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Mitochondria

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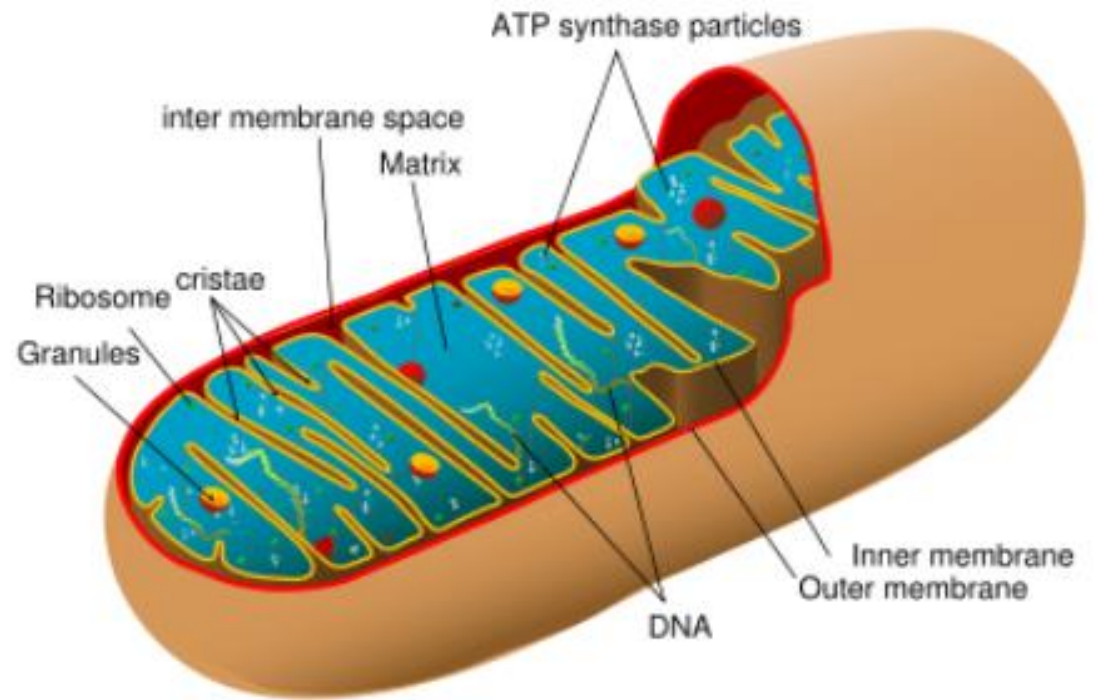
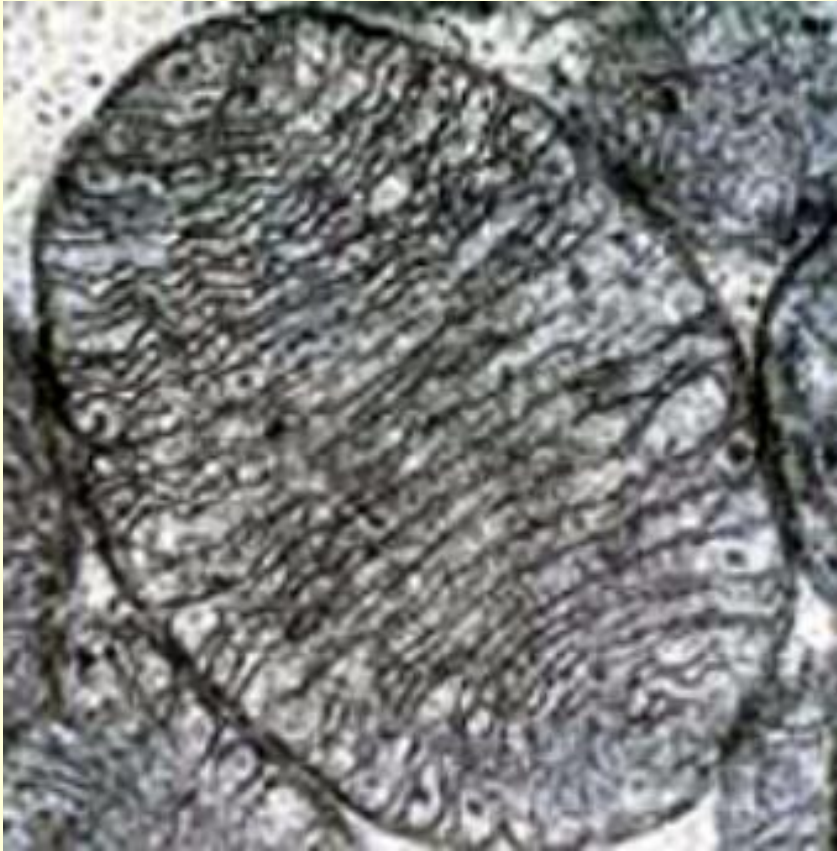
Introduction

