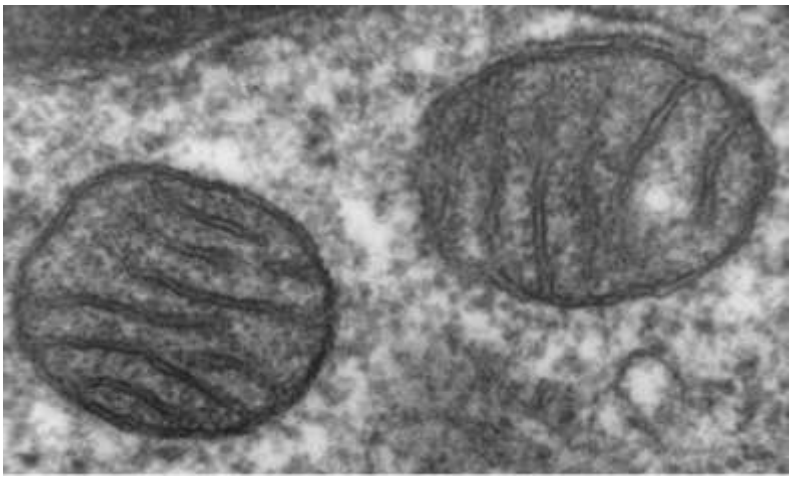
Mitochondrion::

In cell biology, a mitochondrion (plural mitochondria) is a membrane-enclosed organelle found in most eukaryotic cells. These organelles range from 0.5 to 1.0 μm in diameter. Mitochondria are sometimes described as "cellular power houses" because they generate most of the cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy. Mitochondria have been implicated in several human diseases, including mitochondrial disorders and cardiac dysfunction, and may play a role in the aging process.



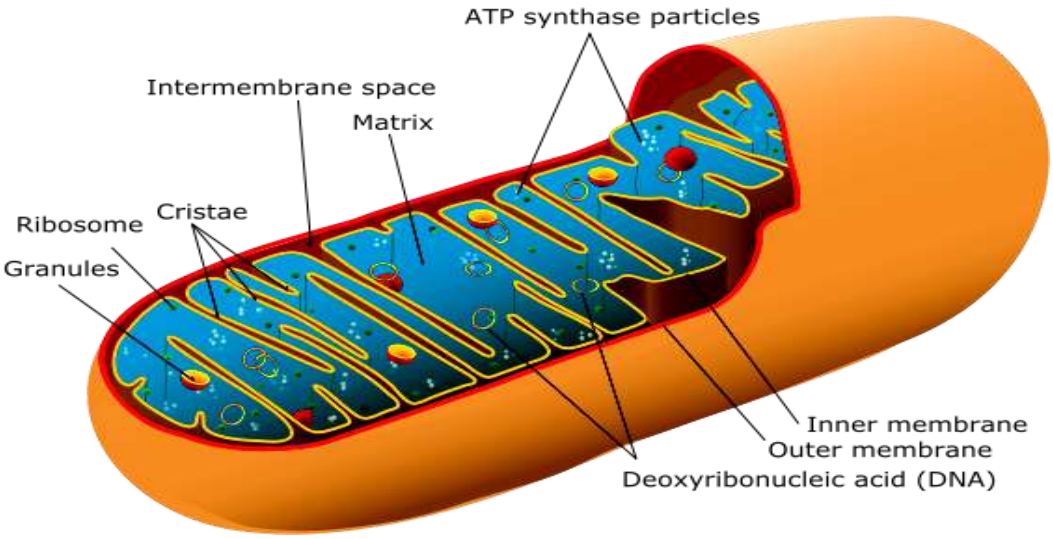
Two mitochondria from mammalian lung tissue displaying their matrix and membranes as shown by electron microscopy.

Several characteristics make mitochondria unique. The number of mitochondria in a cell varies widely by organism and tissue type. Many cells have only a single mitochondrion, whereas others can contain several thousand mitochondria. The organelle is composed of compartments that carry out specialized functions. These compartments or regions include the outer membrane, the intermembrane space, the inner membrane, and the cristae and matrix. Mitochondrial proteins vary depending on the tissue and the species. In humans, 615 distinct types of proteins have been identified from cardiac mitochondria, whereas in rats, 940 proteins encoded by distinct genes have been reported. Although most of a cell's DNA is contained in the cell nucleus, the mitochondrion has its own independent genome. Further, its DNA shows substantial similarity to bacterial genomes.

