Name _____ Class _____ Date _____

CHAPTER 15 The Atmosphere

SECTION 1

Characteristics of the Atmosphere

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is Earth's atmosphere made of?
- How do air pressure and temperature change as you move away from Earth's surface?
- What are the layers of the atmosphere?

National Science Education Standards
ES 1h

What Is Earth's Atmosphere Made Of?

An **atmosphere** is a layer of gases that surrounds a planet or moon. On Earth, the atmosphere is often called just "the air." When you take a breath of air, you are breathing in atmosphere.

The air you breathe is made of many different things. Almost 80% of it is nitrogen gas. The rest is mostly oxygen, the gas we need to live. There is also water in the atmosphere. Some of it is invisible, in the form of a gas called *water vapor*. ☑

Water is also found in the atmosphere as water droplets and ice crystals, like those that make up clouds. The atmosphere also contains tiny *particles*, or solid pieces. These particles are things like dust and dirt from continents, salt from oceans, and ash from volcanoes.

STUDY TIP

Define When you come across a word you don't know, circle it. When you figure out what it means, write the word and its definition in your notebook.

READING CHECK

1. List Which two gases make up most of Earth's atmosphere?

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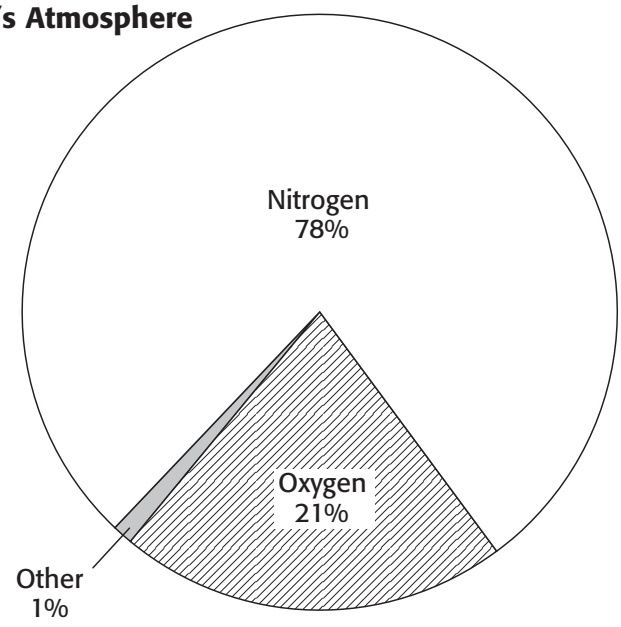
Gases in Earth's Atmosphere



Math Focus

2. Analyze Data About what fraction of the Earth's atmosphere is NOT made of nitrogen? Give your answer as a reduced fraction.

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Where Do the Gases in the Atmosphere Come From?

The gases in Earth's atmosphere come from many different sources. The table below shows some of those sources.

Gas	Where the gas comes from
Oxygen	Plants give off oxygen as they grow.
Nitrogen	Nitrogen is given off when dead plants and animals decay.
Water vapor	Liquid water evaporates and becomes water vapor. Plants give off water vapor as they grow. Water vapor comes out of the Earth during volcanic eruptions.
Carbon dioxide	Carbon dioxide comes out of the Earth during volcanic eruptions. When animals breathe, they give off carbon dioxide. Carbon dioxide is given off when we burn things that were once plant or animal material.

TAKE A LOOK

3. Identify Name two gases that volcanoes contribute to the atmosphere.

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Why Does Air Pressure Change with Height?

Air pressure is how much the air above you weighs. It is a measure of how hard air molecules push on a surface. We don't normally notice air pressure, because our bodies are used to it. ☑

READING CHECK

4. Define Write your own definition for air pressure.

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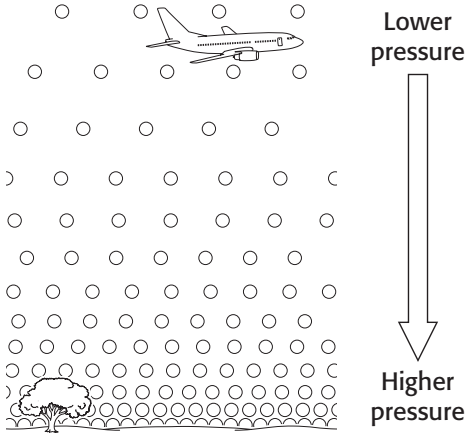
As you move up from the ground and out toward space, there are fewer gas molecules pressing down from above. Therefore, the air pressure drops. The higher you go, the lower the air pressure gets.



TAKE A LOOK

5. Compare How is the air pressure around the tree different from the air pressure around the plane?

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Why Does Air Temperature Change with Height?

