other organisms release carbon dioxide back into the air during respiration.

Carbon is also stored when organic matter is buried underground and, over millions of years, is converted to peat, coal, oil, or natural gas deposits. Carbon dioxide gas is released into the atmosphere when the fossil fuel is burned for energy.

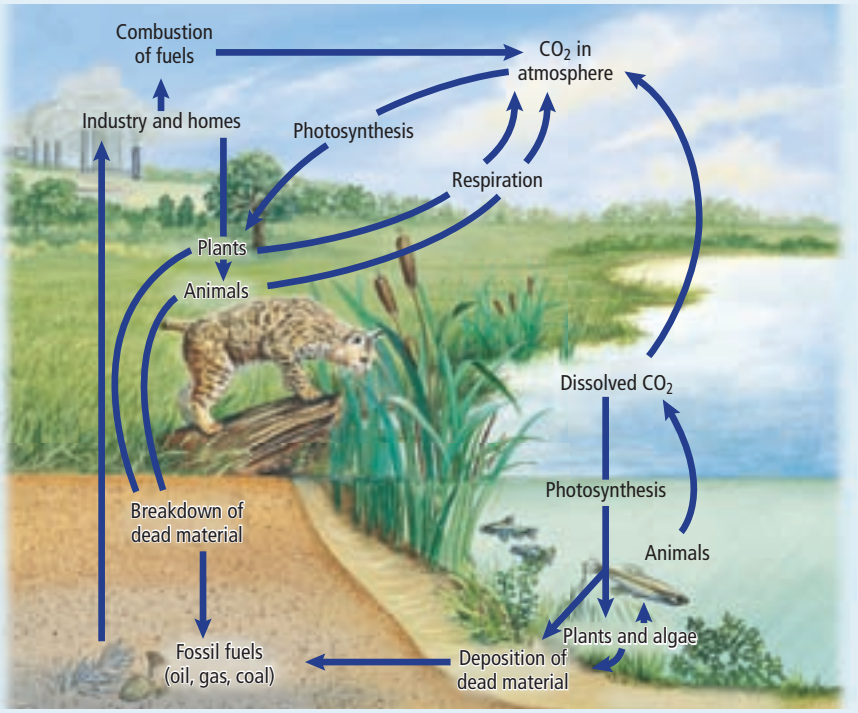
Reading Check **Explain** how photosynthesis and respiration cycle carbon between living things and Earth's atmosphere.

Nitrogen cycle Nitrogen is an element that organisms need to produce proteins. Nitrogen makes up 78 percent of the atmosphere, but plants and animals cannot use nitrogen directly from the atmosphere. Some species of bacteria, called **nitrogen-fixing bacteria,** live in water or soil, or grow on the roots of some plants and can capture nitrogen gas. The nitrogen-fixing bacteria convert the nitrogen into a form that can be used by other plants to build proteins. Nitrogen continues through the food chain as one organism eats another. As organisms excrete waste and later die, the nitrogen returns to the soil and air. In the nitrogen cycle, nitrogen moves from the atmosphere to the soil, to living organisms, and then back to the atmosphere.

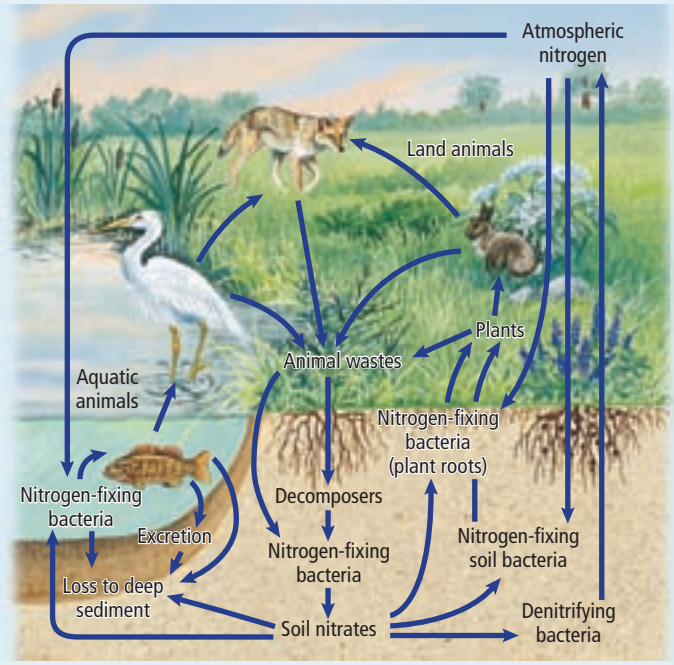
Visualizing Carbon and Nitrogen Cycles

NATIONAL GEOGRAPHIC

Figure 24.11 All life-forms depend on carbon and nitrogen in many different ways, as shown.



Humans have influenced the carbon cycle through the combustion of fuels. When fuels such as coal or oil are burned, one by-product of this combustion is carbon dioxide. Once released, the carbon dioxide enters the atmosphere and continues in the carbon cycle.



Nitrogen-fixing bacteria are an integral part of the nitrogen cycle. When animals produce waste, or when plants or animals die and begin to decompose, one by-product of this process is nitrogen. Nitrogen-fixing bacteria can break down the nitrogen, making it accessible for use by other plants and animals.

Concepts in Motion To explore more about the carbon and nitrogen cycles, visit glencoe.com.

Earth Science online

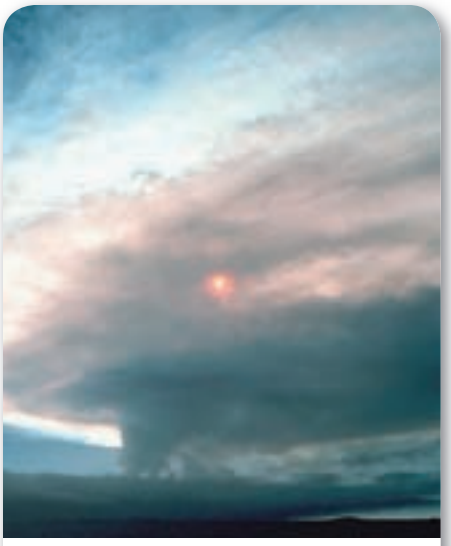


Figure 24.12 Vog, shown here over Kilauea, is formed when sulfur dioxide and other particulates emitted from a volcano mix with oxygen and moisture in the presence of sunlight.

Natural Air Pollution Sources

A **pollutant** is a substance that enters Earth's geochemical cycles and can harm the well-being of living things or adversely affect their activities. Air pollution can come from natural or human sources and can affect air outside or inside buildings. Natural sources of air pollution include volcanoes, fires, and radon. You will learn more about pollution sources resulting from human activities in Chapter 26.