Structure:

A mitochondrion contains outer and inner membranes composed of phospholipid bilayers and proteins. The two membranes have different properties. Because of this double-membraned organization, there are five distinct parts to a mitochondrion. They are:

1. the outer mitochondrial membrane,
2. the intermembrane space (the space between the outer and inner membranes),
3. the inner mitochondrial membrane,
4. the cristae (formed by infoldings of the inner membrane).
5. the matrix (space within the inner membrane).



The matrix is the space enclosed by the inner membrane. It contains about 2/3 of the total protein in a mitochondrion. The matrix is important in the production of ATP with the aid of the ATP synthase contained in the inner membrane. The matrix contains a highly-concentrated mixture of hundreds of enzymes, special mitochondrial ribosomes, tRNA, and several copies of the mitochondrial DNA genome. Of the enzymes, the major functions include oxidation of pyruvate and fatty acids, and the citric acid cycle.

Function::

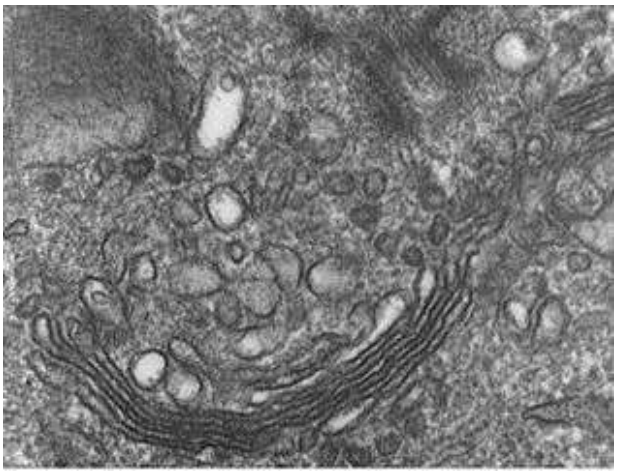
The most prominent roles of mitochondria are to produce the energy currency of the cell, ATP (i.e., phosphorylation of ADP), through respiration, and to regulate cellular metabolism. The central set of

reactions involved in ATP production are collectively known as the citric acid cycle, or the Krebs Cycle. However, the mitochondrion has many other functions in addition to the production of ATP.

- Regulation of the membrane potential
- Apoptosis-programmed cell death.
- Regulation of cellular metabolism.
- Certain heme synthesis reactions.
- Steroid synthesis.
- Some mitochondrial functions are performed only in specific types of cells. For example, mitochondria in liver cells contain enzymes that allow them to detoxify ammonia, a waste product of protein metabolism.

Golgi apparatus

The Golgi apparatus, also known as the Golgi complex, Golgi body, or simply the Golgi, is an organelle found in most eukaryotic cells.
Part of the cellular endomembrane system, the Golgi apparatus packages proteins inside the cell before they are sent to their destination; it is particularly important in the processing of proteins for secretion.



Electron micrograph of Golgi apparatus, visible as a stack of semicircular black rings near the bottom. Numerous circular vesicles can be seen in proximity to the organelle.

Structure::

Golgi is composed of stacks of membrane-bound structures known as cisternae (singular: *cisterna*). A mammalian cell typically contains 40 to 100 stacks. The cisternae stack has four functional regions: the cis-Golgi network, medial-Golgi, endo- Golgi, and trans-Golgi network. Vesicles from the endoplasmic reticulum fuse with the network and subsequently progress through the stack to the trans Golgi network, where they are packaged and sent to their destination. Each region contains different enzymes which selectively modify the contents depending on where they

reside. The cisternae also carry structural proteins important for their maintenance as flattened membranes which stack upon each other.

