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HISTOLOGY

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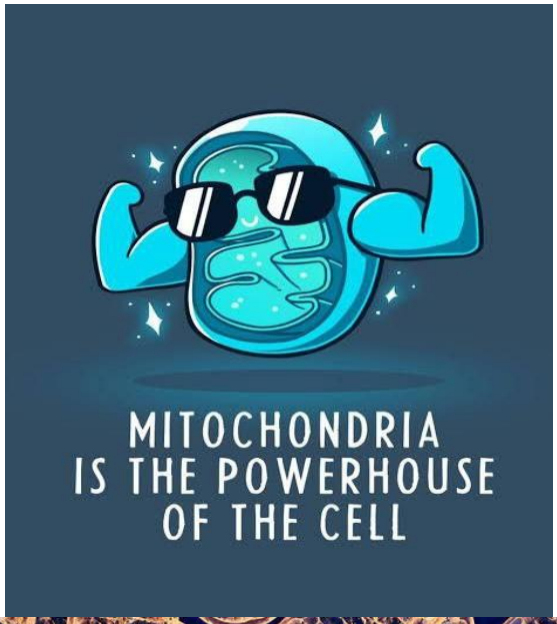
MITOCHONDRIA

What Are MITOCHONDRIA?

Mitochondria are the powerhouse of cells as they generate energy for cell functioning.The structure of mitochondria is unique.The mitochondrion is a rod or sausage-shaped structure found in animal and plant cells. It is a small organelle whose size is between 0.5 to 1 micrometre in diameter. Hence, it cannot be seen under a microscope unless stained.Unlike other organelles, it has two layers; inner and outer. Each layer performs different functions. Let us understand the structure with the mitochondria diagram.



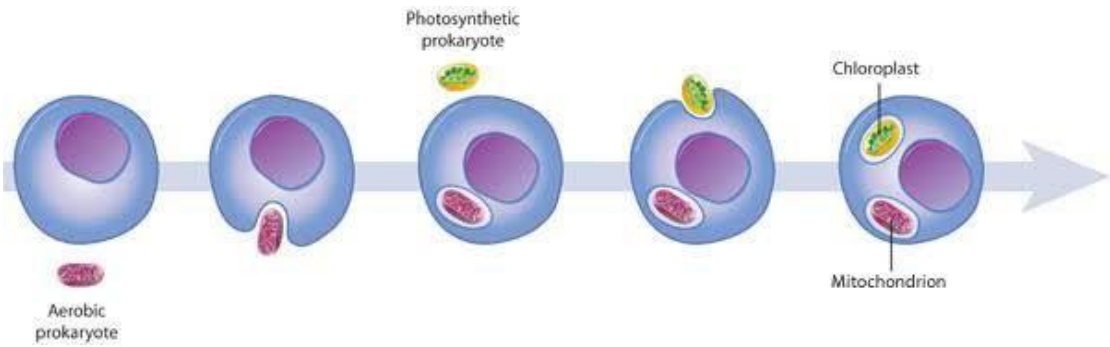
Origin of mitochondria

•Mitochondria are derived from bacteria by a process termed as endosymbiosis.

•Mitochondria arose about 2 billion years ago when a bacterium fused with an archael cell or established a symbiotic relationship with a primitive eukaryotic cell.

•The closest extant relatives of Bacteria that gave rise to mitochondria are Rickettsia.

•The first person to recognise mitochondria as descendents of endosymbiotic bacteria was Ivan



