

# Unit 7

## Resources and the Environment

**H**erds of scimitar-horned oryx meander across the rolling hills and meadows of The Wilds, a unique, 4000 ha wildlife preserve and environmental education center in rural Ohio. The Wilds was developed on land donated by a local power company after the area was strip-mined for coal. When resources such as coal are removed by surface mining, reclamation not only can restore the area to its former contours, but also can provide new educational and recreational activities for local residents.

### Unit Contents

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Go to the [National Geographic Expedition](#) on page 898 to learn more about topics that are connected to this unit.





Scimitar-horned Oryx,  
The Wilds, Cumberland, Ohio

# Chapter 25

## What You'll Learn

- What materials are considered to be Earth resources.
- Which Earth resources are renewable and which are nonrenewable.
- How Earth resources are used.

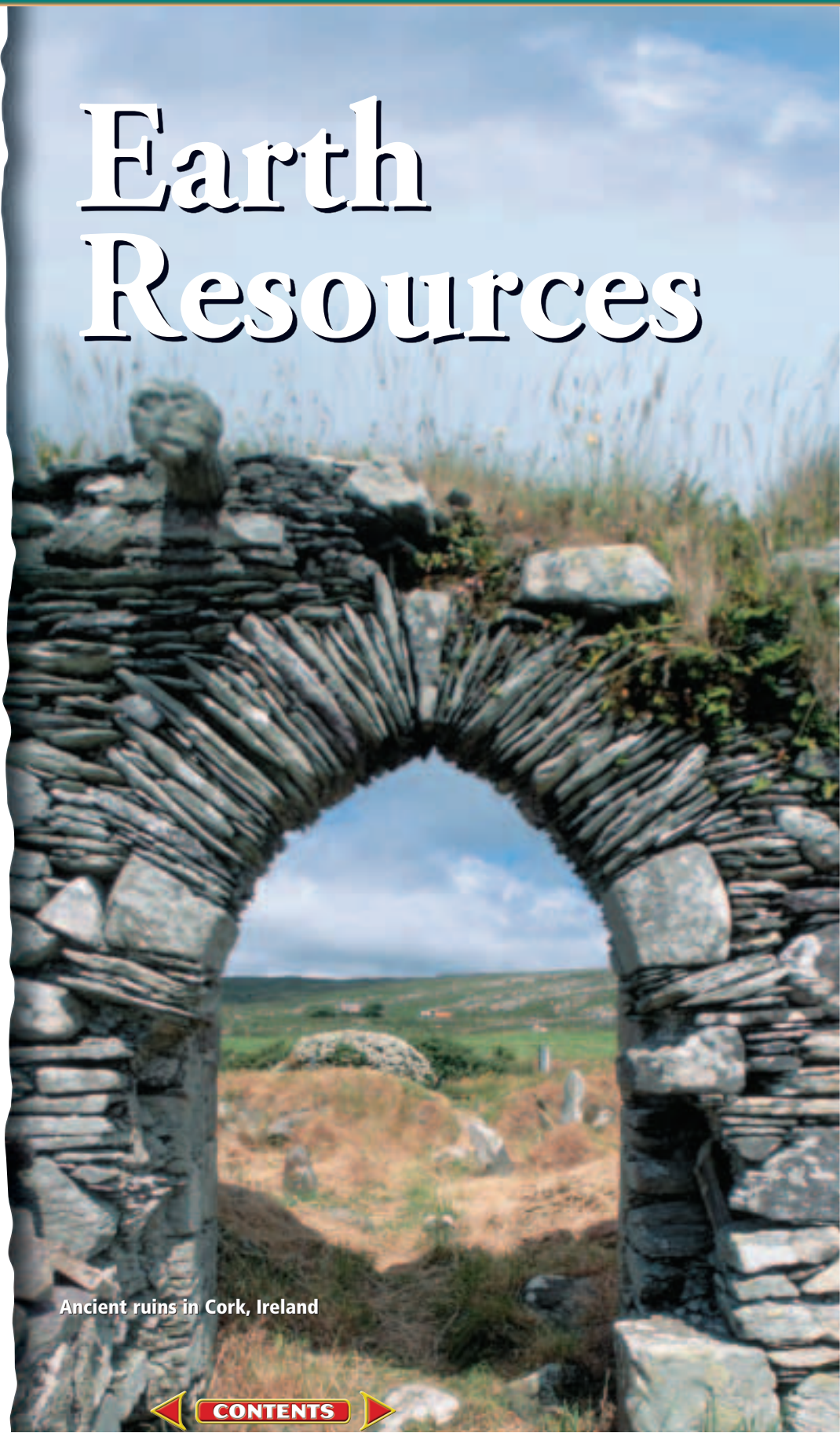
## Why It's Important

Earth resources can be derived from either living or nonliving things. Many Earth resources are essential for life. Once used, some resources cannot be replaced, whereas others can be replaced in relatively short periods of time. The use of Earth resources must be balanced for life on Earth to continue.



To learn more about earth resources, visit the Earth Science Web Site at [earthgeu.com](http://earthgeu.com)

# Earth Resources



Ancient ruins in Cork, Ireland



## Discovery Lab

## Origins of Resources

All the material goods that you use every day are matter. One way in which matter can be classified is whether it comes from living things or from nonliving things. In this activity, you will identify the origins of some common materials.

1. In your science journal, make a data table with the headings “Item,” “Living,” “Nonliving,” “Easily Replaced,” and “Not Replaceable.”
2. Look around your classroom and list common items that you see in the first column of your table.
3. Classify the matter in each item as coming from either living or non-living things, and as being either

easily replaced or not replaceable, by placing check marks in the appropriate columns.

**Classify** Compare your data table with those of several other students. Which of the items were identified as coming from living things? Which came from nonliving things? Which are easily replaced? Which are not replaceable? What criteria did you use to classify each item? Were you unable to classify any item using just these categories? Explain.



### SECTION

## 25.1

## What are resources?

### OBJECTIVES

- **Distinguish** between renewable and non-renewable resources.
- **Identify** renewable and nonrenewable resources.

### VOCABULARY

natural resource  
renewable resource  
sustainable yield  
nonrenewable resource



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. You and every other living thing on Earth must have certain resources to grow, develop, maintain life processes, and reproduce. In addition to food and water, most animals also need shelter. Think about the resources used to provide shelter for you and your family. Maybe your home is made of brick or stone, or perhaps it has wood shingles or aluminum siding. All of these materials come from Earth.

### NATURAL RESOURCES

The resources that Earth provides are known as **natural resources**. Natural resources include Earth’s air, water, and land; all living things; and nutrients, rocks, and minerals in the soil and deep in Earth’s crust. Recall from Chapter 3 that neither matter nor energy can be





**Figure 25-1** Trees are renewable resources because they are living things that reproduce within a relatively short period of time.

created or destroyed, but both can be changed from one form to another. You will find out how some natural resources are transformed in the *Science in the News* feature at the end of this chapter. One way in which natural resources are changed is through cycling, as in the carbon, nitrogen, and water cycles that you learned about in previous chapters.

Have you ever recycled an aluminum can? If you recycle, you probably are already aware that some resources cannot be replaced in a reasonable amount of time. If you have ever mowed a lawn or planted a garden, you know that some other natural resources can be used and replaced through natural processes in a short period of time. Both types of natural resources are necessary for life on Earth.

## RENEWABLE RESOURCES

Do you live in an area that has an autumn season? During the autumn, as the amount of sunlight declines, deciduous trees stop producing chlorophyll and become dormant so that they can survive the cold winter season.

