ELECTRON TRANSPORT CHAIN (RESPIRATORY CHAIN)

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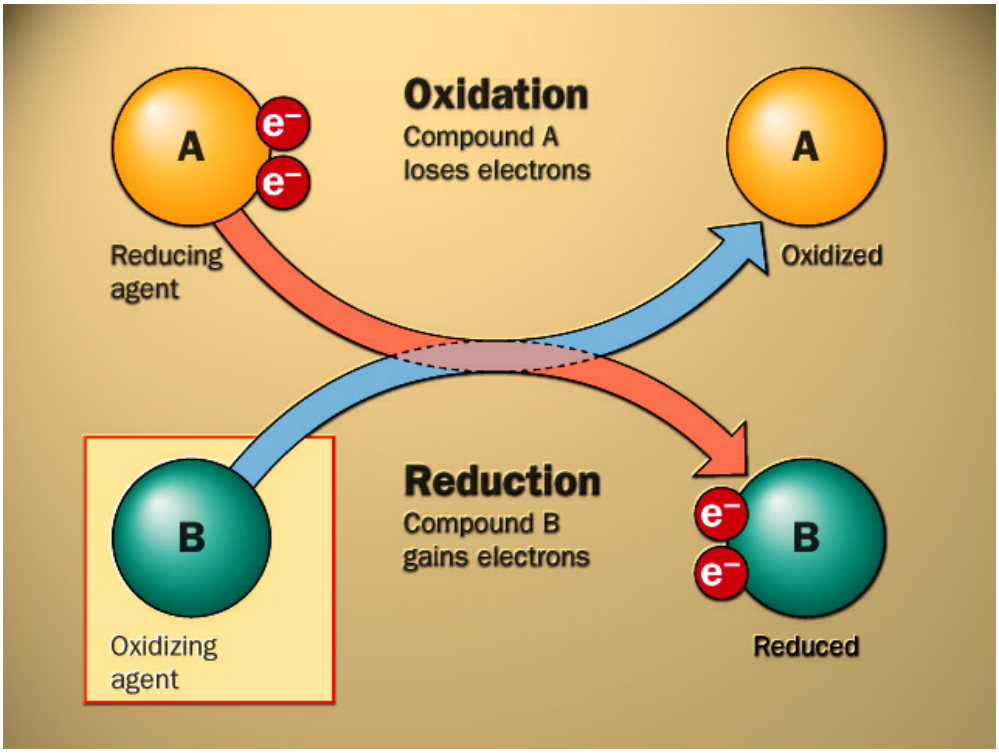
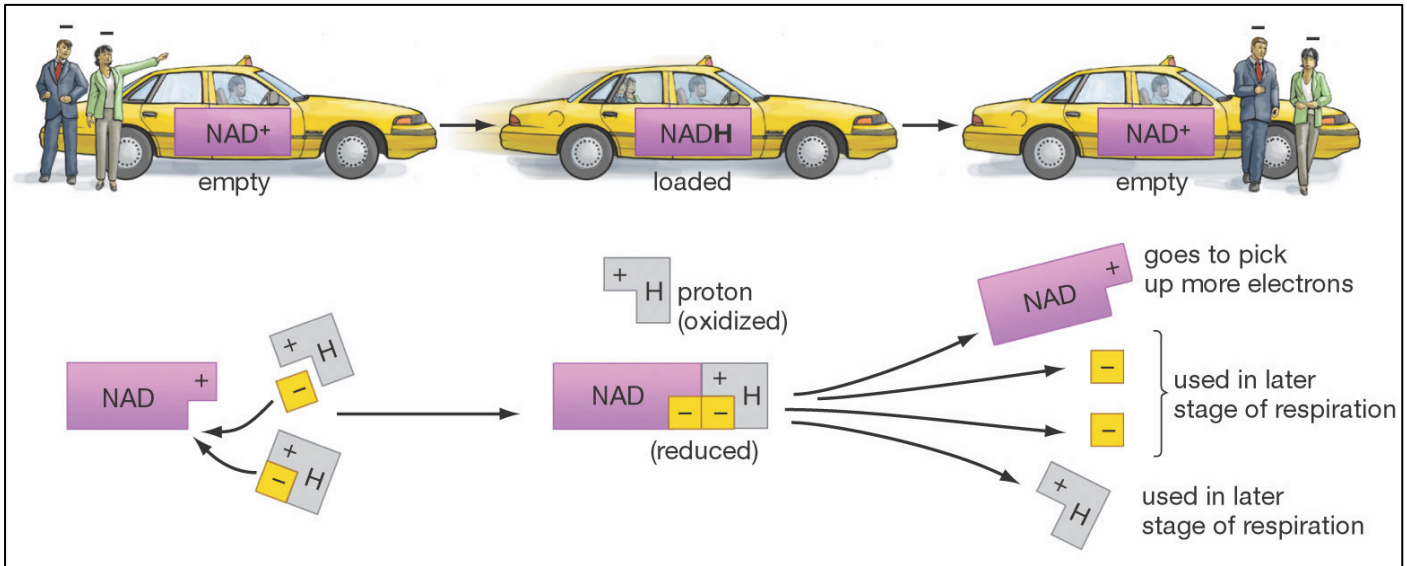
RESPIRATORY BLOCK

