

## PUC 1<sup>ST</sup> YEAR –SEMESTER-2

### UNIT I: Cell Biology

#### Module No: 4: Chloroplast and Mitochondria-structure and function

##### Mitochondria:

Mitochondria are filamentous or granular structures present in the cytoplasm of the cell. They are absent in prokaryotes and in mature RBC cells of eukaryotes. They are the centres of aerobic respiration and produce a large amount of energy in the form of ATP. Hence, they are described as power houses of the cell.

##### Occurrence and shape:

The mitochondria may be variously shaped they may be cylindrical, spherical, granular, rod like, thread like, or sausage shaped structures. They are present in large numbers in those cells which are concerned with secretion of enzymes and the function of respiration.

##### Structure:

The mitochondria are about 1.5 to 10 $\mu$ m long and 0.25-1.00 $\mu$ m wide.

Each mitochondrion is made of a double unit membrane like a thermos flask. Each membrane is 60 $\text{\AA}$  in thickness. The space between the two membranes is peri mitochondrial space. The inner membrane encloses a chamber filled with matrix rich in proteins and lipids. The inner membrane of mitochondria which is towards the matrix is called M-face and its outer surface which is towards perichondrial space is called C-face. The composition of each membrane is similar to that of plasma membrane. The inner membrane is thrown into numerous projections into the matrix called cristae.

On the cristae are found numerous minute projection called elementary particles or  $F_1$  particles. They are also called as oxysomes. These particles are

concerned with electron transport system. Each  $F_1$  particles is made of a base, stalk and a head. The head of these particles contain ATP synthetase enzyme. The outer membrane of mitochondria is smooth and it separates the mitochondria from cytosol. The elementary particles functionally are associated with the the enzymes of the electron transport system and oxidative Phosphorylation which takes place in mitochondria. The enzymes involved in aerobic respiration, amino acid synthesis and fatty acid metabolism are located in the matrix. The matrix has 70S ribosomes. RNAs, circular DNA and inorganic salts.

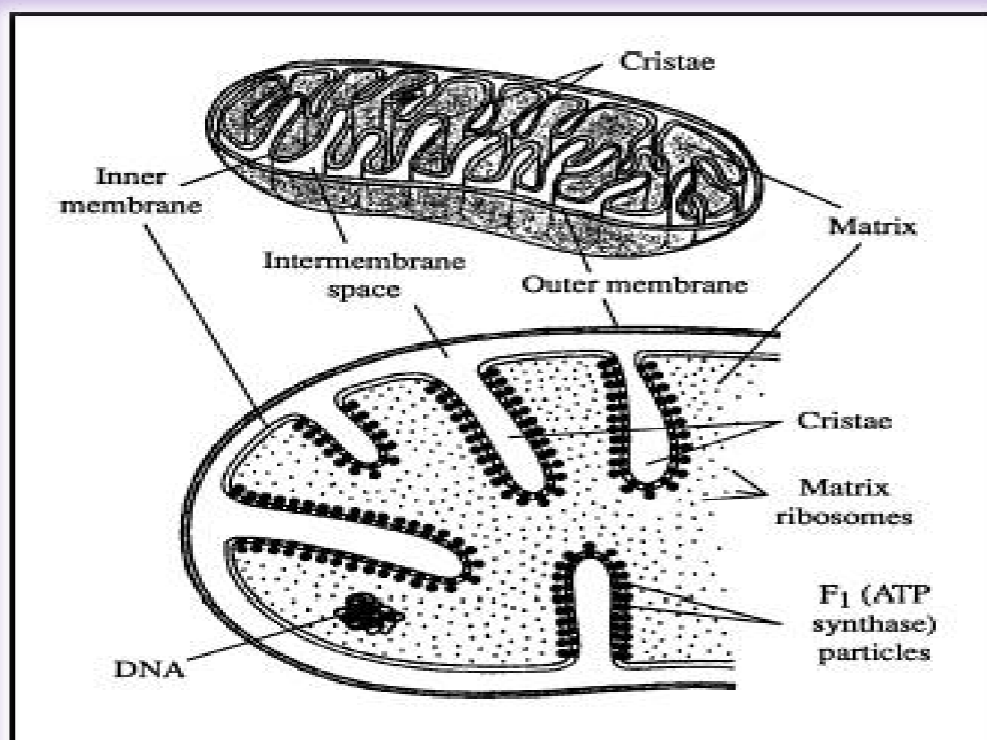


Fig. 8.41. Mitochondrial structure (redrawn from Vander, Sherman, and Luciano,<sup>866</sup> and from Becker and Deamer<sup>939</sup>).

**Functions:**

1. The main function of mitochondria is the synthesis of an energy rich molecule , ATP (Adenosine tri phosphate).
2. Operation of TCA cycle by matrix enzymes.
3. Electron transport from reduced co-enzymes to molecular oxygen coupled with oxidative phosphorylation with the help of enzymes present on the inner membrane.
4. Oxidation of fatty acids.
5. Ion Transport.
6. Respiratory cycle that produces ATP also produce intermediates for the synthesis of cytochromes, chlorophyll, steroids, hemoglobin, amino acids and fatty acids.
7. It is also involved in heat production in animals.

