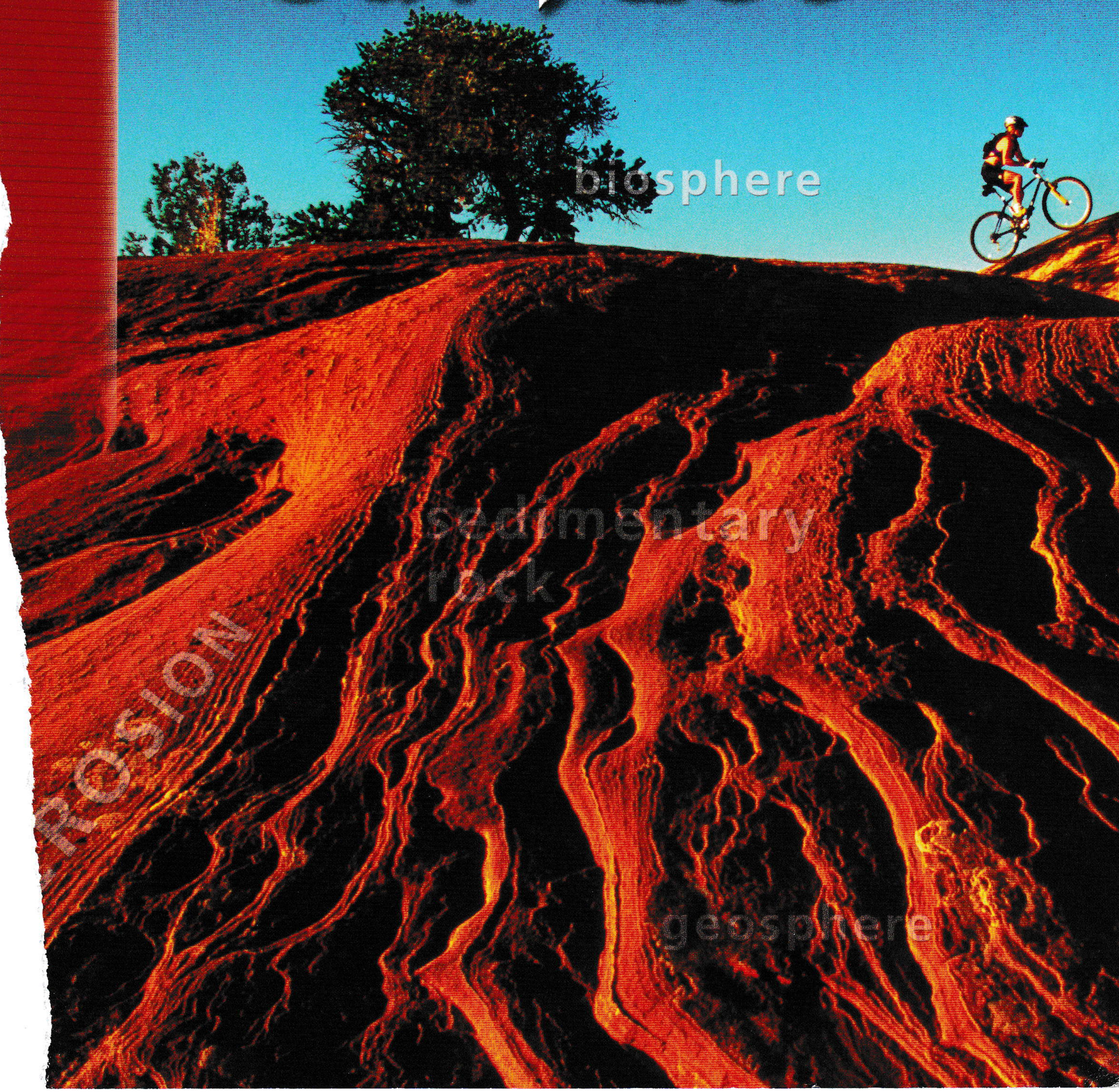
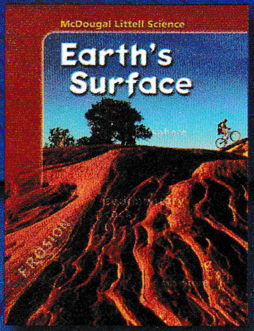
McDougal Littell Science

Earth's Surface





Earth's Surface
Contents Overview

Unit Features

REMOTE SENSING

Technology high above Earth's surface is giving scientists a whole new look at our planet. This image is of Jasper Ridge, near Palo Alto, California.

SCIENTIFIC AMERICAN FRONTIERS

View the video segment "All That Glitters" to learn how explorers use remote sensing and other methods to find valuable materials.

This research jet aircraft carries instruments to study Earth's land surface, ocean, and atmosphere. It flies at high altitudes, allowing it to collect data and images over large areas during a single flight.

Mapping Earth

You're probably familiar with images of gold prospectors in the Old West. Maybe you've seen them in old movies or read about them in history books. Prospectors wandered through the mountains, looking for signs of ores or gemstones, going here and there in response to rumors or stories, pitching camp in remote canyons on a hunch. People still prospect for minerals today, but they're more likely to fly in airplanes than to ride mules. And stories of fabled mines are just stories and fables. Today's prospectors rely on scientific evidence from remote sensing.

Remote sensing—the use of instruments to gather data from a distance—has two great advantages. The first is that sensors mounted in satellites and airplanes can collect vast amounts of detailed information over large areas. The second is that the sensors can easily collect information about the same area again and again.

For example, scientists use remote sensing to make better and more detailed maps of Earth and to track changes over time. Thanks to remote sensing, scientists now know that Mount Everest, the highest point on Earth, is actually getting higher by about 1 centimeter (0.4 in.) per year. Remote sensors on satellites are also mapping global ocean temperatures and showing how they change over the course of a year.

Uncut diamond

Detecting Minerals from Above

One of the many uses of remote sensing is to find new sources of valuable minerals, such as diamonds. To detect minerals from airplanes or satellites, remote sensors make use of the energy in sunlight. Sunlight reaches Earth as radiation, which travels in the form of waves. All objects absorb some types of radiation and reflect others. The particular wavelengths absorbed or reflected depend upon the materials that make up the objects. Each kind of material has a unique "fingerprint" of the wavelengths it absorbs and the wavelengths it reflects.

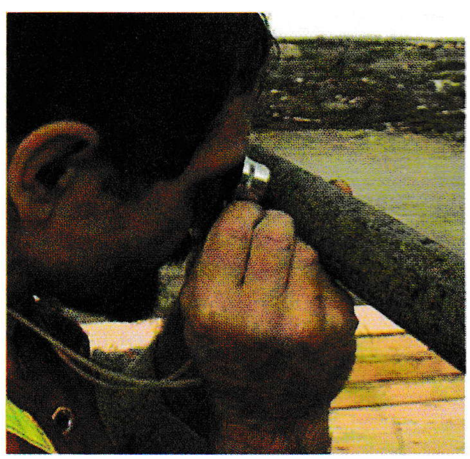
Energy from the Sun reflects at different wavelengths from materials at Earth's surface. Instruments on the jet analyze the reflected energy and map the surface.

When sunlight strikes Earth's surface, some of it is reflected back into the sky. Some of the radiation is absorbed by rocks and other objects and then emitted, or given off, in a different form. Remote sensors in airplanes and satellites collect the reflected and emitted radiation and analyze it to determine which types of rocks and minerals lie on the surface. The remote sensing systems collect so much data that computer processing and analysis are difficult and expensive. Still, the data are usually clear enough to show the types of minerals located in the regions scanned. However, minerals that are buried cannot be detected by remote sensing from aircraft or satellites. The sensors receive only energy from or near the surface.

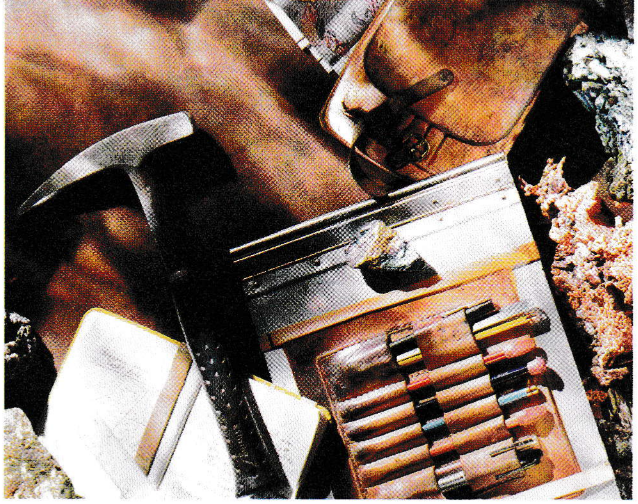
SCIENTIFIC AMERICAN FRONTIERS

View the "All that Glitters" segment of your *Scientific American Frontiers* video to see how finding certain common minerals can indicate the presence of a valuable mineral like diamond.

IN THIS SCENE FROM THE VIDEO **a mineral prospector searches for diamonds in a cylinder of rock drilled from beneath Earth's surface.**



SEARCHING FOR DIAMONDS People used to think that North America did not have many diamonds. However, northern Canada is geologically similar to the world's major diamond-producing areas: southern Africa, Russia, and Australia. A few diamond prospectors kept searching, using remote sensing and other techniques. The prospectors looked for more common minerals that form under the same conditions as diamonds. They made maps showing where these minerals were most plentiful and used the maps to search for diamond-rich rock. Once the prospectors realized that the glaciers of the last ice age had moved the minerals, they looked for and found diamonds farther northward. Canada is now a big producer of diamonds.



Remote sensing can show the presence of minerals that occur with diamonds, but people must still use older methods to collect samples for further analysis.

Prospecting for Diamonds

One of the major regions of mineral exploration in which remote sensing is used is in the Northwest Territories of Canada, where the first diamond mine began operating in 1998. The Canada Centre for Remote Sensing has helped develop sensing equipment that can fit easily onto light airplanes and computer equipment to analyze results quickly. The sensing equipment is used to detect certain types of minerals that are often found along with diamonds.

Using remote sensing to locate minerals associated with diamonds or valuable ores is only a beginning. The data cannot show how far the minerals or ores extend underground. Prospectors must still explore the area and take samples. However, remote sensing gives mineral prospectors an excellent idea of where to start looking.

UNANSWERED Questions

As scientists use remote sensing to study Earth's land surface, ocean, and atmosphere, they work to answer new questions.

- Can remote sensing be used to locate sources of iron, platinum, or gold in areas that are difficult to explore on foot?
- How do changes in water temperature at the ocean surface affect long-range weather patterns and the health of ocean organisms?
- How do different types of clouds affect the amount of sunlight reaching Earth's surface and the average temperature of the surface?

UNIT PROJECTS

As you study this unit, work alone or with a group on one of the projects listed below.

Hiker's Guide Video

Like prospectors, wilderness hikers must be able to read maps that show the shape of the land. Prepare a video to teach hikers how to choose hiking and camping areas by reading maps.

- Obtain a topographic map of a wilderness area in a national or state park.
- Write a script outlining what you will teach and how you will videotape it.
- Present your video and display the maps you used.

Diamond Mine Model

Diamonds can be carried toward Earth's surface by kimberlite pipes. Show how diamonds are mined from kimberlite.

- Build a model of a diamond-mine tunnel that passes through kimberlite.
- Present your model to your class. Explain the relationship between kimberlite and diamonds.

Glacier Photo Essay

Make a photo essay showing how glaciers reshape Earth's surface as they move and melt.

- Find images of areas that are or have been affected by glaciers. Write captions for them.
- Present the images as a photo essay on a poster or in a portfolio.

CAREER CENTER
CLASSZONE.COM

Learn more about careers in mineralogy.

CHAPTER 1

Views of Earth Today

the BIG idea

Modern technology has changed the way we view and map Earth.

Key Concepts

SECTION 1
Technology is used to explore the Earth system.
Learn how technology has changed people's view of Earth.

SECTION 2
Maps and globes are models of Earth.
Learn how to locate any place on Earth and how Earth's sphere is portrayed on flat maps.

SECTION 3
Topographic maps show the shape of the land.
Learn about representing the features of Earth's surface on flat maps.

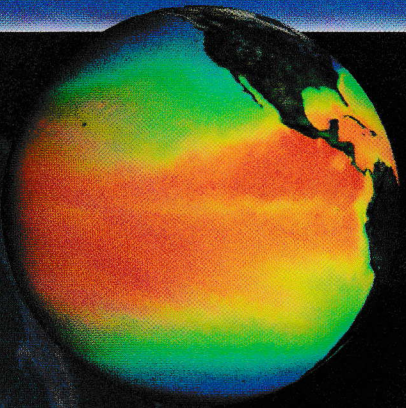
SECTION 4
Technology is used to map Earth.
Learn how satellites and computers are used to provide more detailed maps of Earth.

