ELECTRON TRANSPORT CHAIN

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The electron transport chain is the main source of ATP production in the body and as such is vital for life. The previous stages of respiration generate electron carrier molecules, such as NADH, to be used in the electron transport chain. Clinically, some molecules can interfere with the electron transport chain, which can be life threatening due to its importance and these are discussed in detail later.

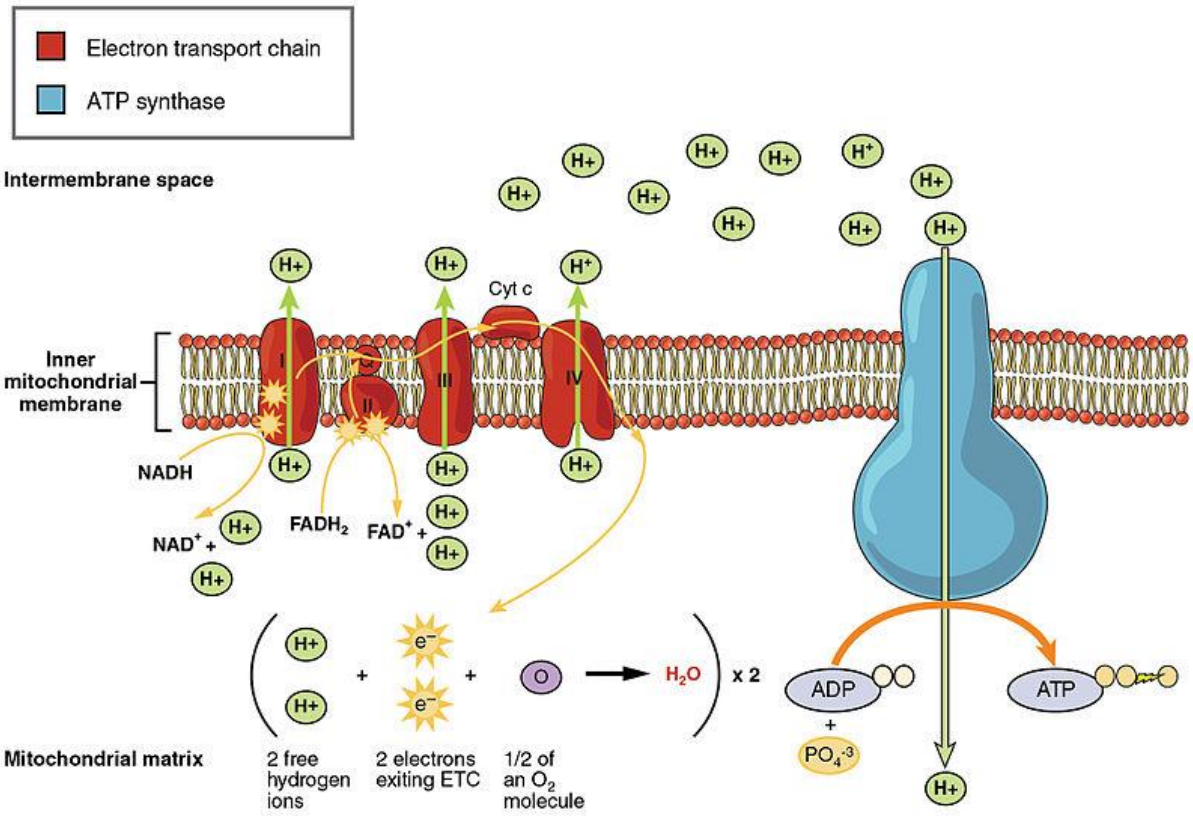
Physiology

The electron transport chain is located in the mitochondria. There are five main protein complexes in the electron transport chain, located in the inner membrane of the mitochondria. These are labelled Complexes I, II, III, IV and V. The two electron carriers, NADH and **$FADH_2$,** begin the chain by donating their electrons to Complex I and Complex II respectively. These electrons are then passed to the next complex in the chain.

This generates energy which is used to pump hydrogen ions into the **intermembrane space**. In doing so, a proton motive force is generated. This is an electrical and chemical gradient of hydrogen ions between the intermembrane space and the matrix. The main route back into the matrix is through ATP synthase. This is key for both pathological and physiological processes, and is discussed in Uncoupling.

Complex V, or **ATP synthase,** allows the proton motive force to be discharged. This enables the energy of hydrogen ions diffusing back into the matrix via Complex V to be harnessed, thereby creating ATP from ADP. When the concentration of ATP rises, there is less ADP for ATP synthase to use. Therefore, there is a natural limitation in periods of high respiration to avoid large amounts of ATP from being produced. Conversely, when the concentration of ADP is high, there is a lot of ADP for ATP synthase to use and so more ATP is made.

The electrons, meanwhile, combine with the hydrogen ions and oxygen to form water by Complex IV. However, this process is not perfect. Electrons can leak out of electron transport chain and can reduce oxygen, which can produce **free radicals** such as superoxide and hydrogen peroxide


Electron transport chain
ATP synthase
Intermembrane space
Inner mitochondrial membrane
Cyt c
I
II
III
IV
NADH
NAD+ +
FADH2
FAD+ +
H+
e−
O
H2O
x 2
ADP
+
PO4-3
ATP
Mitochondrial matrix
2 free hydrogen ions
2 electrons exiting ETC
1/2 of an O2 molecule