

E content for B.Sc. Second semester

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**Mitochondria : The Power House of Cell**

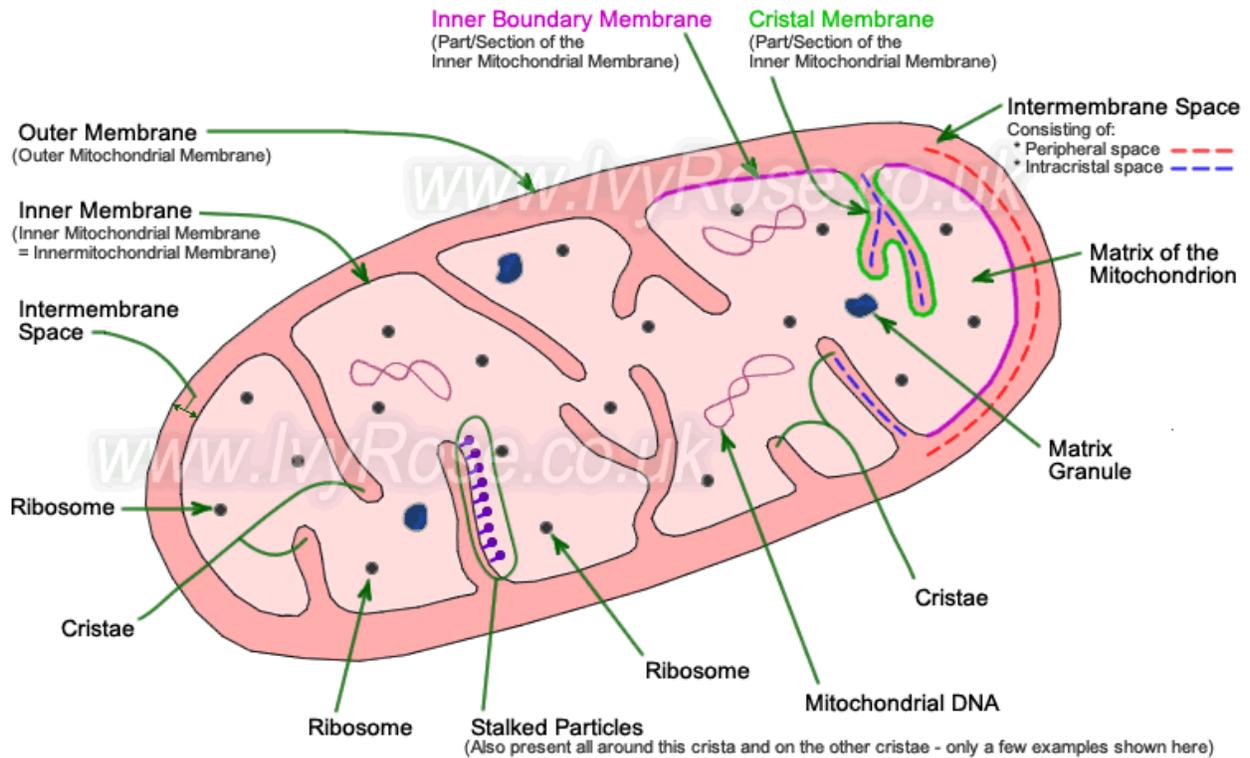


Diagram of a Mitochondrion: Copyright IvyRose Ltd., 2012.

## **Discovery and Exceptions**

Mitochondria, the power house of the cell was first observed as rod like structure in insects muscle cells by Kolliker in 1850.

Flemming named it Fila in 1882.

Richard Altman later termed it as bio blasts or altman granules in 1890.

It was Benda who stained them in alizarin and crystal violet stain and assigned it the present name mitochondria in 1897-98.

Michaelis used the specific stain Janus B green to stain the mitochondria.

Mitochondria are the seat for cellular respiration in all eukaryotic cells where aerobic respiration takes place.

Normally there are 10-12 mitochondria in a normal cell, however Concentration of mitochondria has a functional significance, they are more numerous in cells where continuous flow of energy is required.

Their number varies according to the their metabolic need in a cell . eg.

Mammalian liver cells has 900 to 1000 and Kidney cells has 300 mitochondria.

Giant Amoeba Chaos chaos contains as many as 50.000 mitochondria.

### **Structure**

Mitochondria are found in almost all eukaryotic cells where aerobic respiration takes place except mature erythrocytes.

They are double membrane rod or filamentous structure. Lying in the cytoplasm.

Their size varies normally they are 0.5 micron to 2 micron in diameter and about 40 micron long.

Outer membrane followed by inter membranal space and inner membrane.

Outer membrane is selectively permeable to ions and small molecules.

Outer membrane has a protein called porin which forms an aqueous channel through which proteins up to 10,000 daltons can pass through it and reaches inter membranal space of mitochondria.

Inner membrane is thrown into folding called cristae, it increases the surface area for metabolic activities.

Cristae are the site for oxysomes or F1 particles or elementary particles where oxidative phosphorylation takes place.

Oxysomes or f1 particles were discovered by Fernandez Moran.

The space within inner membrane of mitochondria is filled with jelly like matrix.

In the matrix enzymes of Krebs cycle are found i.e. Krebs cycle takes place in the matrix of mitochondria.

Matrix of mitochondria contains prokaryotic DNA and 70s ribosome which reveals its prokaryotic ancestors.

Sometime during development single membrane mitochondria are produced which are called mitoplast. However, functionally they are similar to double membrane mitochondria.

## **FUNCTIONS**

There are 5 functions attributed to mitochondria

## **1. ATP Production**

Mitochondria well known function is the production of ATP, the energy currency of cell through TCA or Krebs cycle and oxidative phosphorylation. Krebs cycle takes place in the matrix of mitochondria.

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Oxidative phosphorylation takes place on tennis racket like particles called F1 particles or elementary particles found on the cristae of mitochondria.

When one molecules of glucose breaks down aerobically, there is a net gain of 32 ATPs.

Most of the ATP comes from oxidative phosphorylation.

This process is very much crucial for the proper functioning of the cell and its dysfunction leads to variety of diseases ranging from heart disease to parkinsons disease.

## **2. Calcium Homoeostasis**

Flow of calcium in and out of cells mitochondria , a process important in regulation of cell death.

Recent studies suggests that mitochondrion plays vital role in heart functioning and dys functioning.

### **3. Regulation of Innate Immunity**

Innate immunity is the in born system which recognizes and responds to the infections caused by the pathogens, and provides immediate non specific defense to an individual.

Mitochondrial antiviral signaling protein (MAVS) plays a key role in the innate response to the viral infections and helps to induce antiviral and anti inflammatory pathways. Disruption of MAVS may leads to the break down in the immune system.

### **4. Apoptosis ( Programmed cell death)**

Apoptosis is the highly controlled process of programmed cell death.

Apoptosis is used by multicellular organisms in a number of biological processes such as mopping up damaged cells and maintaining cell numbers.

Mitochondria releases protei cytochrome C from inter membranal space in response to cell stresses like hypoxia, heat, infection, increased calcium and nutrient deprivation. Disturbances to this regulation leads to the development of diseases like cancer and tissue damage followed by stroke.

### **5. Stem cell Regulation**

Mitochondria thought to play an important role in the maintenance of pluripotency, differentiation and re programming of induced pluripotent stem cells.

The generation of Reactive Oxygen Species (ROS) by mitochondria has been shown to control somatic stem cells.

