Earth's Atmosphere

Describing Earth's Atmosphere

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	1. Air is empty space.	
	2. Earth's atmosphere is important to living organisms.	

Read to Learn

Importance of Earth's Atmosphere

The **atmosphere** (AT muh sfihr) *is a thin layer of gases surrounding Earth*. Earth's atmosphere is hundreds of kilometers high. However, when compared to Earth's size, the atmosphere is about as thick as an apple's skin is to an apple.

The atmosphere contains the oxygen, carbon dioxide, and water that all life on Earth needs. Earth's atmosphere also acts like insulation in a house. The atmosphere helps keep temperatures within a range in which living organisms can survive.

Without an atmosphere, Earth's temperatures would vary greatly. Daytime temperatures would be very high, and nighttime temperatures would be very low.

Earth's atmosphere helps protect living organisms from some of the Sun's harmful rays. The atmosphere also helps protect Earth's surface from being struck by meteors. Most meteors that fall toward Earth enter the atmosphere and burn up before reaching Earth's surface. Friction with the atmosphere causes them to burn. Only the largest meteors strike Earth.

Key Concepts

- How did Earth's atmosphere form?
- What is Earth's atmosphere made of?
- What are the layers of the atmosphere?
- How do air pressure and temperature change as altitude increases?

Mark the Text

Identify Main Ideas To help you learn about Earth's atmosphere, highlight each heading. Then highlight the details that support and explain it. Use this highlighted text to review the lesson.

Reading Check

1. Explain Why is Earth's atmosphere important to life on Earth?

Reading Check

2. Explain How did Earth's ancient atmosphere form?

Review Vocabulary

liquid
matter with a definite volume but no definite shape that can flow from one place to another

Key Concept Check

3. Explain How did Earth's present atmosphere form? (Circle the correct answer.)

a. from molten rock

b. from photosynthesis

c. from ancient volcanoes

Origins of Earth's Atmosphere

When Earth formed, it was a ball of molten rock. As Earth slowly cooled, its outer surface hardened. Erupting volcanoes released hot gases from inside Earth. These gases surrounded Earth, forming an atmosphere.

Ancient Earth's atmosphere was mainly water vapor with a little carbon dioxide (CO_2) and nitrogen. **Water vapor** *is water in its gaseous form*. Earth's ancient atmosphere did not have enough oxygen to support life as we know it. As Earth and its atmosphere continued to cool, the water vapor condensed into a liquid. Rain fell and then evaporated from Earth's surface over and over again for thousands of years. Oceans began to form as more and more water accumulated on Earth's surface. Most of the CO_2 from Earth's early atmosphere that dissolved in rain is in rocks on the ocean floor. Today, the atmosphere has more nitrogen than CO_2.

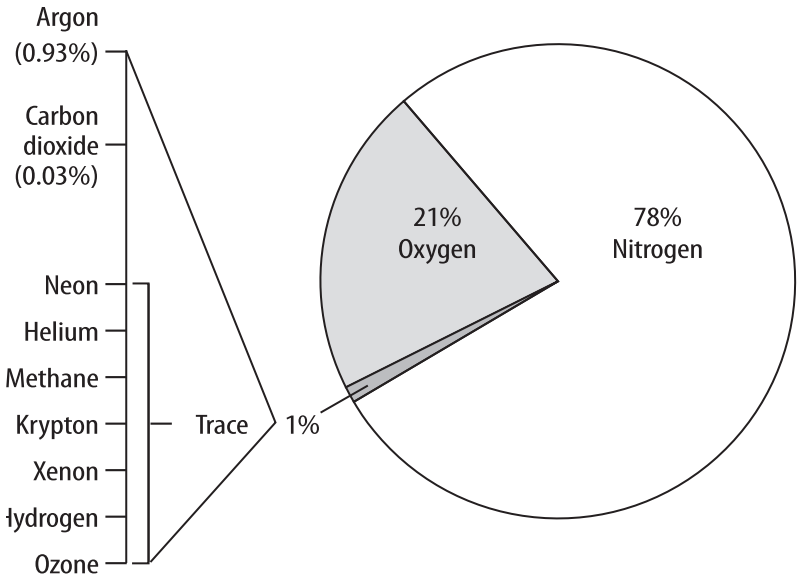
Earth's first organisms could undergo photosynthesis. This changed the atmosphere. Recall that photosynthesis is a process that uses light energy to produce sugar and oxygen from CO_2 and water. Organisms that used photosynthesis removed CO_2 from the atmosphere and released oxygen. After a time, levels of CO_2 and oxygen in the atmosphere supported the development of other organisms.

