Oxydative phosphorylation

ETS is a process by which NADH and $FADH_2$ are oxidized and proton gradient is formed.

~~Oxidative~~ phosphorylation is a process of making ATP by using the proton gradient generated by the ETC.

Oxydative Phosphorylation is a biochemical Process that involves the addition of phosphate to an organic compound. Examples include the addition of phosphate to Adenosine di-Pho phosphate (ADP) to form adenosine triphosphate (ATP).

Phosphorylation is Three types:-

1. Photo-Phosphorylation — ATP formed through a series of sunlight-driven reactions in phototrophic organisms.
2. Oxidative phosphorylation:- ATP formed a series of redox reactions occuring during the final phase of the Respiratory pathway.
3. Substrate level phosphorylation:- Transfer of Phosphate molecule directly from the substrate.

oxidative phosphorylation is oxygen dependent phosphorylation. The site of oxidative phosphorylation is Mitochondria. The elements involved in this process are embedded in the inner Mitochondrial membrane. Actually several redox reaction take place during diff metabolic path way inside the cell and those process there is always an electron donor molecule and one electron acceptor molecule. sometime the electron are donated by diff^t substrate (during their oxidation) and in those cases diff^t electron carriers (such as $NAD^+/NADP^+$ or FAD^+) become reduced and they play the role of electron acceptor. They convert into

$NAD^+ / NADP^+ + 2e^- + 2H^+ \longrightarrow NADH + H^+ / NADPH + H^+$

$FAD^+ + 2e^- + 2H^+ \longrightarrow FADH_2$

Now, they have to oxidized again so that they can serve the purpose of electron acceptor in diff^t metabolic pathways. So that the pathway may remain operative. This oxidation take place inside the mitochondria with the help of oxygen.

There are five diff^t protein complex are involved in oxydative phosphorylation. Four out of five component (complex I- IV) are involved in transfer of Proton (H^+) from matrix side to inner membrane space. This transfer is against the concentration gradient.

In this Process have diff^t electron carriers. These electron

carrier are basically iron Sulphur (Fe-S). Some are Cytochrome (cyt.a, cyt.b, cyt.c) which are iron containing prosthetic group. Complex (IV) has two copper ~~atom~~ They are more energy efficient.

There is a mobile electron carrier in this process known as co-enzyme. (Ubiquinone. The complex I and complex II are convert Q.(Ubiquinone).

Complex I: NADH dehydrogenase - $NADH^{+}+H^{+}$ donates its ~~one~~ electron to this complex. Protons of NADH are released in the matrix, while electron are accepted by Flavin adenine mononucleotide. These electron are transferd to Ubi-quinone. Energy is released The electron are accepted by Q and it take ~~two~~ two protons from the matrix and it convert into QH_2. From Q electron travels to complex III.

Complex II Succinate dehydrogenase:-

This is embedded on the matrix side. No pumping. Less energy release hence unable to transport proton. but it receive electron from $FADH_2$ and convert Q into QH_2 $FADH_2$. Electron are come from β oxidation (TCA cycle).

Complex III: Ubiquinone (Q)

Cytochrome C oxidoreductase / cytochrome bc_1 complex -

It is the centre of recycling of ubiquinone. It consist of cyt. b, cyt c and cyt c_1. It has also two iron-sulphur. In this complex electron are come from the ubiquinone and II Complex..

Complex IV - This complex consist of two cytochrome cyt a and cyt. a_3. and two copper (Cu_a and Cu_b). The two electron gain by cyto. c (by complex III) is transfered to Cu_a Then it reaches

to O_2. Cub through Cyt. a and Cyt. a_3. ~~[illegible]~~
~~[illegible]~~
The required energy comes from the energy released during the flow of electron.

Complex V: ATP synthase complex:-

It is made up of 22 diff^t units of Protein. As inner membrane of mitochondria is completely impermeable for Protons(H^+), hence the Protons are accumulated in the IMS and they create an electrochemical ~~[illegible]~~ gradient.

There are three type of gradient.