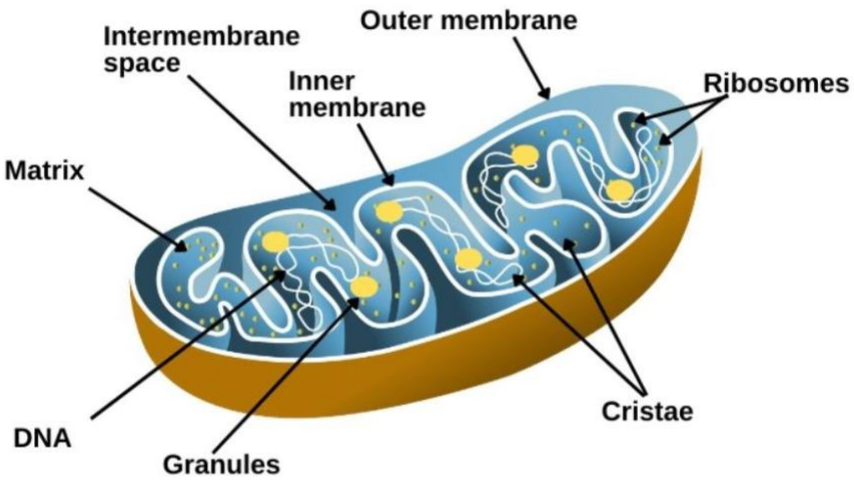
Mitochondria Structure

Outer Membrane - It is made of proteins. The membrane allows small protein-like molecules to pass through it.

Intermembrane Space - It is the space between outer and inner membranes.

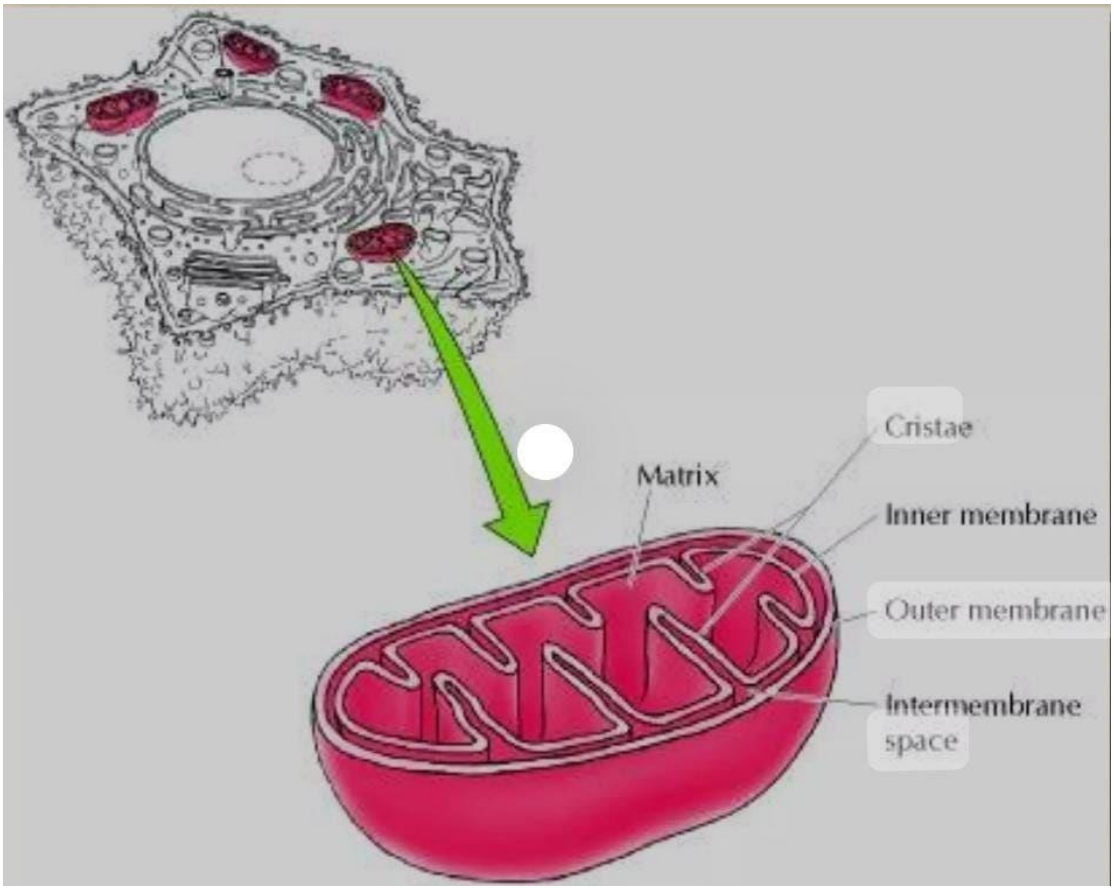
Inner Membrane - This membrane is made of phospholipids and does not allow molecules to pass through it. Special transporters (carrier molecules) are required to transport substances. Here, ATP production takes place.