- Mitochondria were first seen by **kollicker** in 1850 in muscles and called them '**sarcosomes**'
- **Flemming** (1882) described these organelles as '**fila a**'
- **Altmann** (1890) observed these structures and named them '**bioblasts**'.
- **Benda** (1898) stained these organelles with **crystal violet** and renamed them '**mitochondria**'
- **Michaelis** (1900) used **janus green B** as a vital stain to observe mitochondria in living cells.

Morphology

- The shape of mitochondria is highly variable ranges from short rod shape to elongate filamentous form .
- The size of mitochondria is variable ,they generally measures about 0.5 to 2um in diameter.
- Mitochondria have an average length of 3 to 4um.
- The number of mitochondria varies from one cell type to another.
- Mitochondria are not found in prokaryotes.

Structure of Mitochondria



Ultra Structure

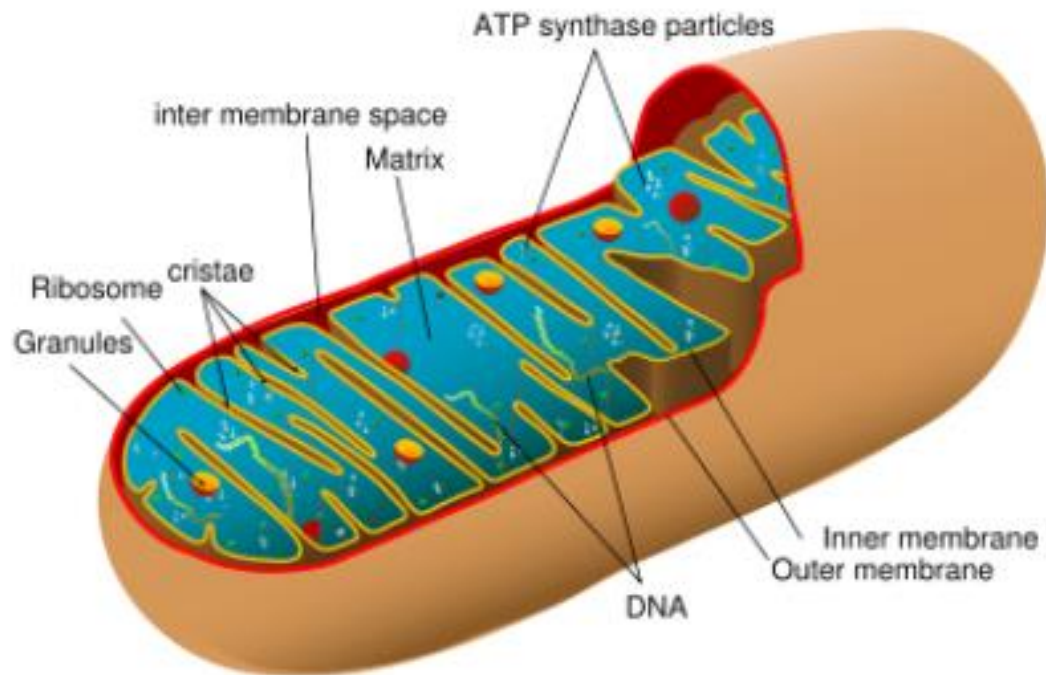
- A mitochondria is enclosed by a double membrane envelope composed of lipid and protein.
- The two membranes are separated by a narrow fluid – filled space called the **outer compartment**.
- The outer membrane is smooth, it is more permeable to small molecules, contains some enzymes but is poorer in proteins.
- The inner membrane surrounds a central cavity or **matrix (inner compartment)** filled with a fluid.
- Folds of inner wall of mitochondria are called **cristae**.

