Section 1
Characteristics of the Atmosphere

Key Concept Earth's atmosphere absorbs solar energy and transports energy around Earth's surface.

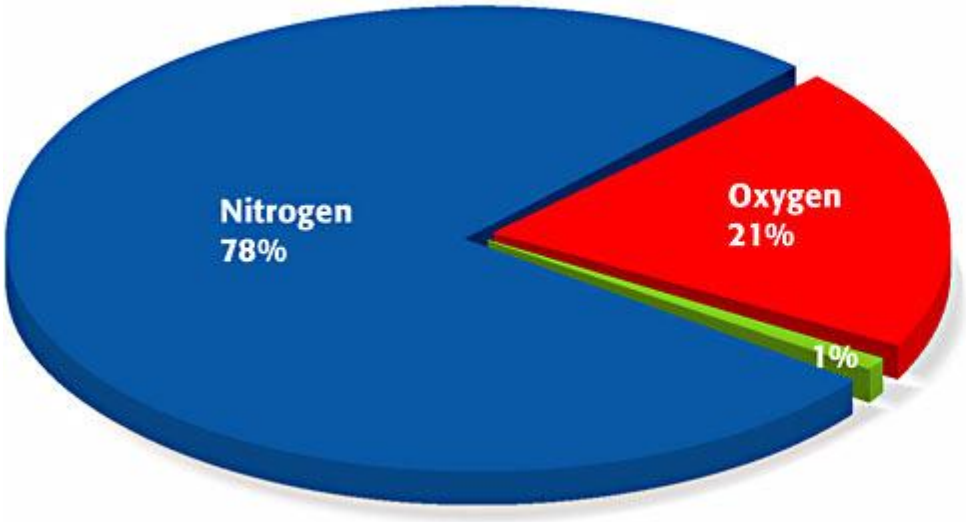
What You Will Learn
- Earth's atmosphere is a mixture of gases that surrounds Earth and absorbs solar radiation.
- Pressure and temperature in the atmosphere change as distance from Earth's surface increases.

Why It Matters
The atmosphere is a protective layer that allows life to survive on Earth's surface.

The **atmosphere** is a mixture of gases that surrounds Earth. The atmosphere contains the oxygen you need to live. It also protects you from the sun's damaging rays. Every breath you take, every tree that is planted, and every automobile you ride in affect the atmosphere's composition.

The Composition of the Atmosphere
The mixture of gases that makes up the atmosphere is commonly called *air*. As you can see in **Figure 1,** most of this mixture is nitrogen. About 78% of the atmosphere is nitrogen. Oxygen makes up about 21% of the atmosphere. The other 1% of the atmosphere is made of other gases, such as argon, carbon dioxide, and water vapor. Water vapor is an invisible gas that forms when water reaches a certain temperature. Sometimes, water vapor can make up as much as 4% of the air.

Figure 1 Composition of the Atmosphere



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The atmosphere also contains liquids and solids. Liquid water (water droplets) and solid water (snow and ice crystals) are found in clouds. The atmosphere also contains small particles, such as dust, volcanic ash, sea salt, dirt, and smoke. You can turn off the lights at night and shine a flashlight to see some of these tiny particles floating in the air.

Air Pressure and Temperature

What would carrying a column of air that is 500 km high feel like? You carry this load every day! You do not notice the load because your body is used to it. At sea level, a square inch of surface area is under almost 7 kg (15 lb) of air.

Altitude and Air Pressure

Gravity pulls gas molecules in the atmosphere toward Earth's surface. As a result, there are a lot of air molecules near Earth's surface. When a large number of air molecules are contained in a small space, those molecules exert a lot of pressure on one another and on surfaces around

them. **Air pressure** is the measure of the force with which air molecules push on a surface. The air pressure at any point in the atmosphere is equal to the weight of the air directly above that point. Air pressure is greatest at Earth's surface because there is a lot of air above Earth's surface. A human pyramid models how air pressure changes in the atmosphere, as shown in **Figure 2.**