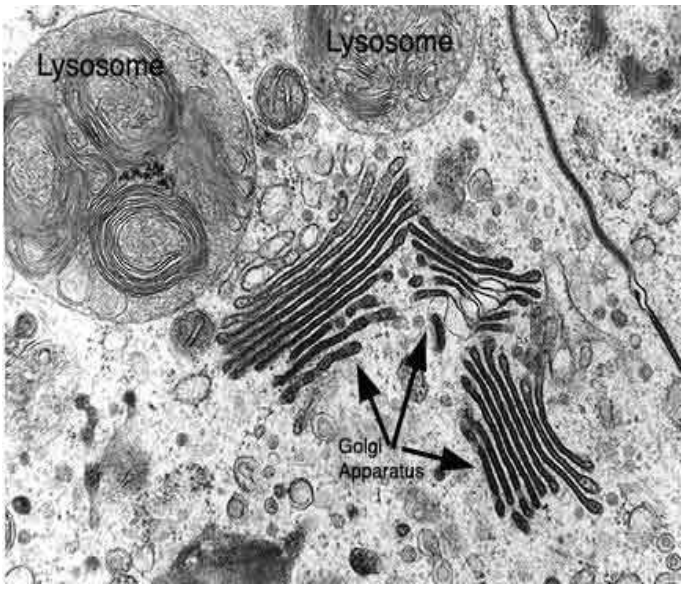
Function::

Cells synthesize a large number of different macromolecules. The Golgi apparatus is integral in modifying, sorting, and packaging these macromolecules for cell secretion· (exocytosis) or use within the cell. It primarily modifies proteins delivered from the rough endoplasmic reticulum but is also involved in the transport of lipids around the cell, and the creation of lysosomes. In this respect it can be thought of as similar to a post office; it packages and labels items which it then sends to different parts of the cell. Enzymes within the cisternae are able to modify the proteins by addition of carbohydrates (glycosylation) and phosphates (phosphorylation).

Lysosomes:::

Lysosomes are cellular organelles that contain acid hydrolase enzymes that break down waste materials and cellular debris. They can be described as the stomach of the cell. They are found in animal cells, while their existence in yeasts and plants are disputed. Some biologists say the same roles are performed by lytic vacuoles, while others suggest there is strong evidence that lysosomes are indeed in some plant cells. Lysosomes digest excess or worn-out organelles, food particles, and engulf viruses or bacteria. The membrane around a lysosome allows the digestive enzymes to work at the 5 pH they require. Lysosomes fuse with vacuoles and dispense their enzymes into the vacuoles, digesting their contents. They are created by the addition of hydrolytic enzymes to early endosomes from the Golgi apparatus. The name *lysosome* derives from the Greek words lysis, *to separate*, and soma, *body*. They are frequently nicknamed "suicide-bags" or "suicide-sacs" by cell biologists due to their autolysis.

The size of a lysosome varies from 0.1–1.2 μm. At pH 4.8, the interior of the lysosomes is acidic compared to the slightly basic cytosol (pH 7.2). The lysosome maintains this pH differential by pumping protons (H^+ ions) from the cytosol across the membrane via proton pumps and chloride ion channels. The lysosomal membrane protects the cytosol, and therefore the rest of the cell, from the degradative enzymes within the lysosome. The cell is additionally protected from any lysosomal acid hydrolases that drain into the cytosol, as these enzymes are pH-sensitive and do not function well or at all in the alkaline environment of the cytosol.This ensures that cytosolic molecules and organelles are not lysed in case there is leakage of the hydrolytic enzymes from the lysosome.



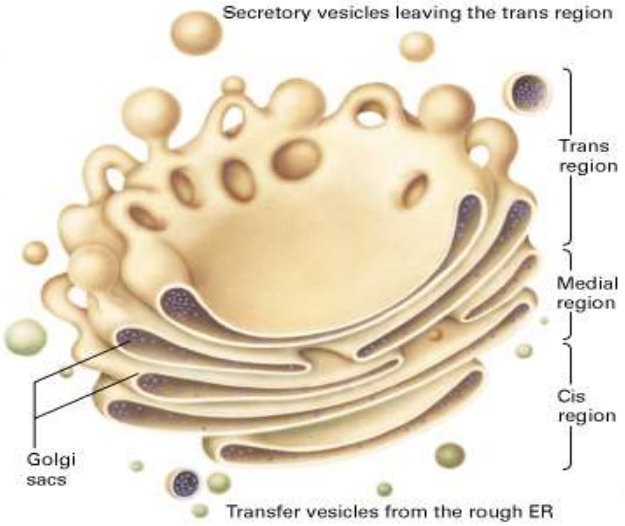
Endoplasmic Reteculum::