Internet Preview

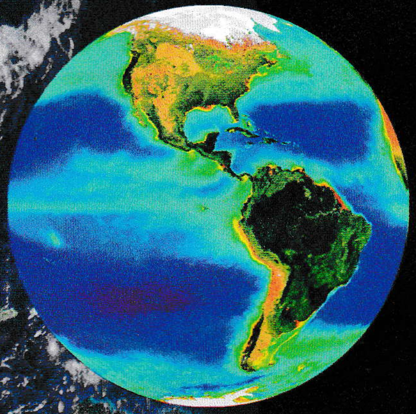
CLASSZONE.COM

Chapter 1 online resources: Content Review, Simulation, Visualization, three Resource Centers, Math Tutorial, and Test Practice

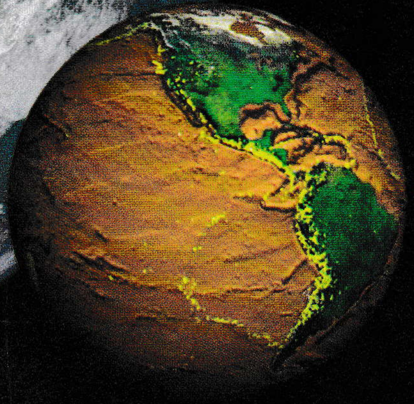
Swirling clouds over North and South America: NASA Terra satellite data



Warm and cool ocean-surface temperatures: NASA satellite image



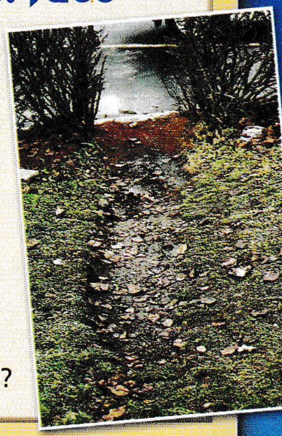
Chlorophyll levels (green) on land and sea: SeaStar spacecraft image



Earth's rocky surface without the oceans: NASA satellite data

EXPLORE the BIG idea

Earth's Changing Surface



Go outside and find evidence of how wind, water, or living things change the surface of Earth. You might look in alleyways, parks, wooded areas, or backyards. For example, you might find a path worn through a grassy area near a parking lot.

Observe and Think What changes do you observe? What do you think caused the changes?

Using Modern Maps

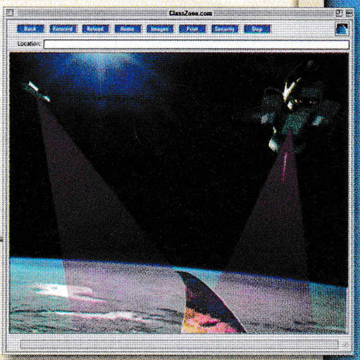
Find a map of a city, a bus or rail system, or a state. Study the names, colors, and symbols on the map and any features of interest.

Observe and Think Which direction on the map is north? What do the symbols mean? How do you measure the distance from one point to another?

Internet Activity: Mapping

Go to **ClassZone.com** to learn more about mapping Earth from space. Find out about a NASA mission to develop the most accurate map of Earth ever made.

Observe and Think Why do you think scientists need different maps produced from satellite data?



NSTA scilinks.org SCILINKS

Earth's Spheres **Code: MDL013**

CHAPTER 1

Getting Ready to Learn

CONCEPT REVIEW

- Earth, like all planets, is shaped roughly like a sphere.
- Earth supports a complex web of life.
- The planet consists of many parts that interact with one another.

VOCABULARY REVIEW

See Glossary for definitions.

energy

matter

planet

satellite

CONTENT REVIEW
CLASSZONE.COM
Review concepts and vocabulary.

TAKING NOTES

MAIN IDEA AND DETAIL NOTES

Make a two-column chart. Write the main ideas, such as those in the blue headings, in the column on the left. Write details about each of those main ideas in the column on the right.

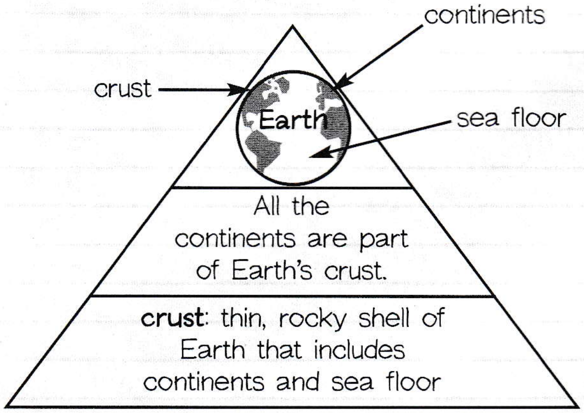
VOCABULARY STRATEGY

Draw a **word triangle** diagram for each new vocabulary term. On the bottom line write and define the term. Above that, write a sentence that uses the term correctly. At the top, draw a picture to show what the term looks like.

See the Note-Taking Handbook on pages R45–R51.

SCIENCE NOTEBOOK

MAIN IDEAS	DETAIL NOTES
1. The Earth system has four main parts.	1. Atmosphere = mixture of gases surrounding Earth 1. Hydrosphere = all waters on Earth



KEY CONCEPT

1.1 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

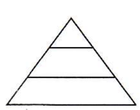
THINK ABOUT

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.

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



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.

Atmosphere

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

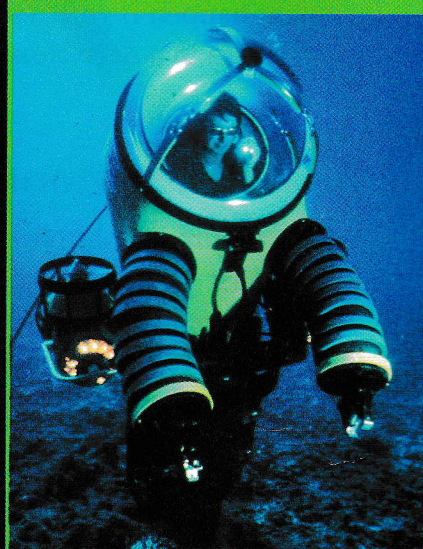
The **hydrosphere** (HY-druh-SFEER) is made up of all the water on Earth in oceans, lakes, glaciers, rivers, and streams and underground. Water covers nearly three-quarters of Earth's surface. Only about 3 percent of the hydrosphere is fresh water. Nearly 70 percent of Earth's fresh water is frozen in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

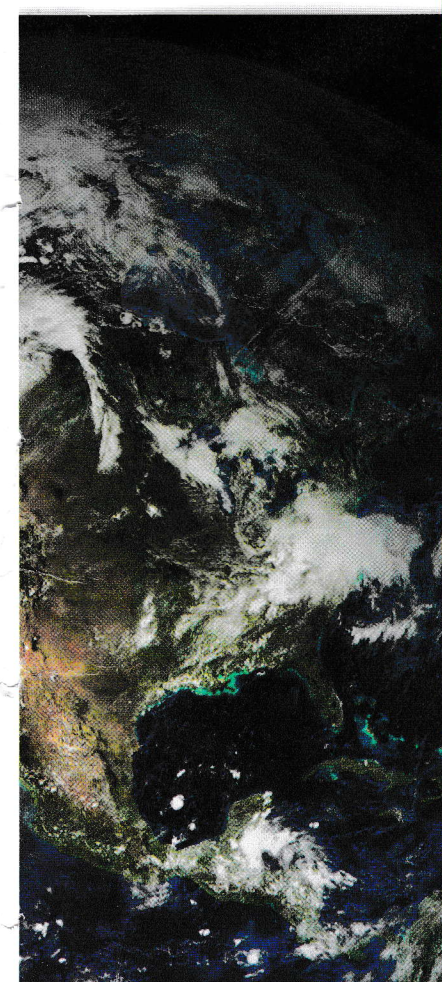
Biosphere

MAIN IDEA AND DETAILS As you read this section, use this strategy to take notes.

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.

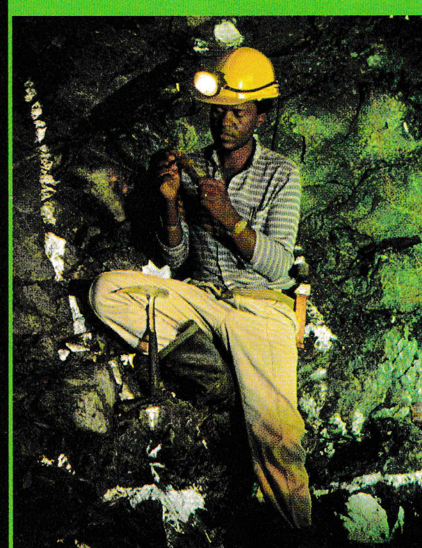
CHECK YOUR READING Name one way the biosphere and the atmosphere interact.



Biosphere

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

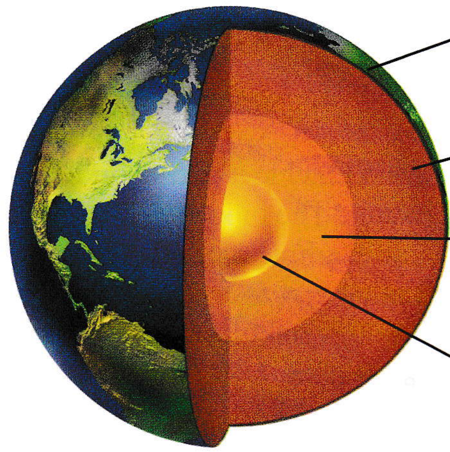
Geosphere



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

Geosphere

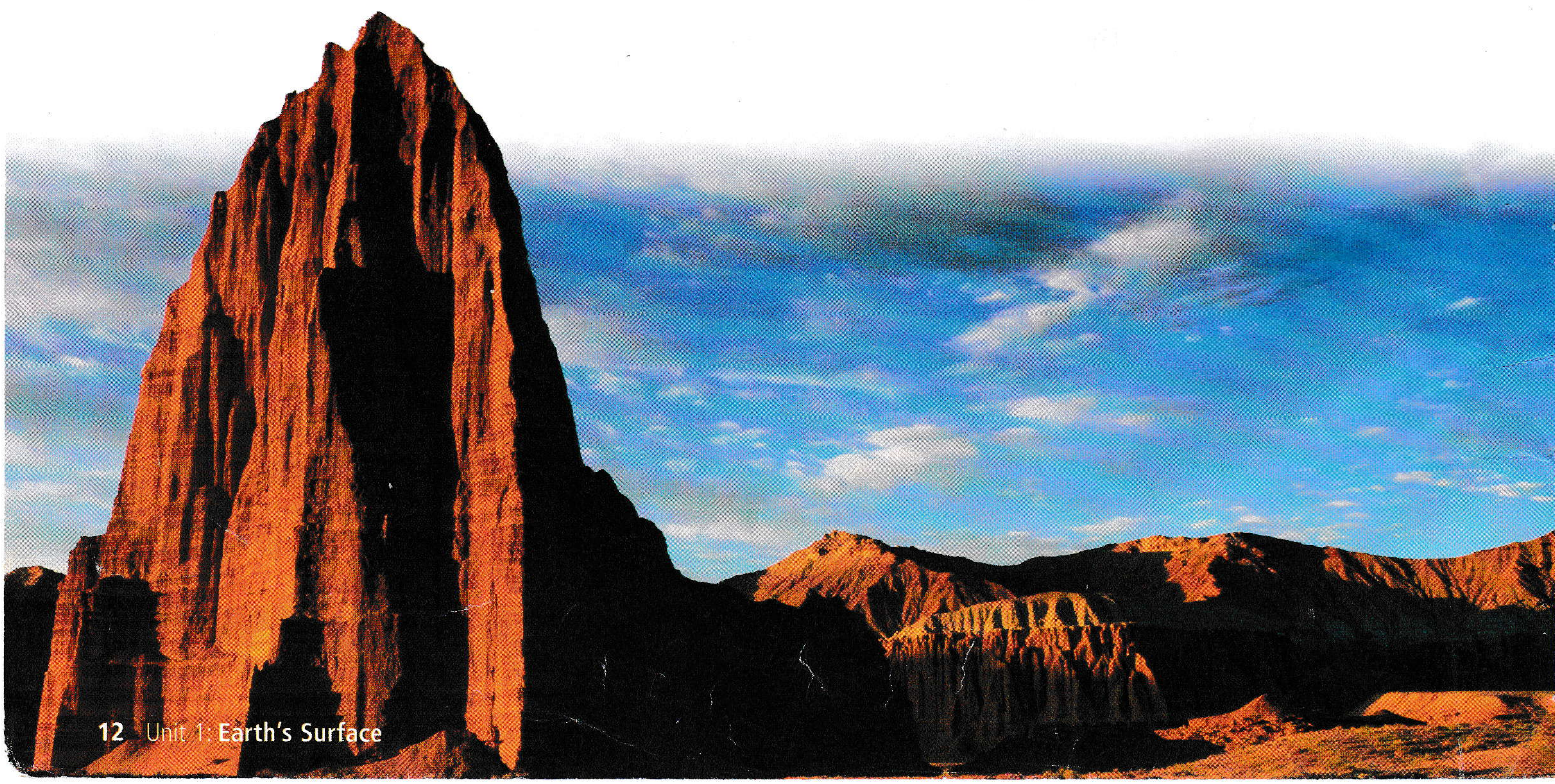
The **geosphere** (JEE-uh-SFEER) includes all the features on Earth's surface—the continents, islands, and sea floor—and everything below the surface. As the diagram illustrates, the geosphere is made up of several layers: crust, mantle, and outer and inner core.



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.

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

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



INVESTIGATE Geosphere's Layers

How can you model the geosphere's layers?