Volcanoes Volcanoes can be significant sources of air pollution. On May 18, 1980, Mount St. Helens in Washington State shot an enormous column of ash 24 km into the sky. It continued to eject ash for about nine hours. Some of the ash reached the eastern United States within three days. Small particles entered the jet stream and circled Earth within two weeks. Mount St. Helens started erupting again in early October, 2004, and has been pumping out between 45,000 and 270,000 kg a day of sulfur dioxide. Italy's Mount Etna produces 100 times more sulfur dioxide than Mount St. Helens and is located in the middle of a heavily populated area. This sulfur helps to create acid rain and a type of bluish smog that volcanologists call vog, shown in **Figure 24.12,** which can cover large areas of land.

Reading Check **Describe** how volcanoes contribute to air pollution.

Fires Smoke is a mixture of gases and fine particles produced when wood and other organic matter burn. The most significant health threat from smoke comes from fine particles. These microscopic particles can get into your eyes and respiratory system, where they can cause health problems such as burning eyes, a runny nose, and illnesses such as chronic bronchitis. People with chronic lung disease can be at risk of serious injury from smoke.

Forest fires can release thousands of tons of carbon monoxide, a gas that interferes with oxygen transport in your blood. Gases from forest fires can also contribute to particulate and smog pollution hundreds of kilometers from the burning forest. In 2004, a large fire in Alaska and Canada, shown in **Figure 24.13,** added about 30 billion kg of carbon monoxide to the atmosphere—about as much as was released during human activities in the United States that year.

Figure 24.13 Forest fires can release dangerous gases into the atmosphere. People with respiratory problems can be at risk of injury from high levels of smoke and gas.

Radon The gas known as radon-222 (Rn-222) is colorless, odorless, tasteless, and naturally occurring. Rn-222 is produced by the radioactive decay of Uranium-238 (U-238). Small amounts of U-238 are found in most soils and rocks, and in underground deposits, mainly in the northern third of the United States. Usually, radon gas from such deposits seeps upward through the soil and is released into the atmosphere, where it is diluted to harmless levels. However, when buildings are constructed with hollow concrete blocks, or when they have cracks in their foundations, radon gas can enter and build up to high levels indoors, as shown in **Figure 24.14.** Once indoors, radon gas decays into other radioactive particles that can be inhaled.

Radon is responsible for about 21,000 lung cancer deaths every year. About 2900 of these deaths occur among people who have never smoked. Because it is impossible to see or smell a buildup of radon gas in a building, the EPA suggests that people test the radon levels in their homes and offices.

Reading Check **Explain** why radon is so dangerous.

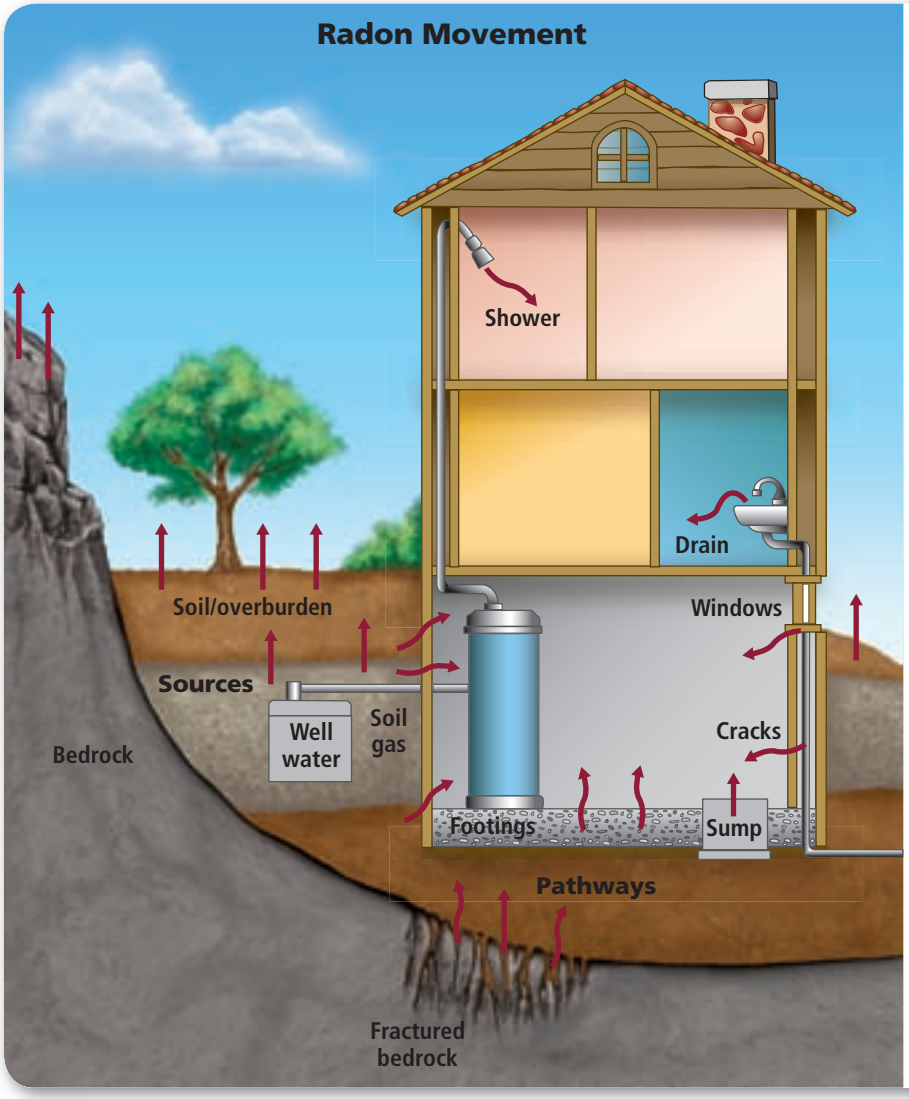


Figure 24.14 There are many ways radon can enter a home or building. Once inside, radon is colorless and odorless, making it difficult to detect. For this reason, many homes are equipped with radon detectors that have an alarm if levels exceed safety. Although radon often enters through cracks in the foundation, or through drains or other openings in the basement, they can also enter through other pathways such as showerheads.

