

This is a photograph of the Earth taken from space. What features of the Earth can you recognize from this photograph?

Learning Objectives

- Explain how the Earth moves through the solar system.
- Explain the theory of how and when the Earth was formed.
- Describe the features of the Earth.
- Identify the Earth's three layers.
- Compare rotation and revolution.
- Identify what causes the seasons.
- Explain longitude, latitude, and time zones.
- LAB ACTIVITY: Explore how the Earth's tilt causes the seasons.
- SCIENCE IN YOUR LIFE: Demonstrate how to use topographic maps.

Words to Know

solar system	the sun and all the planets and other objects that circle around it
orbit	a closed, curved path
continent	a large landmass
equator	an imaginary line that circles the Earth halfway between the North and South poles
core	the layer at the center of the Earth
mantle	the middle layer of the Earth
crust	the outer layer of the Earth
axis	an imaginary line that runs from one pole, through the center of the Earth, to the other pole
globe	a sphere, or ball, that has a map of the Earth on its surface
line of latitude	a line that circles a globe; runs east to west
line of longitude	a line that circles a globe; runs north to south
prime meridian	the 0-degree line of longitude

Words to Know

solar system the sun and all the planets and other objects that circle around it

orbit a closed, curved path

The Earth's Place in Space

Science Fact



The word *solar* means "sun." The solar system is the system of planets revolving around the sun.

The Earth is a planet in the **solar system**. The solar system is made up of the sun and all the planets and other objects that circle around it. The Earth moves in its own closed, curved path around the sun. This kind of path is called an **orbit**. The Earth is like a spaceship on a voyage around the sun.

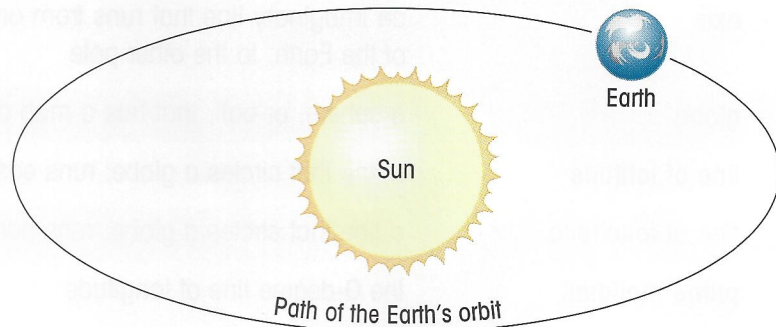


Figure 21-1 *The Earth's orbit is an oval, not a perfect circle.*

The Earth stays in orbit because of the strong pull of gravity from the sun. This pull keeps all the planets and objects of the solar system in their own orbits.

✓ How does the Earth move around the sun?

How the Earth Was Formed

Most scientists think that the Earth formed about 4.5 billion years ago. They think that the Earth and the rest of the solar system started off as a huge cloud of gas and dust. Over time, gravity drew the gas and dust particles together. Eventually, they formed the planets and the sun. The Earth is the third planet from the sun.

Remember

Gravity is the force of attraction between any two objects that have mass.

