

What's in the Air?

Air? Can't see it. Can't taste it. Can't smell it. If you pay attention, you might feel it as a gentle breeze brushing across your skin. Because we are so insensitive to air, it is difficult to understand what it is. Is it one thing, or a mixture of things? And where is it? Is it everywhere or just in some places?

As we go about our everyday business, we usually travel with our feet on the solid Earth and our heads in the atmosphere. The atmosphere completely surrounds us, pressing firmly on every square centimeter of our bodies—top, front, back, and sides. Even if we attempt to get out of the atmosphere by locking ourselves inside a car or hiding in a basement, the atmosphere is there, filling every space we enter.

An **atmosphere** is the layer of gases that surrounds a planet or star. All planets and stars have an atmosphere around them. The Sun's atmosphere is hydrogen. Mars has a thin atmosphere of carbon dioxide with a bit of nitrogen and a trace of water vapor. Mercury has almost no atmosphere at all. Each planet is surrounded by its own mixture of gases.

Earth's atmosphere is composed of a mixture of gases we call **air**. Air is mostly nitrogen (78%) and oxygen (21%), with some argon (0.93%), carbon dioxide (0.03%), ozone, water vapor, and other gases (less than 0.04% together).

Nitrogen (N_2) is the most abundant gas in our atmosphere. It is a stable gas, which means it doesn't react easily with other

substances. When we breathe air, the nitrogen goes into our lungs and then back out unchanged. We don't need nitrogen gas to survive.

Oxygen (O_2) is the second most abundant gas. It takes up about 21% of the air's volume, and, because the oxygen atom is larger than the nitrogen atom, it accounts for 23% of air's mass. Oxygen is a colorless, odorless, tasteless gas. It is the most plentiful element in the rocks of Earth's crust. Oxygen combines with hydrogen to form water. Without oxygen, life as we know it would cease to exist on Earth.

Oxygen and nitrogen are called **permanent gases**. The amount of oxygen and nitrogen in the atmosphere stays constant. The other gases in this chart are also permanent gases, but are found in much smaller quantities.

Permanent Gases of the Atmosphere

Gas	Percentage by volume
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Neon	0.002
Helium	0.0005
Krypton	0.0001
Hydrogen	0.00005
Xenon	0.000009

Air also contains **variable gases**. The amount of a variable gas changes in response to activities in the environment.

Water vapor (H₂O) is the most abundant variable gas. It makes up about 0.25% of the atmosphere's mass. The amount of water vapor in the atmosphere changes constantly. Water cycles between Earth's surface and the atmosphere through evaporation, condensation, and precipitation. You can get a feeling for the changes in atmospheric water vapor by observing clouds and noting the stickiness you feel on humid days.

Carbon dioxide (CO₂) is another important variable gas. It makes up only about 0.036% of the atmosphere. You can't see or feel changes in the amount of carbon dioxide in the atmosphere.

Carbon dioxide plays an important role in the lives of plants and algae. Carbon dioxide is removed from the air during **photosynthesis**. Plants and algae convert light energy into chemical energy by making sugar (food) out of carbon dioxide and water. In the process, oxygen is released to the atmosphere. When living organisms use the energy in food to stay alive, oxygen is removed from the air and carbon dioxide is returned to the air.

Variable Gases of the Atmosphere

Gas	Percentage by volume
Water vapor	~ 0.25
Carbon dioxide	~ 0.036
Ozone	~ 0.01

There are other gases that you may have heard about. **Ozone (O₃)** is a variable gas. It is a form of oxygen that forms a thin layer in the stratosphere. Ozone is absolutely essential to life on Earth because it absorbs

deadly ultraviolet radiation from the Sun. But ozone in high concentration can cause lung damage. In the lower atmosphere, ozone is an air pollutant.

Methane (CH₄) is a variable gas that is increasing in concentration in the atmosphere. Scientists are trying to figure out why this is happening. They suspect several things. Cattle produce methane in their digestive processes. Methane also comes from coal mines, oil wells, and gas pipelines, and is a by-product of rice cultivation. Methane absorbs heat coming up from Earth's surface.

These gases are all mixed together, so that any sample of air is a mixture of all of them. If you rise higher in the atmosphere, there are fewer molecules, but the ratio of each gas to the other is the same. The mixing is caused by the constant movement of the air in the part of the atmosphere near Earth's surface. Above about 90 kilometers, there is much less mixing. Very light gases (hydrogen and helium, in particular) are more abundant above that level.

Think Questions

1. What is the difference between permanent gases and variable gases in the atmosphere?
2. During the daylight hours, plants and algae take in carbon dioxide and release oxygen. If humans continue to destroy rain forests, what might happen to the balance between these gases?