Will & Deni McIntyre/CORBIS

Figure 24.15 When acid rain falls on a forest, the pH of the soil changes. As a result, the growth of the trees can be slowed. They can also become susceptible to disease, which causes large stands of trees to be damaged. **Predict** ***What will happen to this forest if acid rain continues to fall on it?***

Transport and Dilution

As air in the lower atmosphere moves across Earth's surface, it collects both naturally occurring and human-made pollutants. These pollutants are often transported, diluted, transformed, or removed from the atmosphere.

Some pollutants are carried downwind from their origin. Transport depends on wind direction and speed, topographical features, and the altitude of the pollutants. For example, hills, valleys, and buildings interrupt the flow of winds and thus influence the transport of pollutants. Many of the pollutants in the acid precipitation that falls in the mountain ranges of North Carolina, shown in **Figure 24.15,** were transported from coal-burning power plants in the midwestern states. If air movement in the troposphere is turbulent, some pollutants are diluted and spread out, which reduces the damage they cause.

Some air pollutants undergo physical changes. For example, dry particles might clump together and become heavy enough to fall back to Earth's surface. These and other air pollutants are removed from the atmosphere in the form of snow, mist, fog, and rain.

Section 24.3 Assessment

Section Summary

- Earth's early atmosphere had no oxygen; it was supplied over time by photosynthetic organisms.
- Oxygen, carbon, and nitrogen cycle from living organisms to the nonliving environment.
- Volcanoes, fires, and radon are natural sources of air pollution.

Understand Main Ideas

1. MAIN Idea **Explain** why the atmosphere is considered a natural resource.
2. **Compare and contrast** the carbon and nitrogen cycles.
3. **Describe** how coal-burning power plants in the Midwest can cause acid precipitation in New York.

Think Critically

4. **Predict** what might happen if there were no nitrogen-fixing bacteria on Earth.
5. **Apply** How might increasing the energy efficiency of a home lead to increased radon levels indoors?

MATH in Earth Science

6. About 21,000 people die from lung cancer related to radon each year. Of these, 2900 have never smoked. What percentage of people who die from radon-related lung cancer have never smoked?

Earth Science online Self-Check Quiz glencoe.com

Section 24.4

Objectives

- **Explain** why the properties of water are important for life on Earth.
- **Analyze** how water is distributed and used on Earth.
- **Identify** ways in which humans can reduce the need for freshwater resources.

Review Vocabulary

aquifer: rock that holds enough water and transmits it rapidly enough to be useful as a water source

New Vocabulary

hydrogen bond
desalination

Water Resources

MAIN Idea **Water is essential for all life, yet it is unevenly distributed on Earth's surface.**

Real-World Reading Link What did you eat for dinner last night? How much water did it take to prepare the meal? Water is not only used to prepare, cook, and clean up, but it is also needed to grow the food that you eat.

Properties of Water

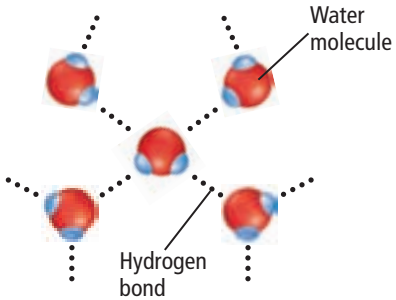
About 71 percent of Earth's surface is covered by water. The world's oceans help regulate climate, provide habitats for marine organisms, dilute and degrade many pollutants, and even have a role in shaping Earth's surface. Freshwater is an important resource for agriculture, transportation, recreation, and numerous other human activities. In addition, the organisms that live on Earth are made up mostly of water. Most animals are about 50 to 65 percent water by mass, and even trees can be composed of up to 60 percent water.

Liquid water What properties of water allow it to be so versatile? Water has a high boiling point, 100°C, and a low freezing point, 0°C. As a result, water remains liquid in most of the environments on Earth. Water can exist as a liquid over a wide range of temperatures because of the hydrogen bonds between water molecules. **Hydrogen bonds** form when the positive ends of some water molecules are attracted to the negative ends of other water molecules. Hydrogen bonds, shown in **Figure 24.16,** also cause water's surface to contract and allow water to adhere to and coat a solid. These properties enable water to rise from the roots of a plant through its stem to its leaves.

Thermal energy storage capacity Liquid water can store a large amount of thermal energy without a significant increase in temperature. This property protects aquatic organisms from rapid temperature changes, and it also contributes to water's ability to regulate Earth's climate. Because of this same property, water is used as a coolant for automobile engines, power plants, and other thermal energy-generating processes. Have you ever perspired heavily while participating in an outdoor activity on a hot day? Evaporation of perspiration from your skin helps you cool off because large quantities of thermal energy are released as the water in the perspiration changes into water vapor.

Water as a solvent Liquid water can dissolve a variety of compounds. This enables water to carry nutrients into, and waste products out of, the tissues of living things. The diffusion of water across cell membranes enables cells to regulate their internal pressure.

Figure 24.16 The attractions between the slightly positive and slightly negative ends of water molecules are called hydrogen bonds.



Richard Hamilton Smith/CORBIS

Figure 24.17 In a rock formation where weathering has previously occurred, water can enter cracks in the formation. When the water freezes, it expands, causing the cracks to widen.

Solid water Unlike most liquids, water expands when it freezes. Because ice has a lower density than liquid water, it floats on top of water. As a result, bodies of water freeze from the top down. If water did not have this property, ponds and streams would freeze solid, and aquatic organisms would die each winter. **Figure 24.17** shows that expansion of water as it freezes can also fracture rocks. Thus, ice formation in cracks in Earth's surface becomes part of the weathering process.