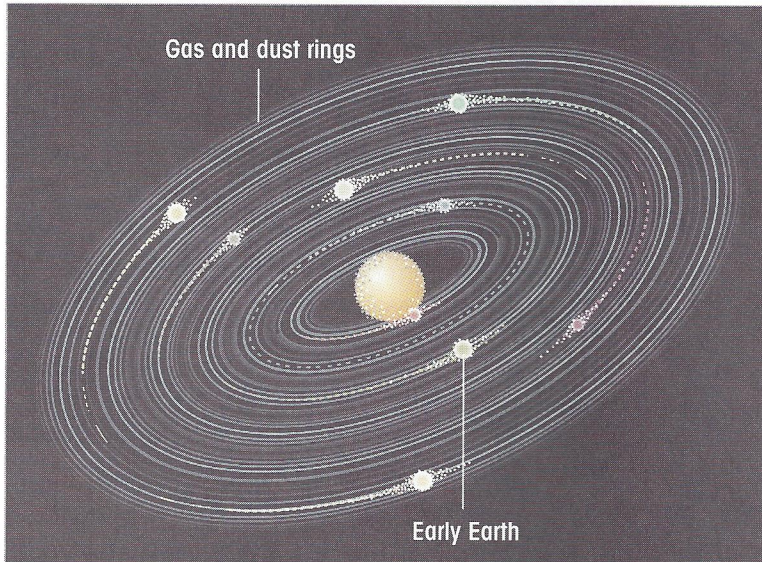


Figure 21-2 Most scientists believe that the Earth and the rest of the solar system were formed from gas and dust.

- ✓ How do most scientists think the Earth was formed?

Lesson Review

1. What is the solar system made up of?
2. How long ago do scientists think the Earth was formed?
3. What is the third planet from the sun?
4. **CRITICAL THINKING** Why don't the Earth and the other planets bump into one another as they move around the sun?

Words to Know

continent	a large landmass
equator	an imaginary line that circles the Earth halfway between the North and South poles
core	the layer at the center of the Earth
mantle	the middle layer of the Earth
crust	the thin, outer layer of the Earth
axis	an imaginary line that runs from one pole, through the center of the Earth, to the other pole



Science Fact

The color of ocean water varies from dark gray to blue and green. The color is caused partly because of microscopic organisms near the surface.

The Earth's Surface

Water

Seventy percent of the Earth's surface is covered with water. Water covers so much of our planet that it is sometimes called the "water planet." This is why the Earth appears blue from space.

There are four oceans, or seas, on Earth: the Arctic Ocean, the Atlantic Ocean, the Indian Ocean, and the Pacific Ocean. All of the oceans are made of salt water, and they are all connected. There are also rivers, streams, lakes, ponds, and large masses of ice on Earth. These are mostly made of fresh water.

Land

A **continent** is a large landmass. The Earth has seven continents: Africa, Antarctica, Asia, Australia, Europe, North America, and South America. Mountains, plains, deserts, and islands are found on or near the surface of the continents.

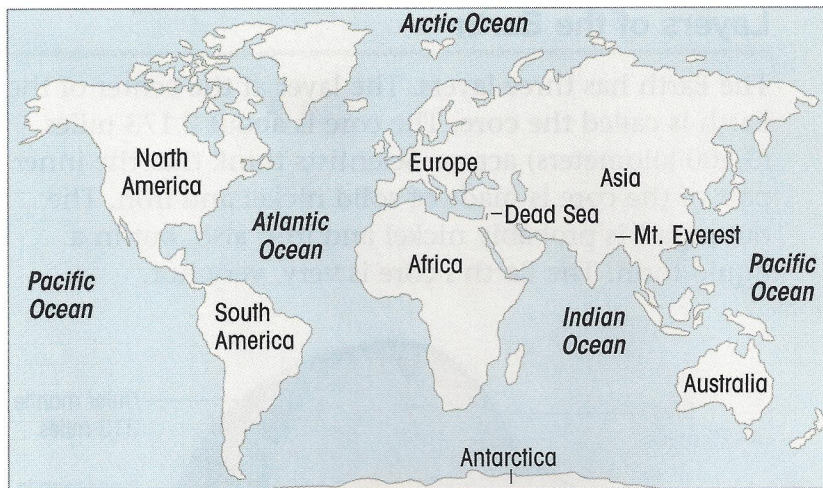


Figure 21-3 *The Earth has seven continents and four oceans.*

The highest point on Earth is at the top of Mount Everest. This mountain rises to a height of 29,028 feet (8,848 meters) above sea level. Mount Everest is on the border between Nepal and Tibet in Asia.

The lowest point of land on Earth's surface is the shore of the Dead Sea. It is 1,310 feet (almost 400 meters) below sea level. The Dead Sea is found between Israel and Jordan in the Middle East.

