# THE EARTH'S ATMOSPHERE

## The Composition of Earth's Atmosphere

The Earth is unique in our solar system because it has an atmosphere that can support life. By comparison, Venus has an atmosphere that is high in ammonia and other caustic gases; it is so dense that it would crush a human. On the other hand, Mars has no atmosphere at all. Earth's atmosphere contains oxygen, nitrogen, water and other gases. It is 78% nitrogen, 21% oxygen and 1% other gasses including carbon dioxide and water vapor.

## Properties of the Earth's Atmosphere

Earth's atmosphere has mass and weight because it contains gaseous elements that have mass and weight. The force that gases in the atmosphere exert on a surface is called **air pressure** or **atmosphe**ear sea level becau close to the Earth's s near Earth's sur stances from the E ses at greater alt



Diffe ment. **Wind** is si ces in air pressure between different regions. In general, surface winds blow from the poles to the equator. The air pressure at the poles is higher than the air pressure at the equator. This is because the air is warmer at the equator and therefore is less dense while the air is colder at the poles and therefore is denser. Air pressure increases with air density.

Global wind patterns are very complex. Bands of winds that blow in different directions occur in regular patterns as one moves from the equator to the poles. For example, the winds that blow from 30 degrees latitude (north and south) and in a westerly direction are called the **trade winds**. The **westerlies** are winds that blow from the southwest to the northeast from 30 degrees to 60 degrees latitude (north and south). The **easterlies** are winds that blow from the poles to 60 degrees latitude (north and south). The easterlies blow toward the west.

There are also belts of high-speed winds that occur high in the atmosphere. They significantly affect weather patterns. These winds can move at speeds as great as 500 kilometers/hour. These high-speed winds are known as **jet streams**.

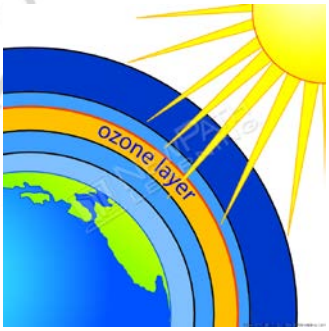

## *Lesson Checkpoint: What is a jet stream?*

## Structure of the Earth's Atmosphere

The Earth's atmosphere is composed of layers each with different characteris… e is the densest of … n dioxide, water vapo… er is the **troposph**…



Tem… e. The next layer … Surprisingly, temperature increases with altitude in the stratosphere. The upper portions of the stratosphere are heated by ultraviolet radiation from the sun. The stratosphere includes the **ozone layer**. The ozone layer is a protective layer of ozone molecules that filter ultraviolet radiation from the sun, thus protecting Earth's organisms from its harmful effects. **Ozone** is a molecule that contains three oxygen atoms. Commercial airliners fly in the lower portions of the stratosphere because this gets them above the effects of weather.



The next layer above the stratosphere is the **mesosphere**. "Mesosphere" is from two Greek words that mean "middle ball," because this layer is in the middle of the atmosphere. It is the coldest layer of the atmosphere: temperatures here can be as low as −100 degrees Celsius. It is the least understood of the atmospheric layers.

Above the mesosphere is the **thermosphere**. In this layer of the atmosphere, temperature increases with altitude. There are very few particles in this layer, but the particles move very rapidly. It does not feel hot in the thermosphere, however. It is described as having a very high temperature because the particles in the thermosphere are moving so rapidly. (Temperature is a function of the motion of particles, not of how "hot" it feels. When particles are close to one another, as in the troposphere, they bump into each other and heat is created.)

The ionosphere is the upper part of the thermosphere. The **ionosphere** is a portion of the atmosphere that radiates energy in the form of different colors. These colors can be seen near the poles. In the north t thern lights) and uthern lights).

The e **exospher** d individual gases can escape fro



***Lesson Checkpoint:***
***Name two layers of the Earth's atmosphere.***

## Air Quality

Air is affected by a number of naturally occurring and human-produced factors. These factors in turn affect the environment.

One reason that Earth is habitable is that the air near its surface holds heat. Energy is transferred from the sun as electromagnetic radiation. The heat we feel at the surface of the Earth is the result of the molecules moving rapidly due to this radiation. This movement results in heat. Obviously, without the right amount of heat, life could not exist.

Different processes transfer heat in the troposphere (that is, the air at Earth's surface). When two objects touch each other, heat moves by **conduction** from the warmest to the coolest until the temperatures of the two objects are equal. Heat transfers to the air from solid objects on the Earth's surface and from the surface itself.

Moving currents of air transfers most of the heat energy that is in the atmosphere. This is called **convection**. Warm air near the surface is less dense so it rises. As it does, it cools and becomes denser so it sinks back to the surface. This creates circular currents called **convection currents** (which work just like convection currents that circulate magma in the Earth's mantle).

There is growing concern that heat is building up near the Earth's surface. **Radiation balance** is the phrase that refers to the balance between the amount of electromagnetic radiation that comes into the Earth's atmosphere and the amount of heat that leaves the atmosphere. When the balance is thrown off, too much heat can accumulate which can cause dramatic changes in global environments. Some scientists have studied the Earth's present climate and have concluded that there is a dangerous accumulation of carbon dioxide and other gases in the atmosphere from the burning of fossil fuels. This accumulation of carbon dioxide and other gases in the atmosphere is believed to trap heat nearer the Earth causing average temperatu
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changes in habitats and the consequences this will have on wildlife, and changes in weather patterns are all considered outcomes of global warming.

## Pollution

The atmosphere can also be altered, and damaged, by **pollution**. Some pollution is created naturally. For example, volcanic ash and gases, dust, swamp gas, pollen and smoke from wildfires are all considered forms of natural pollution. As we know, humans put tons of pollutants into the atmosphere every day.

Scientists categorize air pollution into two groups. **Primary pollution** is pollution that is put directly into the air, such as volcanic ash or exhaust from a car. **Secondary pollution** is pollution that is created when primary pollution reacts with something in the air. For example, smog is a secondary pollutant. When car exhaust reacts with light and air, ozone is created. Ozone in turn reacts with more car exhaust to create smog.

**Acid precipitation** is another secondary pollutant created by the burning of fossil fuels. Burning coal and oil that has high sulfur content releases the sulfur into the air. The sulfur then reacts with water to form sulfuric acid. Sulfuric acid raises the pH of lakes, ponds and streams and causes corrosion.

Air pollution is truly a global concern. When pollutants are put into the air in one place, they are easily carried by winds to distant places. The acid rain and other problems created by airborne pollution are never just a local problem. They are carried hundreds of miles and can affect the environments of communities hundreds if not thousands of miles away.

## *Lesson Checkpoint: What is secondary pollution?*