SKILL FOCUS
Modeling

MATERIALS
apple slice

TIME
15 minutes

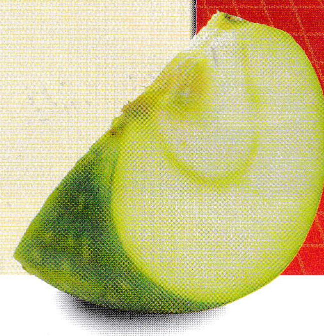
PROCEDURE

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?



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.

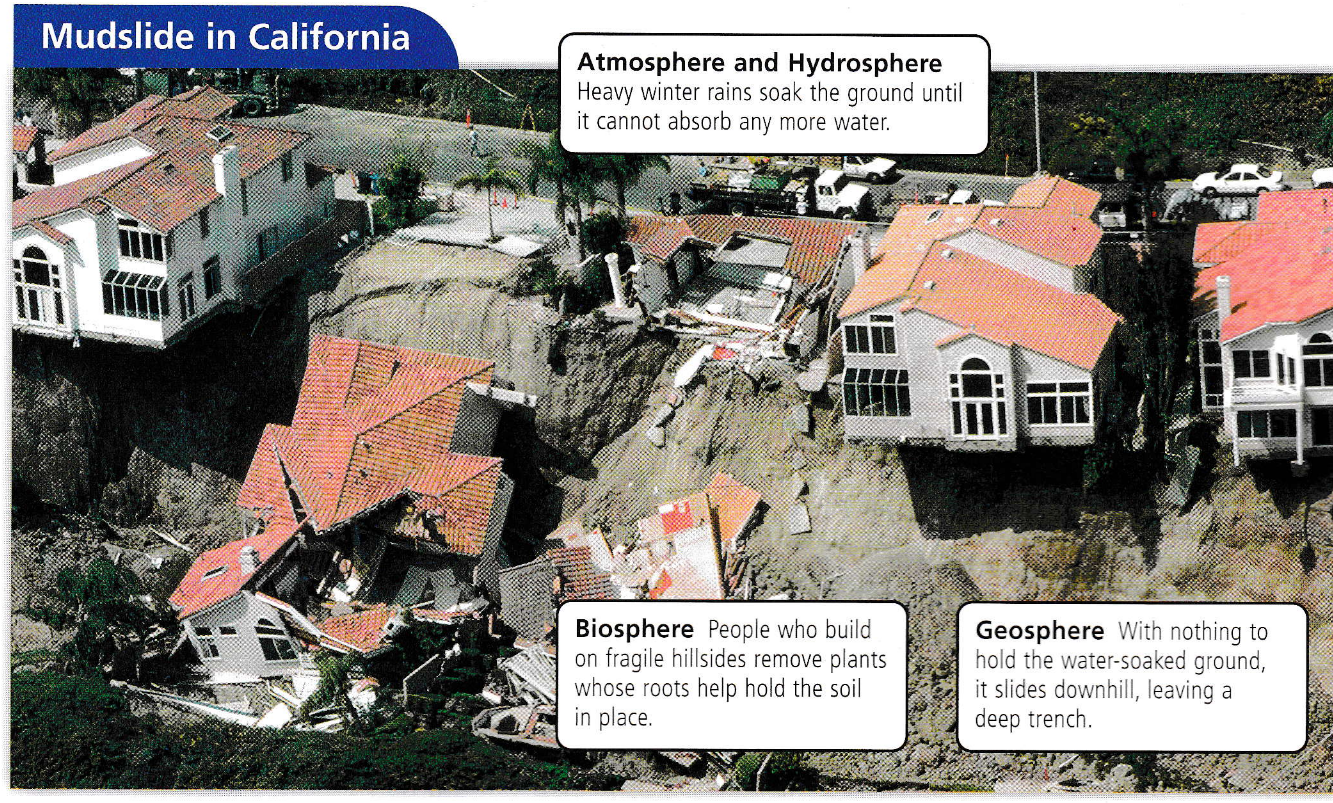
Geosphere Landmasses pushing together have set off earthquakes and formed volcanoes and mountain ranges around the world.

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."



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.

KEY CONCEPT

1.2 Maps and globes are models of Earth.

BEFORE, you learned

- The Earth system has four main parts: atmosphere, hydrosphere, biosphere, and geosphere
- Technology is used to study and map the Earth system
- The Earth system's parts interact to shape Earth's surface

NOW, you will learn

- What information maps can provide about natural and human-made features
- How to find exact locations on Earth
- Why all maps distort Earth's surface

VOCABULARY

relief map p. 16
map scale p. 17
map legend p. 17
equator p. 18
latitude p. 18
prime meridian p. 19
longitude p. 19
projection p. 20

EXPLORE Mapping

What makes a good map?

PROCEDURE

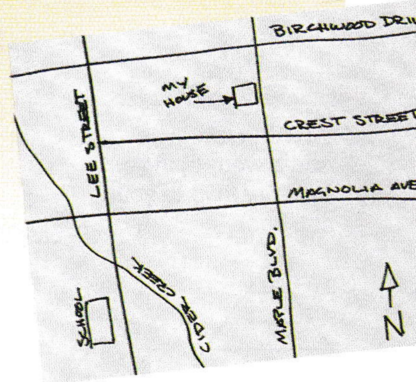
1. Draw a map to guide someone from your school to your home or to a point of interest, such as a park, statue, or store, near your school.
2. Trade maps with a classmate. Is his or her map easy to understand? Why or why not?
3. Use feedback from your partner to revise your own map.

WHAT DO YOU THINK?

What visual clues make a map easy to understand and use?

MATERIALS

- paper
- pencil or pen



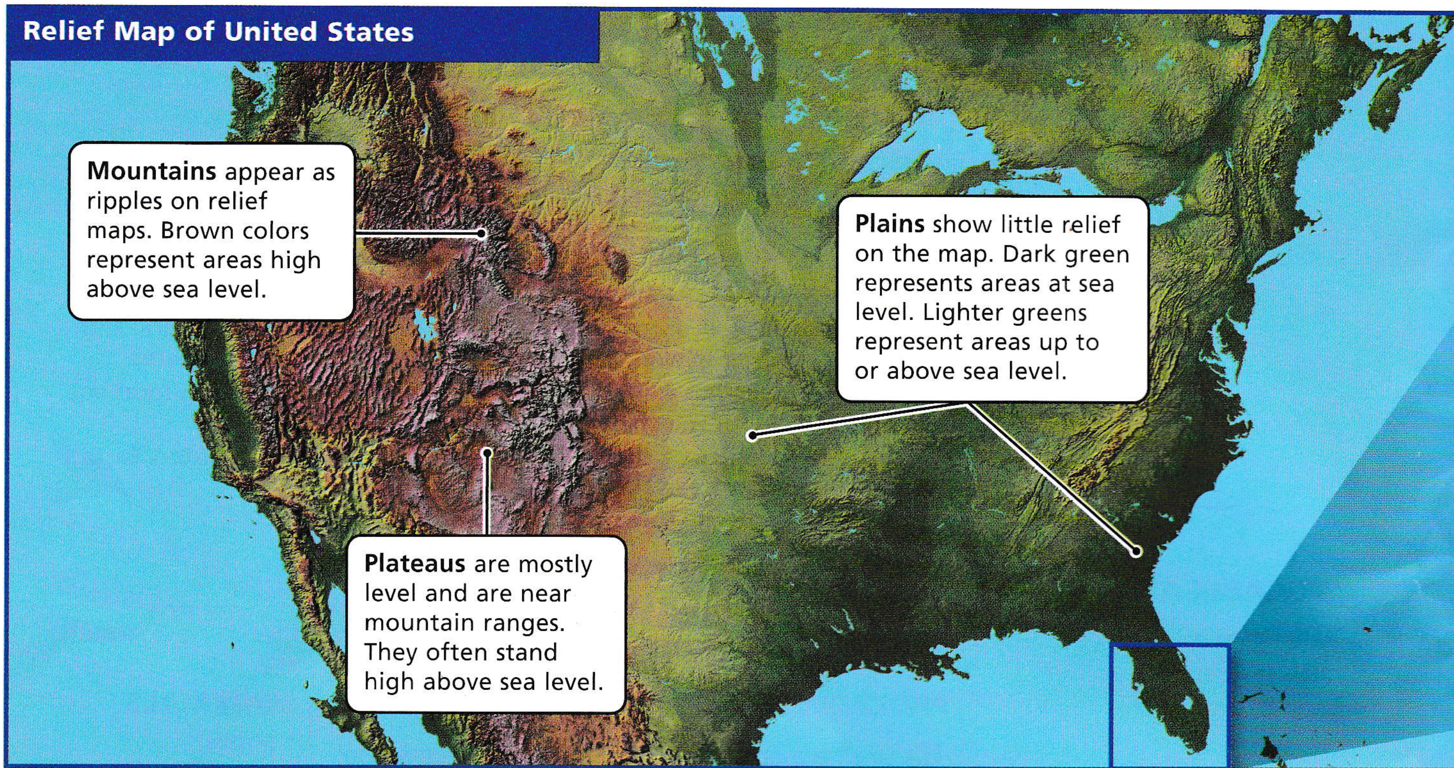
Maps show natural and human-made features.

Have you ever drawn a map to help someone get to your home? If so, your map is actually a rough model of your neighborhood, showing important streets and landmarks. Any map you use is a flat model of Earth's surface, showing Earth's features as seen from above.

On the other hand, a globe represents Earth as if you were looking at it from outer space. A globe is a sphere that shows the relative sizes and shapes of Earth's land features and waters.

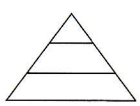
In this section you will learn how maps and globes provide different types of information about Earth's surface. They can show everything from city streets to land features to the entire world.

CHECK YOUR READING How are maps and globes alike? How are they different?



Land Features on Maps

VOCABULARY
Add a word triangle for *relief map* to your notebook.



When scientists or travelers want to know what the landscape of an area actually looks like, they will often use a relief map. A **relief map,** such as the one above, shows how high or low each feature is on Earth. A mapmaker uses photographs or satellite images to build a three-dimensional view of Earth's surface. A relief map shows three main types of land features: mountains, plains, and plateaus.

Mountains stand higher than the land around them. A mountain's base may cover several square kilometers. A group of mountains is called a mountain range. Mountain ranges connected in a long chain form a mountain belt. The Rocky Mountains in the United States are part of a huge mountain belt that includes the Canadian Rockies and the Andes Mountains in South America.

Plateaus have fairly level surfaces but stand high above sea level. Plateaus are often found near large mountain ranges. In the United States, the Colorado Plateau is about 3350 meters (11,000 ft) above sea level. This plateau includes parts of Arizona, Colorado, New Mexico, and Utah.

Plains are gently rolling or flat features. The United States has two types of plains—coastal plains near the eastern and southeastern shores, and interior plains in the center of the nation. The interior Great Plains cover the middle third of the United States.

CHECK YOUR READING How is a plateau different from either a mountain or a plain?

Scale and Symbols on Maps

The maps most people use are road and city maps like the ones above. These maps provide information about human-made features as well as some natural features. To use these maps, you need to know how to read a map scale and a map legend, or key.

1. A **map scale** relates distances on a map to actual distances on Earth's surface. Notice that on the map of southern Florida above, the scale is in kilometers and miles. On the Miami Beach map, the scale is in meters and yards. The smaller the area a map shows, the more detail it includes.

   The scale can be expressed as a ratio, a bar, or equivalent units of distance. For example, a ratio of 1:25,000 means that 1 centimeter on the map represents 25,000 centimeters (0.25 kilometer) on Earth.

Three Types of Map Scale

Ratio 1:25,000

Bar scale 0 1 2 3 km

Equivalent-units scale 1 cm = 1 km

2. A **map legend,** also called a key, is a chart that explains the meaning of each symbol used on a map. Symbols can stand for highways, parks, and other features. The legend on the Miami Beach map shows major points of interest for tourists.

3. A map usually includes a compass rose to show which directions are north, south, east, and west. In general, north on a map points to the top of the page.

READING TIP

As used here, *legend* does not refer to a story. It is based on the Latin word *legenda,* which means "to be read."

CHECK YOUR READING What information do map scales and map legends provide?

VISUALIZATION
CLASSZONE.COM

Explore how latitude and longitude help you find locations on Earth's surface.

Latitude and longitude show locations on Earth.

Suppose you were lucky enough to find dinosaur bones in the desert. Would you know how to find that exact spot again? You would if you knew the longitude and latitude of the place. Latitude and longitude lines form an imaginary grid over the entire surface of Earth. This grid provides everyone with the same tools for navigation. Using latitude and longitude, you can locate any place on the planet.