The Poles and the Equator

The northernmost part of the Earth is called the *North Pole*. The southernmost part is called the *South Pole*. An imaginary line circles the Earth halfway between the North and South poles. This line is called the **equator**.

The Earth is shaped like a ball. This ball shape is called a *sphere*. However, the Earth is not a perfect sphere. It is slightly squashed at the poles, and it bulges at the equator. A *diameter* is a straight line drawn through the center of a circle or a sphere. The Earth's diameter at the equator is 7,926 miles (12,753 kilometers). The diameter of the Earth from pole to pole is 7,899 miles (12,709 kilometers).



Science Fact

The circumference of the Earth, or distance around the Earth at the equator, is 24,901 miles (40,075 kilometers).

✓ What covers most of the Earth's surface?

Layers of the Earth

The Earth has three layers. The layer at the center of the Earth is called the **core**. The core is about 2,173 miles (3,500 kilometers) across. Scientists think that the inner part of the core is made of solid nickel and iron. The outer part is probably nickel and iron also, but in a liquid form. The Earth's core is very, very hot.

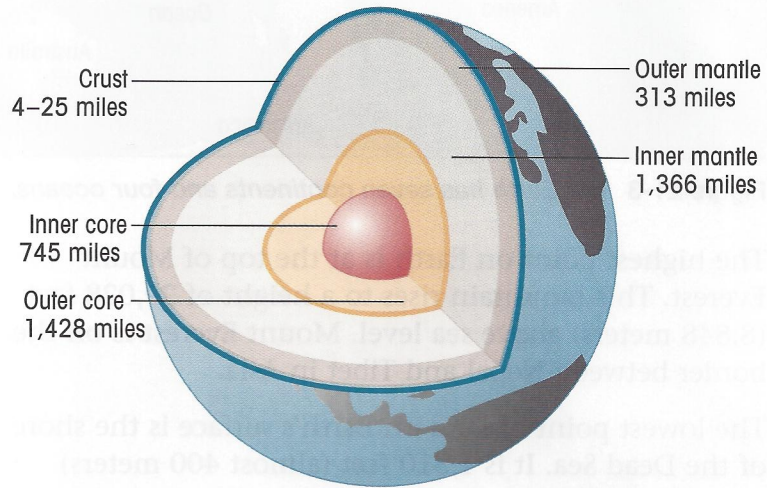


Figure 21-4 *The Earth has three layers: the core, the mantle, and the crust.*

The middle layer of the Earth is called the **mantle**. The mantle is about 1,700 miles (2,720 kilometers) thick. Most of it is made up of solid rock. The outer 93 miles (150 kilometers) of the mantle is more like thick molasses. It moves very slowly. The mantle is made of silicon, oxygen, aluminum, iron, and magnesium.

The outer layer of the Earth is the **crust**. The crust is very thin. In some places, it is only about 4 miles (6 kilometers) thick. In other places, it is about 25 miles (40 kilometers) thick. The continents and ocean floor are part of the Earth's crust, which is like a hard shell around the mantle.

Remember

Silicon, oxygen, aluminum, iron, and magnesium are elements. An element is a basic material out of which matter is made.

✓ What are the three layers of the Earth?

Movements of the Earth

The Earth moves in two ways. First, it orbits the sun. One full orbit around the sun is called a *revolution*. The Earth takes $365\frac{1}{4}$ days to revolve around the sun. That is one year.

As the Earth orbits the sun, it also spins like a top on its **axis**. The Earth's axis is an imaginary line. It runs from one pole, through the center of the Earth, to the other pole. The Earth makes one complete turn, or *rotation*, on its axis once a day, or every 24 hours.

The spinning of the Earth causes the cycle of day and night. The areas on Earth facing the sun have daylight. When those same areas are facing away from the sun, the light is blocked. So, that side of the Earth experiences night.

The Earth spins on its axis from west to east. This explains why the sun appears to rise in the east and to set in the west.

