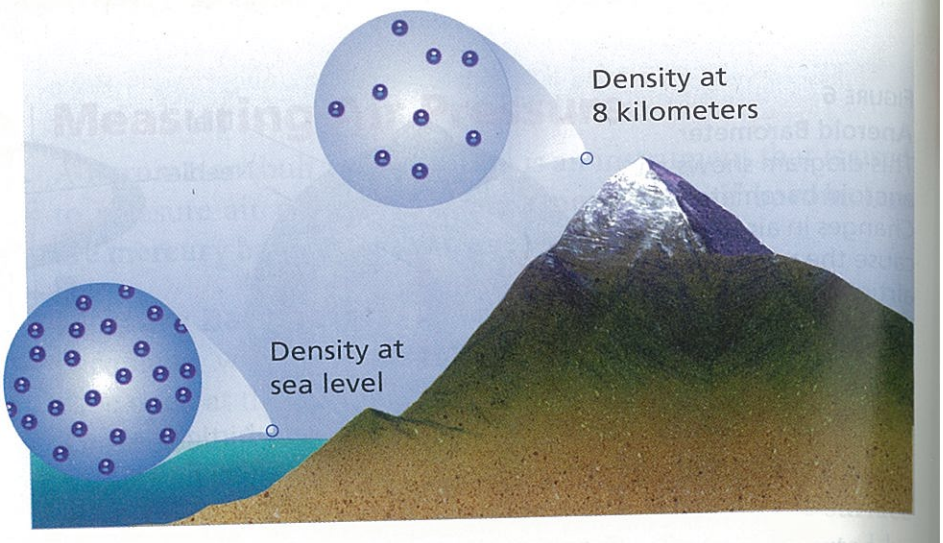


IGURE 8
ltitude and Density
he density of air decreases as ltitude increases. Air at sea level as more gas molecules in each ubic meter than air at the top of mountain.

Discovery CHANNEL SCHOOL

The Atmosphere

Video Preview
▶ Video Field Trip
Video Assessment

Altitude Also Affects Density As you go up through the atmosphere, the density of the air decreases. This means the gas molecules that make up the atmosphere are farther apart at high altitudes than they are at sea level. If you were near the top of a tall mountain and tried to run, you would quickly get out of breath. Why? The air contains 21 percent oxygen, whether you are at sea level or on top of a mountain. However, since the air is less dense at a high altitude, there are fewer oxygen molecules to breathe in each cubic meter of air than at sea level. So you would become short of breath quickly at high altitudes.

Reading Checkpoint **Why is it hard to breathe at the top of a mountain?**

Section 2 Assessment

Target Reading Skill **Identifying Main Ideas** Use your graphic organizer to help you answer Question 1 below.

Reviewing Key Concepts

1. a. **Defining** What is air pressure?
   b. **Explaining** How does increasing the density of a gas affect its pressure?
2. a. **Listing** What two instruments are commonly used to measure air pressure?
   b. **Measuring** What units are commonly used to measure air pressure?
   c. **Calculating** How many millibars are equal to 27.23 inches of mercury?
3. a. **Defining** What is altitude?
   b. **Relating Cause and Effect** As altitude increases, how does air pressure change? How does density change?
   c. **Predicting** What changes in air pressure would you expect if you carried a barometer down a mine shaft?

Lab zone **At-Home Activity**

Model Air Pressure Here's how you can show your family that air has pressure. Fill a glass with water. Place a piece of cardboard over the top of the glass. Hold the cardboard in place with one hand as you turn the glass upside down. **CAUTION:** *Be sure the cardboard does not bend.* Now remove your hand from the cardboard. What happens? Explain to your family that the cardboard doesn't fall because the air pressure pushing up on it is greater than the weight of the water pushing down.

Section 3

Layers of the Atmosphere

Reading Preview

Key Concepts

- What are the four main layers of the atmosphere?
- What are the characteristics of each layer?

Key Terms

- troposphere
- stratosphere
- mesosphere
- thermosphere
- ionosphere
- exosphere

Target Reading Skill

Previewing Visuals Before you read this section, preview Figure 9. Then write at least two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

Layers of the Atmosphere

Q. Where is the ozone layer?
A.
Q.

Lab zone Discover Activity

Is Air There?