Latitude

READING TIP

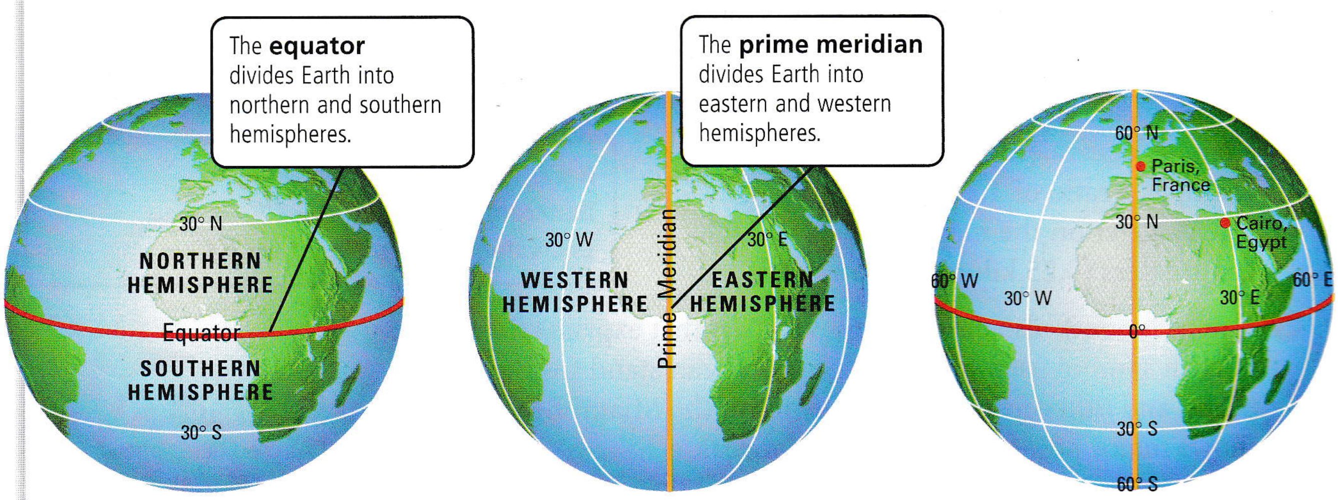
Hemi- is a Greek prefix meaning "half."

Latitude is based on an imaginary line that circles Earth halfway between the north and south poles. This line is called the **equator,** and it divides Earth into northern and southern hemispheres. A hemisphere is one half of a sphere.

Latitude is a distance in degrees north or south of the equator, which is 0°. A degree is 1/360 of the distance around a full circle. If you start at one point on the equator and travel all the way around the world back to that point, you have traveled 360 degrees.

The illustration below shows that latitude lines are parallel to the equator and are evenly spaced between the equator and the poles. Also, latitude lines are always labeled north or south of the equator to

Latitude and Longitude



Latitude is a distance in degrees north or south of the equator.

Longitude is a distance in degrees east or west of the prime meridian.

You can find a location by noting where latitude and longitude lines cross.

READING VISUALS What are the approximate latitudes and longitudes of Cairo, Egypt, and Paris, France?

show whether a location is in the northern or southern hemisphere. For instance, the North Pole is 90° north, or 90°N, while the South Pole is 90° south, or 90°S. Latitude, however, is only half of what you need to locate any spot on Earth. You also need to know its longitude.

Longitude

Longitude is based on an imaginary line that stretches from the North Pole through Greenwich, England, to the South Pole. This line is called the **prime meridian.** Any place up to 180° west of the prime meridian is in the Western Hemisphere. Any place up to 180° east of the prime meridian is in the Eastern Hemisphere.

READING TIP

There is an easy way to remember the difference between latitude and longitude. Think of longitude lines as the "long" lines that go from pole to pole.

Longitude is a distance in degrees east or west of the prime meridian, which is 0°. Beginning at the prime meridian, longitude lines are numbered 0° to 180° west and 0° to 180° east.

Longitude lines are labeled east or west to indicate whether a location is in the eastern or western hemisphere. For example, the longitude of Washington, D.C., is about 78° west, or 78°W. The city of Hamburg, Germany, is about 10° east, or 10°E. If you understand latitude and longitude, you can find any spot on Earth's surface.

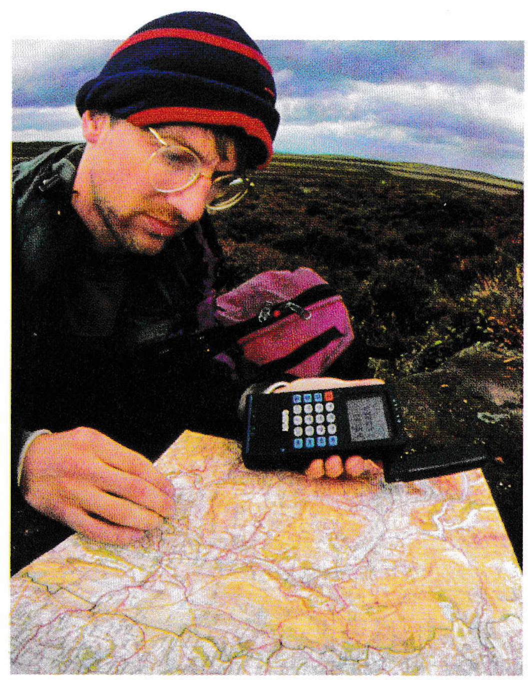
CHECK YOUR READING Why do all cities in the United States have a north latitude and a west longitude?

Global Positioning System

The Global Positioning System (GPS) is a network of satellites that are used to find the latitude, longitude, and elevation, or height above sea level, of any site. Twenty-four GPS satellites circle Earth and send signals that are picked up by receivers on the surface. At least three satellites need to be above the horizon for GPS to work. A computer inside a receiver uses the satellite signals to calculate the user's exact location—latitude, longitude, and elevation. GPS is an accurate, easy method for finding location.

GPS devices are used by many people, including pilots, sailors, hikers, and map makers. Some cars now have GPS receivers and digital road maps stored in their computers. A driver types in an address, and the car's computer finds the best way to get there.

CHECK YOUR READING Explain how GPS can help someone find their exact location.



Never be lost again. This hiker turns on his GPS unit to find out his current latitude and longitude. He then locates these data on his map to pinpoint his exact location.

Map projections distort the view of Earth's surface.

The most accurate way to show Earth's surface is on a globe. A globe, however, cannot show much detail, and it is awkward to carry. People use flat maps for their detail and convenience. A **projection** is a way of representing Earth's curved surface on a flat map. Mapmakers use different types of projections, all of which distort, or misrepresent, Earth's surface in different ways.

Cylindrical Projection

The Mercator projection shows Earth as if the map were a large cylinder wrapped around the planet. The outlines of the landmasses and seas are then drawn onto the map. As shown in the diagram on page 21, the cylinder is unrolled to form a flat map. Latitude and longitude appear as straight lines, forming a grid of rectangles.

The Mercator projection is useful for navigating at sea or in the air. It shows the entire world, except for regions near the poles, on one map. Sailors and pilots can draw a straight line from one point to

INVESTIGATE Map Projections

How do you show the curved Earth on a flat surface?

SKILL FOCUS
Modeling

MATERIALS
- top 8 inches of 2-liter bottle
- marker pen
- walnut-sized piece of clay
- poster board
- flashlight

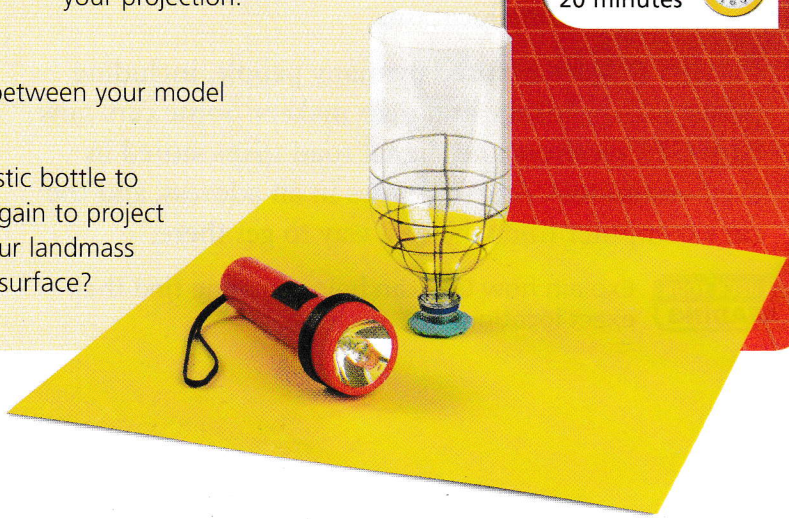
TIME
20 minutes

PROCEDURE

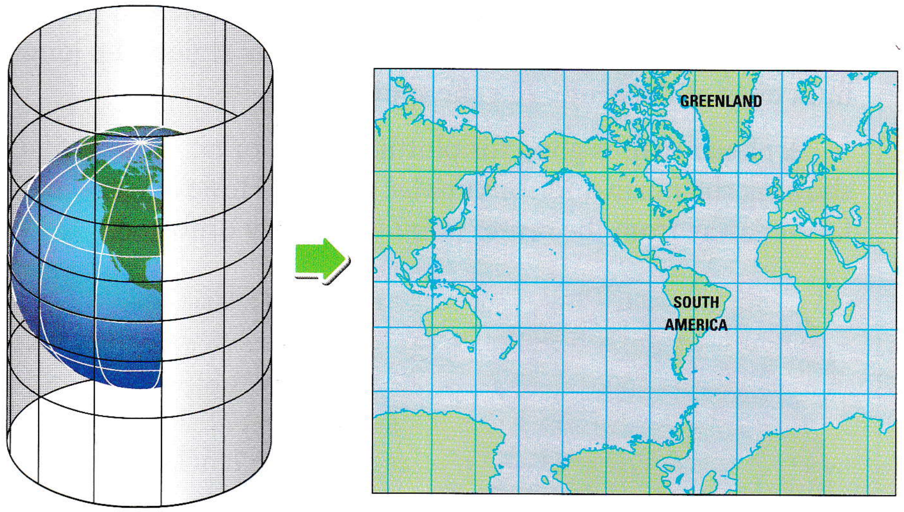
1. Work with a small group. For a model of a hemisphere, use the top section of a 2-liter plastic bottle that your teacher has cut.
2. Carefully draw three or four latitude lines and six or eight longitude lines on the bottle.
3. Place a piece of clay in the center of a piece of poster board. Press the bottle top into the clay.
4. Shine a flashlight downward above the center of the model. Trace the lines on the poster board to make your projection.

WHAT DO YOU THINK?
What are the similarities and differences between your model and your projection?

CHALLENGE Draw a shape on the plastic bottle to represent a landmass. Use the flashlight again to project the hemisphere. How did the shape of your landmass appear when it was projected onto a flat surface?



another to plot a course. The problem with Mercator maps is that areas far away from the equator appear much larger than they really are. On the map below, Greenland looks bigger than South America. In reality, South America is about eight times larger than Greenland.



Mercator projection Latitude and longitude lines form a grid of rectangles. Areas away from the equator are distorted.

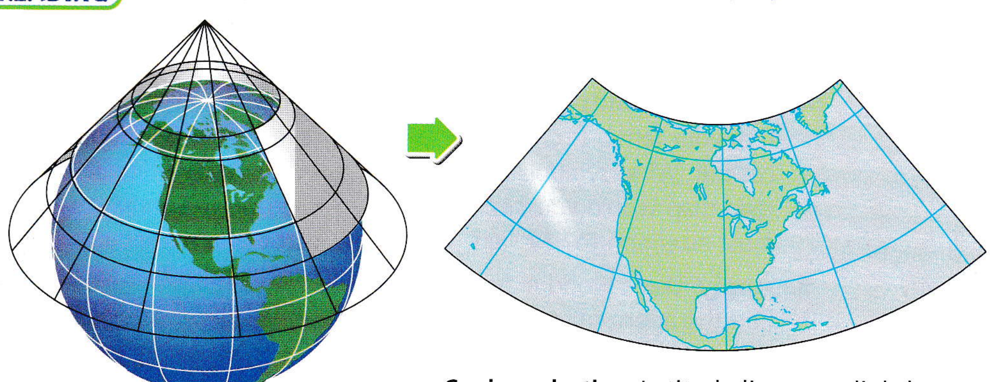
Conic Projections

Conic projections are based on the shape of a cone. The diagram below shows how a cone of paper might be wrapped around the globe. The paper touches the surface only at the middle latitudes, halfway between the equator and the North Pole.

When the cone is flattened out, the latitude lines are curved slightly. The curved lines represent the curved surface of Earth. This allows the map to show the true sizes and shapes of some landmasses.

Conic projections are most useful for mapping large areas in the middle latitudes, such as the United States. However, landmasses near the equator or near the north or south pole will be distorted.

CHECK YOUR READING What are the main uses of Mercator and conic projections?



Conic projection Latitude lines are slightly curved. Only mid-latitude areas are the correct size and shape.

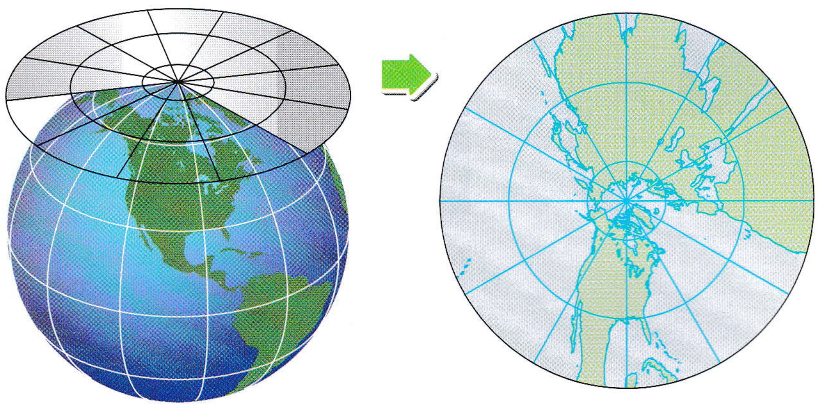
Planar Projections

RESOURCE CENTER
CLASSZONE.COM

Find out more about map projections and how they are used.