Inner Membrane

- Inner membrane is the site of the e^- transport chain, across which the proton pump occurs and contains ATP synthase.
- Inner membrane is highly folded – called **cris**
ae – increasing the surface area on which the above reactions can take place

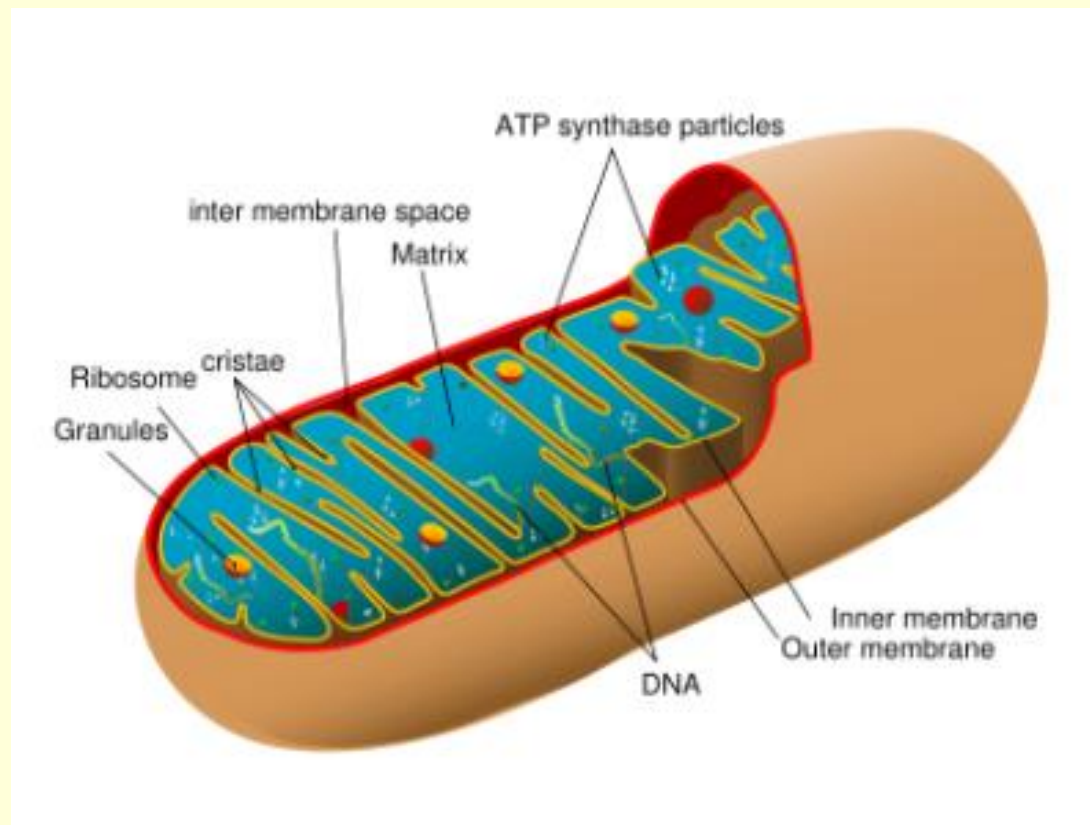
Mitochondrial Inner Membrane

The inner mitochondrial membrane is compartmentalized into numerous cristae, which expand the surface area of the inner mitochondrial membrane, enhancing its ability to generate ATP. In typical liver mitochondria, for example, the surface area, including cristae, is about five times that of the outer membrane. Mitochondria of cells which have greater demand for ATP, such as muscle cells, contain more cristae than typical liver mitochondria.



