**Dr. Rima Kumari: Date: 07/09/2020**

Online class and e- content for MSc. IIIrd semester students

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| Date and Time | Online class medium  | E. content topic |
| 07/09/202001:30 p.m to 2.20 p.m | Via Google meetLink: Meeting URL: https://meet.google.com/oto-cqax-fot | **Mitochondria** |

**Mitochondria**

Mitochondria are commonly known as the "power house" of cells. The popular term "powerhouse of the cell" was coined by [Philip Siekevitz](https://en.wikipedia.org/wiki/Philip_Siekevitz) in 1957 . These are the distinct organelles of all eucaryotic cells, plants, animal, fungi and some protista. In the cell, mitochondria are the sites of aerobic respiration. They are enclosed by a double membrane. The inner membrane is thrown into folds which are called as **'cristae**'. Oxidative enzymes are located on these cristae. Mitochondria contain circular and naked DNA. They reproduce by fission, like bacteria. In the absence of mitochondria, eucaryotic cells would have to respire anaerobically and they will have to depend on an inefficient process, like glycolysis for their energy needs. It is interesting that mitochondria resemble an aerobic and non-photosynthetic bacterium like Paracoccus. In fact, in one of the eukaryote like Pleomp pcllustris, there are no mitochondria. In this organism, in place of mitochondria there are aerobic bacteria which help the organism in respiration. The association of bacteria with the organism shows a kind of symbiotic (mutual advantage) relationship, wherein bacteria help organism in respiration and in turn bacteria are benefitted by living at the expense of organism permanently. This relationship suggests that mitochondria are procaryotes which have entered the "eucaryotic" cell as endosymbionts, i.e.. they have association inside the cell even before the entry of chloroplasts in the cell, In other words, we can say that mitochondria have evolved earlier than the chloroplasts.

Mitochondria, earlier called bioblasts termed by Richard Altmann,, are found in the cytoplasm of eucaryotic cells and are characterised by specific morphological. biochemical and functional properties. The term "mitochondria" was coined by Carl Benda in 1898. Mitochondria (mito-thread, chondrion- granules) are generally rod shaped elongated structures. They are commonly known as the " power house" of the cell, as they are the sites of ATP (energy currency) production in the cell. Mitochondria are considered to be capable of movement, changing in both shape and position within the cell. The concept of the phosphate bonds of ATP being a form of energy in cellular metabolism was developed by Fritz Albert Lipmann in 194a.  Eugene Kennedy and Albert Lehninger  discovered in 1948 that mitochondria are the site of oxidative phosphorylation in eukaryotes.

The **mitochondrion** is a semi-autonomous double-membrane-bound organelle found in most eukaryotic organisms. Some cells in some multicellular organisms may, however, lack mitochondria (for example, mature mammalian red blood cells). Mitochondria are commonly between 0.75 and 3 [μm](https://en.wikipedia.org/wiki/Micrometre)² in areabut vary considerably in size and structure. Unless specifically stained, they are not visible. A mitochondrion consists of two membranes (outer and inner) and two compartments (outer and inner). The outer three layered membrane and is separated by a space of 6-8 nm from the inner membrane. The inner membrane has a number of infoldings which are called **cristae** or **mitochondrial crests.** Cristae vary in number and shape. Generally they lie parallel to one another, or are stacked on top of each other forming incomplete compartments as in liver cells. The number of cristae depends on metabolic activity of the cell. Mitochondria themselves are often found concentrated in region of high metabolic activity such cells of cardiac muscles, flight muscles of insect and bird etc.

The fluid filled space between the outer and inner membrane is called the **intermembrane space.** The space surrounded by inner membrane is called **mitochondrial matrix.** It isdense and is made-up of proteinaceous material. The matrix is generally homogeneous butsometimes, may contain a fine filamentous material or small dense granules which are thesites for binding of Mg2+ and Ca2+ ions. Matrix is continuous within the mitochondria as thecristae do not divide the inner chamber into separate sections. Matrix contains ribosomes,RNA and one or more molecules of circular DNA; an important characteristic ofmitochondria. It is because of the presence of DNA, RNA and ribosomes that mitochondriaare self replicating and can synthesise some of their own proteins and membrane material.

The enzymes involved in TCA cycle and fatty acid oxidation are found in the matrix.

Oxidation and reduction reactions are specifically associated with the inner membrane of mitochondria which brings about the conversion of ADP to ATP.

Cristae appear to be covered with mushroom-like particles, called as **F1** particles,

elementary particles or **oxysomes**. These particles are small stalked sphere-like structures containing an enzyme, ATPase, involved in oxidative phosphorylation. F, particles cannot be seen in the intact mirochondria as they are an integral part of the inner membrane. Since the inner membrane of the mitochondria is the site of ATP production in the cell, greater the number of cristae, the larger the surface area for ATP production.

The structure of mitochondria changes according to the physiological activity occurring- in the organelle. If the external ADP content is low or the respiratory chain is inhibited, the mitochondria are seen in orthodox state or inactive state. In this state, matrix occupies a larger area of the mitochondria and consequently the outer chamber becomes small. Howwever. if ADP is added to the medium, there is a sudden contraction of the inner compartment. This is called the condensed state, i.e. when mitochondria are actively involved in phosphorylation and electron transport. In the condensed state, the cristae are more randomly distributed and the intemembrane space remains greatly enlarged.

