

What Is A Free Radical?

by Dr. Diana Howard

Free radicals may be formed through natural human physiological processes as well as from the environment. They may be the result of diet, stress, smoking, alcohol, exercise, inflammation, drugs or exposure to sunlight and air pollutants. While there are many types of free radicals that can be formed, the most common in aerobic (oxygen breathing) organisms are oxygen free radicals, often referred to as Reactive Oxygen Species (ROS), which include superoxides, hydroxyl anions, hydrogen peroxide and singlet oxygen.

What is a Free Radical?

A free radical is an atom or group of atoms that has an unpaired electron and is therefore unstable and highly reactive.

An atom's chemical behavior is determined by the number of electrons in its outermost shell. When the outermost shell is full, the atom is stable and tends not to engage in chemical reactions. When, however, the outermost shell is not full, the atom is unstable. It will try and stabilize itself by either gaining or losing an electron to either fill or empty its outermost shell. Or it will share its electrons by bonding with another atom that is also looking to complete its outer shell. It is not uncommon for an atom to complete its outer shell by sharing an electron with another atom and forming a bond.

Free radicals form when one of these weak bonds between electrons is broken and an uneven number of electrons remain. This means the electron is unpaired, making it chemically reactive. It will now try and steal an electron from a neighboring molecule to stabilize itself.

Once a free radical forms and it succeeds in gaining another electron from a nearby molecule, it leaves its victim short an electron and has now made this new molecule a free radical, which will in turn, try and steal an electron as well. The result is what we call a free radical cascade, an enormous chain reaction of free radicals that quickly wreaks havoc on living tissue. It is estimated that the chain reaction can trigger 6.023×10^{21} billion molecules to react per second!

How Do Free Radicals Form?

Free radicals may form spontaneously or they may be the result of exposure to heat, light or something in the environment. Sometimes the body's immune system creates them on purpose to neutralize viruses and bacteria.

In the human body, we have a vast array of molecules that are more susceptible to free radical attacks than others. These include fats, DNA, RNA, cellular membranes, proteins, vitamins and carbohydrates.

Unfortunately, oxygen is very susceptible to free radical formation, and with aerobic organisms,

this can be lethal. Oxygen free radicals are implicated in the overall aging process and are responsible for photoaging, cancer and inflammation in the skin. Oxygen free radicals cause lipid peroxidation, which results in damage to cell membranes and this can cause premature aging, skin cancer and cell death.