REVISION TO UNDERSTAND QUICKLY





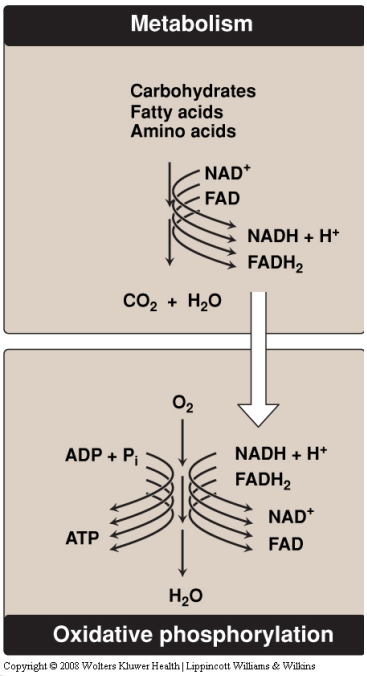
1. NAD^+ within a cell, along with two hydrogen atoms that are part of the food that is supplying energy for the body.

2. NAD^+ is reduced to NAD by accepting an electron from a hydrogen atom. It also picks up another hydrogen atom to become NADH.

3. NADH carries the electrons to a later stage of respiration then drops them off, becoming oxidized to its original form, NAD^+.

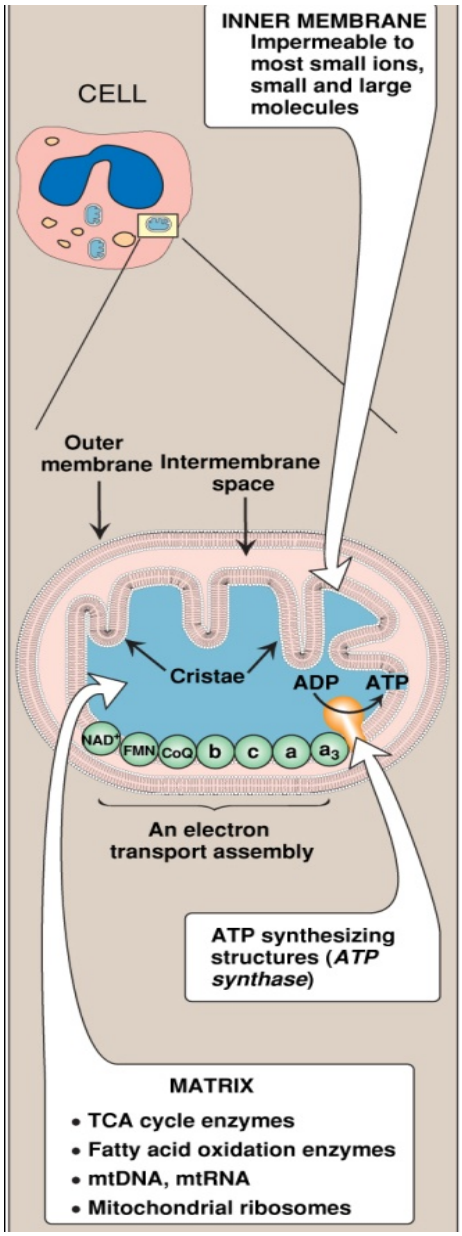
Electron Transport Chain (ETC)

