

The Electron Transport Chain

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Reduction of Oxygen

- How is oxygen reduced using NADH and FADH_2 ?
- How is the energy that's released used to make ATP?
- The key system that accomplishes this is called the electron transport chain.

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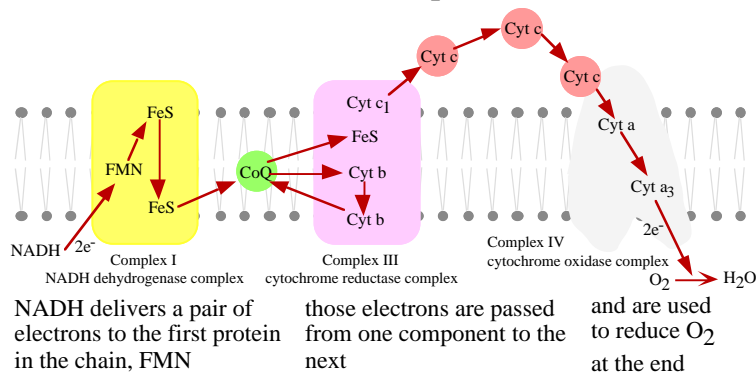
What is the electron transport chain?

- The electron transport chain is a highly organized group of proteins and associated cofactors.
- NADH and FADH₂ deliver electrons to the beginning of this chain and ...
- oxygen is reduced to water at the end.

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How does the electron transport chain function?

The Electron Transport Chain



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Why do electrons flow in only one direction?

- Two factors govern the sequence of electron transfers:
 - The spatial arrangement of the components and ...
 - their relative energy.
- Most of the components that receive electrons later in the chain are lower in reduction potential than the components that receive electrons earlier in the chain.
 - The components later in the chain have a higher affinity for electrons, less tendency to transfer them to other substances, thus lower reduction potential.

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From High Energy To Low Energy

- Thus the electrons are flowing from high redox potential (high energy) to low redox potential (low energy)...
- from substances with lower electron affinity to higher electron affinity.
- Transferring electrons to substances that attract electrons more, releases energy because it corresponds to the natural tendency.
- The energy released can be used to oppose the natural tendency for some other process.

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How is ATP formed?

- The electron transport system is located in the mitochondrial membrane.
- The energy that is released by these electron transfers is used to pump protons out of the mitochondrion.
- The greater concentration of protons outside the mitochondrion than inside represents useful energy.
 - A difference in concentration in two different regions is called a concentration gradient.
 - Creating this concentration gradient opposes the natural tendency and therefore requires energy.

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How is the proton gradient energy used?

- That energy is used by a protein to make ATP.
- That protein is called the proton-translocating ATPase or ATP synthase.
- It makes ATP by using energy obtained by allowing protons to flow into the mitochondrion.

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Questions For Discussion

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NADH & FADH₂ in Electron Transport

What is the biochemical role of NADH and FADH₂ in the electron transport chain?

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Reduction of Oxygen

What is the metabolic purpose of reducing oxygen in the electron transport system?

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The Location of the Electron Transport Chain

Where are the components of the electron transport chain located in the cell?

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The Composition of the Electron Transport Chain

Draw a diagram indicating the composition and arrangement of the electron transport chain. How many protein complexes are involved and what are their components?

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Mediation of Electron Transfers

**What mediates electron transfer between
Complex I and III?**

**What mediates electron transfer between
Complex III and IV?**

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Unidirectional Electron Flow

What two factors account for the transfer of electrons among the components of the electron transport system in a specific sequence and direction?

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ATP Synthesis

How is the electron transport system used to make ATP?

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The Proton Gradient

Which protein uses the proton gradient to make ATP?

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Energy For Making ATP

What is the direct or immediate source of energy used by the proton translocating ATPase to make ATP?

How is the location of the electron transport system in the cell related to its ability to make ATP?

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