1. Use a heavy rubber band to tightly secure a plastic bag over the top of a wide-mouthed jar.
2. Gently try to push the bag into the jar. What happens? Is the air pressure higher inside or outside the bag?
3. Remove the rubber band and line the inside of the jar with the plastic bag. Use the rubber band to tightly secure the edges of the bag over the rim of the jar.
4. Gently try to pull the bag out of the jar with your fingertips. What happens? Is the air pressure higher inside or outside the bag?

Think It Over

Predicting Explain your observations in terms of air pressure. How do you think differences in air pressure would affect a balloon as it traveled up through the atmosphere?

Imagine taking a trip upward into the atmosphere in a hot-air balloon. You begin on a warm beach near the ocean, at an altitude of 0 kilometers above sea level.

You hear a roar as the balloon's pilot turns up the burner to heat the air in the balloon. The balloon begins to rise, and Earth's surface gets farther and farther away. As the balloon rises to an altitude of 3 kilometers, you realize that the air is getting colder. As you continue to rise, the air gets colder still. At 6 kilometers you begin to have trouble breathing. The air is becoming less dense. It's time to go back down.

What if you could have continued your balloon ride up through the atmosphere? As you rose higher, the air pressure and temperature would change dramatically.

Scientists divide Earth's atmosphere into four main layers classified according to changes in temperature. These layers are the troposphere, the stratosphere, the mesosphere, and the thermosphere. The four main layers of the atmosphere are shown in Figure 9. Read on to learn more about each of these layers.

