

Animal cell ultrastructure

Lysosomes are sacs that contain high concentrations of hydrolytic (digestive) enzymes. These enzymes are kept apart from the cell contents which they would otherwise destroy, and they are kept inactive by an alkaline environment within the lysosome. They are especially abundant in cells with a high phagocytic activity, such as some *neutrophils*.

Free ribosomes are the sites of protein synthesis, principally for proteins destined for intracellular use. There may be 50 000 or more in a typical eukaryote cell.

Endocytic vesicle may contain molecules or structures too large to cross the membrane by active transport or diffusion.

Microtubules are hollow tubes of the protein *tubulin*, about 25 nm in diameter. They are involved in intracellular transport (e.g. the movement of mitochondria), have a structural role as part of the cytoskeleton and are components of other specialized structures such as the centrioles and the basal bodies of cilia and flagella.

Nucleus is the centre of the regulation of cell activities since it contains the hereditary material, DNA, carrying the information for protein synthesis. The DNA is bound up with histone protein to form chromatin. The nucleus contains one or more nucleoli in which ribosome subunits, ribosomal RNA, and transfer RNA are manufactured. The nucleus is surrounded by a double nuclear membrane, crossed by a number of nuclear pores. The nucleus is continuous with the endoplasmic reticulum. There is usually only one nucleus per cell, although there may be many in very large cells such as those of striated (skeletal) muscle. Such multinucleate cells are called coenocytes.

Mitochondrion (pl. mitochondria) is the site of aerobic respiration. Mitochondria have a highly folded inner membrane which supports the proteins of the electron transport chain responsible for the synthesis of ATP by oxidative phosphorylation. The mitochondrial matrix contains the enzymes of the TCA cycle, an important metabolic 'hub'. These organelles are abundant in cells which are physically (*skeletal muscle*) and metabolically (*hepatocytes*) active.

Microvilli are extensions of the plasmamembrane which increase the cell surface area. They are commonly abundant in cells with a high absorptive capacity, such as *hepatocytes* or cells of the *first coiled tubule of the nephron*. Collectively the microvilli represent a *brush border* to the cell.

Peroxisome is one of the group of vesicles known as *microbodies*. Each of them contains oxidative enzymes such as *catalase*, and they are particularly important in delaying cell ageing.

Centrioles are a pair of structures, held at right angles to one another, which act as organizers of the nuclear spindle in preparation for the separation of chromosomes or chromatids during nuclear division.

Secretory vesicle undergoing exocytosis. May be carrying a synthetic product of the cell (such as a protein packaged at the Golgi body) or the products of degradation by lysosomes. Secretory vesicles are abundant in cells with a high synthetic activity, such as the cells of the *Islets of Langerhans*.

Smooth endoplasmic reticulum is a series of flattened sacs and sheets that are the sites of synthesis of steroids and lipids.

Rough endoplasmic reticulum is so-called because of the many ribosomes attached to its surface. This intracellular membrane system aids cell compartmentalization and transports proteins synthesized at the ribosomes towards the Golgi bodies for secretory packaging.

Golgi apparatus consists of a stack of sacs called *cisternae*. It modifies a number of cell products delivered to it, often enclosing them in vesicles to be secreted. Such products include trypsinogen (from *pancreatic acinar cells*), insulin (from *beta-cells of the Islets of Langerhans*) and mucin (from *goblet cells in the trachea*). The Golgi is also involved in lipid modification in cells of the ileum, and plays a part in the formation of lysosomes.

Cytoplasm is principally water, with many solutes including glucose, proteins and ions. It is permeated by the *cytoskeleton*, which is the main architectural support of the cell.

Microfilaments are threads of the protein *actin*. They are usually situated in bundles just beneath the cell surface and play a role in endo- and exocytosis, and possibly in cell motility.

Plasmalemma (plasmamembrane) is the surface of the cell and represents its contact with its environment. It is differentially permeable and regulates the movement of solutes between the cell and its environment. There are many specializations of the membrane, often concerning its protein content.

