

Secretory epithelial cells are often collected together to form a gland that specializes in the secretion of a particular substance. As illustrated, **exocrine glands** secrete their products (such as tears, mucus, and gastric juices) into ducts. **Endocrine glands** secrete hormones into the blood.

BLOOD

Erythrocytes (red blood cells) are very small cells, and in mammals have no nucleus or internal membranes. When mature they are stuffed full of the oxygen-binding protein hemoglobin.

1 cm³ of blood contains 5 billion erythrocytes

their normal shape is a biconcave disc

Leucocytes (white blood cells) protect against infections. Blood contains about one leucocyte for every 100 red blood cells. Although leucocytes travel in the circulation, they can pass through the walls of blood vessels to do their work in the surrounding tissues. There are several different kinds, including

lymphocytes—responsible for immune responses such as the production of antibodies.

macrophages and neutrophils—move to sites of infection, where they ingest bacteria and debris.

GERM CELLS

Both **sperm** and **egg** are *haploid*, that is, they carry only one set of chromosomes. A sperm from the male fuses with an egg from the female, which then forms a new diploid organism by successive cell divisions.

MUSCLE

Muscle cells produce mechanical force by their contraction. In vertebrates there are three main types:

skeletal muscle—this moves joints by its strong and rapid contraction. Each muscle is a bundle of muscle fibers, each of which is an enormous multinucleated cell.

smooth muscle—present in digestive tract, bladder, arteries, and veins. It is composed of thin elongated cells (not striated), each of which has one nucleus.

cardiac muscle—intermediate in character between skeletal and smooth muscle. It produces the heart beat. Adjacent cells are linked by electrically conducting junctions that cause the cells to contract in synchrony.

SENSORY CELLS

Among the most strikingly specialized cells in the vertebrate body are those that detect external stimuli. **Hair cells** of the inner ear are primary detectors of sound. They are modified epithelial cells that carry special microvilli (stereocilia) on their surface. The movement of these in response to sound vibrations causes an electrical signal to pass to the brain.

stereocilia are very rigid because they are packed with actin filaments

Rod cells in the retina of the eye are specialized to respond to light. The photosensitive region contains many membranous discs (*red*) in whose membranes the light-sensitive pigment rhodopsin is embedded. Light evokes an electrical signal (*green arrow*), which is transmitted to nerve cells in the eye, which relay the signal to the brain.