Remember
An orbit is a closed, curved path.

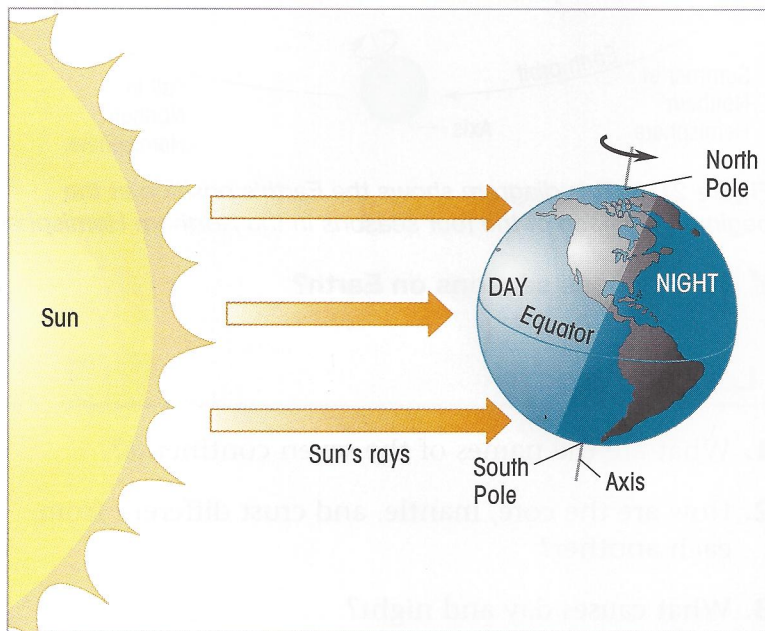


Figure 21-5 *The Earth revolves around the sun and rotates on its axis.*

✓ What are the two ways the Earth moves in space?

The Seasons

The four seasons result because the Earth is tilted on its axis. While one hemisphere is tilted toward the sun, the other is tilted away. As the Earth orbits the sun, the direction of the tilt changes. The number of daylight hours also changes. These differences cause the change of seasons.

It is winter in the hemisphere tilted away from the sun. This is because the sun's rays strike the Earth at more of an angle. There are also fewer hours of daylight. It is summer in the hemisphere tilted toward the sun. Here the sun's rays strike the Earth at less of an angle. There are also more hours of daylight.

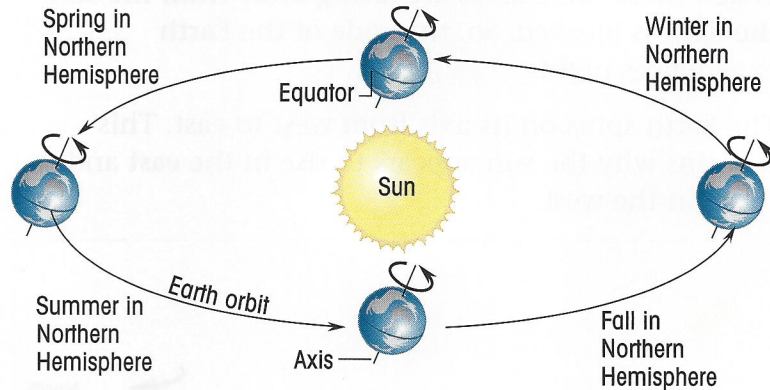


Figure 21-6 This diagram shows the Earth's position at the beginning of each of the four seasons in the Northern Hemisphere.

✓ What causes seasons on Earth?

Lesson Review

1. What are the names of the seven continents?
2. How are the core, mantle, and crust different from each another?
3. What causes day and night?
4. **CRITICAL THINKING** How would conditions on Earth be different if the Earth were not tilted on its axis?