When the leaves of trees do not contain the green pigment chlorophyll, many other colors can be seen, as shown in *Figure 25-1*. Eventually, all of these colorful leaves fall to the ground. However, in the spring, new leaves appear and the trees continue their life cycles. If you cut down a tree, you can replace that tree by planting a seedling in its place. Trees are examples of **renewable resources**, which are natural resources that it is possible to use indefinitely without causing a reduction in the available supply. Renewable resources include fresh air; fresh surface water in lakes, rivers, and streams; most groundwater; fertile soil; elements that cycle through Earth's systems, such as nitrogen, carbon, and phosphorus; and all living things. Resources that exist in an inexhaustible supply, such as solar energy, also are renewable resources. Renewable resources are replaced through natural processes at a rate that is equal to, or greater than, the rate at which they are being used.

**Living Things** Organisms in the biosphere are important renewable resources. Plants and animals reproduce, and 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, also can 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 also can be replaced after a period of up to 60 years. Humans who use natural resources responsibly are practicing management techniques to replace resources as they are used, as shown in **Figure 25-2**. The replacement of renewable resources at the same rate at which they are consumed results in a **sustainable yield**.

**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 to be a renewable resource because it will continue to be available for at least the next 5 billion years.

## NONRENEWABLE RESOURCES

Suppose you visit a fine jewelry store. You notice that diamonds, such as those shown in **Figure 25-3**, are very expensive. Why are diamonds so expensive? After all, they form through geologic processes, just like quartz and feldspar do. Diamonds are expensive because the supply of diamonds is limited. When all the diamond mines that currently exist have been exhausted, no more natural diamonds will become available. Diamonds are 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 hundreds of 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. Nonrenewable resources are exhaustible because they are being extracted and used at a much faster rate than the rate at which they were formed.

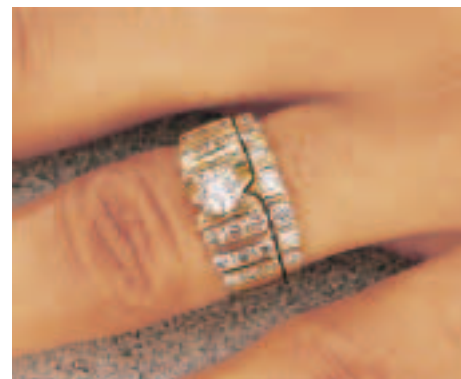
## DISTRIBUTION OF RESOURCES

Do you live in an area that has coal mines, oil wells, or deposits of bauxite, the ore that contains aluminum? Perhaps you live near a scenic river or a hot spring. Wherever you live, you probably have noticed that natural resources are not distributed evenly on Earth. The availability of natural resources helps determine the wealth and the power of countries around the world. Countries with many natural resources, such as the United States, are able to support higher living standards for their citizens than countries with fewer resources. However, smaller countries may have an abundance of

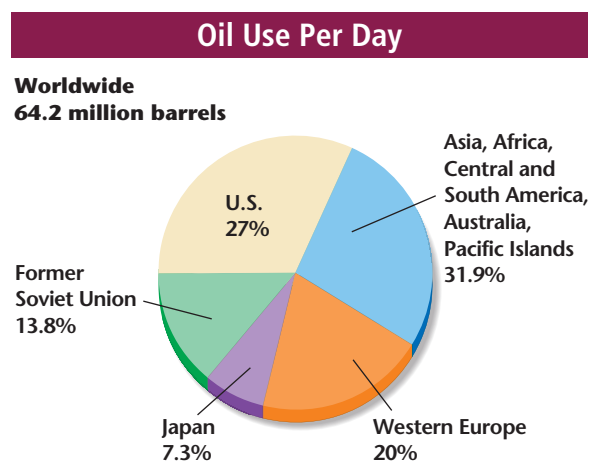


**Figure 25-2** Paper companies may cut down entire forests to provide wood for pulp and paper, but they also manage the forests and replant on a regular schedule so that the forest resources are always available.

**Figure 25-3** Diamonds form through geologic processes. *Why is a diamond ring so expensive?*



**Figure 25-4** This graph shows the percentage of crude oil that is consumed by the United States and worldwide. Note that the United States consumes 27 percent of the total crude oil used each day.



one natural resource that is needed by many other countries. Surinam and Guyana, in South America, for example, have some of the richest reserves of bauxite in the world. Saudi Arabia and Kuwait have some of the richest petroleum reserves.

The United States has a high standard of living and it consumes approximately 30 percent of Earth's mineral and energy resources each year, even though it has only 6 percent of the world's population. Some countries with larger populations have lower standards of living than the United States, and thus, these countries do not consume as many resources. One nonrenewable resource that developed countries consume in ever-increasing amounts is crude oil. **Figure 25-4** shows the percentage of total worldwide consumption of crude oil versus the amount used in the United States daily. 🌱

## SECTION ASSESSMENT

1. What is a natural resource?
2. Explain the difference between a renewable resource and a nonrenewable resource.
3. Name three renewable resources and three nonrenewable resources.
4. Explain why it is important to know whether a resource that you are using is renewable or nonrenewable.
5. **Thinking Critically** Fossil fuels are derived from the remains of once-living organisms, and living things are renewable resources. Why, then, are fossil fuels considered to be nonrenewable resources?
6. **Concept Mapping** Make a concept map of the major ideas in this section using the section headings and the vocabulary terms. For more help, refer to the *Skill Handbook*.

### SKILL REVIEW



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

### PROTECTED LAND

Of all the land in the United States, 42 percent is certified as public land, which consists of forests, parks, and wildlife refuges. Of this public land, 73 percent is located in Alaska, and 22 percent is located in the western states. These land areas are federally administered to protect timber, grazing areas, minerals, and energy resources. Some public land, such as national forests, is managed for sustainable yield and includes multiple-use areas where resources are used for many purposes, including recreation. Public land includes grasslands, prairies, deserts, scrub forests, and other open spaces. Some of these more remote areas eventually may become wilderness areas, places that are maintained in their natural state and protected from development.

The national park system 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 provide protection of habitats and breeding areas for wildlife, and some provide protection for endangered species, as shown in *Figure 25-5*. 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 each individual refuge.

### SOIL

Do you know what is in the soil under your feet? 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 bare ground without plant cover can increase topsoil loss. The loss of topsoil makes soil less fertile and less able to hold water. The result is poorer crops. Today, topsoil is eroding faster than it forms on about

### OBJECTIVES

- **Describe** why land is considered to be a natural resource.
- **Recognize** the need to protect Earth's land as a resource.
- **Explain** how humans adjust to the uneven distribution of land resources.

### VOCABULARY

desertification  
bedrock  
aggregate  
ore  
gangue

**Figure 25-5** The Aransas National Wildlife Refuge was established in 1937 to protect the vanishing wildlife of coastal Texas. The whooping crane, an endangered migratory bird species in the United States, makes its winter home in this refuge.







**Figure 25-6** When animals are allowed to graze on marginal land in arid or semi-arid climates, the topsoil can be eroded easily, and desertification can result.

one-third of Earth’s croplands. Each decade, Earth loses about seven percent of its topsoil, yet the eroded croplands must feed an ever-increasing human population. In arid and semi-arid 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, as shown in *Figure 25-6*, or when soil is compacted by large herds of heavy animals or heavy farm equipment.

Desertification is a growing problem in cattle-producing areas in North Africa south of the Sahara, in the Middle East, in the western half of the United States, and in Australia. Desertification also occurs when trees and shrubs are cut down for use as fuel in areas with few energy resources. When these plants are not replaced, erosion can lead to the loss of topsoil. Desertification can be prevented by reducing overgrazing and by planting trees and shrubs to anchor soils and retain water.