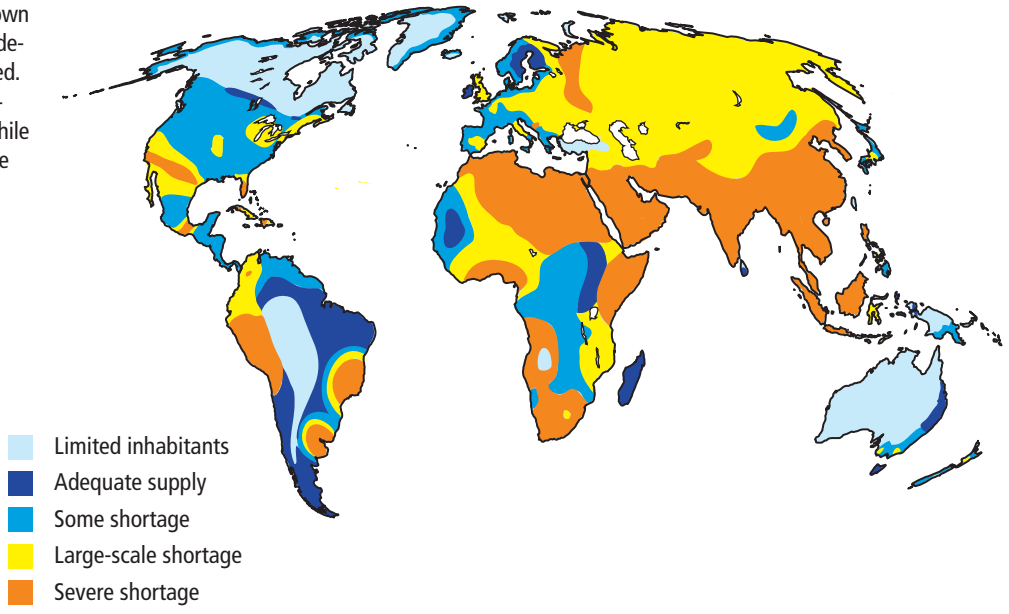
Location of Freshwater Resources

Freshwater resources are not distributed evenly across Earth's landmasses. The eastern United States receives ample precipitation, and most freshwater in these states is used for cooling, energy production, and manufacturing. By contrast, southwestern states often have little precipitation. In the southwestern United States, the largest use of freshwater is for agricultural uses such as irrigation. Water tables in these areas might drop as people continue to use the groundwater faster than it can be recharged.

Water distribution is a continuing problem worldwide, even though most continents have plenty of water. Since the 1970s, scarcity of water has resulted in the deaths of more than 24,000 people each year. In areas where water is scarce, women and children often walk long distances each day to collect water for domestic uses. Millions of people also try to survive on land that is prone to drought. About 25 countries, primarily in Africa, experience chronic water shortages. **Figure 24.18** shows projected water stress levels across the globe for the year 2025. These stress levels are predicted in large part by projected population growth, as well as other factors.

Figure 24.18 By the year 2025, scientist predict the water stress levels will reach those shown here. The areas with projected adequate water supply will be limited. Most of the United States is projected to have some shortage while much of Asia is predicted to have large-scale shortage.

Projected World Water Stress Levels in 2025



Use of Freshwater Resources

Recall from Chapter 10 that the upper surface of groundwater is called the water table, and that the water-saturated rock through which groundwater flows is called an aquifer. Aquifers are refilled naturally as rain percolates through soil and rock.

In the United States, about 23 percent of all freshwater used is groundwater pumped from aquifers. Water moves through aquifers at a rate of only about 1 m/y. If the withdrawal rate of an aquifer exceeds its natural recharge rate, the water table around the withdrawal point is lowered, called drawdown. If too many wells are drilled into the same aquifer in a limited area, the drawdown can lower the water table, and, as a result, wells might run dry.

Worldwide consumption Uses of freshwater vary worldwide, but, about 70 percent of the water withdrawn each year is used to irrigate 18 percent of the world's croplands. About 23 percent of freshwater is used for cooling purposes in power plants, for oil and gas production, and in industrial processing. Domestic and municipal uses account for only 7 percent of the freshwater withdrawal.

Managing Freshwater Resources

Most countries manage their supplies of freshwater by building dams, transporting surface water, or tapping groundwater. The dam shown in **Figure 24.19** was built to hold back the floodwaters of the Yangtze River in China. Called the Three Gorges Project, the structural construction of this dam was completed in 2006, and it is expected to provide freshwater and supply power to 150 million people by 2009. However, when full, water held by the dam will displace about one million people who live nearby.

Figure 24.19 Dams are often built to contain freshwater resources in rivers. While this provides a readily available source of freshwater for human use, there are many other factors involved that make the damming of rivers controversial, including the flooding of farmland and displacement of people.

Du Huaju/XINHUA/CORBIS

MiniLab

Determine the Hardness of Water

How easily are soap suds produced? Water contains different minerals depending on its source. When water has a high mineral content it is referred to as "hard."

Procedure

1. Read and complete the lab safety form.
2. Obtain six **clean baby food jars.** Label them *A* through *F*.
3. Measure 20 mL of one **water sample.** Pour the water into the jar marked *A*.
4. Repeat Step 3 four more times, using a different water sample for jars B through E.
5. Measure 20 mL of **distilled water.** Pour this water into jar F.
6. Make a data table in your science journal. In the first column, write the letters *A* through *F*.
7. Place one drop of **liquid soap** in sample jars A through E. Do not place any soap in jar F. Tighten the lids. Shake each jar vigorously for five seconds.
8. Using the following rating scale, record in your data table the amount of suds in each jar: 1—no suds, 2—few suds, 3—moderate amount of suds, 4—lots of suds.

Analysis

1. **Order** the water samples in order from hardest to softest.
2. **Explain** What is the difference between hard and soft water?
3. **Determine** What are some disadvantages of hard water?
4. **Analyze** What was the purpose of sample F?

Dams and reservoirs Building dams is one of the primary ways that countries manage their freshwater resources. Large dams are built across river valleys, and the reservoirs behind dams capture the river's flow as well as rain and melting snow. Because the runoff is captured, flooding downstream is controlled. The water held in these reservoirs can be released as necessary to provide water for irrigation; municipal uses, such as in homes and businesses; or to produce hydroelectric power. Reservoirs also provide opportunities for recreational activities, such as fishing and boating. Dams and reservoirs currently control between 25 and 50 percent of the total runoff on every continent.

Reading Check **Explain** several advantages of building dams.

Transporting surface water If you were to visit Europe or the Middle East, you would likely see many ancient aqueducts. The Romans built aqueducts 2000 years ago to bring water from other locations to their cities. Today, many countries use aqueducts, tunnels, and underground pipes to move water from areas where it is plentiful to areas that need freshwater.

The State Water Project in California, illustrated in **Figure 24.20,** is one example of the benefits, as well as the costs, of transporting surface water. In California, about 75 percent of the precipitation occurs north of the city of Sacramento, yet 75 percent of the state's population lives south of that city. The California Water Project uses a system of dams, pumps, and aqueducts to transport water from northern California to southern California. Eighty-two percent of this water is used for agriculture. The residents of Los Angeles and San Diego are withdrawing groundwater faster than it is being replenished. As a result, there is a demand for even more water to be diverted to the south. Conflicts over the transport of surface water could increase as human populations increase.