Mitochondrial Outer Membrane

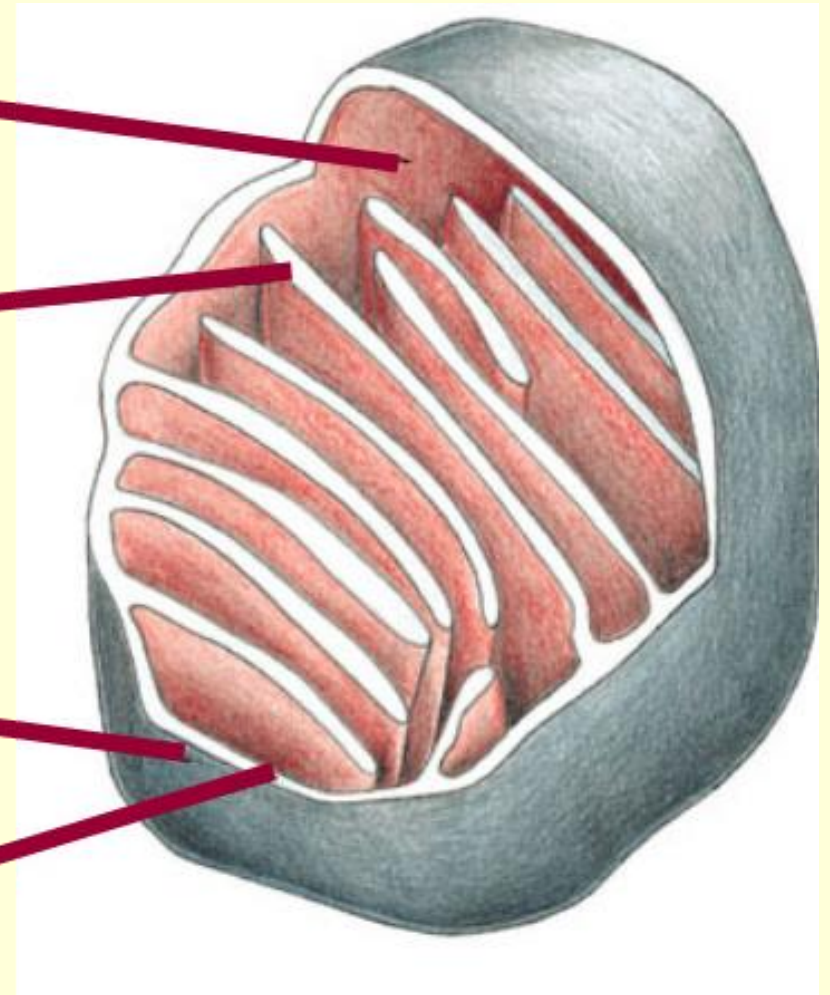
The outer mitochondrial membrane, which encloses the entire organelle, has a protein-to-phospholipid ratio similar to the eukaryotic plasma membrane (about 1:1 by weight). It contains numerous integral proteins called porins, which contain a relatively large internal channel (about 2-3 nm) that is permeable to all molecules of 5000 daltons or less. Larger molecules, for example most proteins, can only traverse the outer membrane by active transport.



Mitochondria

- Double membrane creates 2 spaces
 - Matrix – large internal space
 - Intermembrane space – between the membranes