Planar projections were developed to help people find the shortest distance between two points. They are drawn as if a circle of paper were laid on a point on Earth's surface. As you look at the diagram below, notice how the shape of the sphere is transferred to the flat map. When a planar map represents the polar region, the longitude lines meet at the center like the spokes of a wheel.

A planar map is good for plotting ocean or air voyages and for showing the north and south polar regions. However, landmasses farther away from the center point are greatly distorted.



Planar projection Only areas near the center point are the correct size and shape.

The Mercator, conic, and planar projections are all attempts to solve the problem of representing a curved surface on a flat map. Each projection can show certain areas of the world accurately but distorts other areas.

CHECK YOUR READING What areas does the planar projection show accurately?

1.2 Review

KEY CONCEPTS

1. What natural and human-made features can maps show? Give two examples of each.
2. Explain how latitude and longitude can help you locate any place on Earth.
3. Why do all flat maps distort Earth's surface?

CRITICAL THINKING

4. **Provide Examples** Imagine that your family is on a long car trip. What symbols on a road map would you pay the most attention to? Explain.
5. **Apply** Use a world map to find the approximate latitudes and longitudes of Moscow, Russia; Tokyo, Japan; Denver, Colorado; and La Paz, Bolivia.

CHALLENGE

6. **Apply** Working with a partner or with a small group, select the shortest airline route from Chicago to London, using a globe and a Mercator map. **Hint:** Notice that as you go farther north on the globe, the longitude lines become closer together.

MATH in SCIENCE

SKILL: USING PROPORTIONS

MATH TUTORIAL
CLASSZONE.COM
Click on Math Tutorial for more help with solving proportions.

How Far Is It?

A science class is visiting Chicago and is using the map on the left to walk to the lakefront museums. Remember, a map scale shows how distances on the map compare to actual distances on the ground.


Buckingham Fountain

Example

In this case, the map scale indicates that 1 centimeter on the map represents 300 meters on the ground. The map scale shows this as equivalent units. By using these units to write a proportion, you can use cross products to determine actual distances.

What distance does 3 cm on the map represent? Set up the problem like this:

$$\frac{1\text{ cm}}{300\text{ m}} = \frac{3\text{ cm}}{x}$$

(1) $1\text{ cm} \cdot x = 3\text{ cm} \cdot 300\text{ m}$

(2) $x = 3 \cdot 300\text{ m}$

(3) $x = 900\text{ m}$

ANSWER 3 centimeters on the map represents 900 meters on the ground.

Use cross products and a metric ruler to answer the following questions.

1. The science class divides into two groups. Each group starts at Buckingham Fountain. How far, in meters, will one group walk to get to the Adler Planetarium if they follow the red dotted line?
2. How far, in meters, will the other group walk to get to the end of Navy Pier if they follow the blue dotted line?
3. The group that walked to Adler decides to take a boat to join the other group at Navy Pier. How far, in meters, is their boat ride along the red dotted line?

CHALLENGE What is the total distance, in kilometers, that the two groups traveled? Set up the problem as a proportion. **Hint:** There are 1000 meters in a kilometer.

KEY CONCEPT

1.3 Topographic maps show the shape of the land.

BEFORE, you learned

- Different maps provide information about natural and human-made features
- Latitude and longitude are used to find places on Earth
- All flat maps distort Earth's surface

NOW, you will learn

- How contour lines show elevation, slope, and relief
- What rules contour lines follow
- What common symbols are used on topographic maps

VOCABULARY

topography p. 24
contour line p. 25
elevation p. 25
slope p. 25
relief p. 25
contour interval p. 26

EXPLORE Topographic Maps

How can you map your knuckles?

PROCEDURE

1. Hold your fist closed, knuckles up, as shown in the photo.
2. Draw circles around the first knuckle. Make sure the circles are the same distance from each other.
3. Flatten out your hand. Observe what happens. Write down your observations.

MATERIAL

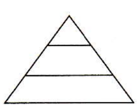
washable colored pen

WHAT DO YOU THINK?

- How does the height of your knuckles change when you clench your fist, then flatten out your hand?
- What do you think the circles represent?

Topographic maps use contour lines to show features.

VOCABULARY
Add a word triangle for *topography* to your notebook.

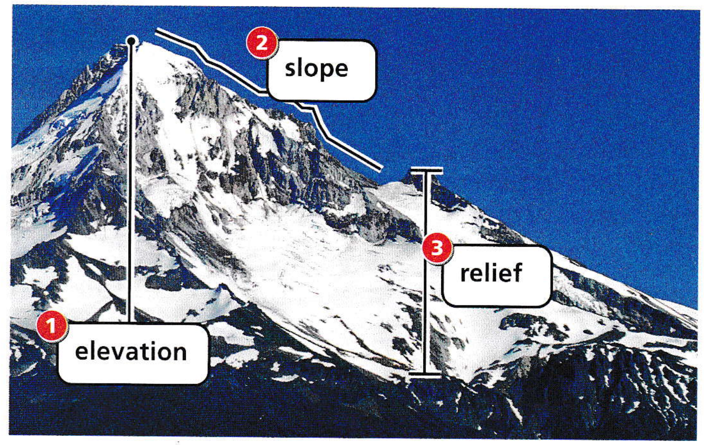


Imagine you are on vacation with your family in a national park. You have a simple trail map that shows you where to hike. But the map does not tell you anything about what the land looks like. Will you have to cross any rivers or valleys? How far uphill or downhill will you have to hike?

To answer these questions, you need to know something about the topography of the area. **Topography** is the shape, or features, of the land. These features can be natural—such as mountains, plateaus, and plains—or human-made—such as dams and roads. To show the topography of an area, mapmakers draw a topographic map.

A topographic map is a flat map that uses lines to show Earth's surface features. Distance and elevation can be given in feet or meters. Take a look at the topographic map of Mount Hood on this page. The wiggly lines on the map are called **contour lines,** and they show an area's elevation, slope, and relief.

1. The **elevation** of a place is how high above sea level it is. An area can range from a few meters to several thousand meters above sea level. The numbers on the contour lines show the elevations of different points in the Mount Hood area.



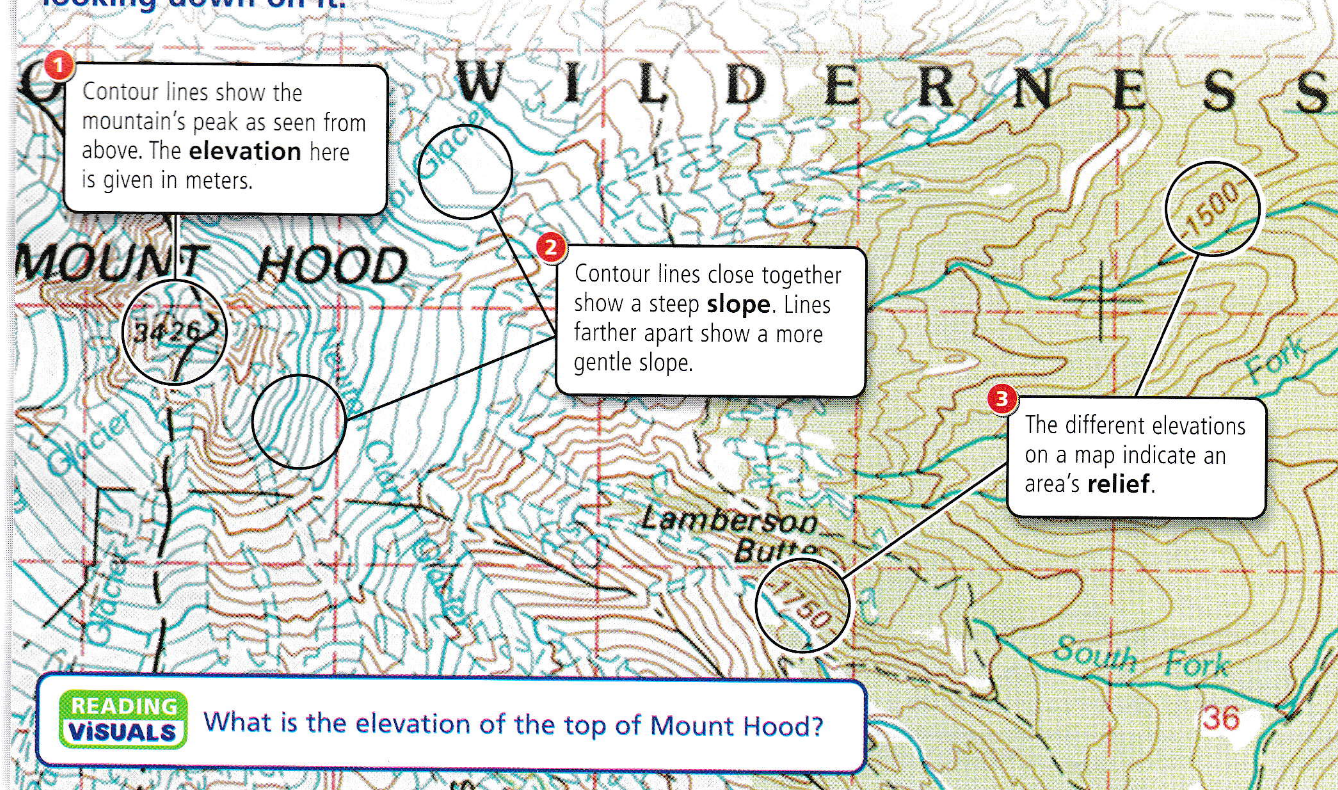
2. The **slope** of a landform or area is how steep it is. The more gradual the slope, the farther apart the contour lines on the map. The steeper the slope, the closer together the contour lines.

3. The **relief** of an area is the difference between its high and low points. For example, subtracting the lowest elevation on the map from the highest gives you a measure of the area's relief.

CHECK YOUR READING What is the difference between elevation and slope?

Mount Hood Topographic Map

A topographic map shows the land as if you were above the land looking down on it.



READING VISUALS What is the elevation of the top of Mount Hood?

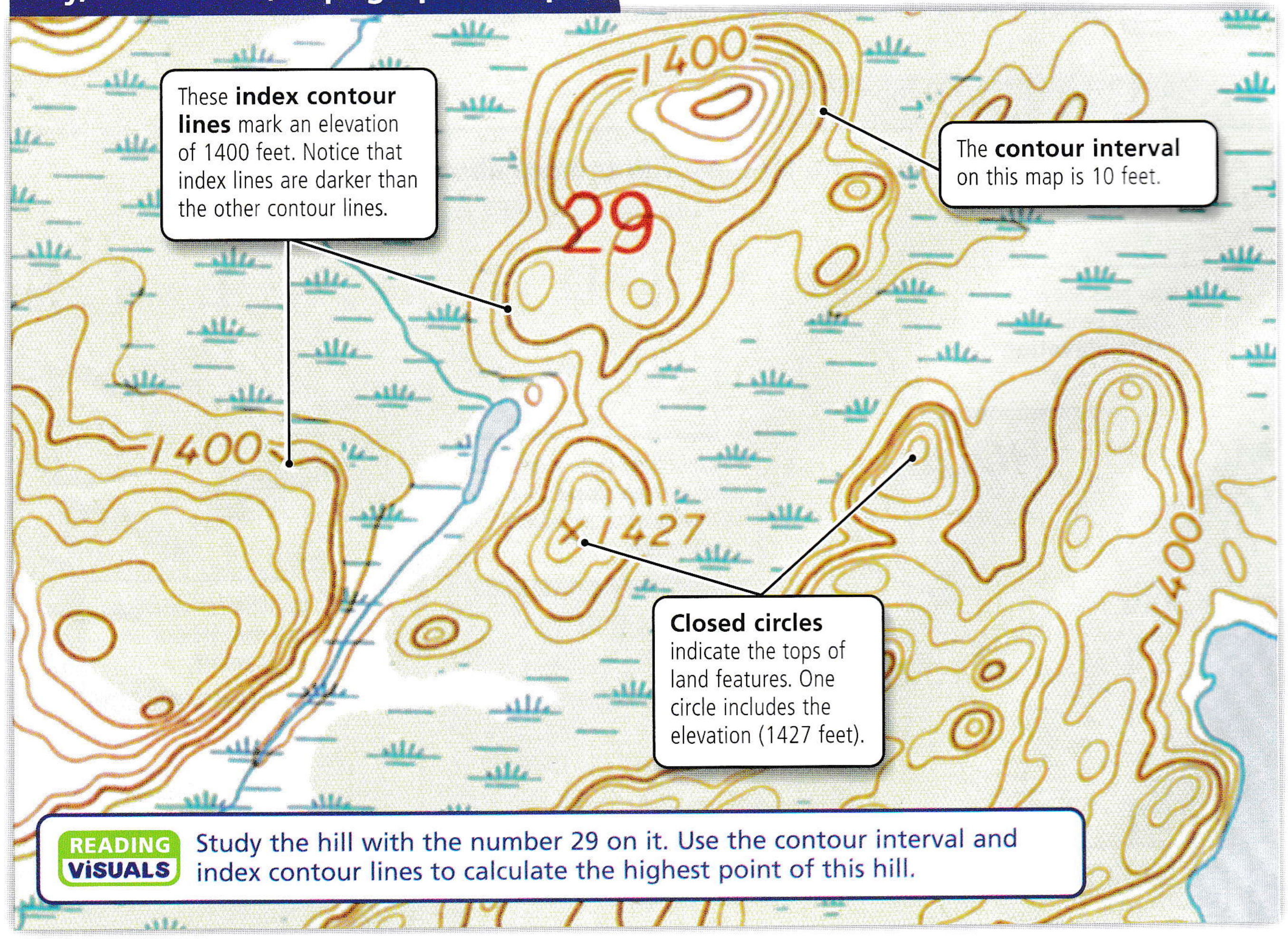
Contour lines follow certain rules.