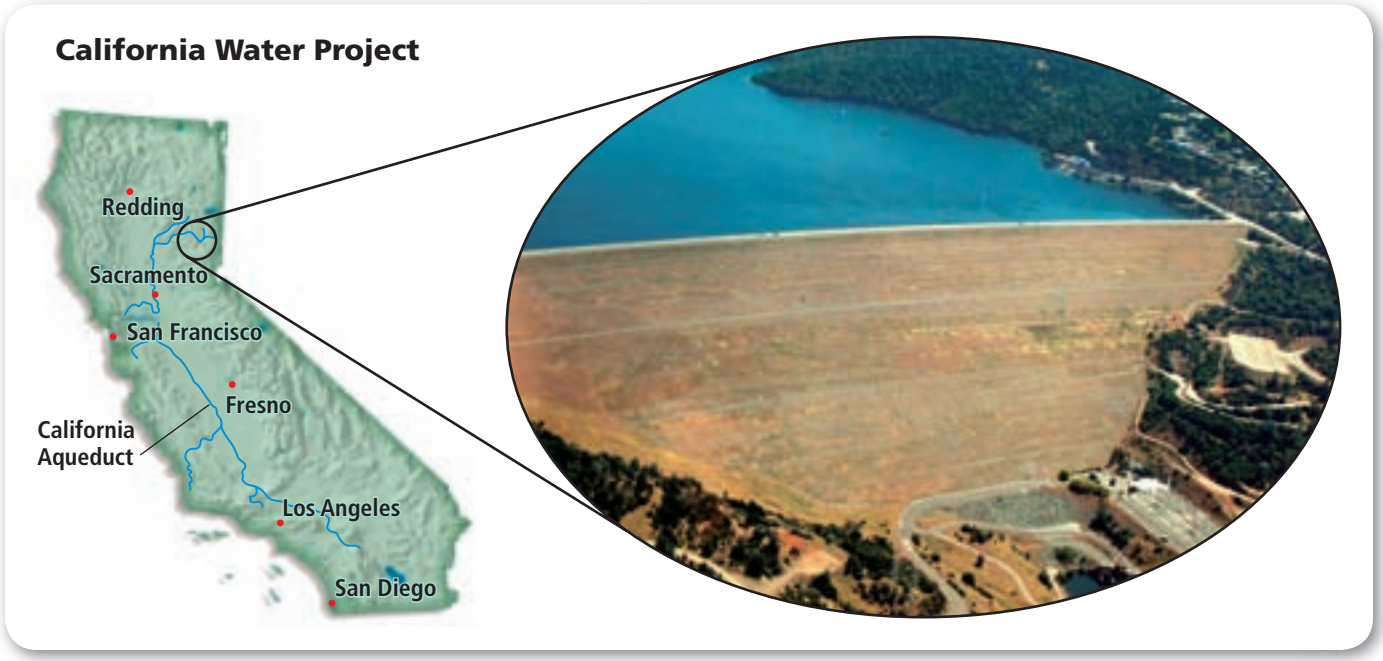


Figure 24.20 A system of dams, pumps, and aqueducts moves water in California from the North, where there is more rainfall, to the South, where the climate is more arid.

Juan José Pascual/Age Fotostock

Figure 24.21 Desalination can be accomplished using several different methods. One method, called distillation, removes salt by boiling the water. Another process involves pumping the water through a filtration system to remove the salt. In some places water is desalinated in plants like this one.

Concepts in Motion

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

Desalination With all the water available in the oceans, some countries have explored the possibility of removing salt from seawater to provide freshwater in a process called **desalination.** Several methods are available to desalinate seawater. One way is through distillation—water is first heated until it evaporates, and then it is condensed and collected. This evaporation process leaves the salts behind. Most countries that use desalination to produce freshwater use solar energy to evaporate seawater. Although the evaporation of seawater by solar energy is a slow process, it is an inexpensive way to provide needed freshwater. Some desalination plants, shown in **Figure 24.21,** use fuel to distill seawater, but because this process is expensive, it is used primarily to provide drinking water.

Section 24.4 Assessment

Section Summary

- Water has unique properties that allow life to exist on Earth.
- Water is not evenly distributed on Earth's surface.
- Water management methods distribute freshwater resources more evenly through the use of dams, aqueducts, and wells.

Understand Main Ideas

1. MAIN Idea **Describe** how the distribution of freshwater resources affects humans.
2. **Explain** why the thermal energy storage capacity of water is important to life on Earth.
3. **Explain** why water in a pond freezes from the top down.

Think Critically

4. **Propose** Do you think the process of desalination is a good option for areas like the southwestern United States where there is a high demand for freshwater? Explain your reasoning.
5. **Analyze** What are two things you could do to reduce your daily water usage?

WRITING in Earth Science

6. Imagine there is a large river near your hometown. For years, residents have used the river to fish, canoe, and swim. Recently a group has proposed damming the river to provide a clean, renewable energy source. Write two newspaper editorials—one in support of the construction of a dam and one against it.

Earth Science & Society

The Price of Water

When you go to the water fountain to get a drink, do you ever wonder where the water comes from? Depending on where you live, your water could come from groundwater or surface water, from a well or a water treatment plant.

The source of our water Water might seem like an abundant resource—after all, nearly 75 percent of our planet is covered with it. However, less than 1 percent of all the water on Earth is suitable for everyday uses such as drinking, cooking, and irrigation. Because water is a limited resource, its source is becoming a very important issue.

A green desert The hot, dry climate of the southwestern United States is probably the last place you would expect to see green lawns and palm trees lining the streets. Most of the area is classified as arid due to the low amounts of yearly rainfall. Yet, as many cities in this area continue to grow in population, the demand for water continues to increase.

Many cities in the Southwest draw from the same groundwater source. Often, more water is withdrawn than can be replaced by the yearly rainfall, causing the water supply to run low. Some larger cities are attempting to fix this problem by using water from rivers, streams, and lakes for residential use.

Drinking it dry Over 80 years ago, residents of some western states recognized the need for water from the Colorado River. In 1922, The Colorado River Compact was established to regulate who could use the water and how much they were allowed to use.

Today, 25 million people use water from the Colorado River. As the demand for water upstream increases, less water is available for use downstream. By the time the Colorado River reaches the U.S./Mexican border, it is a small trickle. This reduced flow has caused tension between Mexico and the United States. Residents of northern Mexico argue that they have as much right to the water of the Colorado River as those upriver.

The Glen Canyon Dam on the Colorado River is one of a series of dams that controls the river's flow.

Environmental implications By harnessing the river for public use, some of the natural ecosystems that depend on the river have been impacted. Some areas of the river have been dammed, as shown in the figure, or diverted, jeopardizing native fish species.

As the river flows south and the flow of water decreases, valuable nutrients and sediments are no longer carried to the Colorado River Delta. Plant and animal species that once thrived in this area can no longer survive.