## BEDROCK

Underneath the topsoil is a layer of soil consisting of inorganic matter, including broken-down rock, sand, silt, clay, and gravel. This deeper soil layer lies on a base of unweathered parent rock called **bedrock**. Bedrock is solid rock, and it may consist of limestone, granite, marble, or other rocks that can be mined in quarries, as shown in *Figure 25-7*. Slabs of bedrock are often cut from quarry faces. Such large pieces of bedrock are used in the construction of buildings, monuments, flooring, and fireplaces.

## AGGREGATES

Have you ever watched a highway being built? You may have seen construction workers place layers of crushed or broken stone, pebbles, or sand on the ground before they began to build the highway surface. The materials used for this first layer come from an **aggregate**, which is a mixture of gravel, sand, and crushed stone that naturally accumulates on or close to Earth’s surface. Some aggregates 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. Some aggregates contain erratics, shown in *Figure 25-8*, which are rocks or rock fragments deposited by glaciers far from their origins.

**Figure 25-7** The finest-grained marble in the world is obtained from the bedrock at Carrara, Italy.



Aggregates used in construction are mixed with cement, lime, gypsum, or other materials to form concrete or mortar. An aggregate provides volume and stability to the resulting mixture, and it also makes the finished surface more resistant to erosion and weathering. The most commonly used natural aggregates are sand, crushed or broken rocks, and gravel.

## ORES

An **ore** is a natural resource that can be mined at 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 ( $\text{Fe}_2\text{O}_3$ ) 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 to be 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, whereas others are formed by processes at Earth's surface.

**Settling of Crystals** Ores associated with igneous rocks may contain iron, chromium, and platinum. Chromium and platinum ores can 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 sills and other igneous intrusions. One of the largest deposits of chromium and platinum in the world is the Bushveldt Complex in South Africa.

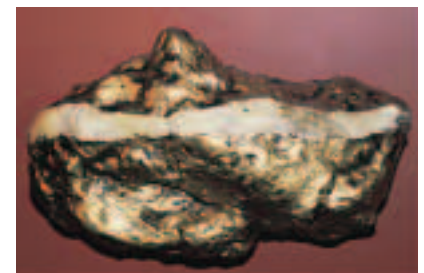
**Hydrothermal Fluids** The most important sources of metallic ore deposits are hydrothermal fluids. Hot water and other fluids may be part of the magma that is injected into surrounding rock during the last stages of magma crystallization. Because atoms of metals such as copper and gold do not fit into the crystals of feldspar and other 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. Hydrothermal veins, such as the one shown in *Figure 25-9*, commonly form along faults and joints.

**Chemical Precipitation** Ores of manganese and iron most commonly originate from chemical precipitation in layers. Iron ores in sedimentary rocks are often found in bands made up of alternating layers of iron-bearing minerals and chert. The origin of these ores,



**Figure 25-8** Glaciers often deposit erratics in areas with rocks that are vastly different. Some erratics are deposited on softer rocks, which erode more quickly, and thus, the erratics are left perched on top.

**Figure 25-9** This gold nugget contains a hydrothermal vein that is composed of quartz.



called banded iron formations, is not fully understood. Banded iron formations may have resulted from volcanic activity or weathering and then may have been deposited in layers in shallow, water-filled basins during the Precambrian to form sedimentary rocks. Banded iron deposits are discussed in more detail in Chapter 22.

**Placer Deposits** Some sediments, such as grains of gold and silver, are heavy. When stream velocity decreases, as, for example, when a stream flows around a bend, heavy sediments may be 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, and gemstones, as well as 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.

**Concentration by Weathering** Some ores form when the minerals in rocks are concentrated by weathering. For example, aluminum forms in bauxite through weathering in tropical climates. Other metals that become more concentrated as rocks weather include nickel, copper, silver, lead, tin, mercury, uranium, and manganese.

**Figure 25-10** The Wieliczka Salt Mine in Poland has been mined continuously since the thirteenth century. Today, it is well known for its many rock-salt structures, including the underground Queen Kinga's Chapel. The statues, chandeliers, railings, altars, and candlesticks are carved from rock salt.



## OTHER LAND RESOURCES

Are there many brick buildings where you live? Bricks are made from clay, another resource found on land. Clay is a sediment, and a group of minerals, made up of tiny particles with diameters of less than 0.004 mm. In addition to bricks, clay is used to make china, ceramics, tiles, and pottery. It is also used in the paper-making process.

Salt, or sodium chloride, also occurs in deposits both on Earth's surface and underground. One of the most famous salt mines in the world, the Wieliczka Salt Mine in Poland, is shown in *Figure 25-10*. Other mineral resources found on land include gypsum, which is used to make plaster; talc, which is used in cosmetics; and graphite, which is used as a lubricant. Both salt and gypsum deposits can form when seawater evaporates.

## USING LAND RESOURCES

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 negative impacts. Mines that are used to remove materials from the ground surface destroy the original ground contours. Open-pit mines leave behind waste rock that can weather and release pollutants into the air and water. The extraction of mineral ores often involves grinding parent rock to separate the ore. The material left after the ore is extracted, called **gangue**, may release harmful chemicals into groundwater or surface water. Sometimes, chemicals that harm the environment are used to separate ores. Mercury is used to extract gold from alluvial deposits of sand along rivers in the Amazon River Basin. Liquid mercury dissolves the gold particles in these deposits, forming a solution. When the solution is heated, as shown in **Figure 25-11**, the mercury evaporates, leaving the gold behind. Miners who have inhaled mercury vapors and people who live downstream from the mining operations have been poisoned by mercury. Mining sometimes exposes other materials, such as pyrite, that 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: of all occupations, it has the highest yearly death rate. 🌱



**Figure 25-11** Small-scale miners in the Amazon River Basin use mercury to extract gold.

### SECTION ASSESSMENT

1. Describe two resources found on land.
2. Why is the loss of topsoil through erosion considered to be a worldwide problem?
3. Name five ways in which ores can form, and give an example of a mineral that forms in each way.
4. What is the difference between an aggregate and an ore?
5. **Thinking Critically** What options would humans have if a land resource became depleted?

### SKILL REVIEW

6. **Predicting** Many developing countries would like to have the same standard of living as that enjoyed by citizens of the United States. As these countries become industrialized, what may happen to the demand for land resources? How can this demand be met? For more help, refer to the *Skill Handbook*.

**OBJECTIVES**

- **Recognize** that the atmosphere is an Earth resource.
- **Describe** the importance of clean air.

**VOCABULARY**

*pollutant*  
*air pollution*

**Figure 25-12** The forests of the Amazon River Basin are sometimes called the lungs of Earth. They help to balance gas exchange for the entire planet.



Have you ever gone outside after a rainstorm and noticed how clean and fresh the air smelled? Most of the time, people don't think about air. However, air contains substances that all organisms need to survive, including nitrogen, oxygen, carbon dioxide, hydrogen, methane, and ozone. Water vapor can make up as much as five percent of air by volume. For humans and all other animals, the most important component of air is oxygen. Oxygen makes up 21 percent of air.

**ORIGIN OF OXYGEN**

Most organisms on Earth require oxygen or carbon dioxide to maintain their life processes. Oxygen has not always been a part of Earth's atmosphere. Scientists hypothesize that 4.6 to 4.5 billion years ago, Earth's atmosphere was similar to the mixture of gases released by erupting volcanoes. These gases include carbon dioxide, nitrogen, and water vapor. As Earth 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 and water vapor. Over time, oxygen in the atmosphere built up to levels that allowed the evolution of organisms that required oxygen for life processes.