Composition of the Atmosphere

Today's atmosphere is mostly made up of invisible gases with some solid and liquid particles. The gases include nitrogen, oxygen, and carbon dioxide. Some of the solid and liquid particles include ash from erupting volcanoes and water droplets.

Gases in the Atmosphere

The graph on the next page shows the gases in Earth's atmosphere. About 78 percent of Earth's atmosphere is made up of nitrogen. Oxygen makes up about 21 percent of Earth's atmosphere. Other gases, including argon, carbon dioxide, and water vapor, make up the remaining 1 percent of the atmosphere.



The concentrations, or amounts, of water vapor, carbon dioxide, and ozone vary. Concentrations can be different in different locations. The concentration of water vapor, for example, can be as little as 0 percent or as much as 4 percent. Carbon dioxide currently makes up 0.038 percent of the atmosphere. Ozone is a gas found in very small amounts at very high altitudes. Ozone also occurs near Earth's surface in urban areas.

Solids and Liquids in the Atmosphere

Earth's atmosphere also contains tiny solid particles. Many of these solids, such as pollen, dust, salt, and volcanic ash, enter the atmosphere through natural processes. Some solid particles enter Earth's atmosphere as the result of human activities, such as driving vehicles that exhaust soot.

Water droplets are the most common liquid particles in Earth's atmosphere. They are microscopic but visible when they form clouds. Other liquids include acids given off by erupting volcanoes and by the burning of fossil fuels. Sulfur dioxide and nitrous oxide combine with water vapor in the air and form the acids.

Visual Check

4. Read a Graph What percent of the atmosphere is made up of oxygen and nitrogen?

_____

Think it Over

5. Calculate Use the graph to add up the percentages of different gases in Earth's atmosphere. What is the total? Why?

_____

_____

_____

_____

Key Concept Check

6. State What is Earth's atmosphere made of?

_____

_____

_____

_____

Layers of the Atmosphere

Earth's atmosphere has five different layers, as shown in the figure below. Each layer has unique properties, including the gases that make up the layer and how temperature changes with altitude. Notice that the scale between 0–100 km is not the same as from 100–700 km.

Troposphere

The atmospheric layer closest to Earth's surface is called the **troposphere** (TRO puh sfihr). The troposphere extends from Earth's surface to a height of about 8–15 km. Most people spend their whole lives within the troposphere. The name comes from the Greek word *tropos,* which means "change." The temperature in the troposphere decreases as you move away from Earth. The warmest part of the troposphere is found near Earth's surface. This is because most sunlight passes through the atmosphere and warms Earth's surface. The warmth radiates to the troposphere, causing weather.