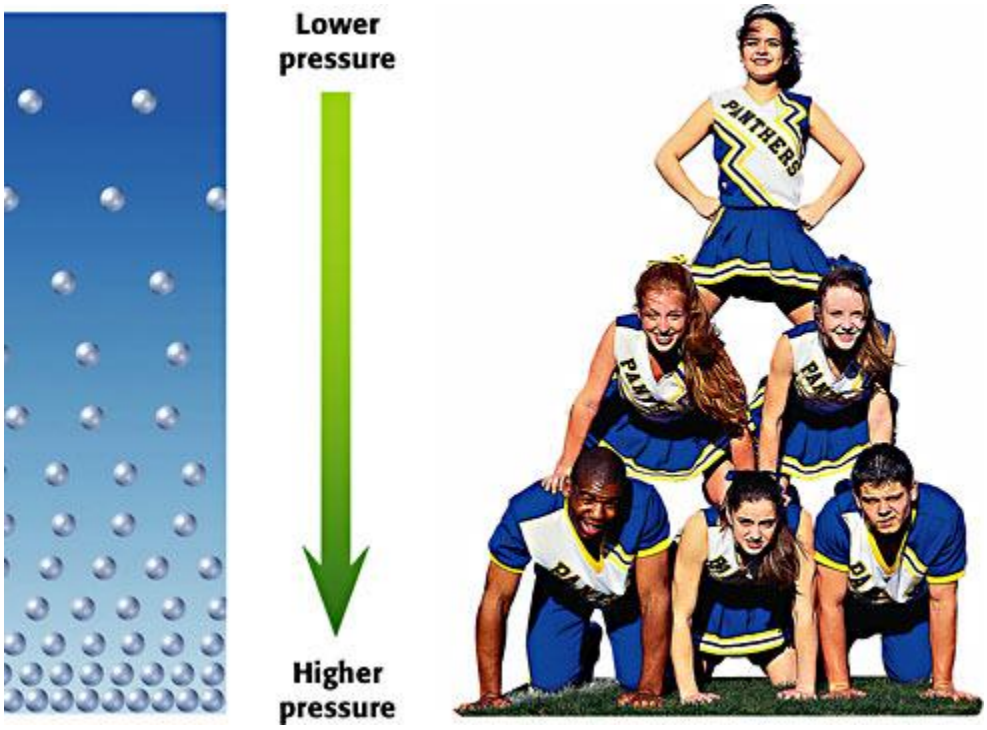

Figure 2 In the atmosphere, air pressure is greatest at Earth's surface. In a human pyramid, pressure is greatest at the bottom.

Standards Check Why is air pressure highest near Earth's surface?

Atmospheric Composition and Air Temperature

Air temperature also changes as altitude increases. The temperature differences result from the way that energy is absorbed by gases in the atmosphere. Some parts of the atmosphere are warmer because they contain higher concentrations of gases that absorb energy from the sun or from Earth's surface.

Layers of the Atmosphere

Gases in Earth's atmosphere absorb solar energy differently, which causes temperature gradients. The atmosphere is divided into four main layers based on these temperature differences, as shown in **Figure 3.**