MAIN IDEA AND DETAILS
Use your main idea and details chart to take notes on the rules for reading a topographic map.

Contour lines on topographic maps can help you visualize landforms. Think of the following statements as rules for reading such maps:

- **Lines never cross.** Contour lines never cross, because each line represents an exact elevation.
- **Circles show highest and lowest points.** Contour lines form closed circles around mountaintops, hilltops, and the centers of depressions, which are sunken areas in the ground. Sometimes, the elevation of a mountain or hill is written in meters or feet in the middle of the circle.
- **Contour interval is always the same on a map.** The **contour interval** is the difference in elevation from one contour line to the next. For example, the contour interval on the map below is 10 feet. This means that the change in elevation between contour lines is always 10 feet. The contour interval can differ from map to map, but it is always the same on a particular map.

Ely, Minnesota, Topographic Map



READING VISUALS Study the hill with the number 29 on it. Use the contour interval and index contour lines to calculate the highest point of this hill.

- **Index contour lines mark elevations.** The darker contour lines on a map are called index contour lines. Numbers that indicate elevations are often written on these lines. To calculate higher or lower elevations, simply count the number of lines above or below an index line. Then multiply that number by the contour interval. For instance, on the Ely map, one index line marks 1400 feet. To find the elevation of a point three lines up from this index line, you would multiply 10 feet (the contour interval) by 3. Add the result, 30, to 1400. The point's elevation is 1430 feet.

SIMULATION
CLASSZONE.COM
Discover the relationship between topographic maps and surface features.

CHECK YOUR READING What information do index contour lines provide?

Besides contour lines, topographic maps also contain symbols for natural and human-made features. Below are some common map symbols that the United States Geological Survey (USGS) uses on its topographic maps.

Topographic Map Symbols

Marsh or swamp	Hiking trail
Vegetation	Stream
Lake or pond	Railroad tracks

The USGS provides topographic maps for nearly every part of the United States. These maps cover urban, rural, and wilderness areas. Hikers and campers are not the only ones who use topographic maps. Engineers, archaeologists, forest rangers, biologists, and others rely on them as well.

1.3 Review

KEY CONCEPTS

1. How do contour lines show elevation, slope, and relief?
2. Why do contour lines never cross on a topographic map?
3. How would you show the top of a hill, an area of vegetation, or a hiking trail on a topographic map?

CRITICAL THINKING

4. **Apply** For an area with gently sloping hills and little relief, would you draw contour lines close together or far apart? Explain why.
5. **Compare and Contrast** How would a road map and a topographic map of the same area differ? What information would each provide?

CHALLENGE

6. **Synthesize** Work with a group to make a topographic map of the area around your school. First decide how big an area you will include. Then choose a contour interval, a map scale, and symbols for buildings, sports fields, and other features. Let other students test the map's accuracy.

CHAPTER INVESTIGATION

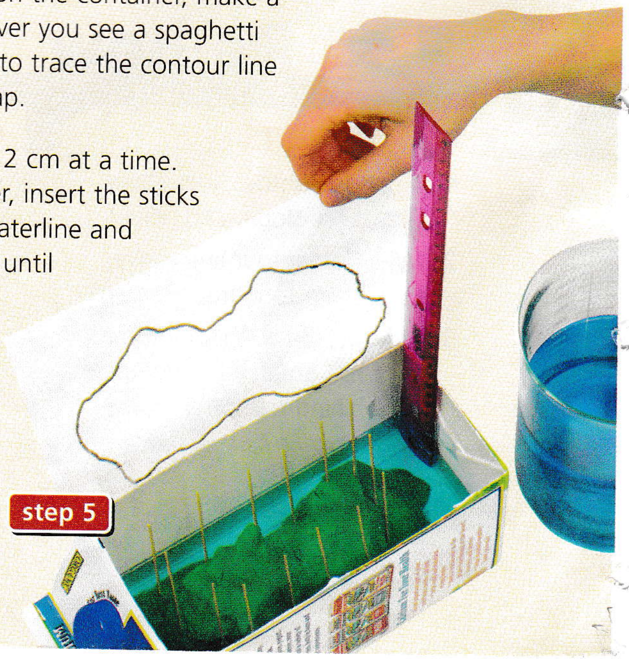
Investigate Topographic Maps

OVERVIEW AND PURPOSE Topographic maps show the shape of the land. In this lab you will use what you have learned about how Earth's three-dimensional surface is represented on maps to
- make a terrain model out of clay
- produce a topographic map of the model

Procedure

1. Build a simple landscape about 6–8 cm high from modeling clay. Include a variety of land features. Make sure your model is no taller than the sides of the container.
2. Place your model into the container. Stand a ruler upright inside the container and tape it in place.
3. Lay the clear plastic sheet over the container and tape it on one side like a hinge. Carefully trace the outline of your clay model.
4. Add 2 cm of colored water to the container.
5. Insert spaghetti sticks into the model all around the waterline. Place the sticks about 3 cm apart. Make sure the sticks are vertical and are no taller than the sides of the container.
6. Lower the plastic sheet back over the container. Looking straight down on the container, make a dot on the sheet wherever you see a spaghetti stick. Connect the dots to trace the contour line accurately onto your map.
7. Continue adding water, 2 cm at a time. Each time you add water, insert the sticks into the model at the waterline and repeat step 6. Continue until the model landscape is underwater. Carefully drain the water when finished.


step 3


step 5

MATERIALS
- half-gallon cardboard juice container
- scissors
- modeling clay
- clear plastic sheet (transparency or sheet protector)
- cellophane tape
- ruler
- water
- food coloring
- box of spaghetti
- erasable marker pen

Observe and Analyze

Write It Up

1. Compare your topographic map with the three-dimensional model. Remember that contour lines connect points of equal elevation. What do widely spaced or tightly spaced contour lines mean? What does a closed circle mean?
2. Make a permanent record of your map to keep in your **Science Notebook** by carefully tracing the contour lines onto a sheet of white paper. To make reading the map easier, use a different color for an index contour line.
3. What is the contour interval of your model landscape? For example, each 2 centimeters might represent 20 meters in an actual landscape. Record the elevation of the index contour line on your map.

Conclude

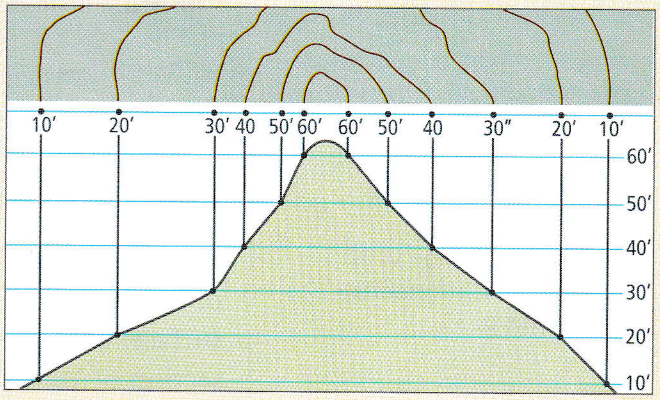
Write It Up

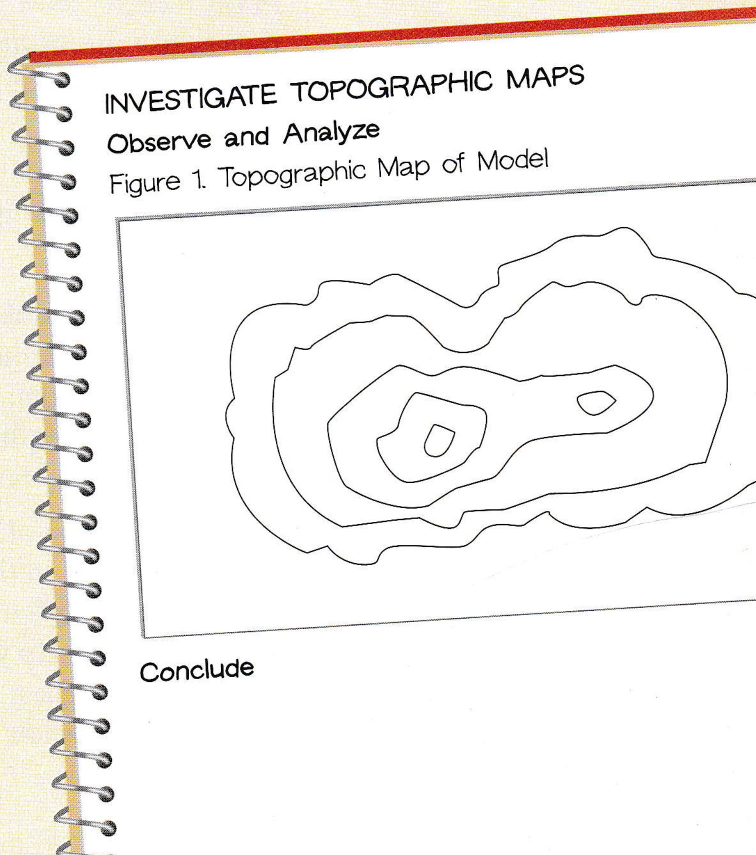
1. **INFER** How would you determine the elevation of a point located halfway between two contour lines?
2. **EVALUATE** Describe any errors that you may have made in your procedure or any places where errors might have occurred.
3. **APPLY** Explain how you would use a topographic map if you were planning a hiking trip or a cross-country bike race.

INVESTIGATE Further

CHALLENGE Choose one feature on a topographic map—such as the map on page 26—to translate into a cross-sectional diagram.

1. Lay a piece of ruled paper across the center of the topographical feature.
2. Mark each of the contour lines on the ruled paper and label each mark with the elevation.
3. Mark the same elevations on the side of the paper, as shown in the example.
4. Use a ruler to draw a straight line down from each mark to the matching elevation on the side of the paper.
5. Connect the points to draw a profile of the landform.





KEY CONCEPT

1.4 Technology is used to map Earth.

BEFORE, you learned

- Contour lines are used on topographic maps to show elevation, slope, and relief
- Contour lines follow certain rules
- Map symbols show many natural and human-made features

NOW, you will learn

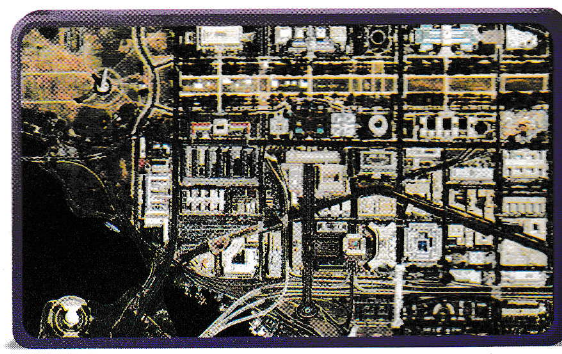
- How remote-sensing images can provide detailed and accurate information about Earth
- How geographic data can be displayed in layers to build maps

VOCABULARY

remote sensing p. 30
sensor p. 31
false-color image p. 32
geographic information systems p. 33

THINK ABOUT

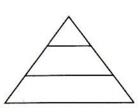
What can you see in this image?



Satellites can record all types of information about Earth's surface. This image shows a section of Washington, D.C. The satellite that collected the data is 680 kilometers (420 mi) above Earth. What familiar items can you see in the picture? How might images like this be useful to scientists, mapmakers, and engineers?

Remote sensing provides detailed images of Earth.

VOCABULARY
Add a word triangle for *remote sensing* to your notebook.



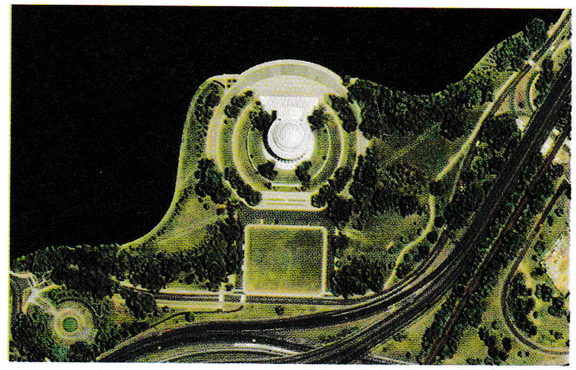
If you have ever looked at an object through a pair of binoculars, you have used remote sensing. **Remote sensing** is the use of scientific equipment to gather information about something from a distance. Remote-sensing technology can be as simple as a camera mounted on an airplane or as complex as a satellite orbiting Earth.

To get an idea of how important remote sensing is, imagine you are a mapmaker in the 1840s. You have been asked to draw a map of a state, but you have no cameras, no photographs from airplanes, and no satellites to help you. To get a good view of the land, you have to climb to the highest points and carefully draw every hill, valley, river, and landform below you. It will take you months to map the state.

Today, that same map would take far less time to make. Modern mapmakers use remote-sensing images from airplanes and satellites to develop highly detailed and accurate maps of Earth's surface.

Airplane cameras use film to record data, but satellites use sensors to build images of Earth. A **sensor** is a mechanical or electrical device that receives and responds to a signal, such as light. Satellite sensors detect far more than your eyes can see. They collect information about the different types of energy coming from Earth's surface. The satellites then send that information to computers on Earth.