Reading Check

7. Identify How many layers are in Earth's atmosphere?

Reading Check

8. Describe the troposphere.

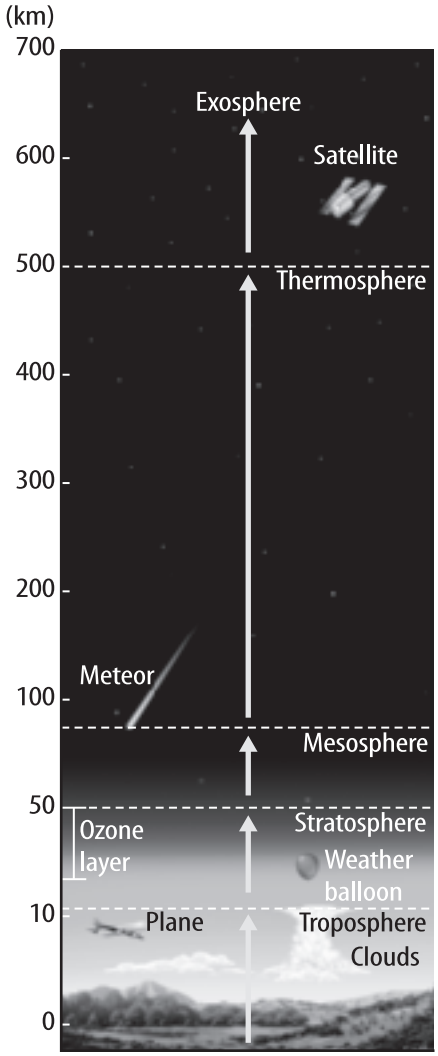
Visual Check

9. Identify In which layer of the atmosphere do planes fly? (Circle the correct answer.)

a. mesosphere

b. stratosphere

c. troposphere



Stratosphere

The atmospheric layer directly above the troposphere is the **stratosphere** (STRA tuh sfihr). **The stratosphere extends from about 15 km to about 50 km above Earth's surface. The bottom half of the stratosphere contains the highest concentration of ozone gas.** *The area of the stratosphere with a high concentration of ozone is often referred to as the* **ozone layer.** **The ozone layer causes temperatures in the stratosphere to increase as altitude increases.**

An ozone (O_3) molecule is not the same as a molecule of the oxygen gas (O_2) that you breathe. Ozone has three oxygen atoms instead of two. This small difference is important. Ozone absorbs the Sun's ultraviolet rays more effectively than oxygen does. Ozone protects Earth from ultraviolet rays. Ultraviolet rays can kill plants, animals, and other organisms and they can cause skin cancers in humans.

Mesosphere and Thermosphere

The mesosphere extends from the stratosphere to about 85 km above Earth. Directly above the mesosphere is the thermosphere. The thermosphere can extend to more than 500 km above Earth. Combined, the mesosphere and the thermosphere are much broader than the troposphere and the stratosphere. However, only about 1 percent of the atmosphere's gas molecules are found in the mesosphere and the thermosphere. Most meteors burn up in these layers instead of striking Earth.

The Ionosphere *The* **ionosphere** *is a region within the mesosphere and thermosphere that contains ions*. **Between 60 km and 500 km above Earth's surface, the ions in the ionosphere reflect AM radio waves transmitted from Earth. After sunset, when ions recombine, this reflection increases.**

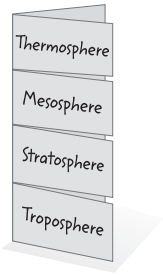
Auroras **Displays of colored lights, called auroras, occur in the ionosphere. Auroras occur when ions from the Sun strike air molecules, causing them to give off bright colors of light. People who live in the higher latitudes, nearer to the North Pole and South Pole, are most likely to see auroras.**

Exosphere

The exosphere is the atmospheric layer farthest from Earth's surface. Pressure and density are so low in the exosphere that individual gas molecules rarely strike one another. The molecules move at fast speeds after absorbing the Sun's radiation. These molecules can escape the pull of gravity and travel into space.

10. Describe Why is the stratosphere important to Earth?

Make a vertical four-tab book to record similarities and differences among these four layers of the atmosphere.



Key Concept Check

11. Name What are the layers of the atmosphere?

Air Pressure and Altitude

Gravity is the force that pulls all objects toward Earth. When you stand on a scale, you can read your weight. This is because gravity pulls you toward Earth. Gravity also pulls the atmosphere toward Earth. The pressure that a column of air exerts on anything below it is called air pressure. Gravity's pull on air increases its density. At higher altitudes, air is less dense. Air pressure is greatest near Earth's surface because the air molecules are closer together. This dense air exerts more force than the less-dense air near the top of the atmosphere. Mountain climbers sometimes carry oxygen tanks at high altitudes because fewer oxygen molecules are in the air at high altitudes.