Like air pressure, air temperature changes as you move higher in the atmosphere. Air pressure always gets lower as you move higher, but air temperature can get higher or lower. The air can get hotter or colder. ☑

There are different layers of the atmosphere. Each layer is made of a different combination of gases. Air temperature depends on the gases in the atmosphere. Some gases absorb energy from the sun better than others. When a gas absorbs energy from the sun, the air temperature goes up.

READING CHECK

6. Compare How are the changes in air temperature with height different from changes in air pressure with height?

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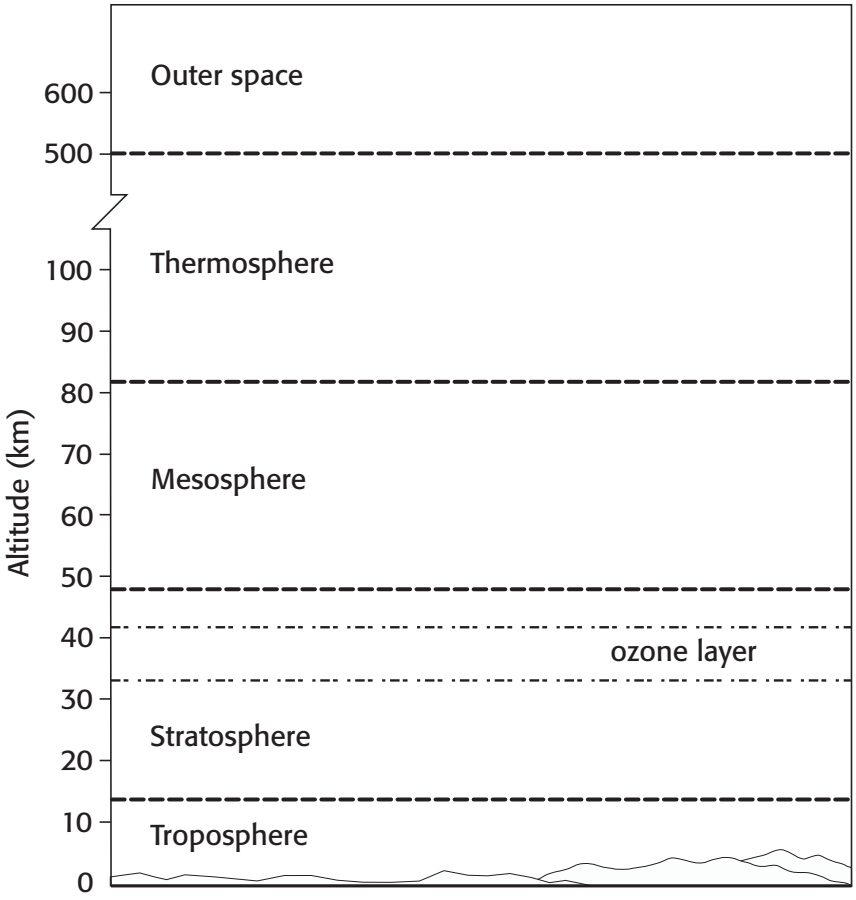
What Are the Layers of the Atmosphere?

There are four main layers of the atmosphere: troposphere, stratosphere, mesosphere, and thermosphere. You cannot actually see these different layers. The divisions between the layers are based on how each layer's temperature changes with height.



Say It

Make Up a Memory Trick In groups of two or three, make up a sentence to help you remember the order of the layers of the atmosphere. The words in the sentence should start with T, S, M, and T. For example, "Tacos Sound Mighty Tasty." A sentence like this is called a *mnemonic*.

TAKE A LOOK

7. Identify At what altitude does the mesosphere end and the thermosphere begin?

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Critical Thinking

8. Explain Why is the troposphere important to people?

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TAKE A LOOK

9. Analyze What does the map tell you about the air temperature in the troposphere?

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READING CHECK

10. Explain Why is ozone in the stratosphere important for living things?

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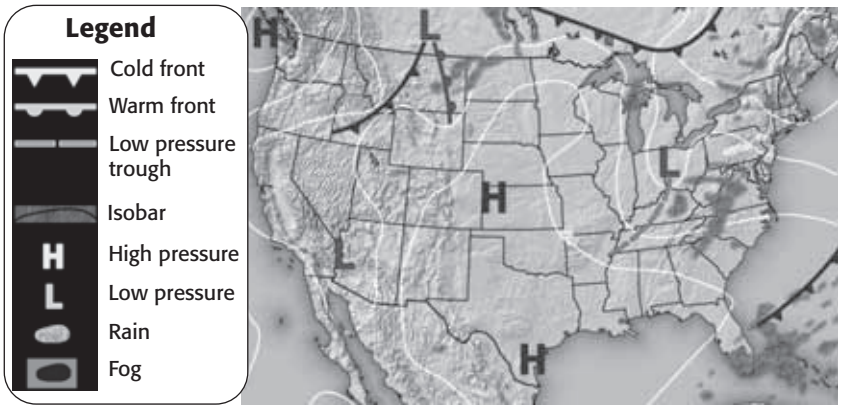
THE TROPOSPHERE

The **troposphere** is the layer of the atmosphere that we live in. It is where most of the water vapor, carbon dioxide, pollution, and living things on Earth exist. Weather conditions such as wind and rain all take place in the troposphere.

