Aging is a normal process accompanied by a progressive alteration of the body’s homeostatic adaptive responses; the specialized branch of medicine that deals with the medical problems and care of elderly persons is called geriatrics.

The obvious characteristics of aging are well known: graying and loss of hair, loss of teeth, wrinkling of skin, decreased muscle mass, and increased fat deposits. The physiological signs of aging are gradual deterioration in function and capacity to respond to environmental stresses. Metabolism slows, as does the ability to maintain a constant internal environment (homeostasis) in response to changes in temperature, diet, and oxygen supply. These signs of aging are related to a net decrease in the number of cells in the body and to the dysfunctioning of the cells that remain.

The extracellular components of tissues also change with age. Collagen fibers, responsible for the strength in tendons, increase in number and change in quality with aging. These changes in the collagen of arterial walls are as much responsible for their loss of extensibility as are the deposits associated with atherosclerosis, the deposition of fatty materials in arterial walls. Elastin, another extracellular component, is responsible for the elasticity of blood vessels and skin. It thickens, fragments, and acquires a greater affinity for calcium with age – changes that may also be associated with the development of atherosclerosis.

Glucose, the most abundant sugar in the body, may play a role in the aging process. According to one hypothesis, glucose is added, haphazardly, to proteins inside and outside cells, forming irreversible cross-links between adjacent protein molecules. As a person ages, more cross-links are formed, and this probably contributes to the stiffening and loss of elasticity that occurs in aging tissues.

Although many millions of new cells normally are produced each minute, several kinds of cells in the body—heart cells, skeletal muscle fibers, nerve cells—cannot be replaced. Experiments have shown that many other cell types have only a limited capability to divide. Cells grown outside the body divide only a certain number of times and then stop. The number of divisions correlates with the donor’s age and with the normal life span of the different species from which the cells are obtained. These observations provide strong evidence for the hypothesis that cessation of mitosis is a normal, genetically programmed event. According to this view, an “aging” gene is part of the genetic blueprint at birth, and it turns on at a preprogrammed time, slowing down or halting processes vital to life.

Another theory of aging is the free radical theory. Free radicals are electrically charged molecules that have an unpaired electron. Such molecules are unstable and highly reactive and can easily damage proteins. Some effects are wrinkled skin, stiff joints, and hardened arteries. Free radicals may also damage DNA. Among the factors that produce free radicals are air pollution, radiation, and certain foods we eat. Other substances in the diet such as vitamin E, vitamin C, beta-carotene, and selenium are antioxidants and inhibit free radical formation. The free radical theory of aging is bolstered by two recent discoveries. Strains of fruit flies bred for longevity produce larger-than-normal amounts of an enzyme called superoxide dismutase, which functions to neutralize free radicals. Also, injection of genes that lead to production of superoxide dismutase into fruit fly embryos prolongs their average lifetime.

Whereas some theories of aging explain the process at the cellular level, others concentrate on regulatory mechanisms operating within the entire organism. For example, the immune system, which manufactures antibodies against foreign invaders, may start to attack the body’s own cells. This autoimmune response might be caused by changes in the surfaces of cells, causing antibodies to attach and mark the cell for destruction. As surface changes in cells increase, the autoimmune response intensifies, producing the well-known signs of aging.