WRITING in Earth Science

Research To learn more about sustainable water use, visit glencoe.com. Does your city have a sustainable level of water use? Write an essay explaining if your city's water usage is sustainable.

GEOLAB

DESIGN YOUR OWN: MONITOR DAILY WATER USAGE

Background: **The average American uses between 300 and 380 L of water per day. Think about all the ways you use water each day, from brushing your teeth to washing your clothes.**

Question: *How much water do you use each day?*

Materials

water usage table
calculator

Procedure

1. Read and complete the lab safety form.
2. Obtain a water usage table from your teacher.
3. Complete the column labeled *estimations.* Your estimations should be how many liters of water you might use in one day for each of the activities.
4. For the next five days, record your water usage and complete the table.

Analyze and Conclude

1. **Calculate** the number of liters of water you used each day to flush the toilet.
2. **Calculate** the number of liters you used each day to shower.
3. **Calculate** the total daily average number of liters of water you used.
4. **Analyze** For what purposes did you use the most water? Was this the same for all of your classmates?
5. **Predict** how this water usage might change during different seasons.
6. **Recommend** two ways you could reduce the total amount of water you use each day.

TRY AT HOME

Revise Utilizing the two recommendations you made in Question 6, record your daily water usage for another five days. Were you able to reduce your total water usage? Why or why not? For more information on water conservation visit glencoe.com.

Water Usage Activity	Liters Per Use	Estimations	Day 1	Day 2	Day 3	Day 4	Day 5	Total
Flushing the toilet	23 L/flush							
Showering	26.5 L/min							
Bathing	26.5 L/min							
Dishwasher	57 L/load							
Washing machine	227 L/load							
Bathroom sink	7.5 L/min							
Kitchen sink	11 L/min							
							Total liters used	

CHAPTER 24

Study Guide

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

BIG Idea People and other organisms use Earth's resources for everyday living.

Section 24.1 Natural Resources

Vocabulary

- natural resource (p. 678)
- nonrenewable resource (p. 680)
- renewable resource (p. 678)
- sustainable yield (p. 679)

Key Concepts

MAIN Idea Resources are materials that organisms need; once used, some resources can be replaced, whereas others cannot.

- Natural resources are the resources that Earth provides, including organisms, nutrients, rocks, minerals, air, and water.
- Renewable resources are replaced at a rate equal to or greater than the rate at which they are being used.
- Nonrenewable resources exist in a fixed amount and take millions of years to replace.

Section 24.2 Resources from Earth's Crust

Vocabulary

- aggregate (p. 684)
- bedrock (p. 684)
- desertification (p. 683)
- ore (p. 684)
- tailings (p. 686)

Key Concepts

MAIN Idea Earth's crust provides a wide variety of resources to grow food, supply building materials, and provide metals and minerals.

- Loss of topsoil can lead to desertification.
- Aggregates, composed of sand, gravel, and crushed stone, can be found in glacial deposits.
- An ore is a resource that can be mined at a profit. Ores can be associated with igneous rocks or formed by processes on Earth's surface.

Section 24.3 Air Resources

Vocabulary

- nitrogen-fixing bacteria (p. 688)
- pollutant (p. 690)

Key Concepts

MAIN Idea The atmosphere contains gases required for life on Earth.

- Earth's early atmosphere had no oxygen; it was supplied over time by photosynthetic organisms.
- Oxygen, carbon, and nitrogen cycle from living organisms to the nonliving environment.
- Volcanoes, fires, and radon are natural sources of air pollution.

Section 24.4 Water Resources

Vocabulary

- desalination (p. 697)
- hydrogen bond (p. 693)

Key Concepts

MAIN Idea Water is essential for all life, yet it is unevenly distributed on Earth's surface.

- Water has unique properties that allow life to exist on Earth.
- Water is not evenly distributed on Earth's surface.
- Water management methods distribute freshwater resources more evenly through the use of dams, aqueducts, and wells.

Vocabulary Review

Complete each sentence with the correct vocabulary term from the Study Guide.

1. Coal and oil are _____ resources because it is not possible to replace them in a short period of time.
2. Bamboo is an example of a(n) _____ because it is possible to use it indefinitely without a reduction in the supply.
3. A mixture of sand, gravel, and crushed stone is called a(n) _____.

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

4. Ore is solid rock found underneath the loose soil and rocks in Earth's crust.
5. Soil is the residue of rock material left behind after the ore is removed.
6. The removal of salt from seawater is called nitrification.
7. The overuse of land resources might result in fertile land undergoing the process of soil formation.

Define each vocabulary term in a complete sentence.

8. pollutant
9. sustainable yield
10. ore

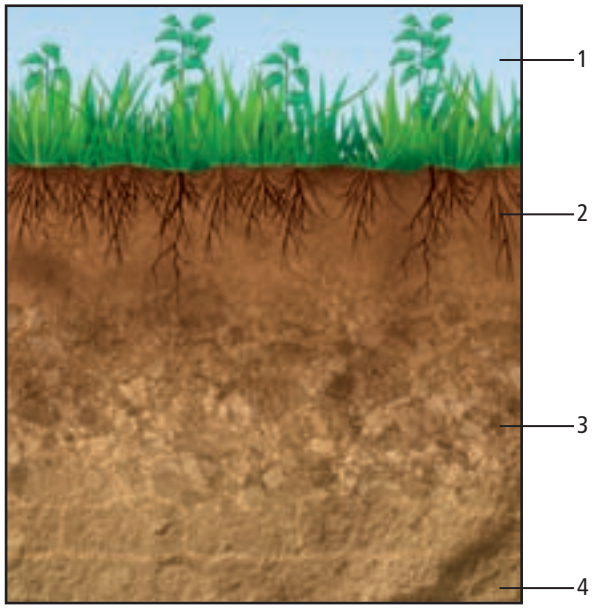
Identify the vocabulary term from the Study Guide that best fits each definition below.

11. the resources Earth provides
12. bacteria that live in soil or water and capture nitrogen gas
13. when the positive ends of some water molecules are attracted to the negative ends of other water molecules

Understand Key Concepts

14. Which resource can be replaced at a sustainable rate?
    - **A.** iron
    - **B.** wheat
    - **C.** gold
    - **D.** diamonds
15. Why are nitrogen-fixing bacteria important?
    - **A.** they are prey for larger animals
    - **B.** they are part of the carbon cycle
    - **C.** plants and animals cannot use nitrogen directly from the atmosphere
    - **D.** they are part of photosynthesis

Use the figure below to answer Questions 16 and 17.



