

Technology is used to explore the Earth system.

BEFORE, you learned

- Earth has a spherical shape and supports a complex web of life
- Earth's environment is a system with many parts

NOW, you will learn

- About the Earth system and its four major parts
- How technology is used to explore the Earth system
- How the parts of the Earth system shape the surface

VOCABULARY

system p. 9
 atmosphere p. 10
 hydrosphere p. 10
 biosphere p. 11
 geosphere p. 12

THINK ABOUT

How do these parts work together?

Look closely at this terrarium. Notice that the bowl and its cover form a boundary between the terrarium and the outside world. What might happen to the entire terrarium if any part were taken away? What might happen if you placed the terrarium in a dark closet?



The Earth system has four major parts.

A terrarium is a simple example of a **system** —an organized group of parts that work together to form a whole. To understand a system, you need to see how all its parts work together. This principle is true for a small terrarium, and it is true for planet Earth.

Both a terrarium and Earth are closed systems. They are closed because matter, such as soil or water, cannot enter or leave. However, energy can flow into or out of the system. Just as light and heat pass through the glass of the terrarium, sunlight and heat enter and leave the Earth system through the atmosphere.

Within the Earth system are four connected parts: the atmosphere (Earth's air), the hydrosphere (Earth's waters), the biosphere (Earth's living things), and the geosphere (Earth's interior and its rocks and soils). Each of these parts is an open system because both matter and energy move into and out of it. The four open systems work together to form one large, closed system called Earth.

VOCABULARY

Remember to draw a word triangle in your notebook for each vocabulary term.



Atmosphere

READING TIP

The names of the Earth system's four parts contain Greek prefixes. *Atmo-* refers to vapor or gas. *Hydro-* refers to water. *Bio-* refers to life, and *geo-* refers to earth.

The **atmosphere** (AT-muh-SFEER) is the mixture of gases and particles that surrounds and protects the surface of Earth. The most abundant gases are nitrogen (about 78%) and oxygen (nearly 21%). The atmosphere also contains carbon dioxide, water vapor, and a few other gases.

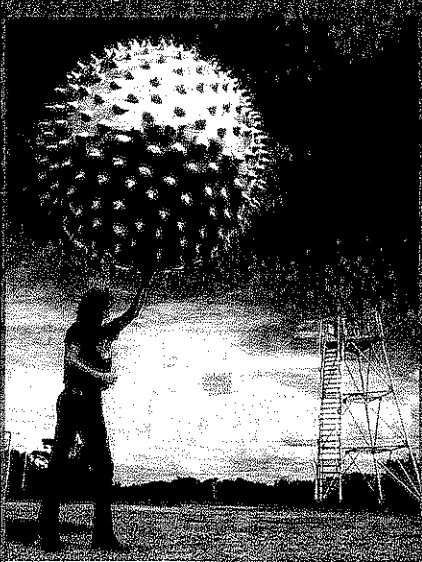
Before the 1800s, all studies of the atmosphere had to be done from the ground. Today, scientists launch weather balloons, fly specially equipped planes, and view the atmosphere in satellite images. The data they collect show that the atmosphere interacts with the other parts of the Earth system to form complex weather patterns that circulate around Earth. The more scientists learn about these patterns, the more accurately they can predict local weather.

Hydrosphere

The **hydrosphere** (HY-druh-SFEER) is made up of all the water on Earth in oceans, lakes, glaciers, rivers, and streams and underground. Water covers nearly three-quarters of Earth's surface. Only about 3 percent of the hydrosphere is fresh water. Nearly 70 percent of Earth's fresh water is frozen in glaciers and polar ice caps.

Parts of the Earth System

Atmosphere



Over 400 cones make this weather balloon more stable as it gathers data about the atmosphere.

Hydrosphere



Scientists need special diving equipment to study Earth's oceans.

In the past 50 years, scientists have used deep-sea vehicles, special buoys, satellite images, and diving suits, such as the one shown on page 10, to study the world's oceans. They have discovered that the oceans contain several layers of cold and warm water. As these layers circulate, they form cold and warm ocean currents. The currents interact with wind patterns in the atmosphere and affect Earth's weather.

CHECK YOUR READING

How does the hydrosphere affect the atmosphere?

Biosphere

The **biosphere** (BY-uh-SFEER) includes all life on Earth, in the air, on the land, and in the waters. The biosphere can be studied with a variety of technologies. For example, satellite photos are used to track yearly changes in Earth's plant and animal life. As the photograph below shows, special equipment allows scientists to study complex environments, such as rain forests, without damaging them.

Scientists have learned a lot about how the biosphere interacts with the other parts of the Earth system. For example, large forests act as Earth's "lungs," absorbing carbon dioxide and releasing oxygen into the atmosphere. When dead trees decay, they return nutrients to the soil.

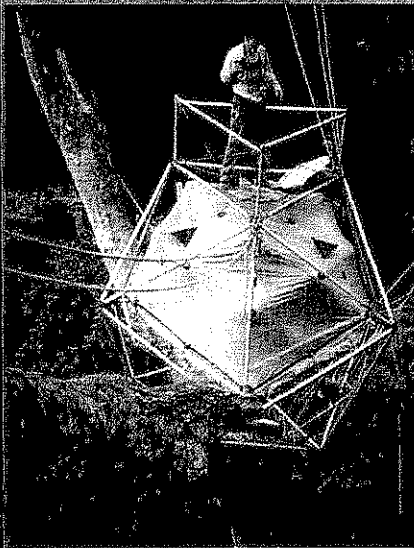
MAIN IDEA AND DETAILS

As you read this section, use this strategy to take notes.