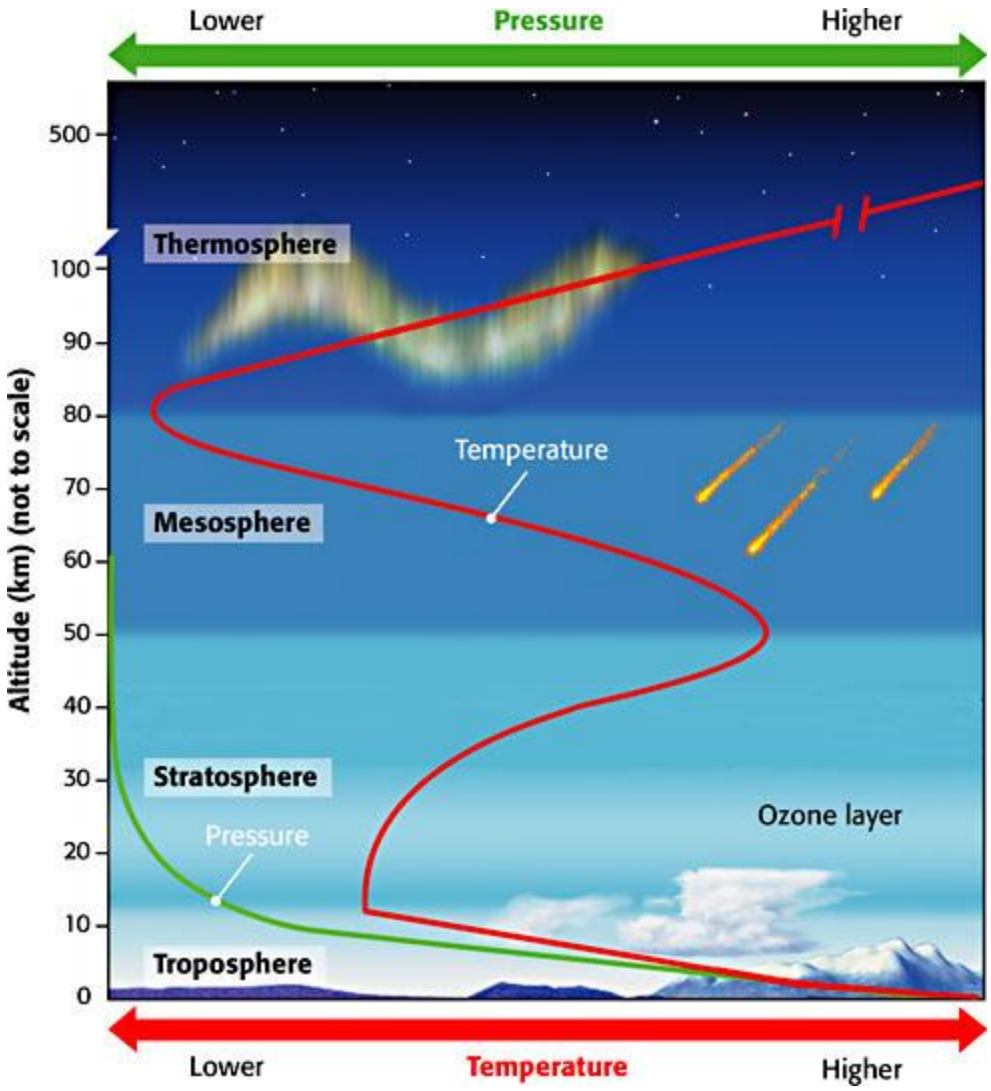

Figure 3 The layers of the atmosphere are defined by changes in temperature.

The Troposphere: The Layer in Which We Live

The **troposphere** is the layer of the atmosphere that lies next to Earth's surface. This layer contains almost 90% of the atmosphere's total mass.

Almost all water vapor, air pollution, and weather are in this layer. Temperature decreases as altitude increases in the troposphere. Differences in air temperature and density cause gases in this layer to mix continuously.

The Stratosphere: Home of the Ozone Layer

The layer above the tropo sphere is called the **stratosphere.** The air in this layer is thin and has little moisture. In this layer, temperature rises as altitude increases. This rise happens because a layer of gas called *ozone* absorbs radiation from the sun, so the air warms. The *ozone layer* protects life on Earth by absorbing harmful ultraviolet radiation.

The Mesosphere: The Middle Layer

Above the stratosphere is the mesosphere. The **mesosphere** is the middle layer of the atmosphere. It is also the coldest layer. As in the troposphere, temperature decreases as altitude increases in the mesosphere.

The Thermosphere: The Edge of the Atmosphere

The uppermost atmospheric layer is called the **thermosphere.** In the thermosphere, temperature again increases with altitude. Temperature increases in this layer because atoms of nitrogen and oxygen absorb high-energy solar radiation.

Standards Check Why are temperatures high in the stratosphere and thermosphere?

Section Summary

- Nitrogen and oxygen make up most of Earth's atmosphere.
- Air pressure decreases as altitude increases.
- The composition of atmospheric layers affects their temperature.
- The troposphere is the lowest atmospheric layer. It is the layer in which we live.

- The stratosphere contains the ozone layer, which protects us from harmful ultraviolet radiation.
- The mesosphere is the coldest atmospheric layer.
- The thermosphere is the uppermost layer of the atmosphere.