16. Which labeled area represents where aggregates are found?
    - **A.** 1
    - **B.** 2
    - **C.** 3
    - **D.** 4
17. Which layer is labeled *3*?
    - **A.** topsoil
    - **B.** bedrock
    - **C.** aggregate
    - **D.** ore

18. Which occurs when the velocity of water carrying sediments is reduced?
- **A.** Bedrock dissolves.
- **B.** Fine sand is pushed up and moved.
- **C.** Heavy sediments are deposited.
- **D.** New minerals form.

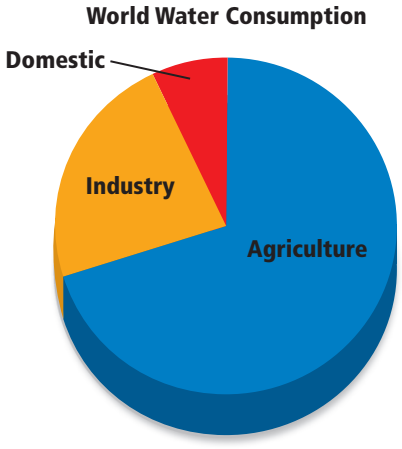
19. Which resource is found in an unlimited supply?
- **A.** sunlight
- **B.** gemstones
- **C.** lumber
- **D.** fish

20. What condition could result from overgrazing of cattle?
- **A.** soil formation
- **B.** chemical precipitation
- **C.** aggregate buildup
- **D.** desertification

21. Which is not part of the nitrogen cycle?
- **A.** the atmosphere
- **B.** plants
- **C.** photosynthesis
- **D.** soil

22. Why is water considered to be a polar molecule?
- **A.** A water molecule has a pole.
- **B.** Each water molecule has a positive and negative pole.
- **C.** Water molecules form in the polar region.
- **D.** Water molecules are attracted to magnets.

Use the figure below to answer Question 23.

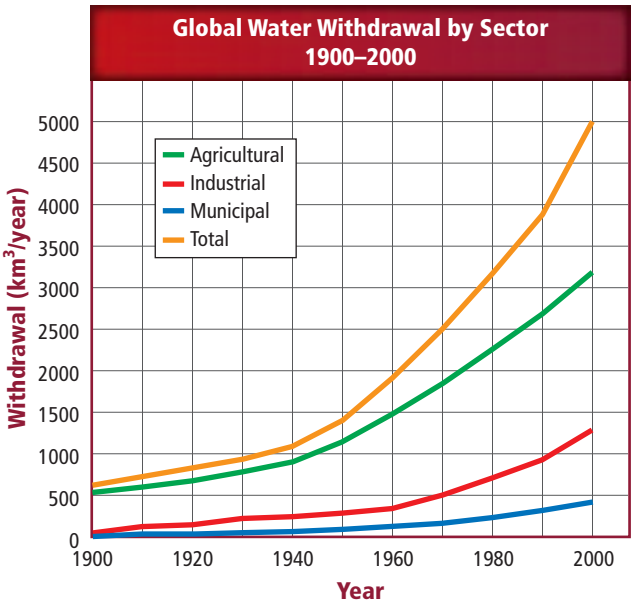


23. Industry is responsible for approximately what percent of the world's water consumption?
- **A.** 7 percent
- **B.** 23 percent
- **C.** 70 percent
- **D.** 100 percent

Constructed Response

24. Explain why beef and chicken purchased in the grocery store are considered renewable resources.

Use the figure below to answer Questions 25 and 26.



25. Explain why the current worldwide rate of freshwater withdrawal has changed since 1900.

26. Determine What type of water withdrawal has increased the most since 1900?

27. Explain why the loss of the forest cover in the Amazon River Basin is a world-wide concern.

28. Explain what issues would have to be considered if construction of a dam were proposed.

29. Identify several regions of the world that have a shortage of freshwater.

30. Identify In what states of matter can water naturally be found on Earth?

31. Differentiate between Earth's atmospheric composition billions of years ago and its composition today.

32. Explain how a substance could be both a pollutant and a requirement for life on Earth.

Earth Science online Chapter Test glencoe.com

Think Critically

33. Explain If Earth processes recycle water resources, why is water pollution a problem?

34. Consider how the study of a landfill could provide insight into how efficiently our natural resources are being used.

Use the figure below to answer Question 35.

Nick Hawkes; Ecoscene/CORBIS

35. Infer Based on the conditions discussed in this chapter, what caused damage to this statue? How?

36. Explain how early miners applied the principle of density to finding valuable deposits of natural resources.

37. Predict what would happen to carbon in the atmosphere if photosynthesis decreased.

38. CAREERS IN EARTH SCIENCE Research and describe one job in your community or a nearby city that is closely related to providing or protecting the local water resource.

Concept Mapping

39. Make a concept map using the section titles and vocabulary words from the sections. For more help, refer to the *Skillbuilder Handbook*.

Challenge Question

40. Determine the source of water supply for your school. What procedure would you follow to answer this question?

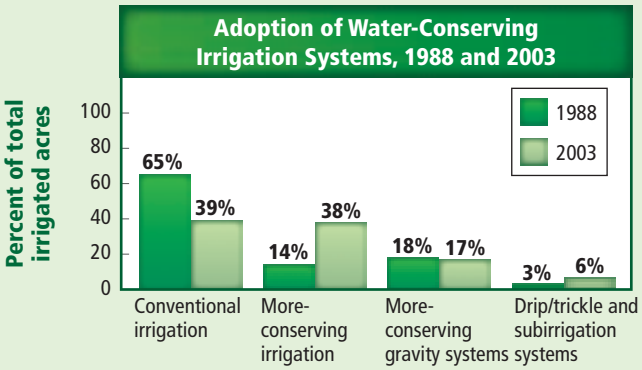
Additional Assessment

41. WRITING in Earth Science Research your local parks and preserves. Is there an area near you that has been proposed for development? Are there endangered species in your area? Write a letter to your local congressional representative detailing what action you think should be taken.

DBQ Document–Based Questions

Data obtained from: Weibe, K., and N. Gollehon, eds. 2006. Agriculture resources and environmental indicators. *USDA* (July):134-143.

The 17 western states account for 77 percent of all irrigated land in the U.S. The average annual amount of water applied ranges from 150 acre-feet to over 2500 acre-feet. In an effort to conserve water, the USDA has suggested methods of water conservation.