**Chloroplast:**

Plastids are double membraned cell organelles mainly present in plant cells. They are three types

1. **Leucoplasts:** They are colourless plastids and help in storing the food materials.
2. **Chromoplasts:** They are coloured plastids containing carotenoid pigments. They are non- Photosynthetic.
3. **Chloroplasts:** These are photosynthetic plastids present in green plants and are capable of synthesizing organic food from inorganic raw materials.

**Chloroplast:**

These are double membrane organelles present in plant cells. They are disc shaped or lens shaped structures with a length of 4-10 $\mu$ m.

**Structure:** There are three major structural regions of the Chloroplast.

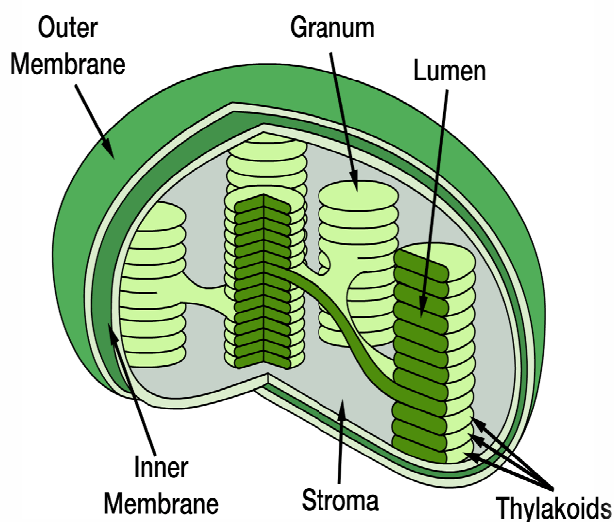
1. **Envelope:** Consisting of an outer and inner membranes with an enclosed space called perichloroplastidial space filled with a fluid matrix or stroma.

2. **Stroma or matrix:** The matrix contains the enzymes for protein synthesis, metabolism, DNA, RANs and ribosomes.

3. **Thylakoids:** The internal membranes form discs which are stacked together like a pile of coins to form a granum. Each disc is a sac or vesicle and is termed a thylakoid. Chlorophyll is found in the thylakoid membranes.

Built into the thylakoid membranes are pigment systems and electron carriers which carry out the light phase of Photosynthesis.

## Chloroplast



**Function:**

1. Chloroplasts serve as the site of photosynthesis. They convert the energy of sunlight to chemical energy of organic compounds.
2. During Photosynthesis oxygen is produced which is important for the survival of aerobic organisms.
3. They keep the level of carbon dioxide in the atmosphere in appropriate limits by utilizing it for Photosynthesis.

**Check Points**

- Mitochondria are described as power houses of the cell.
- Mitochondria are bounded by double membrane – the outer and inner membranes.
- Inner membrane forms cristae into the matrix.
- Elementary particles or  $F_1$  Particles or oxysomes are found on cristae.
- Enzymes of electron transport system and oxidative phosphorylation are found on the cristae.
- Enzymes of amino acid synthesis and fatty acid metabolism are found in the matrix.
- Main function of Mitochondria is the synthesis of ATP.
- Chloroplasts are the photosynthetic plastids found in green plants.
- Chlorophyll is found in the thylakoid membranes.
- Chloroplasts serve as the site of Photosynthesis.

**Object Type Questions**

1. Mitochondria Possesses

- A. Dictyosome    B. Quinacrine    **C. Oxysome**    D. Polysome
2. ATP is
- A. An Enzyme    B. A hormone    C. An energy rich protein
- D. A molecule with high energy phosphate bond.**
3. In Chloroplasts, chlorophyll is found in
- A. Outer membrane    B. Inter membrane space    C. Stroma
- D. Thylakoid membranes**
4. Mitochondria are absent in
- A. Prokaryotes    B. Eukaryotes    C. In mature RBC    **D. A & C**
5. Power houses of the cell
- A. Golgi    **B. Mitochondria**    C. Ribosomes    D. Lysosomes.
6. One of the following is not the function of mitochondria
- A. Synthesis of ATP    B. Electron transport    C. Oxidation of fatty acids
- D. Photosynthesis**
7. Matrix of the Chloroplasts contain
- A. Enzymes    B. DNA & RNA    C. Ribosomes    **D. All**
8. In chloroplasts Pigment systems and electron carriers are present in
- A. **Thylakoid membranes**    B. Pericloroplastidial space
- C. Stroma    D. Inner membrane
9. Plastids capable of synthesizing organic food from inorganic raw materials.
- A. Leucoplasts    B. Chromoplasts    **C. Chloroplasts**    D. All
10. One of the following keeps the level of CO<sub>2</sub> in the atmosphere in appropriate limits by utilising it for synthetic purpose.
- A. Leucoplasts    **B. Chloroplasts**    C. Chromoplasts    D. None

### Short Answer Questions

1. Write short notes on plastids?
2. Describe different types of plastids?
3. Describe briefly the structure of chloroplasts?
4. What are the parts of mitochondria?
5. Write short notes on oxysomes?
6. List out the functions of mitochondria?
7. Describe Thylakoids?

### **Long Answer Questions**

1. Describe the structure and function of mitochondria?
2. What are chloroplasts? Describe the structure and function of chloroplasts?