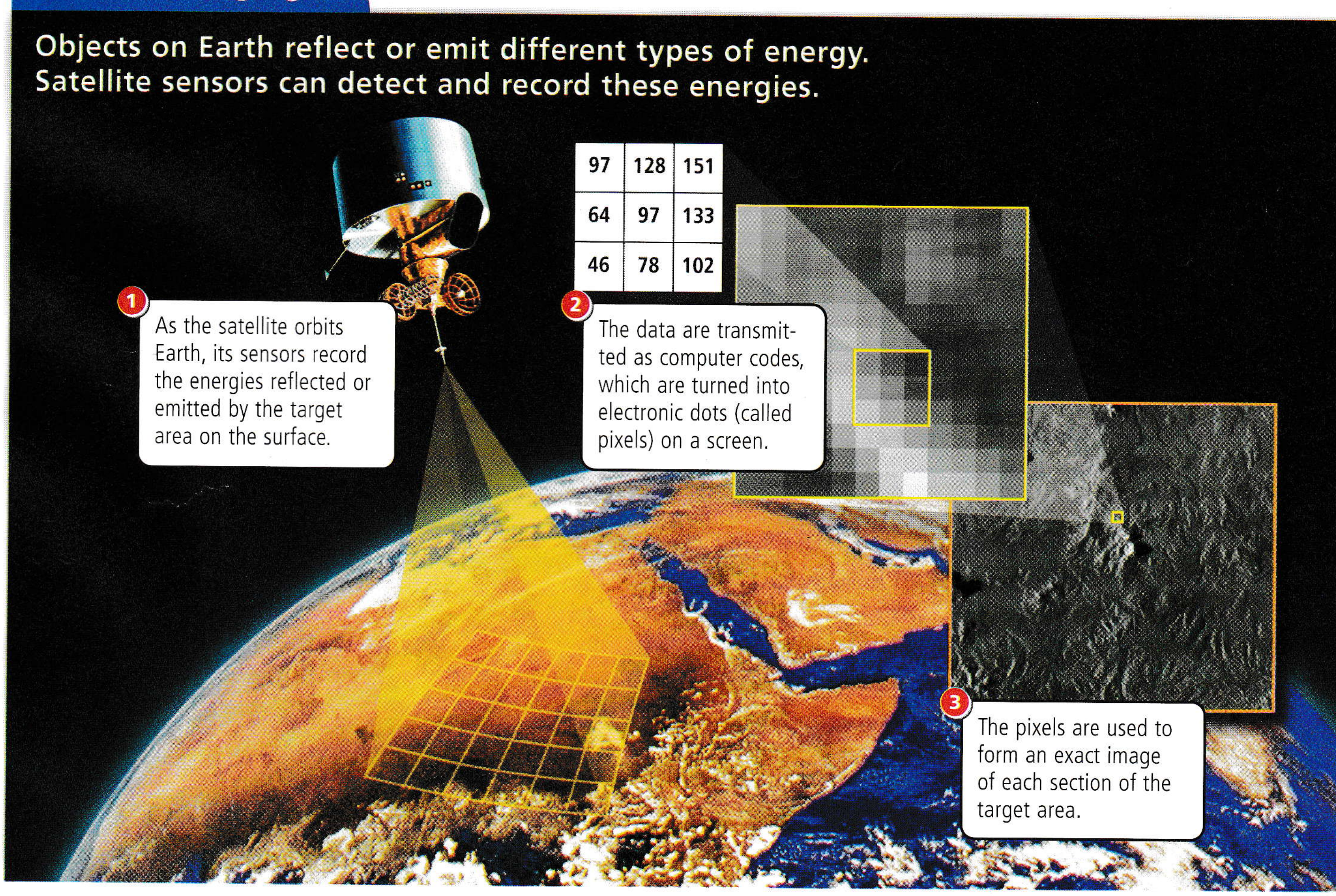
The computers turn the information into images, as shown in the illustration below. Satellite data can be used to build an image of the entire planet, a single continent, or a detail of your area. For example, the image on the right shows a closeup of the Jefferson Memorial in Washington, D.C.



This satellite image includes the Jefferson Memorial, walkways, and roads. See if you can find the memorial in the image on page 30.

CHECK YOUR READING Explain how remote sensing is used to gather information about Earth.

Satellite Imaging



Geographic information systems display data in layers.

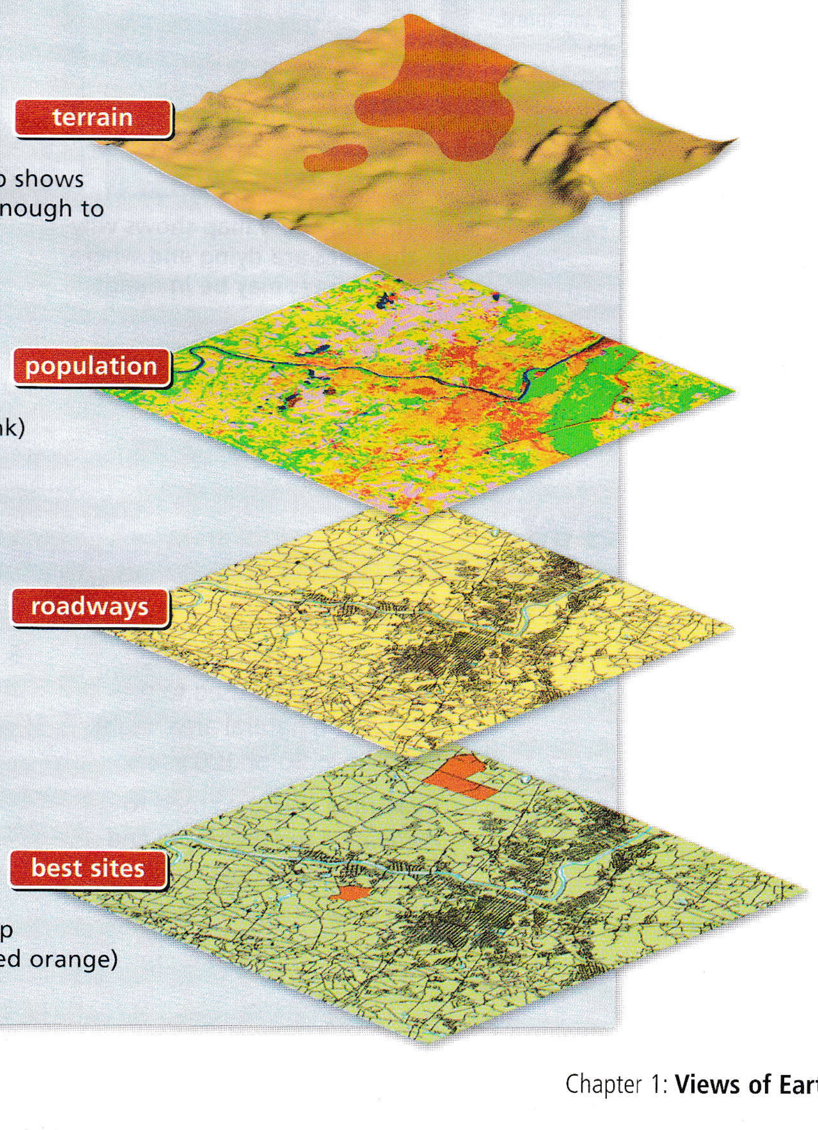
RESOURCE CENTER
CLASSZONE.COM
Find out more about how GIS is used.

Any good city map will show you what is on the surface—buildings, streets, parks, and other features. But suppose you need to know about tunnels under the city. Or maybe you want to know where the most students live. An ordinary map, even one based on remote-sensing images, will not tell you what you want to know.

Instead, you would turn to geographic information systems. **Geographic information systems** (GIS) are computer systems that can store and arrange geographic data and display the data in many different types of maps. Scientists, city planners, and engineers all use GIS maps to help them make decisions. For example, suppose your city wants to build a new airport. It must be away from populated areas and near major highways. The illustration below shows how city officials might use GIS to pick the best site.

Geographic Information Systems

GIS can be used to produce maps that help people make decisions.



City officials want to build a new airport. A terrain map shows areas (shaded orange) flat enough to land airplanes.

The airport must be built in one of the areas (shaded pink) with the fewest homes.

The airport must be easily reached by roadways (all areas have good roadways).

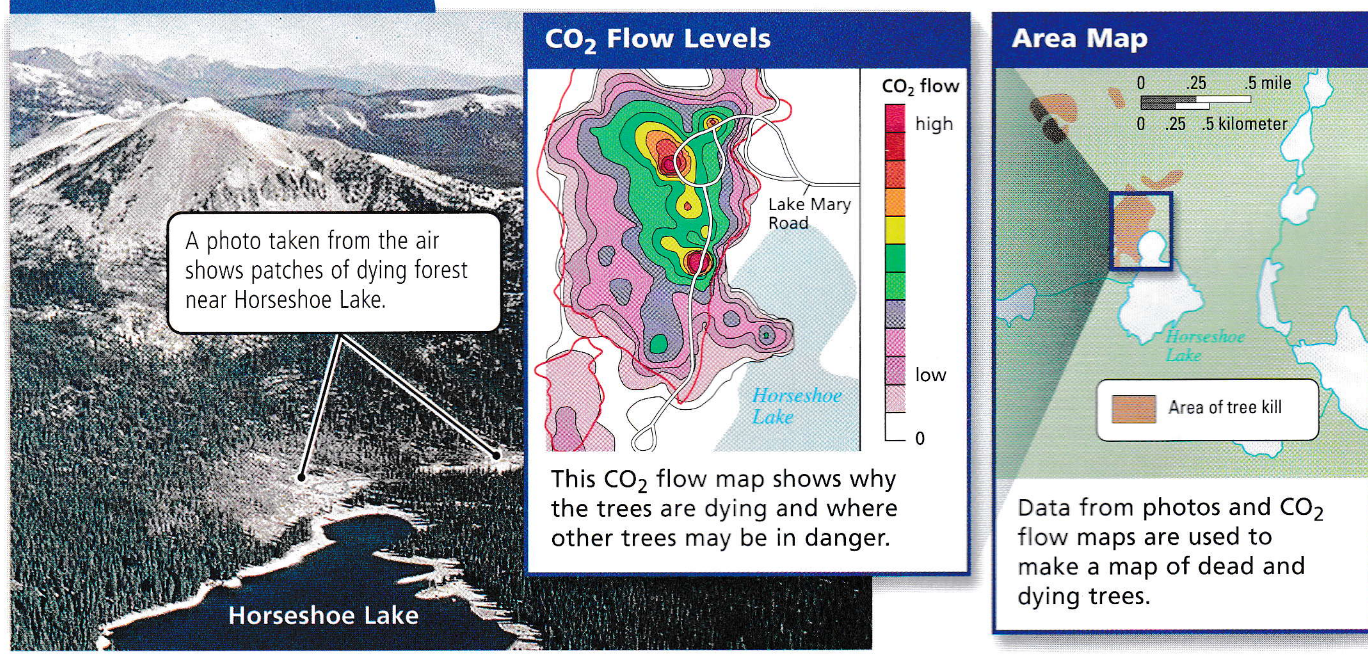
The data are combined by a computer to produce a map showing the best sites (shaded orange) for the airport.

Any geographic information can be entered into GIS and converted into a map. These systems are especially useful in displaying information about changes in the environment.

For example, near Long Valley in California, the volcano known as Mammoth Mountain began giving off carbon dioxide, or CO_2. As the gas rose through the soil, it began killing the roots of trees nearby. Scientists measured the flow of CO_2 around Horseshoe Lake and other areas. They used computer software to build the maps shown below.

CHECK YOUR READING Summarize the ways GIS maps can be helpful to engineers, city planners, and scientists.

Mammoth Mountain



This CO_2 flow map shows why the trees are dying and where other trees may be in danger.

Data from photos and CO_2 flow maps are used to make a map of dead and dying trees.

1.4 Review

KEY CONCEPTS

1. How are satellites used to make images of Earth from outer space?
2. What are some of the types of information obtained by remote sensing?
3. Explain in your own words what a GIS map is.

CRITICAL THINKING

4. **Infer** Explain how satellite images might be used to predict what a natural area might look like in 50 or 100 years.
5. **Evaluate** If you wanted to compare a region before and during a flood, how could false-color images help you?

CHALLENGE

6. **Analyze** Work with a small group. Suppose you wanted to ask the city to build a skateboard park. What types of information would you need in order to propose a good site? Draw a map to display each type of information.

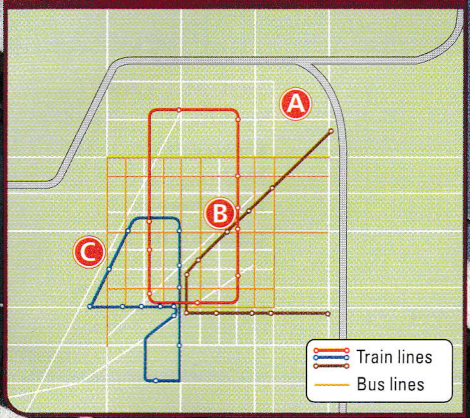
Think SCIENCE

SKILL: INTERPRETING DATA

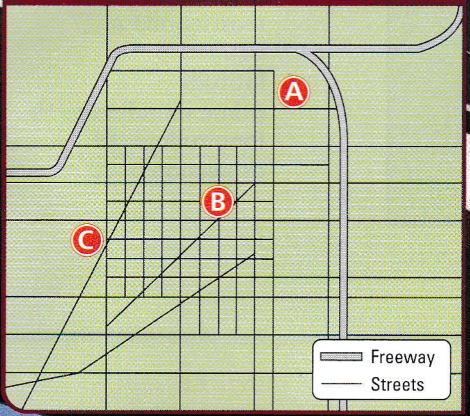
Which Site Is Best for an Olympic Stadium?

