A free radical is an atom or group of atoms that contains at least one unpaired electron. Electrons are negatively charged particles that usually occur in pairs, forming a chemically stable arrangement. If an electron is unpaired, another atom or molecule can easily bond with it, causing a chemical reaction. Because they join so readily with other compounds, free radicals can effect dramatic changes in the body, and they can cause a lot of oxidative damage. Each free radical may exist for only a tiny fraction of a second, but the damage it leaves behind can be irreversible, particularly damage to the heart muscle cells, nerve cells, and certain immune system sensor cells.

Free radicals are normally present in the body in small numbers. Oxygen-charged particles are created in the body as we breathe. Diets rich in antioxidants can more than neutralize these particles. Dietary supplements rich in antioxidants act in the same way. Biochemical processes naturally lead to the formation of free radicals, and under normal circumstances the body can keep them in check. Indeed, not all free radicals are bad. Free radicals produced by the immune system destroy viruses and bacteria. Other free radicals are involved in producing vital hormones and activating enzymes that are needed for life. We need free radicals to produce energy and various substances that the body requires. If there is excessive free radical formation, however, damage to cells and tissues can occur. The formation of a large number of free radicals stimulates the formation of more free radicals, leading to even more damage.

Many different factors can lead to an excess of free radicals. Exposure to radiation, whether from the sun or small amounts from medical x-rays, activates the formation of free radicals, as does exposure to environmental pollutants such as tobacco smoke and automobile exhaust. Diet also can contribute to the formation of free radicals. When the body obtains nutrients through the diet, it utilizes oxygen and these nutrients to create energy. In this oxidation process, oxygen molecules containing unpaired electrons are released. These oxygen free radicals can cause damage to the body if produced in extremely large amounts. Being overweight or consuming a diet that is high in fat can increase free radical activity because oxidation occurs more readily in fat molecules than it does in carbohydrate or protein molecules. Cooking fats at high temperatures, particularly frying foods in oil, can produce large numbers of free radicals.

The presence of a dangerous number of free radicals can alter the way in which the cells code genetic material. Changes in protein structure can occur as a result of errors in protein

synthesis. The body's immune system may then see this altered protein as a foreign substance and try to destroy it. The formation of mutated proteins can eventually damage the immune system and lead to leukemia and other types of cancer, as well as to many other diseases.

In addition to damaging genetic material, free radicals can destroy the protective cell membranes. Calcium levels in the body may be upset as well. Over time, the body produces more free radicals than it does scavengers. The resulting imbalance contributes to the aging process.

Substances known as antioxidants neutralize free radicals by binding to their free electrons. Antioxidants available in supplement form include the enzymes superoxide dismutase and glutathione peroxidase; vitamin A, beta-carotene, and vitamins C and E; the minerals selenium and zinc; and the hormone melatonin. By destroying free radicals, antioxidants help to detoxify and protect the body.