**DISRUPTING EARTH'S CYCLES**

The geochemical cycles of Earth's atmosphere are in a delicate balance. Volcanic eruptions release various gases and dust particles into the atmosphere. Photosynthetic organisms in the oceans and on land take in and use carbon dioxide and release oxygen. Other organisms take in this oxygen and release carbon dioxide. Life on Earth continues to survive as a result of this balanced gas exchange.

However, human activities are disrupting these cycles. For example, humans burn fossil fuels to produce electricity and burn forests to clear land. These two activities release carbon dioxide into the atmosphere. Increased amounts of carbon dioxide are thought to play a role in global warming, which is the gradual rising of Earth's average surface temperature. The human alteration of the carbon cycle has the potential to change global climate and therefore the environments of food-producing regions. Rainfall patterns in the tropical rain forests of the Amazon River Basin have already changed as a result of the loss of forest cover. One of these rain forests is shown in *Figure 25-12*. You will find out how deforestation is affecting tropical rain forests worldwide in the *Problem-Solving Lab* on the next page.

Humans also disrupt other geochemical cycles. By burning fossil fuels and using fertilizers that contain nitrogen, humans release about three times as much nitrogen oxide and ammonia gas into the atmosphere as do the natural processes of the nitrogen cycle. In the atmosphere, nitrogen oxides are converted to nitric acid, which returns to Earth in acid precipitation and damages surface water, plants, and soil. Human activities also release sulfur into the atmosphere when coal and oil are burned to produce electricity. Sulfur in the atmosphere is converted to sulfuric acid, which also returns to Earth in the form of acid precipitation. Both the excess nitrogen oxides and sulfur are **pollutants**, which are substances that can adversely affect the survival, health, or activities of organisms. These are only a few of the chemicals that human activities release into the atmosphere. Small amounts of toxic metals, such as lead, cadmium, and arsenic, also are released. When pollutants in air occur in quantities that become harmful to human health and the health of the environment, **air pollution** results.

## Problem-Solving Lab

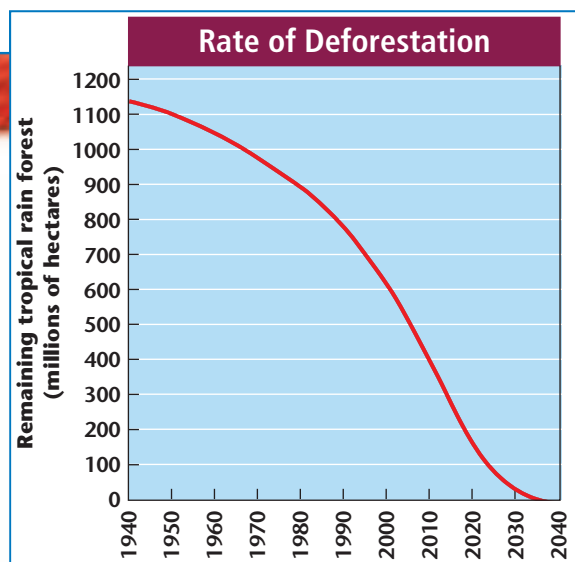
### Interpreting Graphs

#### Calculate the rate of deforestation

Many experts are concerned about the loss of the forest cover in tropical rain forests worldwide. In the Amazon River Basin, for example, scientists estimate that 1 hectare (ha, about 2.47 acres) of forest is cut down each hour. Nearly 20 million ha of rain forest is destroyed each year worldwide. If this rate continues, there will be no tropical rain forests left in just 40 years. The graph indicates the fate of the world's tropical rain forests if the current rate of deforestation continues.

#### Analysis

1. How much tropical rain forest has been depleted since the year you were born?
2. According to the graph, when will all the rain forests be depleted?



#### Thinking Critically

3. What are the rates of deforestation for the 1950–1985 and 1985–2000 time periods?
4. How do the rates of deforestation between 1950–1985 and 1985–2000 compare?
5. What might be the reason for the change in the rate of deforestation between these two time periods?



**Figure 25-13** Air pollution can be caused by natural phenomena, such as volcanic eruptions (A) and forest fires (B).

## SOURCES OF AIR POLLUTION

Air pollution has both natural and human origins. Two natural sources of air pollution are shown in **Figure 25-13**. Human sources of air pollution include gases, smoke, and dust. One of the biggest sources of air pollution is the burning of fossil fuels. Power plants that generate electricity burn coal and oil, which produce many types of air pollution. However, the single largest source of air pollution in the United States is the exhaust from motor vehicles that burn fossil fuels in the form of gasoline. In the United States, motor vehicles cause 90 percent of the carbon monoxide pollution in cities. In cities such as Los Angeles, Rome, and Mexico City, shown in **Figure 25-14**, motor vehicles are responsible for 80 to 88 percent of the air pollution.

Air pollution can make humans ill. When humans inhale harmful gases, the gases can be absorbed by the bloodstream and interfere with various body systems. Carbon monoxide, a colorless and odorless gas, interferes with the body's ability to absorb oxygen and causes headaches, chest pains, dry throat, and nausea. Pollution can also cause burning eyes, irritated throats, and breathing difficulties. Some chemical air pollutants can cause cancer, birth defects, brain damage, long-term injury to lungs, and even death.

As clean air in the troposphere moves across Earth's surface, it collects both naturally occurring and human-made pollutants. What happens to these pollutants? They may be transported, diluted, transformed, or removed from the atmosphere.

**Transport and Dilution** Some pollutants may be carried downwind from their origin. Transport depends upon wind direction and speed, topographical features, and the altitude of the pollutants. For example, hills, valleys, and buildings interrupt the flow of winds and

**Figure 25-14** Air pollution from vehicles in Mexico City is so concentrated that people who have breathing difficulties often listen to the radio to find out whether it is safe for them to go outdoors.



thus influence the transport of pollutants. Many of the pollutants in the acid precipitation that falls in the Adirondack Mountains of New York State 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 their concentration.

**Transformation and Removal** Other pollutants undergo chemical changes, called photochemical changes, that are triggered by reactions with ultraviolet (UV) radiation. Photochemical smog, for example, forms when a mixture of nitrogen oxides and volatile organic compounds interact under the influence of sunlight.

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

## INDOOR AIR POLLUTION

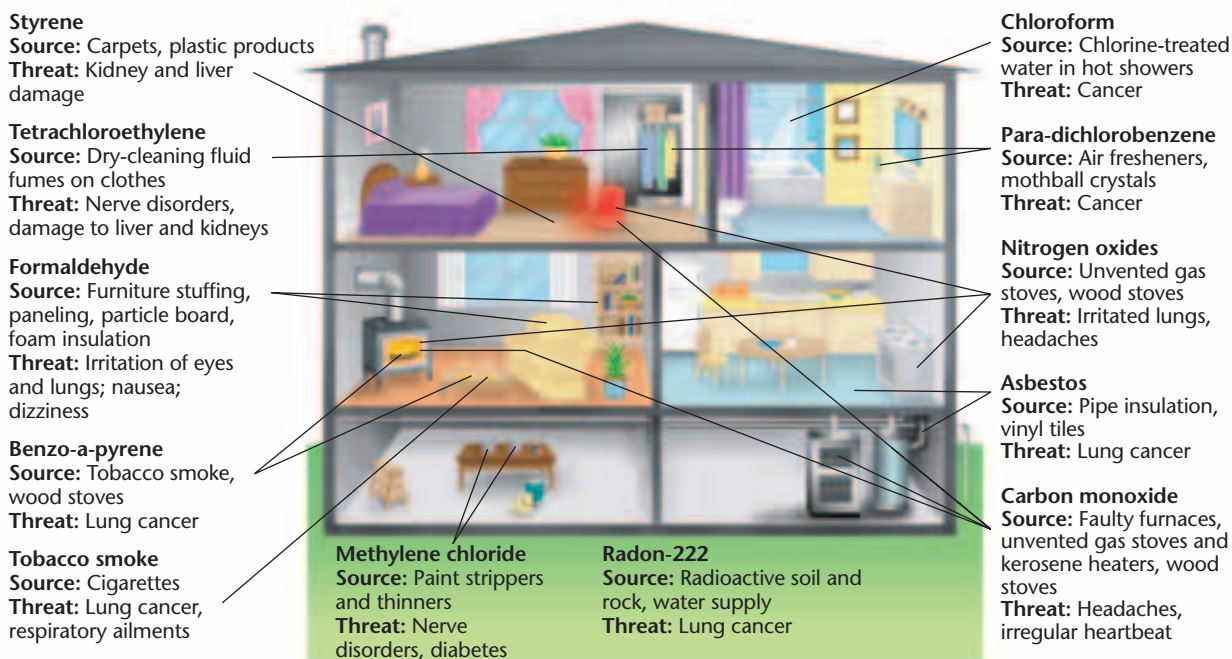
Have you ever shopped at a fabric store? Some people cannot even enter such a store because they are sensitive to the chemical formaldehyde, which is used in fabrics to prevent damage from insects. About 90 percent of the furniture sold in the United States also contains formaldehyde. Formaldehyde is just one of the many air pollutants that occurs indoors, as shown in *Figure 25-15*.