Words to Know

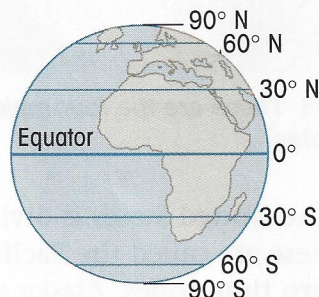
globe	a sphere, or ball, that has a map of the Earth on its surface
line of latitude	a line that circles a globe; runs east to west
line of longitude	a line that circles a globe; runs north to south
prime meridian	the 0-degree line of longitude

Lines of Latitude and Longitude

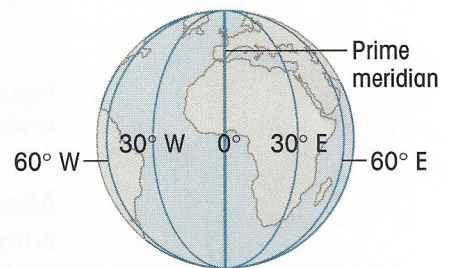
A **globe** is a sphere, or ball, that has a map of the Earth on its surface. Globes have lines running around them from east to west and north to south. These lines help people find different places and features on Earth.

A line that runs east to west is called a **line of latitude**. The equator is a line of latitude. A line that runs north to south is called a **line of longitude**. Lines of longitude run from the North Pole to the South Pole.

Lines of latitude and longitude are assigned numbers called *degrees*. Lines of latitude are measured in degrees north and south of the equator. The equator is at 0 degrees. It lies halfway between the poles. The North Pole is 90 degrees north latitude. The South Pole is 90 degrees south latitude.



Lines of Latitude



Lines of Longitude

Figure 21-7 All globes show lines of latitude and longitude.

The 0-degree line of longitude is called the **prime meridian**. It runs through Greenwich, England. The other lines of longitude are measured in degrees east and west of the prime meridian. Directly opposite the prime meridian is the 180-degree line of longitude.

✓ Why do globes have lines of latitude and longitude?

Time Zones Around the World

There are 24 time zones that have been set up around the world. A time zone is an area in which the same time is used. Each zone covers about 15 degrees of longitude. The time zones are like this because the Earth rotates 15 degrees of longitude in 1 hour.

The boundaries of the time zones are not always straight lines. They are drawn so that most states and small countries fit into one time zone.

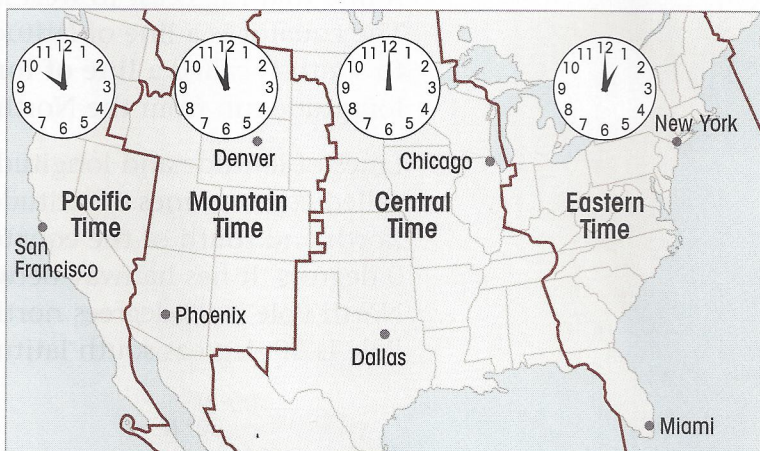


Figure 21-8 These are the four major time zones in the United States.

Most of the United States is divided into four time zones. These are called the Pacific, Mountain, Central, and Eastern time zones. Alaska and Hawaii are west of the Pacific zone, so they fall into different time zones.

Each time zone is one hour different from the ones on either side. If you travel east, you lose one hour as you cross into each new time zone. Going west, you gain one hour as you cross into each new time zone.