Cristae - These are the irregular folds of the inner membrane. They increase the space for chemical reactions to take place by increasing the surface area of the membrane.



Matrix - It is fluid within the inner membrane. This fluid has several enzymes required for ATP production. It also contains ribosomes, mitochondrial DNA, inorganic and organic molecules, etc.

•It is the space filled with fluid enclosed by the inner membrane.
•Gel like consistency Dense, homogenous.
•Contains 2/3 rd of total protein of mitochondria.
•It contains proteins, lipids, some ribosomes, RNA, one or two DNA molecules and certain fibrils, crystals and dense granules
•The matrix is important in the production of ATP with the aid of the ATP synthase contained in the inner membane.
•Major enzymes include enzymes involved in
- Synthesis of nucleic acid and proteins.
- Fatty acid oxidation.



Function of Mitochondria

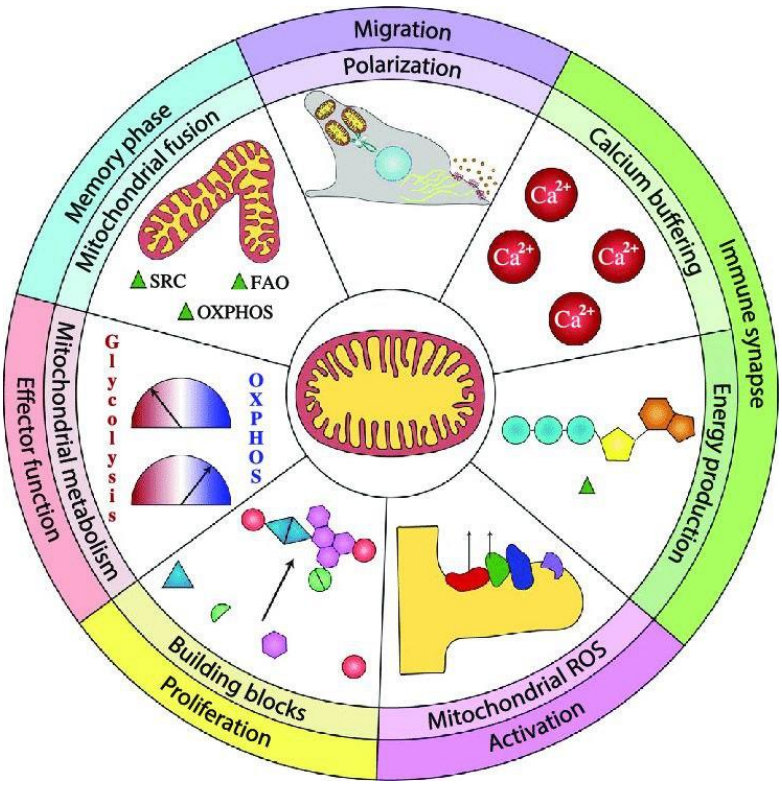
The most common function of Mitochondria is energy generation. However, it performs several other vital functions of the body. These include the following.

Energy Generation- Mitochondria help produce ATP molecules which are the energy units of cells. Most energy production takes place in the cristae or folds of the inner membrane. It generates energy by converting chemical energy from food.

Cell Death- Apoptosis or cell death is an essential part of the regeneration of new cells. As cells damage or become old, they are destroyed by the mitochondria, and new cells are formed. It releases enzymes like Cytochrome C, which helps in cell degeneration.

Heat Production- In extreme colds, the body generates its heat by utilising tissue fat. Mitochondria release energy in the form of heat in cold climatic conditions.

Storing Calcium- Calcium is involved in several cellular processes. For example, releasing neurotransmitters for nerve conduction and muscle movement, blood clotting, fertilisation, hormone signalling, steroid synthesis, and cellular metabolism. As calcium is so important for the body, cells regulate it tightly. Mitochondria help in the absorption of calcium ions and store them until they are used.