1. Electrical gradient — As Protons have positive charge. while Matrix negative charge.

2. Chemical gradient - the Presence of Proton make the environment acidic.

3. Osmotic gradient:- Protons are transfered from matrix to IMS.

The gradient generates a force which is experienced by inner mitochondrial membrane. But the protons have only one way back, i.e, ATP synthase complex. Now, the Proton motive force exerted by the flow of proton provides the required energy for the association of ADP and Pi to form ATP. The Protons accumulated in IMS acts like water behind dam and the ATP synthase complex acts like turbine. As the water flows from the channels through the turbine, it rotates and generates

electricity. (Hydro electric power plant) similarly the flow of Proton through the ATP synthase complex make its rotation and during rotation a conformational change take place in the β-Protein of the ATP synthase complex. This is the basic concept of oxidative Phosphorylation.

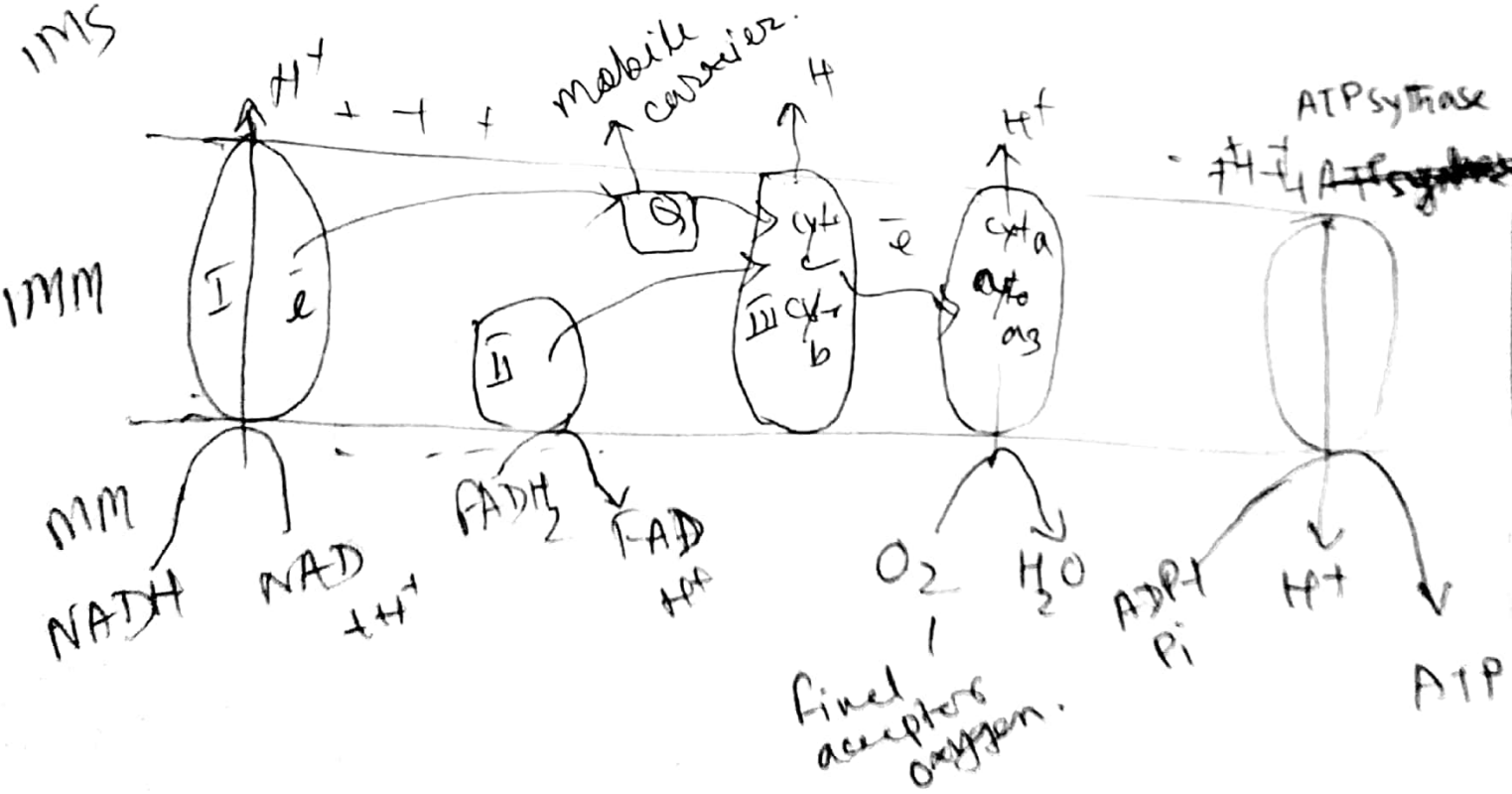

Fig- Oxydative phosphorylation