CHECK YOUR READING

Name one way the biosphere and the atmosphere interact.

Biosphere



These platforms, built in the treetops, are used to observe forest plants and animals.

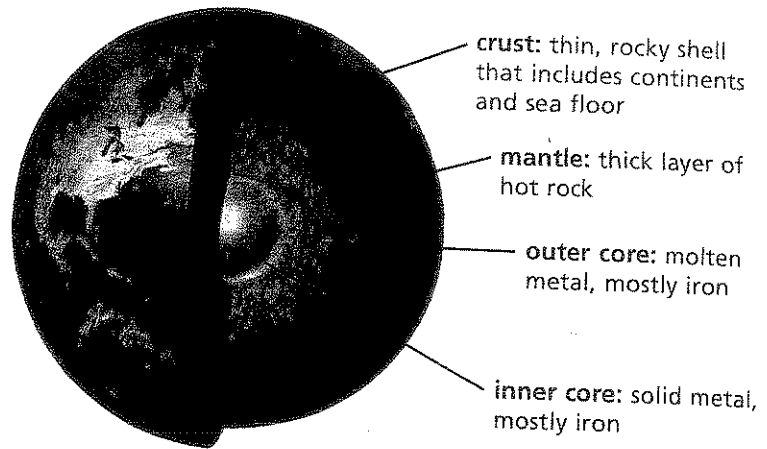
Geosphere



In mines dug deep underground, scientists can explore Earth's minerals and rocks.

Geosphere

The **geosphere** (JEE-uh-SFEER) includes all the features on Earth's surface—the continents, islands, and sea floor—and everything below the surface. As the diagram illustrates, the geosphere is made up of several layers: crust, mantle, and outer and inner core.



People have studied the surface of the geosphere for centuries. Not until the 1900s, however, were people able to study Earth from space or to explore deep within the planet. Today, scientists use satellite images, sound waves, and computer modeling to develop accurate pictures of features on and below Earth's surface. These images show that Earth constantly changes. Some changes are sudden—a volcano explodes, releasing harmful gases and dust into the air. Other changes, such as the birth of new islands, happen over millions of years.

Earth's continents have many unique landforms such as these rock towers in Cathedral Valley, Utah.



Give an example of matter moving from the geosphere to the atmosphere.

INVESTIGATE Geosphere's Layers

How can you model the geosphere's layers?

PROCEDURE

- 1 To model the layers of the geosphere, you will be using a quarter of an apple that your teacher has cut. Note: NEVER eat food in the science classroom.
- 2 Hold the apple slice and observe it carefully. Compare it with the diagram of the geosphere's layers on page 12.
- 3 Draw a diagram of the apple and label it with the names of the layers of the geosphere.

WHAT DO YOU THINK?

- What are the four parts of the apple slice?
- What major layer of the geosphere does each part of the apple resemble?

CHALLENGE What other object do you think would make a good model of the geosphere's layers? What model could you build or make yourself?

SKILL FOCUS
Modeling

MATERIALS
apple slice

TIME
15 minutes



All four parts of the Earth system shape the planet's surface.

Earth's surface is worn away, built up, and reshaped every day by the atmosphere, the hydrosphere, the biosphere, and the geosphere. Here are some of the ways they affect the surface.

Atmosphere and Hydrosphere Not even the hardest stone can withstand wind and water. Over millions of years, rain, wind, and flowing water carve huge formations such as the Grand Canyon in Arizona or the rock towers of Utah, shown on page 12.

Geosphere Landmasses pushing together have set off earthquakes and formed volcanoes and mountain ranges around the world.

Biosphere Plants, animals, and human beings have also changed Earth's surface. For instance, earthworms help make soils more fertile. And throughout human history, people have dammed rivers and cleared forests for farmland.

You are part of this process, too. Every time you walk or ride a bike across open land, you are changing Earth's surface. Your feet or the bike's tires dig into the dirt, wearing away plants and exposing soil to sunlight, wind, and water. If you take the same route every day, over time you will wear a path in the land.

READING TIP

Landmass is a compound word made up of the words *land* and *mass*. *Landmass* means "a large area of land."

Mudslide in California

Atmosphere and Hydrosphere

Heavy winter rains soak the ground until it cannot absorb any more water.

Biosphere People who build on fragile hillsides remove plants whose roots help hold the soil in place.

Geosphere With nothing to hold the water-soaked ground, it slides downhill, leaving a deep trench.

The photograph above shows a good example of how the four parts can suddenly change Earth's surface. A mudslide like this one can happen in a matter of minutes. Sometimes the side of a mountain may collapse, becoming a river of mud that can bury an entire town.

The four parts of the Earth system continue to shape the surface with every passing year. Scientists will continue to record these changes to update maps and other images of the planet's complex system.

CHECK YOUR READING

Find three examples on pages 13 and 14 that show how the parts of the Earth system shape the planet's surface.

1.1 Review

KEY CONCEPTS

1. Define *system*. Compare an open and a closed system.
2. Name the four parts of the Earth system. List one fact about each part that scientists learned through modern technology.
3. Give two examples of how the Earth system's four parts can interact with each other.

CRITICAL THINKING

4. **Apply** One day you see that plants are dying in the class terrarium. What part might be missing from its system?
5. **Infer** You visit a state park and see a thin rock wall with a hole, like a window, worn through it. Which of the four parts of the Earth system might have made the hole? Explain.

CHALLENGE

6. **Predict** Imagine that a meteorite 200 meters wide strikes Earth, landing in a wooded area. Describe one way that this event would affect the biosphere or the geosphere. **Hint:** A meteorite is traveling several thousand kilometers per hour when it strikes the ground.