**Earth Science online**

**Topic: Indoor Air Pollution**  
To find out more about air pollution, visit the Earth Science Web Site at [earthgeu.com](http://earthgeu.com)

**Activity:** Research some ways to reduce indoor air pollution. Design a brochure that informs readers about reducing indoor air pollution.

**Figure 25-15** Major indoor air pollutants are shown in this diagram of a new house.







**Figure 25-16** A radon test kit is a simple device that measures the amount of radon gas infiltrating a building over a week's time.

**“Sick” Buildings** Studies conducted by the United States Environmental Protection Agency (EPA) and by scientists in European countries have linked indoor air pollutants to headaches, coughing, sneezing, burning eyes, nausea, chronic fatigue, and flu-like symptoms. When these symptoms are experienced by 20 percent of the occupants of a building, the building is said to be “sick.” Often, these symptoms disappear when the affected people go outside. New buildings are more likely to be “sick” than older buildings. This is because newer buildings tend to be airtight so that heating and cooling costs can be kept to a minimum, and because new furniture and carpeting release many indoor air pollutants, including styrene and formaldehyde.

**Radon Gas** The gas known as radon-222 is colorless, odorless, tasteless, and naturally occurring. Radon-222 is produced by the radioactive decay of uranium-238. Small amounts of uranium-238 are found in most soils and rocks, and in underground deposits. 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. Once indoors, radon gas decays into radioactive elements that can be inhaled. Scientists have traced approximately 13 000 lung-cancer deaths in the United States each year to high levels of radon gas in homes.


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. Radon test kits, such as the one shown in *Figure 25-16*, measure the levels of radon in buildings. 🌱

## SECTION ASSESSMENT

1. Why is air considered to be an Earth resource?
2. How did oxygen originate on Earth?
3. Explain how the oxygen and carbon-dioxide cycles on Earth are related.
4. Describe how air can be polluted by both natural processes and human activities.
5. **Thinking Critically** Explain why photochemical smog is a major problem in large cities that have little public transportation.

### SKILL REVIEW

6. **Comparing and Contrasting** Compare and contrast the components of indoor air pollution and the components of atmospheric air pollution. Is one type of air pollution more damaging than the other? Explain. For more help, refer to the *Skill Handbook*.

 When astronauts first took photographs of Earth from space, many people were surprised to see how much of Earth's surface is covered by water. One such photograph is shown in **Figure 25-17**. The oceans contain 97 percent of the planet's water, which means that only 3 percent of Earth's water is freshwater. Of this freshwater, about 2.997 percent is either locked up in ice caps and glaciers or stored as groundwater that is too deep to extract. This leaves only 0.003 percent of Earth's total volume of water available to humans for domestic, agricultural, and industrial purposes. This fraction of freshwater is in the form of surface water, water vapor, and obtainable groundwater.

### THE IMPORTANCE OF WATER

About 71 percent of Earth's surface is covered by water. However, this is not the only reason that Earth is sometimes called the “water planet.” 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 weight, and even trees may be composed of up to 60 percent water. Without water, life as we know it could not exist on Earth.

**Liquid Water** Why is water such an important resource? Water is a unique substance with many desirable qualities. Water can exist as a liquid over a wide range of temperatures because of the hydrogen bonds between water molecules. Recall from Chapter 3 that water molecules are polar molecules with positive and negative ends. Hydrogen bonds form when the positive ends of some water molecules are attracted to the negative ends of other water molecules.

### OBJECTIVES

- **Explain** the importance of clean freshwater.
- **Analyze** how water is distributed and used on Earth.
- **Identify** ways in which humans can reduce the need for increasing production of freshwater resources.

### VOCABULARY

desalination



**Figure 25-17** This composite photograph was created by a satellite as it orbited Earth. It depicts the entire surface of Earth, showing the relative sizes of land masses and oceans and their true colors. From this photograph, it is easy to see why Earth is sometimes called the “water planet.”



**Figure 25-18** Perspiration is the body's way of helping you cool off. As the water in perspiration evaporates, it removes heat from your skin.

**Figure 25-19** Ice is less dense than liquid water, and therefore it floats on top of water.



The hydrogen bonds 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. Water also has a high boiling point,  $100^{\circ}\text{C}$ , and a low freezing point,  $0^{\circ}\text{C}$ . As a result, water remains a liquid in most of the environments on Earth.

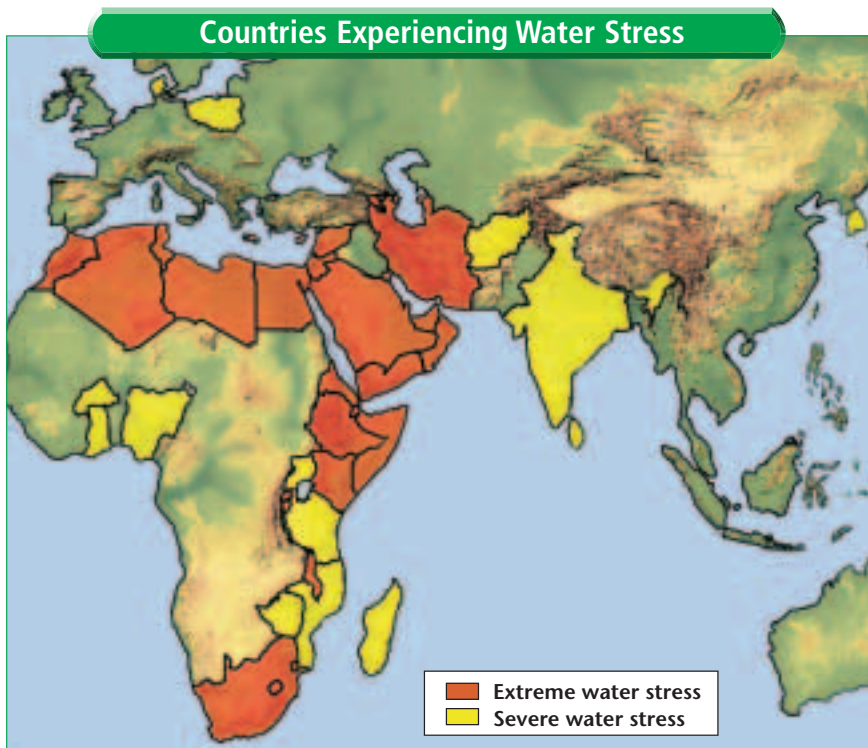
**Heat-Storage Capacity** Liquid water can store a large amount of heat without a correspondingly high increase in temperature. This property protects organisms that live in water from abrupt temperature changes, and it is also responsible for water's ability to regulate Earth's climate. Because of this same property, water is used as a coolant for automobile engines, power plants, and other heat-generating processes. Have you ever perspired heavily while participating in an outdoor activity on a hot day? Evaporation of perspiration from your skin, shown in *Figure 25-18*, helps you cool off because water absorbs large quantities of heat as it changes into water vapor.

