

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (First Year)

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Paper Title: Diversity of Non-Chordates and Cell Biology

Unit: 12

Module Name: Mitochondria - Structure

Module No: 32

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Notes

Mitochondria : Structure

Mitochondria are one of the very important cell organelles present in the cell cytoplasm. They are found to be present in all the eukaryotic cells.

Mitochondria were first observed as granular structures in striated muscle by Kolliker in the year 1850. These granular structures were later named as “Mitochondria” by Benda in 1998.

Morphology of Mitochondria

The morphology of mitochondria generally varies with the cell type in which it is present. The mitochondria found in similar type of cells or cell having similar function are found to exhibit more or less same morphological features.

Shape and Size - Mitochondria are usually granular or filamentous in shape but at certain functional stages the shape may undergo some changes. The length of mitochondria is 3-4 μm and the diameter ranges from 0.5-1.0 μm .

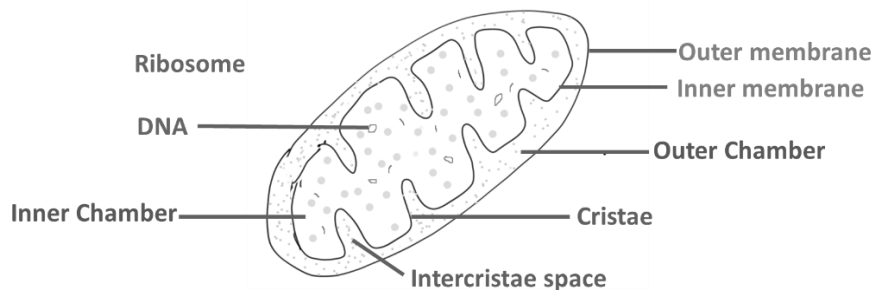
Number - The number of mitochondria in a cell is variable. In Liver cell, 1000 to 1600 mitochondria are present in a single cell. Renal tubules has around 300 to 400 mitochondria.

Sperm cell has only 20 to 24 mitochondria whereas the Oocyte will have around 3,00,000 of mitochondria in the cytoplasm.

Distribution - Mitochondria are usually evenly distributed within the cytoplasm of the cell. But in some cells, they may aggregate near to nucleus or in peripheral cytoplasm. In Sperm cell, the mitochondria are fused to form the neck of the sperm. In Leucocytes, they are radially arranged in the cytoplasm.

Structure of Mitochondria

The ultrastructure of Mitochondria was studied under electron microscope by Palade and Sjostrand in 1940s and 1950s.

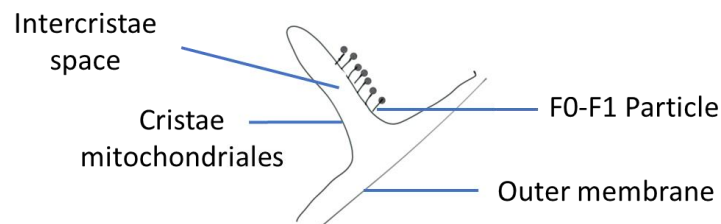


Mitochondrion is double membranous cell organelle present in the cell cytoplasm. The two membranes are named as the Outer mitochondrial membrane and the inner mitochondrial membrane. The space between the two membranes is referred to as Outer Chamber. The space enclosed by the inner membrane is called the Inner Chamber. The inner chamber is filled with a matrix called mitochondrial matrix. Both the membranes are 60-70 Å thick (i.e. 6-7 nm). The outer membrane has more of Phospholipids, Cholesterol in it. Phosphatidyl choline is found to be prominent in the outer membrane. The Protein in the outer membrane constitute 10% of total mitochondrial protein. The Lipid : Protein ratio is 0.8 for outer membrane. Enzymes such as Acetyl CoA synthetase, Hexokinase 2, Choline Phosphotransferase etc. are present in the Outer membrane, which are not associated with electron transfer and oxidative phosphorylation

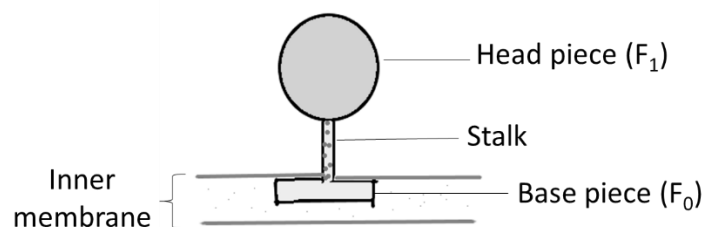
The Inner membrane has lipids such as Di-phosphatidyl glycerol (Cardiolipin) more prominent in it. The Protein in the inner membrane constitute around 60% of total mitochondrial protein. The Lipid : Protein ratio is less than the outer membrane i.e. 0.3 indicating the membrane has more of protein content. Various enzymes associated with

electron transfer and oxidative phosphorylation such as ATPase, Cytochrome oxidase, Succinate dehydrogenase etc. are found to be present in the inner mitochondrial membrane.

The inner membrane is thrown into a number of folds called mitochondrial crests or Cristae mitochondriales. The side of the inner membrane facing the mitochondrial matrix is called M-side and the side facing the outer chamber is called C-side of Inner membrane.



On the M-side of the inner mitochondrial membrane, there is presence of several small stalked particles with uniform spacing. These are Subunits of Fernandez-Moron / F₀-F₁ complex / ATPase complex. Each Subunit of Fernandez-Moron consist of a Head piece (F₁) having ATPase proper (ATP synthetase, enzyme involved in ATP synthesis); Stalk consisting of Oligomycin sensitivity conferring protein (OSCP) and a Base piece (F₀) consisting of a Proton channel for transport of protons (H⁺) across the inner membrane.



Subunit of Fernandez-Moron

The mitochondrial matrix is generally homogeneous, but may contain finely filamentous material or small, highly dense granules in it. The granules are made up of insoluble inorganic salts and are binding sites for divalent ions like Ca²⁺ and Mg²⁺. The ribosomes present in the mitochondrial matrix are of 70s type. Two to six circular DNA molecules are found to be present in the mitochondrial matrix. This DNA is referred to as Mitochondrial DNA or maternal DNA. The matrix also has the different enzymes involved in Citric Acid Cycle (TCA cycle / Krebs Cycle).