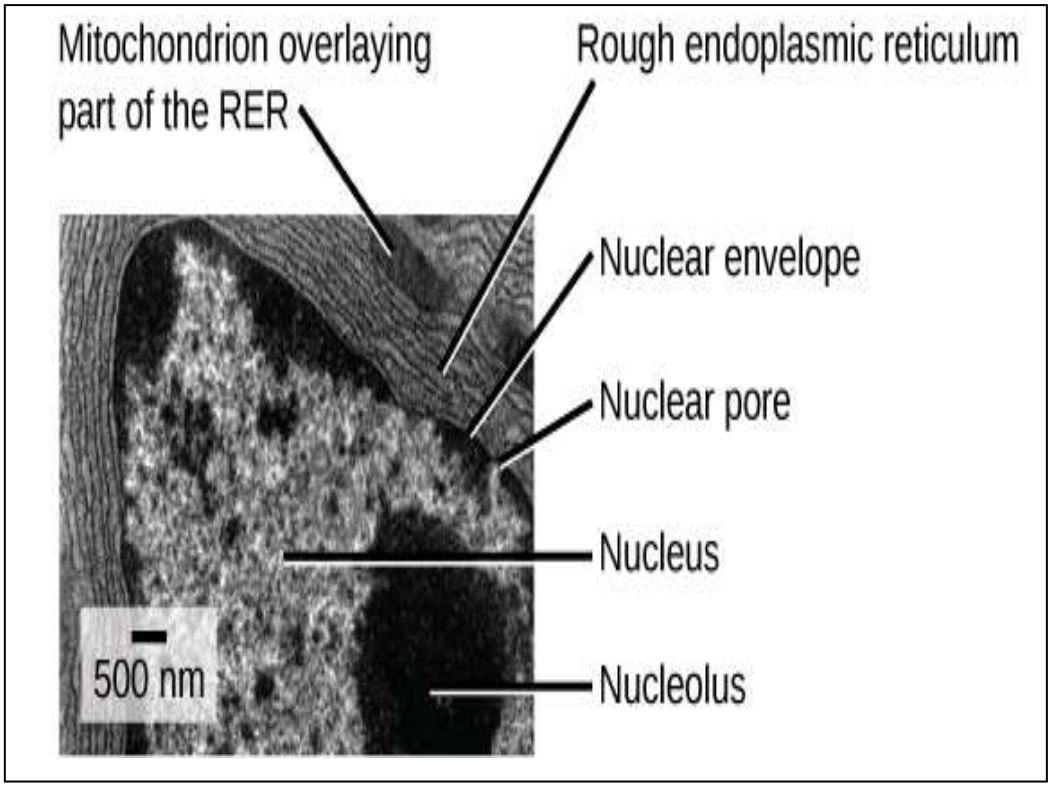
The endoplasmic reticulum (ER) is an organelle of cells in eukaryotic organisms that forms an interconnected network of tubules, vesicles, and cisternae. The rough endoplasmic reticulum is involved in the synthesis of proteins and is also a membrane factory for the cell, while smooth endoplasmic reticula are involved in the synthesis of lipids, including oils, phospholipids and steroids, metabolizing of carbohydrates, regulation of calcium concentration and detoxification of drugs and poisons.

The sarcoplasmic reticulum (SR), from the Greek *sarx*, ("flesh"), is smooth ER found in smooth and striated muscle. The only structural difference between this organelle and the smooth ER is the medley of proteins they have.

The general structure of the endoplasmic reticulum is a membranous network of cisternae (sac-like structures) held together by the cytoskeleton. The phospholipid membrane encloses a space, the cisternal space (or lumen), which is continuous with the perinuclear space but separate from the cytosol.

The membrane of the RER forms large double membrane sheets that are located near, and continuous with the outer layer of the nuclear envelope. Although there is no continuous membrane between the RER and the Golgi apparatus, membrane-bound vesicles shuttle proteins between these two compartments.


Secretory vesicles leaving the trans region
Trans region
Medial region
Cis region
Golgi sacs
Transfer vesicles from the rough ER


Mitochondrion overlaying part of the RER
Rough endoplasmic reticulum
Nuclear envelope
Nuclear pore
Nucleus
Nucleolus
500 nm