Suppose it is 7:00 A.M. in New York. New York is in the Eastern time zone. At that same moment, it would be 6:00 A.M. in Chicago (Central time zone), 5:00 A.M. in Salt Lake City (Mountain time zone), and 4:00 A.M. in Los Angeles (Pacific time zone).

✓ Why are there 24 time zones in the world?

Lesson Review

1. What is the difference between the prime meridian and the equator?
2. About how many degrees are covered by each time zone?
3. **CRITICAL THINKING** If it is 3:00 P.M. in the Eastern time zone, what time is it in the Mountain time zone?

Great Moments in Science

SETTING UP THE TIME ZONES

People used to set their clocks by the time the sun was highest in the sky at that place. So, the time from town to town was often different by a few minutes. This was very confusing for travelers.

In 1883, railroad companies made their railroad schedules simpler by creating four standard time zones in the United States. The next year, the International Meridian Conference set up the 24 worldwide time zones that we use today.

CRITICAL THINKING How might it be confusing not to have time zones? Give an example.



In 1883, railroad companies created standard time zones in the United States.



LAB ACTIVITY

Making a Model of the Seasons

BACKGROUND

A globe is a model of the Earth. It can help us understand things such as seasons, rotation, and tilt.

PURPOSE

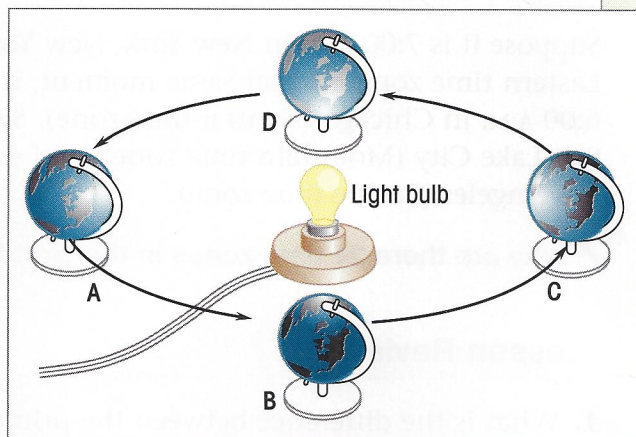
You will use a globe to see what causes the seasons.

MATERIALS

paper, pencil, 60-watt bulb and socket, globe

WHAT TO DO

1. Set the bulb and socket on a table. The bulb represents the sun. Copy the chart to the right.
2. Position the globe as shown in A in the diagram. The globe should be about a foot from the bulb. Turn on the bulb. Record what part of the globe is tilted away from the light. Record what season would occur in the northern part of the Earth in this position.
3. Position the globe as shown in C. Keep the same distance between the globe and bulb. Record what part of the globe is tilted away from the light in this position. Record what season would occur in the southern part of the Earth in this position.
4. Position the globe in position B and then D. What part of the globe is tilted away from the light in this position?



Position	Part of Globe Tilted Away From Light	Season
A		
C		

DRAW CONCLUSIONS

- Do the seasons change at the equator? Why or why not?
- What would happen to the seasons if the Earth were tilted more than it is?

SCIENCE IN YOUR LIFE

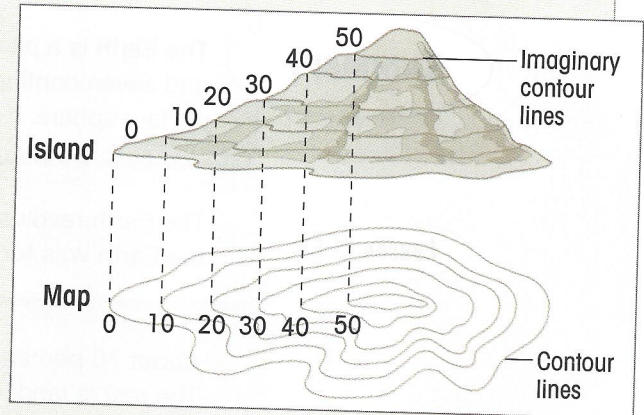
Topographic Maps

If you wanted to explore a natural area, it would be helpful to have a *topographic map*. Topographic maps show the shape and elevation of the Earth's surface. *Elevation* is how far above or below sea level a place is.