**Water as a Solvent** Liquid water also can dissolve a wide variety of compounds. This ability enables water to carry nutrients into, and waste products out of, the tissues of living things. The diffusion of water across cell membranes enables all cells to regulate their internal pressure. Water also dilutes water-soluble waste products of humans and thus serves as an all-purpose cleanser.

**Solid Water Expands** Unlike most liquids, water expands when it freezes. Because ice has a lower density than liquid water, it floats on top of water, as shown in *Figure 25-19*. 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. The expansion of water as it freezes also can fracture rocks when ice crystals form in preexisting cracks and force the cracks to widen. Thus, ice forming in cracks becomes part of the weathering process.

## LOCATION OF FRESHWATER RESOURCES

Freshwater resources are not distributed evenly across Earth's landmasses. Although the United States has plenty of freshwater, much of it is concentrated in certain areas or has been contaminated by agricultural or industrial processes. The eastern states receive ample precipitation, and most freshwater in these states is used for cooling, energy production, and manufacturing. By contrast, western states often have too little precipitation. Thus, in the West, the largest use of freshwater is for irrigation. Water tables in the West are dropping as farmers and cities continue to sink wells into aquifers and use the groundwater faster than it can be recharged.



**Figure 25-20** Countries experience severe water stress when there is less than 1000 m<sup>3</sup> of freshwater per person. Extreme water stress occurs when there is less than 500 m<sup>3</sup> of freshwater per person. Increased populations will impose even greater demands on the freshwater available in these countries.

Worldwide, water distribution is a continuing problem, even though most continents have plenty of water. Since the 1970s, scarcity of water has caused the deaths of more than 24 000 people worldwide each year and created huge numbers of environmental refugees. In areas where water is scarce, women and children often walk long distances each day to collect a meager supply of 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, as shown in *Figure 25-20*. That number is expected to rise to 90 countries by the year 2025.

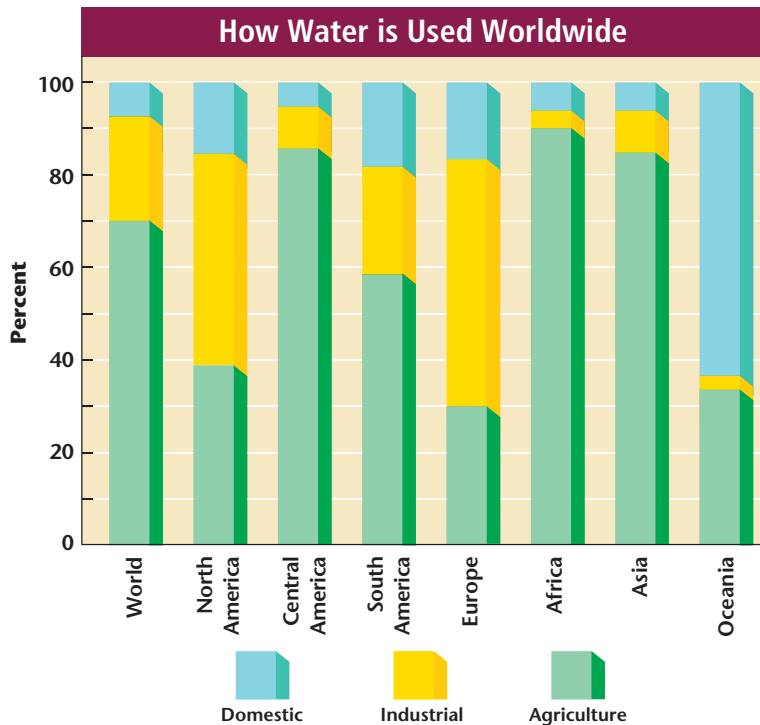
### USE OF FRESHWATER RESOURCES

As you learned in Chapters 9 and 10, freshwater on Earth is held either in surface waters, such as lakes, rivers, and streams, or in the ground as groundwater. Recall that the upper surface of groundwater is called the water table, and that the water-saturated layers of sand, gravel, or bedrock through which groundwater flows are called aquifers. Aquifers are refilled naturally as rain percolates downward through soil and rock in the process known as natural recharge. Many humans worldwide rely on wells drilled into the ground that tap aquifers for freshwater supplies.

The current rate of withdrawal of freshwater from both surface and groundwater sources worldwide is five times greater than it



To learn more about water, go to the [National Geographic Expedition](#) on page 898.



**Figure 25-21** This bar graph identifies the uses of freshwater worldwide. *Where in the world is the most water used for industrial purposes?*

**Figure 25-22** The purpose of the Three Gorges Dam is to reduce China’s reliance on coal for energy production and to regulate the annual flooding of areas along the Yangtze River.



was just 50 years ago. This increase has occurred primarily to meet the drinking-water and agricultural needs of an increasing human population. Withdrawal rates for freshwater resources are expected to double again within the next 20 years.

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. However, much of the water used for irrigation is not used by the plants; nearly 80 percent of this water evaporates or seeps into the ground before it can be used by crops. 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 seven percent of the freshwater withdrawn from surface and groundwater resources. The uses of freshwater worldwide are shown in *Figure 25-21*.

### MANAGING FRESHWATER RESOURCES

The dam shown in *Figure 25-22* is being built to hold back the floodwaters of the Yangtze River in China. Called the Three Gorges Project, the construction of this dam will provide freshwater and supply power to 150 million people. However, the dam will also flood large areas of farmland and displace about 1 million people who live nearby. Some critics think that the Three Gorges Project will ruin the water quality of the Yangtze River and create more severe flooding as the dam fills up with sediment and eventually overflows. However, most countries manage their supplies of freshwater by building dams, by transporting surface water, or by tapping groundwater. Some countries also have had success removing the salts from seawater to provide needed freshwater supplies.

**Dams and Reservoirs** Building dams is one of the primary ways that countries try to manage their freshwater resources. Large dams are built across river valleys, usually to control flooding downstream, and the reservoirs behind dams capture the rivers’ flow as well as rain and melting snow. The water captured in these reservoirs can be released as necessary to provide water for irrigation and municipal



**Figure 25-23** Roman aqueducts, such as this one still standing in France, were considered to be architectural wonders when they were first built (A). This present-day aqueduct transports water from water-rich northern California to semi-arid and arid areas in southern California (B).

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.

**Transporting Surface Water** If you were to visit Europe, you would likely see many ancient aqueducts like the one shown in *Figure 25-23A*. The Romans built aqueducts to bring water from other locations into their cities 2000 years ago. Today, many countries use aqueducts, tunnels, and underground pipes to bring water from areas where it is plentiful to areas in need of freshwater supplies.

The California Water Project 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. Most of this water, 82 percent, 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. However, the residents of northern California object, because the diversion of more water would harm the Sacramento River and threaten fisheries. As this example illustrates, conflicts over the transport of surface water will probably increase as human populations increase and create higher demands for water.

**Tapping Groundwater** Most people in the United States obtain drinking water by turning on a faucet in their kitchens or bathrooms. But do you know where this water comes from? In this country, about 23 percent of all freshwater used is groundwater pumped

**Earth Science Online**

**Update** For an online update of the progress of the Three Gorges Project in China, visit [earthgeu.com](http://earthgeu.com) and select the appropriate chapter.

