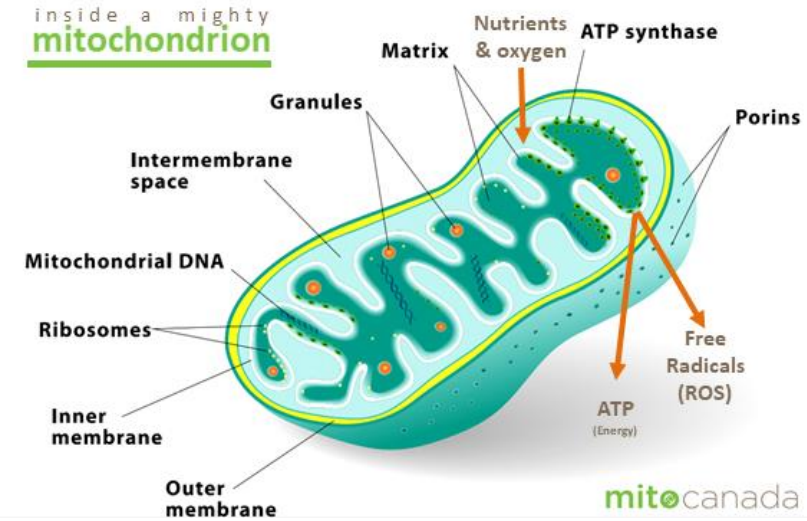
Mitochondria



Mitochondria Definition

Mitochondria (singular: mitochondrion) are organelles within eukaryotic cells that produce adenosine triphosphate (ATP), the main energy molecule used by the cell. For this reason, the mitochondrion is sometimes referred to as "the powerhouse of the cell". Mitochondria are found in all eukaryotes, which are all living things that are not bacteria or archaea. It is thought that mitochondria arose from once free-living bacteria that were incorporated into cells.

- Mitochondria are commonly between 0.75 and 3 μm² in area but vary considerably in size and structure.

Mitochondria Location

- cells with high energy requirements: Muscle, sperm tail, flagella
- generally located where energy consumption is highest in the cell
- Mitochondria (fibroblasts)
- Mitochondria (sperm)
- Energy for sperm motility, microtubules (9+2)

Structure

A mitochondrion contains outer and inner membranes composed of phospholipid bilayers and proteins.[17] The two membranes have different properties. Because of this double-membraned organization, there are five distinct parts to a mitochondrion.

They are:

1. the **outer mitochondrial membrane**,
2. the **intermembrane space** (the space between the outer and inner membranes),
3. the **inner mitochondrial membrane,**
4. the **cristae space** (formed by infoldings of the inner membrane), and
5. the **matrix** (space within the inner membrane).

The **outer mitochondrial membrane**, which encloses the entire organelle, is 60 to 75 Å thick. It has a protein-to-phospholipid ratio similar to that of the cell membrane (about 1:1 by weight). It contains large numbers of integral membrane proteins called **porins** which allow movement of ions into and out of the mitochondrion.

The outer membrane also contains enzymes involved in such diverse activities as the elongation of fatty acids, oxidation of epinephrine, and the degradation of tryptophan. These enzymes include monoamine oxidase, rotenone-insensitive NADH-cytochrome c-reductase, and fatty acid Co-A ligase.

Intermembrane space

The **mitochondrial intermembrane space** is the space between the outer membrane and the inner membrane. It is also known as perimitochondrial space. Because the outer membrane is freely permeable to small molecules, the concentrations of small molecules, such as ions and sugars, in the intermembrane space is the same as in the cytosol.

Inner membrane

The **inner membrane** folds over many times and creates layered structures called **cristae**. The folding of the inner membrane increases the surface area inside the organelle. Since many of the chemical reactions happen on the inner membrane, the increased surface area creates more space for reactions to occur.

Unlike the outer membrane, the inner membrane does not contain porins, and is highly impermeable to all molecules. Almost all ions and molecules require special membrane transporters to enter or exit the matrix.

The inner mitochondrial membrane contains proteins with following functions:

1. Those that perform the redox reactions of oxidative phosphorylation
2. ATP synthase, which generates ATP in the matrix
3. Specific transport proteins that regulate metabolite passage into and out of the mitochondrial matrix
4. Protein import machinery

Matrix

The matrix is the space enclosed by the inner membrane. It contains about 2/3 of the total proteins in a mitochondrion. The matrix is important in the production of ATP with the aid of the ATP synthase contained in the inner membrane. The matrix contains a highly concentrated mixture of hundreds of enzymes, special mitochondrial ribosomes, tRNA, and several copies of the mitochondrial DNA genome.

Mitochondria have their own genetic material, and the machinery to manufacture their own RNAs and proteins

Function of Mitochondria

Mitochondria produce ATP through process of cellular respiration—specifically, aerobic respiration, which requires oxygen. The citric acid cycle, or Krebs cycle, takes place in the mitochondria. This cycle involves the oxidation of pyruvate, which comes from glucose, to form the molecule acetyl-CoA. Acetyl-CoA is in turn oxidized and ATP is produced.

The citric acid cycle reduces nicotinamide adenine dinucleotide (NAD^+) to NADH. NADH is then used in the process of oxidative phosphorylation, which also takes place in the mitochondria. Electrons from NADH travel through protein complexes that are embedded in the inner membrane of the mitochondria. This set of proteins is called an electron transport chain. Energy from the electron transport chain is then used to transport proteins back across the membrane, which power ATP synthase to form ATP.

The **amount of mitochondria** in a cell depends on how much energy that cell needs to produce. Muscle cells, for example, have many mitochondria because they need to produce energy to move the body. Red blood cells, which carry oxygen to other cells, have none; they do not need to produce energy. Mitochondria are analogous to a furnace or a powerhouse in the cell because, like furnaces and powerhouses, mitochondria produce energy from basic components (in this case, molecules that have been broken down so that they can be used).

Mitochondria have many other functions as well.

- They can store calcium, which maintains homeostasis of calcium levels in the cell.
- They also regulate the cell's metabolism and
- cell signaling, and thermogenesis (heat production).
- The liver cells mitochondria have enzymes that detoxify ammonia.

- The mitochondria also play important role in the process of apoptosis or programmed cell death.
- Abnormal death of cells due to the dysfunction of mitochondria can affect the function of organ.

DNA and Inheritance

Mitochondria replicate their DNA by a process called **binary fission** and can use this to make multiple copies in one mitochondrion.Their DNA has **maternal lineage** which means their DNA is passed from mother to child with little change.