Reading Check

12. Explain How does air pressure change as altitude increases?

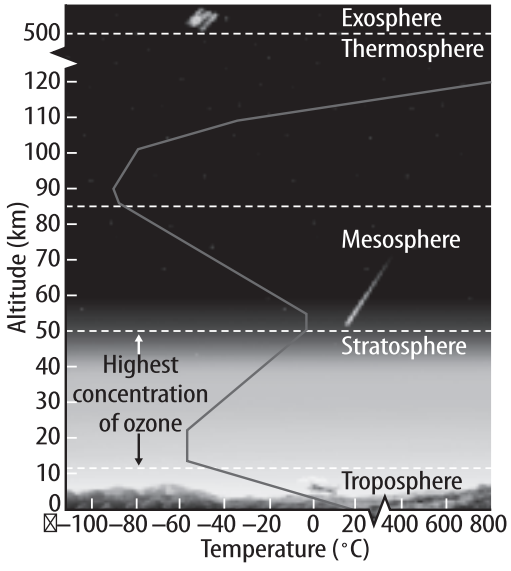
Temperature and Altitude

The figure below shows how temperature changes with altitude in different layers of the atmosphere. If you have ever been hiking in the mountains, you know that the temperature cools as you reach higher elevations. In the troposphere, temperature decreases as altitude increases. Notice that the opposite is true in the stratosphere. As altitude increases in the stratosphere, the temperature increases. This happens because of high amounts of ozone in the stratosphere. Ozone absorbs energy from sunlight, which increases the temperature in the stratosphere.

In the mesosphere, as altitude increases, the temperature again decreases. In the thermosphere and exosphere, temperatures increase as altitude increases. The small number of particles in these layers absorbs large amounts of energy from the Sun. This creates high temperatures.

Key Concept Check

13. Explain How does temperature change as altitude increases?



Visual Check

14. Identify Which layer has a temperature pattern most like the troposphere's?

Mini Glossary

atmosphere (AT muh sfihr): a thin layer of gases surrounding Earth

ionosphere: the region within the mesosphere and thermosphere containing ions

ozone layer: the area of the stratosphere with a high concentration of ozone

stratosphere (STRA tuh sfihr): the atmospheric layer directly above the troposphere

troposphere (TRO puh sfihr): the atmospheric layer closest to Earth's surface

water vapor: water in a gaseous form

1. **Review the terms and their definitions in the Mini Glossary. Write a sentence explaining why the ionosphere has that name.**

2. **Use what you have learned about the layers of Earth's atmosphere to complete the table.**

Layer	Two Characteristics of the Layer
Troposphere	• •
Stratosphere	• •
Mesosphere	• •
Thermosphere	• •
Exosphere	• •

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

ConnectED

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON

Name _____ Date _____

Earth's Atmosphere

How does Earth's atmosphere affect life on Earth?

Before You Read

Before you read the chapter, think about what you know about Earth's atmosphere. Record your thoughts in the first column. Pair with a partner, and discuss his or her thoughts. Write those thoughts in the second column. Then record what you both would like to share with the class in the third column.

Think	Pair	Share

Chapter Vocabulary

Lesson 1	Lesson 2	Lesson 3	Lesson 4
NEW atmosphere water vapor troposphere stratosphere ozone layer ionosphere **REVIEW** liquid	**NEW** radiation conduction convection stability temperature inversion **ACADEMIC** process	**NEW** wind trade winds westerlies polar easterlies jet stream sea breeze land breeze	**NEW** air pollution acid precipitation photochemical smog particulate matter

Lesson 1 Describing Earth's Atmosphere

Scan *Lesson 1. Read the lesson titles and bold words. Look at the pictures. Identify three facts that you discover about Earth's atmosphere. Record these facts in your Science Journal.*

Main Idea

Importance of Earth's Atmosphere

I found this on page _____.

Details

Define atmosphere, *and identify four things the* atmosphere *does for Earth.*

Atmosphere: _____

_____

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

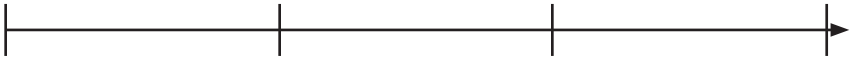
_____

Origins of Earth's Atmosphere

I found this on page _____.

