Oxidative Phosphorylation

Oxidative phosphorylation is the metabolic pathway that occurs across the inner mitochondrial membrane. In the pathway, NADH and FADH2 are oxidized and give up their high-energy electrons to the electron transport chain. This oxidation process is coupled to the phosphorylation of ADP to ATP by the enzyme ATP synthase. For each NADH run through the electron transport chain, 2.5 ATP are produced. For each FADH2 run-through, 1.5 ATP are produced. Overall, this process is driven by the proton motive force created by pumping a large amount of protons into the intermembrane space using proton motors attached to the electron transport chain. Another important fact is that oxygen is the final electron acceptor.



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Inner Mitochondrial Membrane
Inner-tube
Oxidative phosphorylation occurs along the inner mitochondrial membrane, which encloses the mitochondrial matrix and borders the intermembrane space.

Electron Transport Chain
Electrons Transporting through Chain
The electron transport chain accepts electrons from carriers NADH and FADH2 and transfers them down a series of protein complexes.

Oxygen is Final Electron Acceptor
O2-tank Accepting Electrons
Oxygen is the final acceptor of electrons in the electron transport chain and is reduced to water.

Proton Pump
H+ Pump
The protein complexes in the electron transport chain use the transfer of electrons to pump protons into the inter-membrane space and establish the proton motive force.

Proton Motive Force
Proton Motor
The proton motive force is derived from the electrochemical gradient established by pumping protons into the inter-membrane space. Thus, protons build up in the inter-membrane space and want to diffuse back into the matrix.

ATP Synthase
ATP-battery Assembled by Cent-face
ATP synthase converts ADP to ATP by using the energy from the proton motive force. The energy for it is released in the form of a proton moving down the electrochemical gradient.

1 NADH 2.5 ATP
Cigarette-H holding (2.5) Tutu Hand ATP-battery
For each NADH entering oxidative phosphorylation, 2.5 ATP molecules are produced.

1 FADH2 1.5 ATP
Flag-H2 holding (1.5) Wand Hand ATP-battery
For each FADH2 entering oxidative phosphorylation, 1.5 ATP molecules are produced.

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