- Outer membrane
- Inner membrane

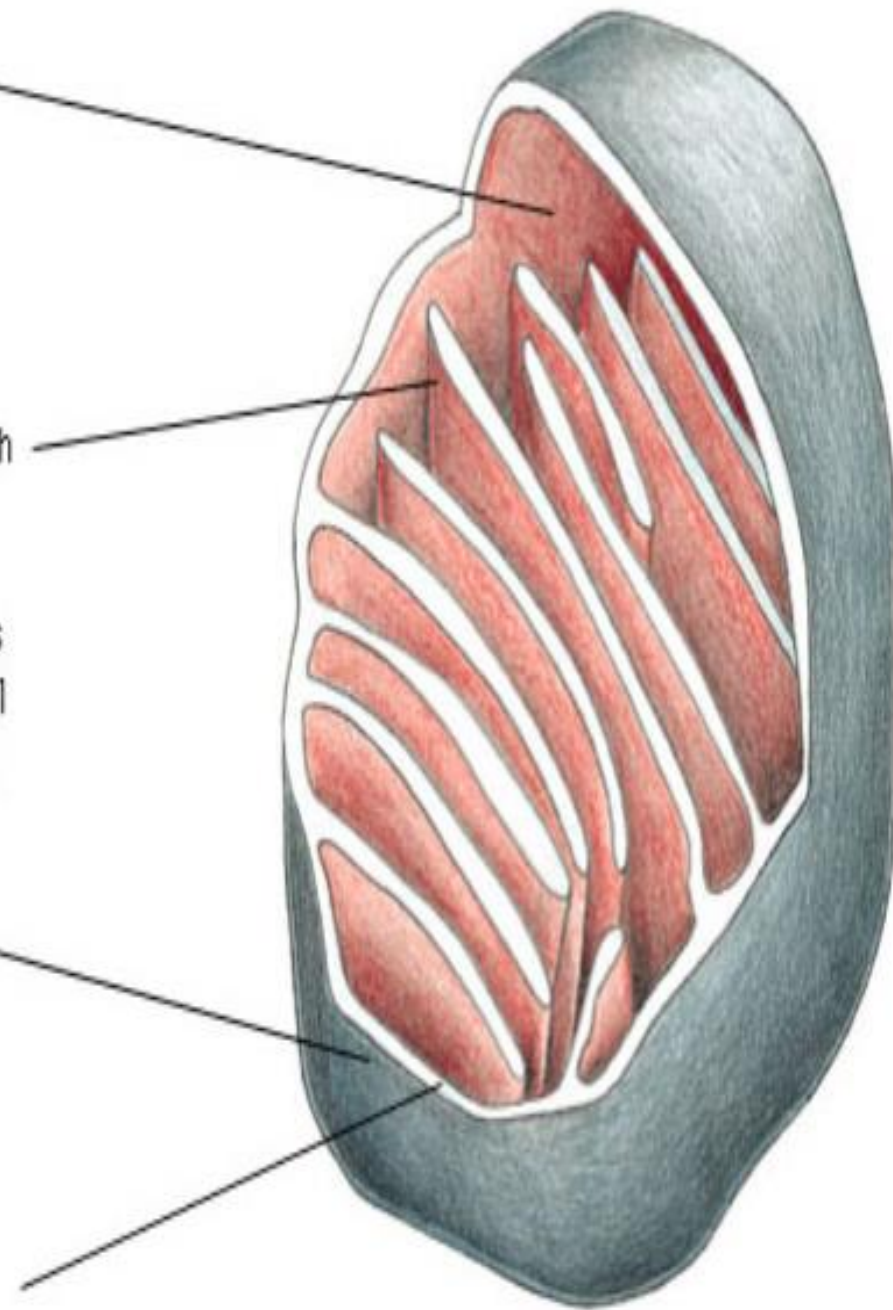


Matrix. This large internal space contains a highly concentrated mixture of hundreds of enzymes, including those required for the oxidation of pyruvate and fatty acids and for the citric acid cycle. The matrix also contains several identical copies of the mitochondrial DNA genome, special mitochondrial ribosomes, tRNAs, and various enzymes required for expression of the mitochondrial genes.

Inner membrane. The inner membrane (*red*) is folded into numerous cristae, which greatly increases its total surface area. It contains proteins with three types of functions: (1) those that carry out the oxidation reactions of the electron-transport chain, (2) the ATP synthase that makes ATP in the matrix, and (3) transport proteins that allow the passage of metabolites into and out of the matrix. An electrochemical gradient of H^+ , which drives the ATP synthase, is established across this membrane, and so it must be impermeable to ions and most small charged molecules.

Outer membrane. Because it contains a large channel-forming protein (called porin), the outer membrane is permeable to all molecules of 5000 daltons or less. Other proteins in this membrane include enzymes involved in mitochondrial lipid synthesis and enzymes that convert lipid substrates into forms that are subsequently metabolized in the matrix.

Intermembrane space. This space (*white*) contains several enzymes that use the ATP passing out of the matrix to phosphorylate other nucleotides.



Chemical Composition

- Mitochondria consists of protein-70 percent & lipids -25 -30percent.
- Mitochondria contain 0.5percent of RNA & traces of DNA .
- Mitochondrial DNA comprises about 1 percent of total cell DNA
- Mitochondria contain enzymes for oxidation phosphorylation & electron transfer.

Mitochondria

- Produce most of a cell's ATP – acetyl groups in the Krebs cycle producing CO_2 and NADH.
- NADH donates the e^- to the electron transport chain and becomes oxidized to NAD^+
- e^- transfer promotes proton pump and ATP synthesis in process called **oxidative phosphorylation**
- Cells that require large amounts of energy such as the heart have large numbers of mitochondria

Mitochondria

- Contain their own copies of DNA and RNA along with transcription and translation system (ribosomes)
- Are able to regenerate themselves without the whole cell undergoing division
- Shape and size dependent on what the cell's function is

THANK

YOU