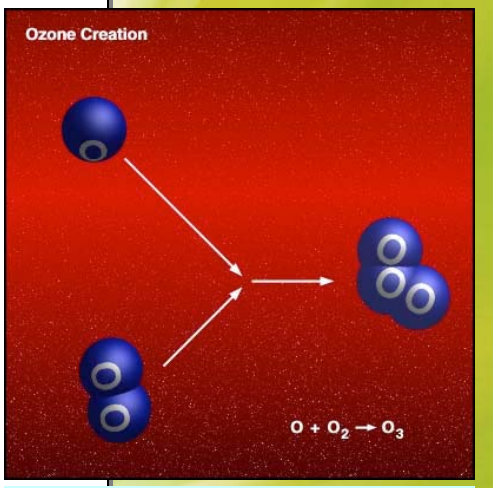
A Molecule for Life

Earth's atmosphere is made of several layers, each with a unique range of temperatures. Temperatures in the lowest layer of the atmosphere, the troposphere, decrease with height. The next highest layer is the stratosphere. Jet airplanes typically fly in the stratosphere to avoid bad weather conditions. For many years, scientists noticed temperatures in the stratosphere increased with height. What could cause temperatures in the stratosphere to increase rather than decrease?



Ozone forms in the stratosphere. The molecule protects Earth from the Sun's radiation.

The answer was a mystery until 1913, when Charles Fabry and Henri Buisson discovered a layer of ozone high in Earth's atmosphere. Ozone is a molecule of gas consisting of three atoms of oxygen. A **molecule** is a bonded group of atoms. A molecule has very different properties from the original atoms that make it up.

All matter is made of atoms. In fact, scientists consider atoms to be the basic building blocks of matter. Examples of atoms include oxygen, carbon, iron, helium, neon, and tin. On the Periodic Table of the Elements, groups of the same atoms are called **elements**. When two or more atoms of elements chemically combine, a molecule forms.

The ability of atoms to combine makes possible a practically endless arrangement of molecules. Ozone is a molecule formed when an extra oxygen atom combines with a diatomic molecule of oxygen. **Diatomic molecules** are molecules made from a single element. O_2 is the diatomic molecule of the element oxygen. Oxygen exists in nature as a diatomic molecule. Other diatomic molecules include hydrogen (H_2) and nitrogen (N_2).

The existence of molecules of ozone in the atmosphere explains why temperatures increase in the stratosphere. Ozone reacts very differently in the environment than its diatomic oxygen counterpart. Diatomic oxygen is breathable oxygen, but ozone is a reactive molecule that filters out harmful radiation from the sun. As the ozone molecules absorb the sun's energy, they also capture the sun's heat, thereby raising temperatures in the stratosphere.

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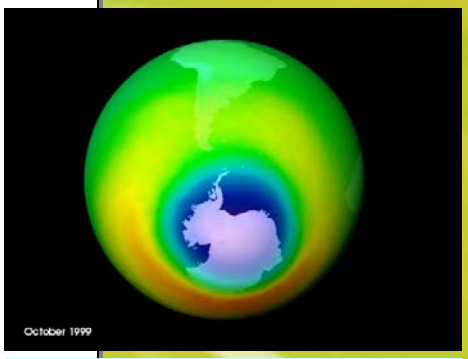
Models of molecules show bonding between the atoms. Molecules are too small to see, so models are necessary to represent the bonding between the individual atoms. Many of the bonds are hard to break. Breaking the bonds requires energy. In the atmosphere, certain chemicals can break apart the ozone molecule.

Beginning in the 1970s, scientists began to worry that the ozone layer was in danger. By studying images captured by satellites, scientists noticed a thinning of the ozone gases in Earth's atmosphere. Over the Antarctic, scientists commonly refer to the thinning ozone gases in the region as the *ozone hole*. Because ozone is a gas, a true hole does not actually exist in the air. Instead, the "hole" contains substantially fewer ozone molecules than other sections of the atmosphere contain.

Models show how atoms in a molecule bond together.

What caused this hole in the ozone layer to form? For many years, people had been releasing a variety of pollutants into the atmosphere. Among these pollutants was a class of molecules called *chlorofluorocarbons*. Aerosol sprays and coolants such as those found in refrigerators and air conditioners were particularly large sources of these molecules. The chlorine atoms in chlorofluorocarbon molecules reacted with ozone molecules in the stratosphere. These reactions destroyed the ozone molecules and led to the hole in the ozone layer.



The release of chlorine in the atmosphere causes the breakdown of ozone molecules. Scientists map the "ozone hole" via satellite.

Molecules are very important for life on Earth. The ozone molecule protects Earth from the sun's ultraviolet rays. Without the layer of ozone gas in the atmosphere, potentially dangerous levels of radiation from the sun would reach Earth's surface. Fortunately, the discovery of the ozone hole helped people realize ozone's importance. Working together, people passed laws to limit their use of ozone-destroying molecules. Although the hole has not yet been completely "patched," ozone levels are gradually returning to normal.