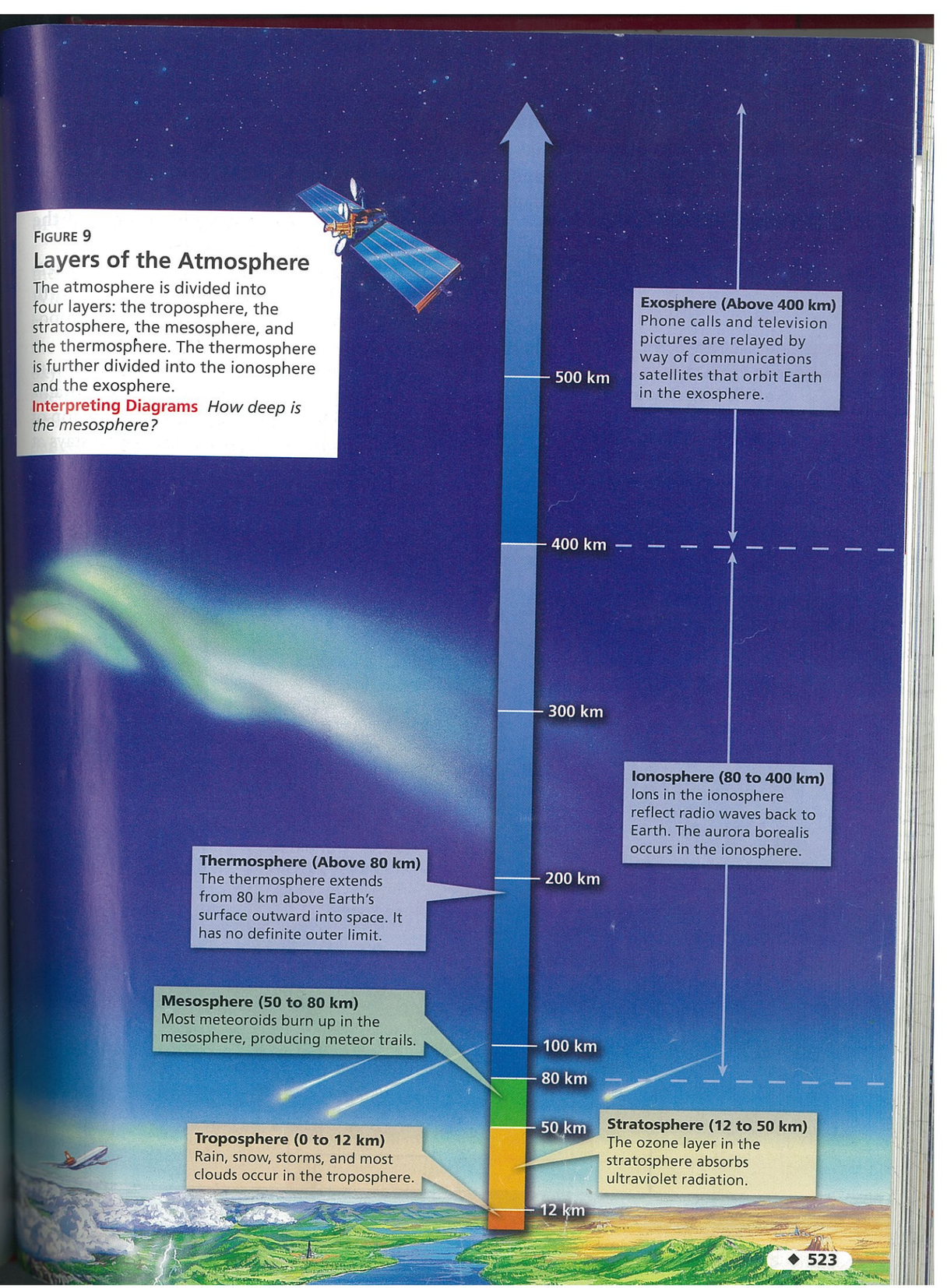
▲ Hot-air balloon

FIGURE 9

Layers of the Atmosphere

The atmosphere is divided into four layers: the troposphere, the stratosphere, the mesosphere, and the thermosphere. The thermosphere is further divided into the ionosphere and the exosphere.

Interpreting Diagrams *How deep is the mesosphere?*



ath Analyzing Data

anging Temperatures

graph shows how temperatures in the nosphere change with altitude. Use it answer the questions below.

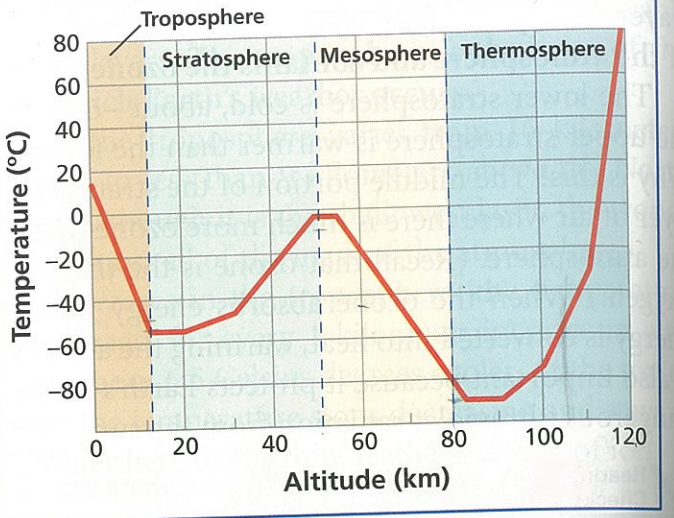
Reading Graphs What two variables are being graphed? In what unit is each measured?

Reading Graphs What is the temperature at the bottom of the stratosphere?

Interpreting Data Which layer of the atmosphere has the lowest temperature?

Making Generalizations Describe how temperature changes as altitude increases in the troposphere.

Temperature in the Atmosphere



The Mesosphere

Above the stratosphere, a drop in temperature marks the beginning of the next layer, the **mesosphere.** *Meso-* means "middle," so the mesosphere is the middle layer of the atmosphere. The mesosphere begins 50 kilometers above Earth's surface and ends at an altitude of 80 kilometers. In the outer mesosphere, temperatures approach −90°C.

The mesosphere is the layer of the atmosphere that protects Earth's surface from being hit by most meteoroids. Meteoroids are chunks of stone and metal from space. What you see as a shooting star, or meteor, is the trail of hot, glowing gases the meteoroid leaves behind in the mesosphere.

The Thermosphere

Near the top of the atmosphere, the air is very thin. At 80 kilometers above Earth's surface, the air is only about 0.001 percent as dense as the air at sea level. It's as though you took a cubic meter of air at sea level and expanded it into 100,000 cubic meters at the top of the mesosphere. **The outermost layer of Earth's atmosphere is the thermosphere.** The **thermosphere** extends from 80 kilometers above Earth's surface outward into space. It has no definite outer limit, but blends gradually with outer space.

The *thermo-* in thermosphere means "heat." Even though the air in the thermosphere is thin, it is very hot, up to 1,800°C. This is because sunlight strikes the thermosphere first. Nitrogen and oxygen molecules convert this energy into heat.