Write *the number of each event on the time line to describe how Earth's* atmosphere *changed over time.*

1. Photosynthetic organisms remove carbon dioxide from the air and release oxygen.
2. Water vapor cools and condenses. Rain falls, evaporates, and eventually accumulates in oceans.
3. Atmosphere contains present levels of carbon dioxide, oxygen, nitrogen, and other gases.
4. Atmosphere is mainly water vapor with a little carbon dioxide and nitrogen.



Early atmosphere **Present time**

Main Idea

Composition of the Atmosphere

I found this on page _____.

I found this on page _____.

I found this on page _____.

Details

Assess *information about the* atmosphere. *Read each statement below. If the statement is true, write* true *on the line. If the statement is false, write* false *on the line and rewrite the underlined portion so that it is true.*

Earth's atmosphere is mostly made of <u>visible</u> gases, including nitrogen, oxygen, and carbon dioxide.

_____

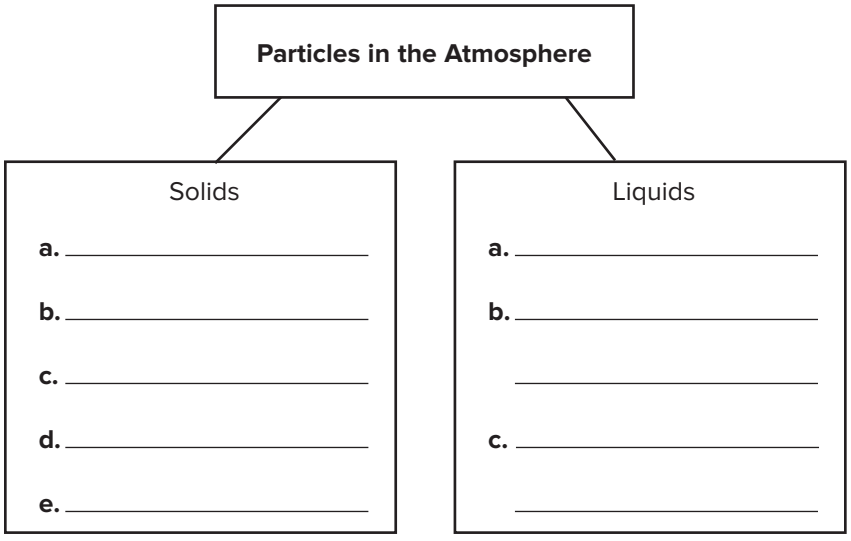
<u>Solid</u> and liquid particles are also present in the atmosphere.

_____

Identify *the gases that make up Earth's* atmosphere.

Gases in the Atmosphere	
Percent	**Gas**
78	
21	
1	**a.** **b.** **c.** **d.**

Identify *solid and liquid particles in the* atmosphere.



Main Idea

Layers of the Atmosphere

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

I found this on page _____.

Details

Describe *the layers of the* atmosphere. *First, list the layers in order from the surface to space. Identify the height of each layer. Then describe each layer.*

Layers of the Atmosphere	
Layer and Height above Earth's Surface	**Description**
_____ above 500 km	
Thermosphere	
_____ extends from about 50 km to about 85 km	
Stratosphere	
_____ from the surface to a height of 8–15 km	

Distinguish ozone *from oxygen.*

Ozone	Oxygen

Main Idea

I found this on page _____.

I found this on page _____.

Air Pressure and Altitude

I found this on page _____.

Temperature and Altitude

I found this on page _____.

Details

Identify *the 2 layers of the* atmosphere *that contain the* ionosphere.

1. _____ **2.** _____

Explain, *in your own words, how auroras form in the* ionosphere.

_____

_____

_____

_____

Describe *the relationship between altitude and air pressure.*

As altitude _____, air pressure _____.

Identify *the changes in temperature and altitude in the different layers of the* atmosphere.

Layer of the Atmosphere	Altitude	Temperature
Troposphere	↑ increases	
Stratosphere	↑ increases	
Mesosphere	↑ increases	
Thermosphere	↑ increases	
Exosphere	↑ increases	

Connect It Suppose that you move from a town near the ocean to a town in the mountains. To what atmospheric changes would your body need to adjust?

_____

_____

_____

_____

_____

_____