## MiniLab

### Hard Water

**Determine** the hardness of water samples by observing how easily soap suds can be produced.

#### Procedure

1. Obtain six clean baby-food jars. Label them A through F.
2. Measure 20 mL of one water sample. Pour the water into the jar marked A.
3. Repeat step 2 four more times, using a different water sample for jars B through E.
4. Measure 20 mL of distilled water. Pour this water into jar F.
5. Make a data table in your science journal. In the first column, write the letters A–F.
6. Place one drop of liquid soap in sample jars A through E. Do not place any soap in jar F. Tighten the lids. Then shake each jar vigorously for five seconds.
7. 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.

#### Analyze and Conclude

1. List the water samples in order from hardest to softest.
2. What is the difference between hard and soft water?
3. What are some disadvantages of hard water?


from aquifers. In some states, such as Florida, Hawaii, and Nebraska, more than 90 percent of the population depends upon groundwater from aquifers for drinking water. Sometimes, groundwater contains substances that make it difficult to use for domestic purposes. For example, water that contains calcium and magnesium ions, known as hard water, does not form suds when soap is added. You will determine the hardness of water samples in the *MiniLab* on this page.

Groundwater normally moves from points of high elevation and pressure to points of lower elevation and pressure. This movement of water is relatively slow; water moves through the ground at a rate of only about 1 m/year. If the withdrawal rate of an aquifer exceeds its natural recharge rate, the water table around the withdrawal point is lowered. This lowering of the water table is known as drawdown. If too many wells are drilled into the same aquifer in a limited area, the drawdown can lower the water table below the bottoms of the wells, and as a result, the wells will run dry. Because groundwater is the source of many streams in the United States, groundwater depletion also affects stream flow. In coastal areas, drawdown of groundwater can also result in the intrusion of salt water into shallow aquifers.

**Desalination** With all the water available in the oceans, some countries have explored the possibility of removing salt from ocean water to provide freshwater in a process called **desalination**. Desalination occurs when salt water is distilled. The water is first heated until it evaporates, 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 sea water. Although the evaporation of seawater

by solar energy is a slow process, it is an inexpensive way to provide needed freshwater. Some desalination plants use fuel to distill seawater, but because this process is expensive, it is used primarily to provide drinking water. You will find out how a simple desalinator works in the *Design Your Own GeoLab* at the end of this chapter.

**Reducing Freshwater Use** The increasing need for freshwater supplies has led to some extremely creative solutions. You may have heard about a plan to tow an Antarctic iceberg to the Middle East to provide needed freshwater to arid countries in that region. However, most experts agree that the best way to meet the need for freshwater is to use available supplies more efficiently. For example, irrigation of field crops loses vast amounts of freshwater to evaporation. Farmers can prevent evaporation of irrigation water by changing their irrigation methods. Trickle irrigation, shown in *Figure 25-24*, provides water directly to plant roots, and thus considerably reduces evaporation rates. Some farmers also monitor the soil and provide irrigation only when necessary. Water can be used more efficiently by industries when they use recycled water instead of clean, freshwater for manufacturing processes.

Domestic uses of water, such as flushing toilets, bathing, and washing dishes and clothing, account for about 78 percent of the water used in a typical home in the United States. In the summer, watering lawns and gardens may account for 80 percent of a home's daily water usage. Many of these domestic uses can be reduced by installing low-flow toilets, using plants that are drought-resistant for landscaping, and fixing leaky pipes and faucets. 



**Figure 25-24** Trickle irrigation uses a system of perforated pipes to release trickles of water next to plant roots. This minimizes evaporation and seepage and brings 80 to 90 percent of the irrigation water directly to the crops.

## SECTION ASSESSMENT

1. Why is clean water important to life on Earth?
2. How does the distribution of freshwater resources affect humans?
3. Describe three ways in which humans provide for their freshwater needs.
4. How can the amount of water used for irrigation be reduced?
5. **Thinking Critically** Many people from the northeastern part of the United States have moved to the sunny southwestern states of Arizona and New Mexico. These

new residents increase local populations. How does this relocation of people affect the demand for freshwater resources?

### SKILL REVIEW

6. **Predicting** Some aquifers are found deep underground and receive very little recharge. These aquifers are sometimes referred to as fossil aquifers. Once water is taken from a fossil aquifer, it rarely fills up again. Is water from fossil aquifers a renewable resource? Explain. For more help, refer to the *Skill Handbook*.



# DESIGN YOUR OWN GeoLab

## Designing a Solar Desalinator

**M**ost of Earth's surface is covered with salty ocean water. Ocean water can be used for drinking water and other purposes if the salts are first removed. Solar energy can be used to evaporate water from seawater, leaving the salts behind. The evaporated water can then be condensed into freshwater.

### Preparation

#### Problem

How can you build a small-scale, working solar desalinator?



#### Possible Materials

clear plastic or Plexiglas  
large pans to hold water  
salt water  
collecting containers  
lamp  
glass pan or beaker  
hot plate

#### Hypothesis

The Sun's energy can be collected to desalinate salt water.

#### Objectives

*In this GeoLab, you will:*

- **Design** a model of a working solar desalinator.
- **Assemble** the model from design plans.
- **Test** the effectiveness of the design model.
- **Analyze** the model to suggest possible improvements.

#### Safety Precautions

Always wear safety goggles and an apron in the lab. Be careful when handling hot materials.

## Plan the Experiment

1. Use the library and go to [earthgeu.com](http://earthgeu.com) to identify designs of solar desalinators.
2. Draw a design for your model desalinator. (Hint: Solar energy must be collected in some way that allows sunlight to enter and causes an increase in temperature inside the container so that water in saturated air can condense and be collected.)
3. Make a list of the materials you will need, and then collect them.
4. Construct the desalinator you designed.
5. Test the desalinator by recording how long it takes to collect the purified water and how much water was collected.
6. Test the water to see if it has been purified by boiling the water away. If any salt remains in the container after the water has evaporated, your desalinator did not remove all of the salts from the salt water.



## Analyze

1. **Interpreting Scientific Illustrations** Draw the desalinator that you constructed.
2. **Interpreting Observations** How well did your desalinator work? On what criteria did you base the effectiveness of your desalinator?
3. **Observing and Inferring** What problems did you encounter in this investigation?
4. **Comparing and Contrasting** Compare and contrast your desalinator with one of your classmates'. What were the advantages or disadvantages of your design?

## Conclude & Apply

1. What factors affected the efficiency of the desalinator?
2. How did your solar desalinator's efficiency compare with the efficiencies of other students' models?
3. How could you improve your desalinator?
4. What conclusions could be drawn from your investigation regarding the viability and use of solar-powered desalinators?



## Glass from the Past

*In the autumn of 1739, Caspar Wistar opened a glass factory in southern New Jersey—the first successful glassworks in North America. He chose a location that had the chief resources he needed to make and ship glass: sand, wood, and water.*

From glass fragments, old documents, and even old advertisements, historians have pieced together the history of Wistar's glassworks. It was likely a wooden building constructed around a large, beehive-shaped furnace. The furnace was built of clay bricks and was divided into three levels. The bottom level held the fire; it had an opening at one end where wood could be added and the condition of the coals could be checked. The middle level of the furnace held specially-made pots into which the ingredients for the glass itself were placed. The pots had to withstand the extreme heat of molten glass—a broken pot meant that the furnace shut down, and production ceased. Completed pieces were placed in the top level of the furnace, the annealing chamber, where they cooled slowly so that they would retain their strength.