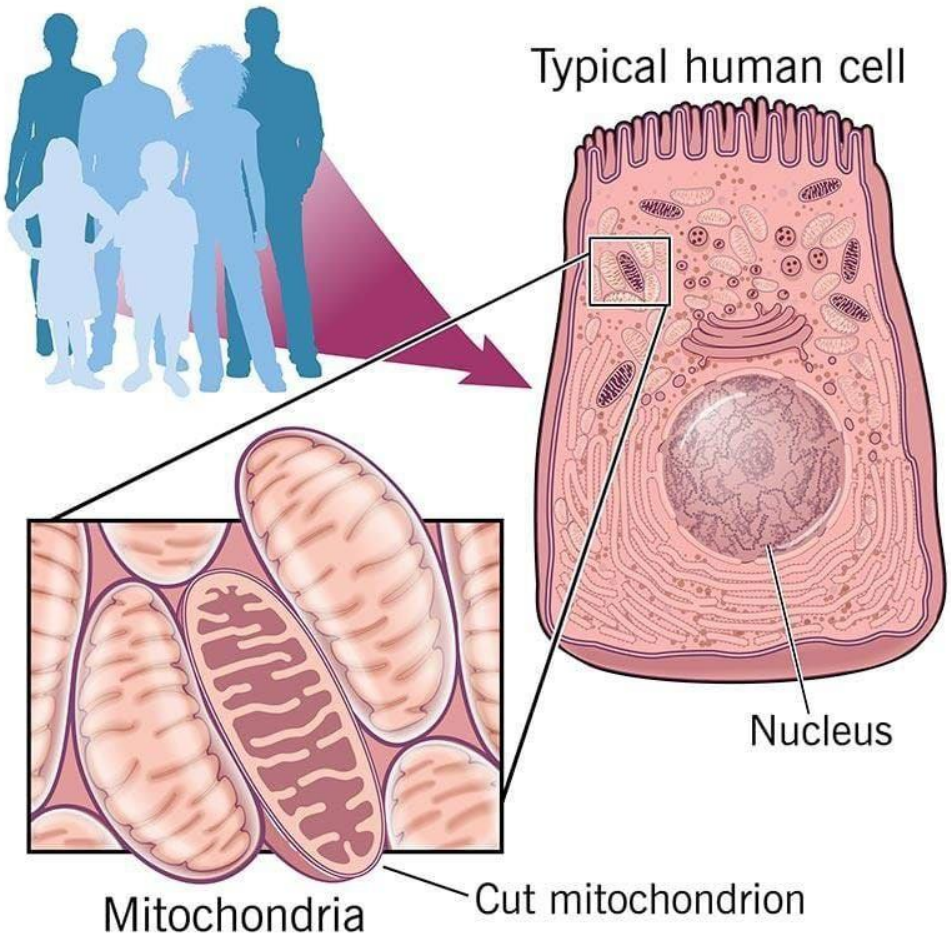
Mitochondrial Diseases

Mitochondrial diseases are chronic (long-term), genetic, often inherited disorders that occur when mitochondria fail to produce enough energy for the body to function properly. (Inherited means the disorder was passed on from parents to children.) Mitochondrial diseases can be present at birth, but can also occur at any age.

Mitochondrial diseases can affect almost any part of the body, including the cells of the brain, nerves, muscles, kidneys, heart, liver, eyes, ears or pancreas.

Mitochondrial dysfunction occurs when the mitochondria don't work as well as they should due to another disease or condition. Many conditions can lead to secondary mitochondrial dysfunction and affect other diseases, including:

Alzheimer's disease.
Muscular dystrophy.
Lou Gehrig's disease.
Diabetes.
Cancer.



Mitochondrial DNA

Mitochondrial DNA (mtDNA or mDNA)[3] is the DNA located in mitochondria, cellular organelles within eukaryotic cells that convert chemical energy from food into a form that cells can use, such as adenosine triphosphate (ATP). Mitochondrial DNA is only a small portion of the DNA in a eukaryotic cell; most of the DNA can be found in the cell nucleus and, in plants and algae, also in plastids such as chloroplasts Mitochondrial DNA is the small circular chromosome found inside mitochondria. These organelles, found in all eukaryotic cells, are the powerhouse of the cell.[1] The mitochondria, and thus mitochondrial DNA, are passed exclusively from mother to offspring through the egg cell.