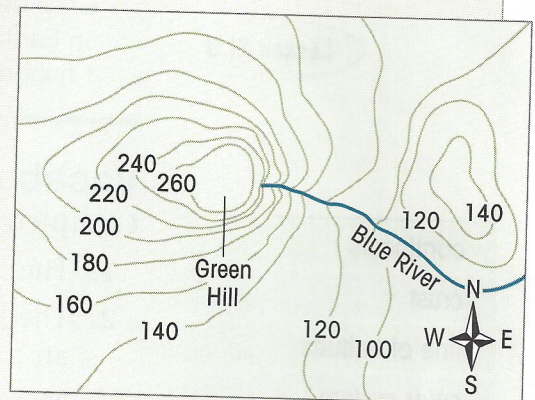
Topographic maps use *contour lines*. A contour line connects all points at the same elevation. The number shows feet above sea level. The drawing above shows an island and how that island looks on a topographic map. Notice how the imaginary contour lines on the island match up with the contour lines on the map. Points located on the 0-foot contour line are at sea level. Points on the 10-foot contour line are 10 feet above sea level. When contour lines are close together, that shows steep slopes. A series of closed loops shows a hill or mountain. Contour lines that form a V show a valley. The V points uphill.

Use the topographic map to the right to answer these questions.

1. How many hills are on the map?
2. Would it be easier to walk up Green Hill from the west or from the east? Why?
3. In which direction does the Blue River flow?



This shows how an island's different elevations would look on a topographic map.



Critical Thinking

How would a contour map help you if you were hiking?

Summary

The Earth is a planet in the solar system. It has four oceans and seven continents. It also has two poles. It is not a perfect sphere. It bulges at the equator.

Lesson 21.1

The Earth revolves around the sun. Most scientists believe the Earth was formed about 4.5 billion years ago.

Lesson 21.2

About 70 percent of the Earth is covered with water. The rest is land. The Earth's three layers are the core, the mantle, and the crust. The seasons are caused by the tilt of the Earth. The Earth takes one year to revolve around the sun and one day to rotate on its axis.

Lesson 21.3

Lines of latitude and longitude help people locate places on Earth. There are 24 time zones. Each time zone is 1 hour different from the ones next to it.

continents

crust

line of latitude

solar system

prime meridian

mantle

orbit

axis

Vocabulary Review

Complete each sentence with a term from the list.

1. The _____ includes the sun and all the planets.
2. The Earth moves in a closed, curved path called an _____.
3. The Earth has seven large landmasses called _____.
4. The _____ is the middle layer of the Earth.
5. The ocean floor is part of the Earth's _____.
6. The Earth's _____ is an imaginary line that runs from one pole through the Earth's center to the other pole.
7. A line that runs east to west on a globe is a _____.
8. The _____ is the 0-degree line of longitude.

Chapter Quiz

Write your answers on a separate sheet of paper.

1. What is the scientific theory for the formation of the Earth? About how long ago did the Earth form?
2. Why is the Earth sometimes called the “water planet”?
3. What are the three layers of the Earth? On which layer do you live?
4. How long does it take for the Earth to make one complete revolution around the sun?
5. What is the difference between the Earth’s rotation and its revolution?
6. Where is the equator located?
7. In what direction do lines of latitude run?
8. In what direction do lines of longitude run?
9. What is a time zone? What are the four major time zones in the United States?
10. If you cross time zones traveling east, how does time change?

Test Tip

Make sure you understand what each test question is asking. Read a question at least twice before you answer it.

Research Project

Doing exercise and using topographic maps are combined in a sport called orienteering. This sport has become quite popular both in the United States and around the world. Do some research to find out about orienteering. Answer these questions: What equipment is needed for orienteering? Who can participate? Are there orienteering clubs in your area?