### Ingredients for Success

The ingredients for making glass have remained the same since the earliest days of glassmaking, about 4000 years ago. The primary ingredient in all glass is sand. In the eighteenth century, glass was made from sand dug from the ground. The dry ingredients, sand, potash—which is potassium carbonate found in wood ashes—lime, and other minerals used for coloring, were mixed in large troughs. The dry mixture was then placed in the hot pots in the

middle level of the furnace. The ingredients melted together to form molten glass.

In addition to sand, glass makers needed a continuous supply of wood because the fire in the furnace could never be allowed to go out. Wistar built his factory near both wood and sand; thus, he never ran out of either resource.

### Importance of Water

Being close to water was important in the location of Wistar's factory for two reasons. First, having water nearby meant that fires could be put out quickly. Many early glassworks were destroyed by fire. Second, being close to water made the shipping of finished pieces much easier. The fewer times that glass had to be handled on its way to the marketplace, the less breakage there was. Given the heaviness of glass, shipping it by water was the transportation method of choice.

### Activity

A variety of minerals and compounds from Earth's crust are used to make different colors of glass. Use the library or go to [earthgeu.com](http://earthgeu.com) to research the different materials used to produce different colors of glass. Record your findings in a data table. Are any of the materials you found surprising? Why?

# CHAPTER 25 Study Guide

## Summary

### SECTION 25.1

#### What are resources?



#### Main Ideas

- Natural resources are the resources that Earth provides, including air, water, land, organisms, rocks, minerals, and nutrients.
- Renewable resources are replaced by natural processes at a rate that is equal to or greater than the rate at which they are being used.
- Nonrenewable resources exist in a fixed amount and can be replaced only by geological, physical, and chemical processes that take hundreds of millions of years.

#### Vocabulary

natural resource (p. 655)  
nonrenewable resource (p. 657)  
renewable resource (p. 656)  
sustainable yield (p. 657)

### SECTION 25.2

#### Land Resources



#### Main Ideas

- Land resources include topsoil, rocks, and minerals. Land also provides space for agriculture, housing, roadways, and protected areas such as national forests, wildlife refuges, and national parks.
- Topsoil is a complex mixture of decaying organic matter, eroded rock, minerals, nutrients, oxygen, and water. In arid areas, loss of topsoil can lead to desertification.
- Bedrock is unweathered parent rock.
- Aggregates, including sand, gravel, and crushed stone, are found in glacial deposits.
- An ore is a natural resource that can be mined at a profit. Ores may be associated with igneous rocks or formed by processes at Earth's surface.

#### Vocabulary

aggregate (p. 660)  
bedrock (p. 660)  
desertification (p. 660)  
gangue (p. 663)  
ore (p. 661)

### SECTION 25.3

#### Air Resources



#### Main Ideas

- The atmosphere contains mostly nitrogen and oxygen, as well as various other gases in smaller amounts. Early Earth had no oxygen; this was supplied by photosynthetic organisms.
- The geochemical cycles of Earth's atmosphere are delicately balanced. Human activities disrupt this balance, and air pollution results.
- Clean air is necessary to most organisms. Both outdoor and indoor air pollution are harmful to living things.

#### Vocabulary

air pollution (p. 665)  
pollutant (p. 665)

### SECTION 25.4

#### Water Resources



#### Main Ideas

- Freshwater is necessary to all life and to many Earth processes. Water is recycled continually through the water cycle.
- 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

desalination (p. 674)

# CHAPTER 25 Assessment

## Understanding Main Ideas

- Which of the following is a renewable resource?
  - oil
  - natural gas
  - trees
  - coal
- What portion of Earth's atmosphere consists of oxygen?
  - 21 percent
  - 78 percent
  - 3 percent
  - trace amounts
- What is the origin of oxygen in Earth's atmosphere?
  - photosynthetic organisms
  - volcanic eruptions
  - meteorites
  - burning fossil fuels
- Marble is what type of land resource?
  - an aggregate
  - an ore
  - soil
  - bedrock
- Which of the following is a nonrenewable resource?
  - bauxite
  - carbon
  - water
  - nitrogen
- Of Earth's surface waters, what percent is freshwater available for human use?
  - 97 percent
  - 3 percent
  - less than 1 percent
  - 21 percent
- Which of these is NOT a way to manage water resources?
  - building dams
  - using aqueducts
  - settling crystals
  - desalination
- What is the process by which productive land becomes desert?
  - deforestation
  - desertification
  - desalination
  - respiration

Use the following table to answer questions 9 and 10.

Irrigation Method	Percent Efficiency	Water Needed to Add 100 mm to Root Zone
Conventional furrow	60%	167 mm
Furrow with surge valve	80%	125 mm
Low-pressure sprinkler	80%	125 mm
Trickle irrigation	95%	105 mm

- Which of the irrigation methods requires the most water to add 100 mm to the root zone of plants?
  - low-pressure sprinkler
  - conventional furrow
  - trickle irrigation
  - furrow with surge valve
- Which of the irrigation methods appears to be the most efficient use of water?
  - low-pressure sprinkler
  - conventional furrow
  - trickle irrigation
  - furrow with surge valve
- Which air pollutant is more harmful to human health inside a building than outside?
  - smog
  - radon gas
  - carbon dioxide
  - nitrogen oxide

## Test-Taking Tip

**TABLES** If a test question involves a table, skim the table before reading the question. Read the title, column heads, and row heads. Then read the question and interpret the information in the table.

# CHAPTER 25 Assessment

12. Which of these is NOT a manner in which ores form?
- crystal settling
  - weathering
  - chemical precipitation
  - photochemical changes
13. Which of the following is NOT a property of water?
- It has a high heat-storage capacity.
  - It exists mostly as a gas.
  - It expands when it freezes.
  - It dissolves many compounds.

## Applying Main Ideas

14. What is the atmosphere's role in the exchange of gases on Earth?
15. Why is the loss of the forest cover in the Amazon River Basin a worldwide concern?
16. What is the best way to prevent loss of topsoil?
17. How would planting forests help control desertification in arid areas?

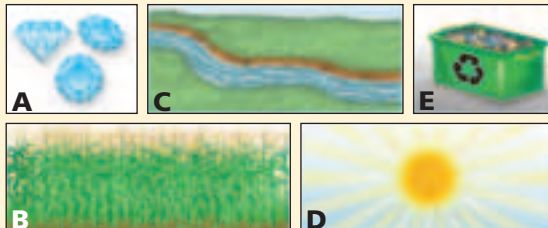
## Thinking Critically

18. If Earth processes recycle water resources, why is water pollution a problem?
19. Most of the water resources on Earth are salt water. Why can't all of the human population's freshwater needs be supplied by the desalination of salt water?
20. Suppose that you recently moved into a new house. Shortly thereafter, you began to feel ill. How can you determine whether the house is "sick"?
21. Volcanic eruptions and other natural events result in air pollution. Why is the air pollution produced by human activities a concern?

## Standardized Test Practice

### INTERPRETING SCIENTIFIC ILLUSTRATIONS

Use the illustrations below to answer questions 1 and 2.



1. Which shows a nonrenewable resource?
- A
  - B
  - C
  - D
2. Which resource is replaced through natural processes more quickly than it is used?
- B
  - C
  - D
  - E
3. Which of the following is NOT an example of a material that is mined at a profit?
- hematite
  - diamonds
  - limonite
  - chromium
4. Which is the greatest source of air pollution in the U.S.?
- power plants
  - industrial smokestacks
  - agricultural processes
  - motor vehicles
5. Which is the most expensive and least commonly used method of providing water to areas that need it?
- tapping groundwater
  - aqueducts
  - desalination
  - dams