A system of electron transport that uses respiratory O2 to finally produce ATP (energy)	Located in the inner mitochondrial membrane	Final common pathway of metabolism	Electrons from food metabolism are transported to O_2	Uses maximum amount of body's oxygen



Components of ETC

- All members/components are located in the inner mitochondrial membrane (IMM)
- IMM contains 5 complexes:
  - Complex I, II, III, IV (part of ETC)
  - Complex V (ATP synthase: catalyzes ATP synthesis)
  - Mobile electron carriers
    - CoQ
    - Cytochrome c
- Each complex accepts or donates electrons to mobile carriers
- Carriers accept electrons from donors and then donate to the next carrier in chain
- Electrons finally combine with oxygen and protons to form water
- Oxygen is required as a final acceptor (respiratory chain)

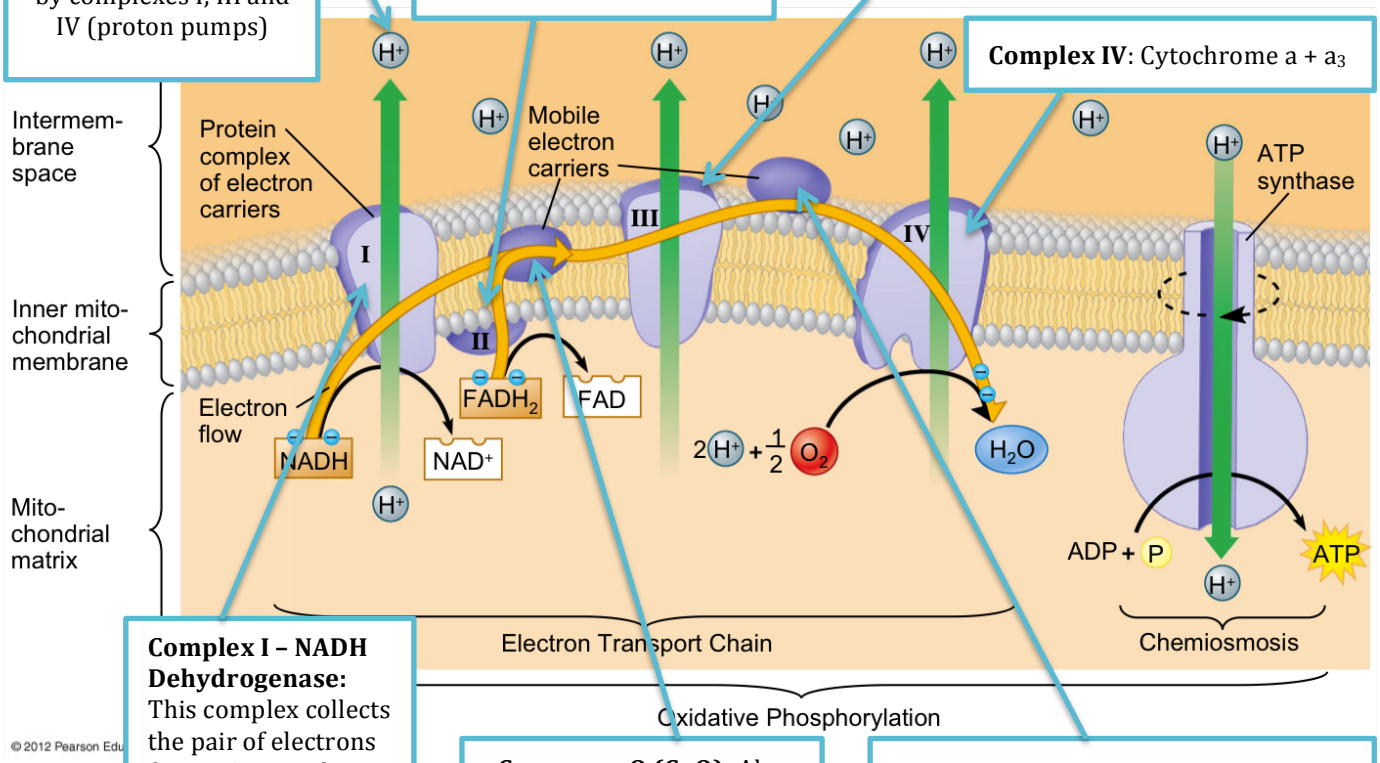


The energy of electron transfer is used to drive the protons out of the matrix. It is done by complexes I, III and IV (proton pumps)

Complex II – Succinate dehydrogenase: It is also a part of the TCA cycle. its function to Transfering electrons to CoQ.

Complex III: Cytochrome bc1

Complex IV: Cytochrome a + a_3

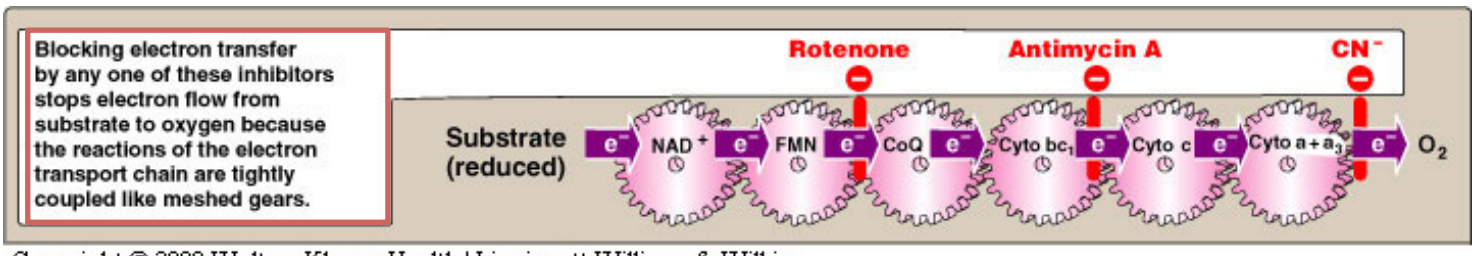


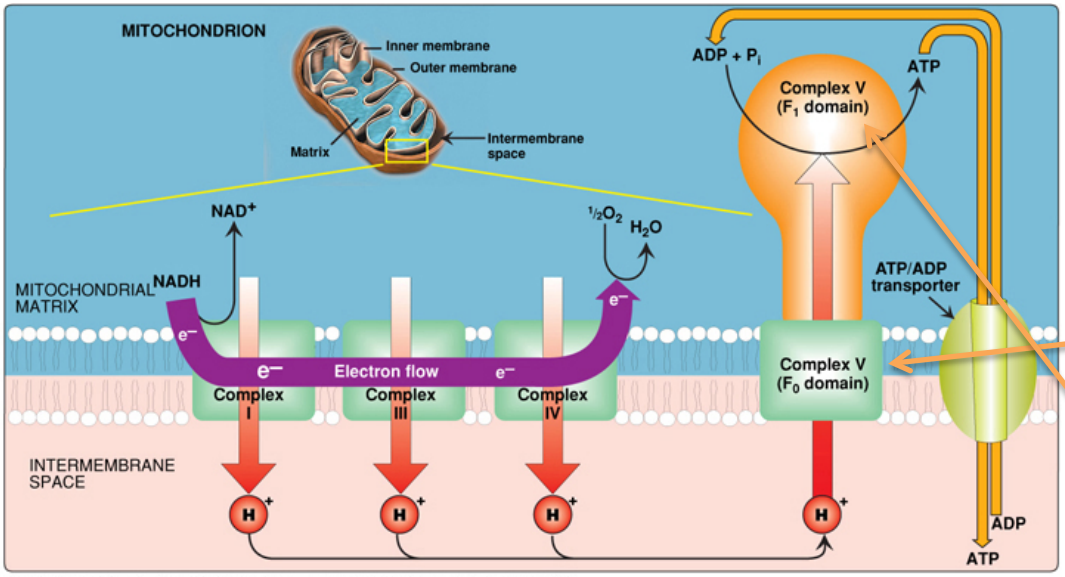
Complex I – NADH Dehydrogenase: This complex collects the pair of electrons from NADH and passes them to CoQ