Imagine you live in a city that has been chosen to host the Summer Olympics. The only question is where to build the Olympic stadium—in the center of town, in the suburbs, or on the site of an old baseball park. The city government has developed maps to help them decide which is the best site. The planners know that thousands of people will come to see the games. Therefore, they reason, the stadium should be (1) easy to reach by car, (2) close to mass-transit stops, and (3) near restaurants and shops.

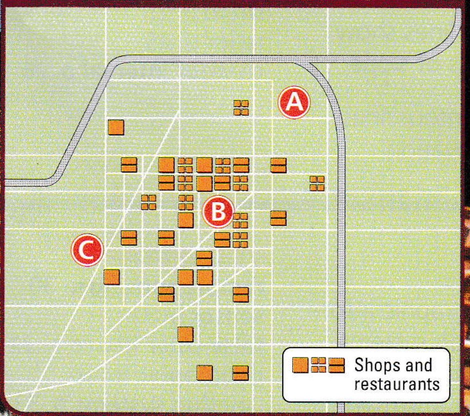
Trains and Bus Lines



Streets and Freeways



Restaurants and Shopping



Analyzing Map Data

As you study the maps, keep these requirements in mind.

1. Which site(s) is/are easiest to reach by car?
2. Which site(s) is/are closest to bus and train lines?
3. Which site(s) is/are close to shopping areas?

Interpreting Data

In your **Science Notebook,** create a chart like the one below to help you interpret the data displayed on the maps. As you fill in the chart, think about which site offers the greatest benefits to all the people who will attend the Olympic Games.

	Site A		Site B		Site C	
	Yes	No	Yes	No	Yes	No
Near mass transit						
Near highways and roads						
Near shopping areas						

As a group Choose the best site based on your interpretation of the data. Discuss your choice with other groups to see if they agree.

CHALLENGE Once the site is chosen, the planners will start building the stadium. What types of information about the site will they need? Sketch maps displaying the information. **Hint:** The stadium will need electricity, water, and delivery of supplies.

1 Chapter Review

the BIG idea

Modern technology has changed the way we view and map Earth.

CONTENT REVIEW
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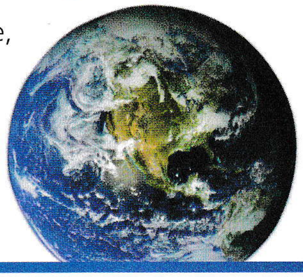
KEY CONCEPTS SUMMARY

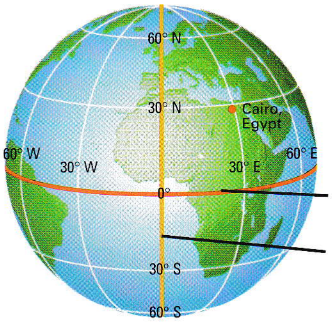
1 Technology is used to explore the Earth system.

The atmosphere, hydrosphere, biosphere, and geosphere work together to form one large system called Earth.



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

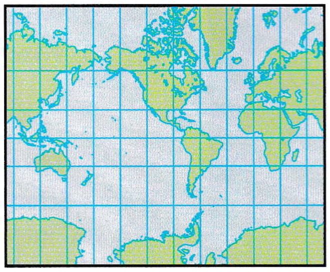
2 Maps and globes are models of Earth.



Latitude and longitude are used to locate any point on Earth.

equator

prime meridian



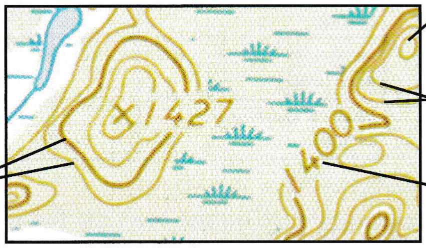
All map projections distort Earth's surface.

VOCABULARY
relief map p. 16
map scale p. 17
map legend p. 17
equator p. 18
latitude p. 18
prime meridian p. 19
longitude p. 19
projection p. 20

3 Topographic maps show the shape of the land.

Contour lines show elevation, slope, and relief.

Contour lines never cross.



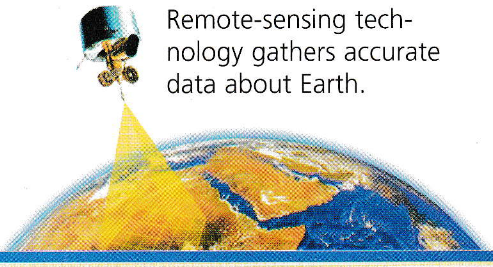
Closed circles represent hilltops.

Contour lines show steepness of slope.

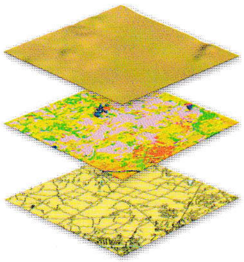
Index contour lines show elevation.

VOCABULARY
topography p. 24
contour line p. 25
elevation p. 25
slope p. 25
relief p. 25
contour interval p. 26

4 Technology is used to map Earth.



Remote-sensing technology gathers accurate data about Earth.



Geographic information systems are computer programs used to merge layers of information.

VOCABULARY
remote sensing p. 30
sensor p. 31
false-color image p. 32
geographic information systems p. 33

Reviewing Vocabulary

Copy and complete the chart below, using vocabulary terms from this chapter.

Term	Use	Appearance
map legend	*to explain map symbols*	*chart of symbols*
1. latitude	to show distance from the equator	
2. longitude		lines going from pole to pole
3.	to show land features	rippled and smooth areas
4. map scale	to represent distances	
5. equator		line at 0° latitude
6. prime meridian	to separate east and west hemispheres	
7.	to show height above sea level	line showing elevation
8. false-color image	to highlight information	

Reviewing Key Concepts

Multiple Choice *Choose the letter of the best answer.*

9. Which Greek prefix is matched with its correct meaning?

a. *hydro* = life **c.** *bio* = earth
b. *atmo* = gas **d.** *geo* = water

10. What portion of Earth is covered by water?

a. one-quarter **c.** three-quarters
b. one-half **d.** nine-tenths

11. The continents and ocean basins are part of Earth's

a. crust **c.** outer core
b. mantle **d.** inner core

12. Which Earth system includes humans?

a. atmosphere **c.** hydrosphere
b. biosphere **d.** geosphere

13. One way the atmosphere shapes Earth's surface is by

a. winds **c.** earthquakes
b. floods **d.** tunnels

14. How are the major parts of the Earth system related to each other?

a. They rarely can be studied together.
b. They often are in conflict.
c. They usually work independently.
d. They continually affect each other.

15. A flat map shows Earth's curved surface by means of

a. elevation **c.** relief
b. topography **d.** projection

16. People use latitude and longitude lines mostly to identify

a. map scales **c.** exact locations
b. country names **d.** distances

17. The most accurate way to show Earth's surface is a

a. globe **c.** cylindrical projection
b. conic projection **d.** planar projection

18. One example of remote sensing is the use of

a. contour lines **c.** GIS
b. projections **d.** binoculars

Short Answer *Write a few sentences to answer each question.*

19. How does the Global Positioning System work? In your answer use each of the following terms. Underline each term in your answer.

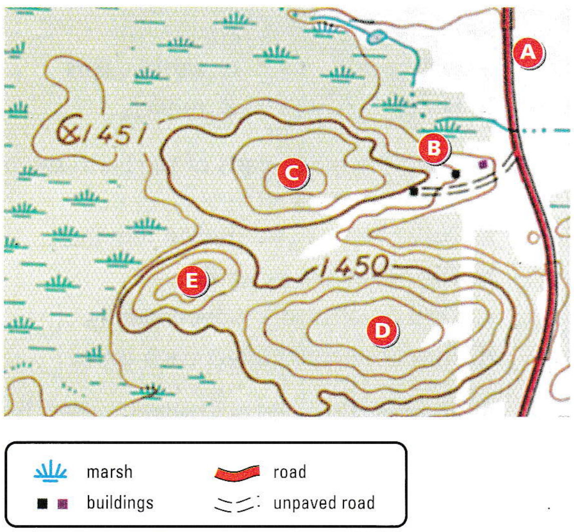
24 satellites	computer	longitude
receiver	latitude	elevation

20. How do Mercator maps distort the view of Earth's surface?

21. How do people use sensors in making maps?

Thinking Critically

Use the topographic map below to answer the next seven questions.



22. **APPLY** Imagine you are hiking through this area. Which hill—*C, D,* or *E*—has the steepest slope? How do you know?

23. **ANALYZE** What is the topography of the land through which the curved road *A* goes?

24. **IDENTIFY CAUSE** The squares at *B* represent buildings. Why do you think the buildings were placed here instead of somewhere else in the area?

25. **APPLY** The contour interval is 10 meters. What is the elevation of the highest point on the map?

26. **SYNTHESIZE** Sketch the two hills *D* and *E*. What would they look like to someone on the ground?

27. **INFER** Suppose someone wanted to build a road through the terrain on the far left side of the map. What are the advantages and disadvantages of such a route?

28. **EVALUATE** Do you think this area would be a good place to ride mountain bikes? Why or why not?

CHART INFORMATION *On a separate sheet of paper, write a word to fill each blank in the chart.*

Feature	Shown on Topographic Maps?	Belongs to Which Major System?
rivers	*yes*	*hydrosphere*
29. slope		
30. winds		
31. plants		
32. lakes		
33. relief		

the BIG idea

34. **APPLY** Look again at the photographs on pages 6–7. Now that you have finished the chapter, reread the question on the main photograph. What would you change in or add to your answer?

35. **SYNTHESIZE** Describe some of the types of information that new technology has provided about Earth.

36. **DRAW CONCLUSIONS** What type of technology do you think has done the most to change the way people view and map Earth? Explain your conclusion.

UNIT PROJECTS

If you are doing a unit project, make a folder for your project. Include in your folder a list of the resources you will need, the date on which the project is due, and a schedule to track your progress. Begin gathering data.

Standardized Test Practice

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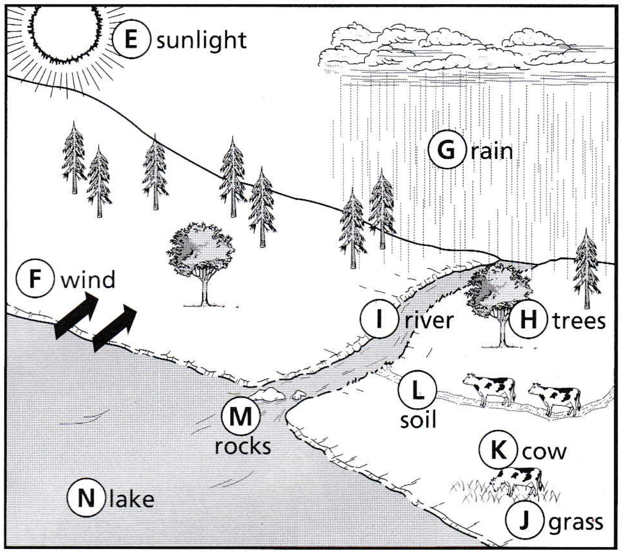
Analyzing a Diagram

This diagram shows the four major parts of the Earth system. Use it to answer the questions below.



1. Where is the main source of energy for the Earth system?

a. E **b.** F **c.** G **d.** L

2. Where is the biosphere shaping the geosphere?

a. E **b.** F **c.** L **d.** M

3. Where is matter moving from one part of the hydrosphere to another?

a. I to N **b.** G to H **c.** J to H **d.** N to M

4. Which items belong to the geosphere?

a. F and G **b.** H and J **c.** I and N **d.** M and L

5. Which process is occurring at M where water is running over the rocks?

a. The geosphere is shaping the atmosphere.
b. The atmosphere is shaping the biosphere.
c. The hydrosphere is shaping the geosphere.
d. The biosphere is shaping the geosphere.

6. Where is matter moving from the atmosphere to the biosphere?

a. E and F **b.** F and M **c.** G and H **d.** I and G

7. At K, the cow is eating grass. What kind of movement in the Earth system does this represent?

a. from the atmosphere to the hydrosphere
b. from the hydrosphere to the biosphere
c. between two parts of the geosphere
d. between two parts of the biosphere

8. Which is an example of how the hydrosphere is supported by the geosphere?

a. I, because the river receives the rain
b. H, because the trees are rooted in the ground
c. M, because the river drains into the lake
d. N, because the lake is contained by a basin

Extended Response

Answer the two questions below in detail. Include some of the terms shown in the word box. In your answers, underline each term you use.

geosphere	surface	system
atmosphere	hydrosphere	biosphere

9. Rain falls and soaks into the soil. Plants and animals use some of the water. More of the water drains into a river, then enters the ocean. Describe this process as movements among the major parts of the Earth system.

10. Describe an example of how people can shape the surface of the geosphere.