42. In 2003, which two methods of irrigation were most commonly used?

43. What percentage of acres were watered by the conventional irrigation system in 1988? In 2003?

44. What percentage acres were watered by the drip/trickle method in 2003?

Cumulative Review

45. Why is volcanic activity associated with convergent plate boundaries? **(Chapter 20)**

46. Explain the source of the heat that causes the geysers and hot springs at Yellowstone National Park. **(Chapter 23)**

Standardized Test Practice

Multiple Choice

1. What is it called when the sea level rises and shorelines move inland?

A. regression **C.** transgression
B. passive margin **D.** Laurentia

Use the table to answer Questions 2 and 3.

Fossil Identification Key	
1	a. Spiral shape; go to Step 2
	b. No spiral shape: go to Step 3
2	a. Less than 6 cm across: gastropod
	b. More than 6 cm across: cephalopod
3	a. Circular: crinoid columnal
	b. Branching: bryozoan

2. Mia has a fossil that is about 7 cm across and has a spiral shape. What kind of fossil did Mia find?

A. gastropod **C.** crinoid columnal
B. cephalopod **D.** byrozoan

3. If Mia found this fossil and chiseled it from a sedimentary rock, what type of fossil most likely is it?

A. cast **C.** index fossil
B. mold **D.** trace fossil

4. Which statement best explains why scientists do not rely on fossil evidence to study the Precambrian?

A. Precambrian life-forms have not had time to fossilize.
B. During the early Precambrian, there were no life-forms on Earth.
C. A global event destroyed all life-forms at some point during the Precambrian.
D. Life-forms on Earth during the Precambrian were too soft-bodied and left very few fossil imprints.

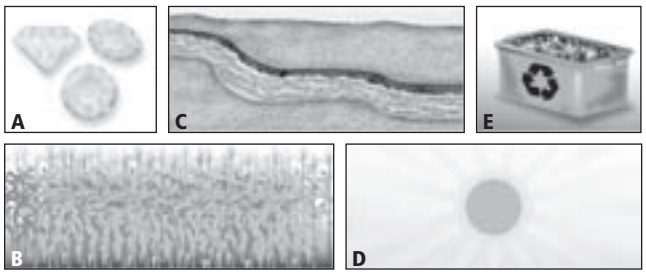
5. How does volcanic activity during early Earth explain the formation of the oceans?

A. Volcanic eruptions caused major depressions in Earth's surface to collect water.
B. Volcanic gas contains water vapor that cooled and condensed into liquid water, filling ocean basins.
C. Volcanic gases created clouds which produced rain that filled ocean basins.
D. Volcanic material blocked the Sun's rays, killing plant life that helped absorb water, and the runoff formed oceans.

6. Which is the correct succession of life-forms during the Phanerozoic Eon?

A. ocean organisms, land plants, land animals
B. land plants, land animals, oceanic organisms
C. land plants, oceanic organisms, land animals
D. land animals, land plants, oceanic organisms

Use the illustrations to answer Questions 7 and 8.



7. Which shows a nonrenewable resource?

A. A **C.** C
B. B **D.** D

8. Which resource is replaced through natural processes more quickly than it is used?

A. B **C.** D
B. C **D.** E

9. Why is radioactive decay useful in the absolute-age dating of rocks?

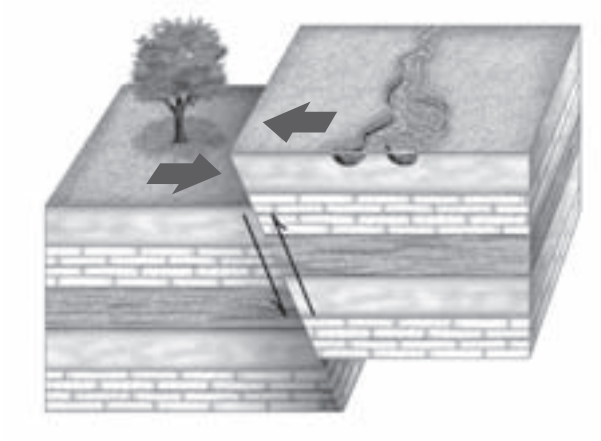
A. It will only break down the fossils within the rock and not the rock itself.
B. It will only break down the rock and not the fossils contained in the rock.
C. It is constant regardless of environment, pressure, temperature, or any other physical changes.
D. It fluctuates depending on environment, pressure, temperature, or any other physical changes.

10. What was formed in North America when Gondwana and Laurasia collided?

A. Ancestral Rocky Mountains
B. Appalachian Mountains
C. Ouachita Mountains
D. Great Permian Reef

Short Answer

Use the illustration below to answer Questions 11 and 12.



11. What type of fault is shown, and how is it formed?

12. Describe how rock surfaces along this fault leads to an earthquake.

13. Why are uplifted mountains unique?

14. Discuss how sources of heat on early Earth made conditions inhospitable to life.

15. What is the purpose of the geologic time scale?

16. Describe the formation of the Rocky Mountains during the Mesozoic Era.

Reading for Comprehension

Native Landscapes

Landscaping with native plants improves the environment. Native plants are hardy because they have adapted to the local conditions. Once established, native plants do not need pesticides, fertilizers, or watering.

A native landscape does not need to be mowed like a conventional lawn. This reduces the demand for nonrenewable resources and improves the water and air quality. The periodic burning required for maintenance of a prairie landscape mimics the natural prairie cycle and is much better for the environment. Landscaping with native wildflowers and grasses helps return the area to a healthy ecosystem. Diverse varieties of animals are attracted to native plants, enhancing biodiversity in the area.

Article obtained from: Green landscaping: greenacres. Green Landscaping with Native Plants. *United States Environmental Protection Agency*. October 2006.

17. Why is periodic burning good for a prairie landscape?

A. It gets rid of any unwanted weeds.
B. It mimics the natural prairie cycle.
C. It gets rid of any possible pests on the plants.
D. It provides a chance to create a new setting.

18. What can be inferred from this passage?

A. Landscaping with native plants is the best option for planting in an area.
B. Only native plants will survive in their given environment.
C. Native landscaping works only in prairie settings.
D. Planting native landscapes can be costly and time consuming, but it is very important.

19. Why would the Environmental Protection Agency be interested in sharing this information?

A. to reduce the number of nonnative plants sold
B. to help conserve nonrenewable resources and protect the environment from harsh chemicals
C. to provide avid gardeners with new approaches to creating their gardens.
D. to identify inexpensive ways of gardening for novice gardeners.

NEED EXTRA HELP?																
If You Missed Question . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Review Section . . .	23.1	21.4	21.4	22.4	22.3	21.1	24.1	24.1	21.3	23.2	19.1	19.1	20.3	22.1	21.1	23.3