Coenzyme Q (CoQ): Also called ubiquinone (ubiquitous in biological systems), a non-protein member of the ETC and lipid soluble and mobile

Cytochrome c: Each cytochrome is a protein that contains Heme group (porphyrin ring + iron in Fe3+ state) When cytochromes accept electron: Fe3+ (ferric) is converted to Fe2+ (ferrous). Fe2+ is reoxidized to Fe3+ when it donates electrons to the next carrier

Electrons flow from: Complex I & Complex II ➔ CoQ ➔complex III ➔ Cyt.c ➔ Complex IV





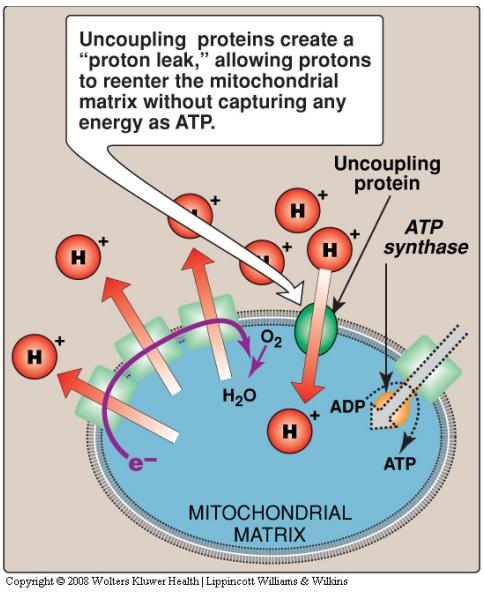
ATP synthase (Complex V) synthesizes ATP. It consists of two domains:

F_0 – membrane spanning domain

F_1 – extramembranous domain

Energetics of ATP synthesis

- The energy required for phosphorylation of ADP to ATP = 7.3kcal/mol
- Energy produced from the transport of a pair of electrons from NADH to O_2 = 52.58 kcal
- No. of ATP molecules produced is 3 (NADH to O_2)
- Excess energy is used for other reactions or released as heat.
- ATP made per oxygen atom reduced
  - ❖ NADH → P:O = 3:1 (through NADH 3 ATP produced per 1 atom oxygen)
  - ❖ $FADH_2$ → P:O =2:1(through $FADH_2$ 2 ATP produced per 1 atom oxygen)



Inhibitors of ATP synthesis

1) Oligomycin:

- Binds to F_0 domain of ATP synthase and closes the H^+ channel

2) Uncoupling proteins (UCPs):

- Create proton leaks (allow protons to reenter the matrix without ATP synthesis)
- Energy is released as heat (nonshivering thermogenesis)

MCQs

1- which one of the following is a mobile electron carrier?
A- CoQ
B- complex 1
C- oligomycin

2- ETC's components and members are located in which of the following:
A- inner mitochondrial membrane
B- outer mitochondrial membrane
C- cytoplasm

3- which of the following is NOT part of the ETC:
A- complex 1
B- complex 3
C- complex 5

4- one of the is an importance of oxygen:
A- receptor of protons
B- receptor of electrons
C- both

5- the name of the first complex in the ETC is:
A- succinate dehydrogenase
B- NADH dehydrogenase
C- ubiquinone

1-A 2-A. 3-C. 4-C. 5-B

GOOD LUCK

Sara alDokhayel
Maha AlRajhi
Layan AlTaweel
Maram AlAqil
Amjad AlBatili
Lamees alMezaini
Ghada AlHindi

Ahmed AlHussien
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