The troposphere is also the densest layer of the atmosphere. This is because the troposphere is at the bottom with all the other layers pushing down from above. Almost 90% of the gases in the atmosphere are in the troposphere. As you move higher into the troposphere (say, to the top of a mountain), both air temperature and air pressure decrease.



Weather happens in the troposphere. A weather map shows what the troposphere is like in different places.

THE STRATOSPHERE

As you go up from the ground, the temperature decreases. At an altitude of about 15 km, however, it starts to increase. This marks the beginning of the **stratosphere**. *Strato* means "layer." The gases in the stratosphere are layered. They do not mix as they do in the troposphere.

The main reason the temperature increases in the stratosphere is because of a gas called *ozone*. Ozone absorbs energy from the sun, making the temperature of the atmosphere increase. The ozone layer is important for life on Earth because it absorbs harmful ultraviolet energy. ☑

THE MESOSPHERE

Above the ozone layer, at an altitude of about 50 km, the temperature begins to drop again. This marks the bottom of the **mesosphere**. The temperature keeps decreasing all the way up to 80 km. The temperatures in the mesosphere can be as low as −93°C.

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THE THERMOSPHERE

The **thermosphere** is the uppermost layer of the atmosphere. In the thermosphere, temperatures begin to rise again. The thermosphere gets its name from its extremely high temperatures, which can be above 1,000°C. *Therm* means "heat." The temperatures in the thermosphere are so high because it contains a lot of oxygen and nitrogen, which absorb energy from the sun. ☑

READING CHECK

11. Explain Why is the thermosphere called the thermosphere?

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THE IONOSPHERE—ANOTHER LAYER

The troposphere, stratosphere, mesosphere, and thermosphere are the four main layers of the atmosphere. However, scientists also sometimes study a region called the ionosphere. The *ionosphere* contains the uppermost part of the mesosphere and the lower part of the thermosphere. It is made of nitrogen and oxygen *ions*, or electrically charged particles.

The ionosphere is where auroras occur. *Auroras* are curtains and ribbons of shimmering colored lights. They form when charged particles from the sun collide with the ions in the ionosphere. The ionosphere is important to us because it can reflect radio waves. An AM radio wave can travel all the way around the Earth by bouncing off the ionosphere.

Layer	How temperature and pressure change as you move higher	Important features
Troposhere	temperature decreases pressure decreases	
Stratosphere		gases are arranged in layers contains the ozone layer
		has the lowest temperatures
Thermosphere	temperature increases pressure decreases	

TAKE A LOOK

12. Identify Use the information from the text to fill in the table.

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Section 1 Review

NSES **ES 1h**

SECTION VOCABULARY

air pressure the measure of the force with which air molecules push on a surface

atmosphere a mixture of gases that surrounds a planet or moon

mesosphere the layer of the atmosphere between the stratosphere and the thermosphere and in which temperature decreases as altitude increases

stratosphere the layer of the atmosphere that is above the troposphere and in which temperature increases as altitude increases

thermosphere the uppermost layer of the atmosphere, in which temperature increases as altitude increases

troposphere the lowest layer of the atmosphere, in which temperature decreases at a constant rate as altitude increases

1. Define Write your own definition for atmosphere.

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2. Explain Why does air temperature change as you move up from the Earth's surface?

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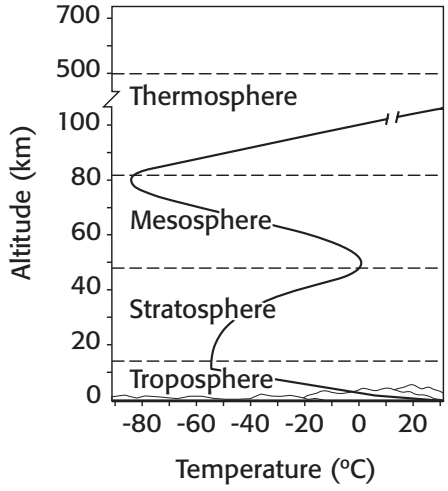
3. Make a Graph The graph below shows how the temperature changes as you move up through the atmosphere. On the graph, draw a curve showing how the pressure changes.



4. Identify Relationships How does the sun affect air temperatures?

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