

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.