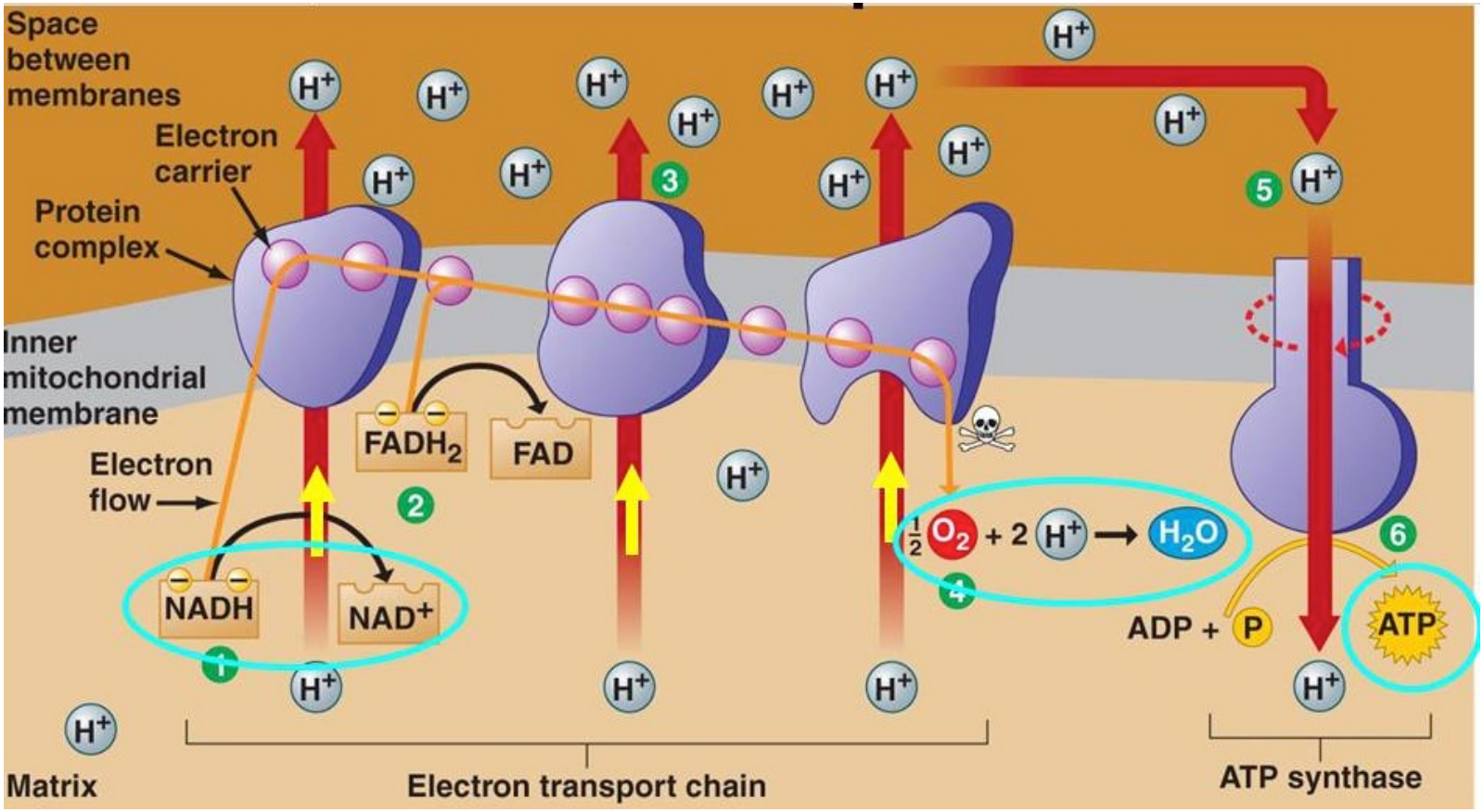
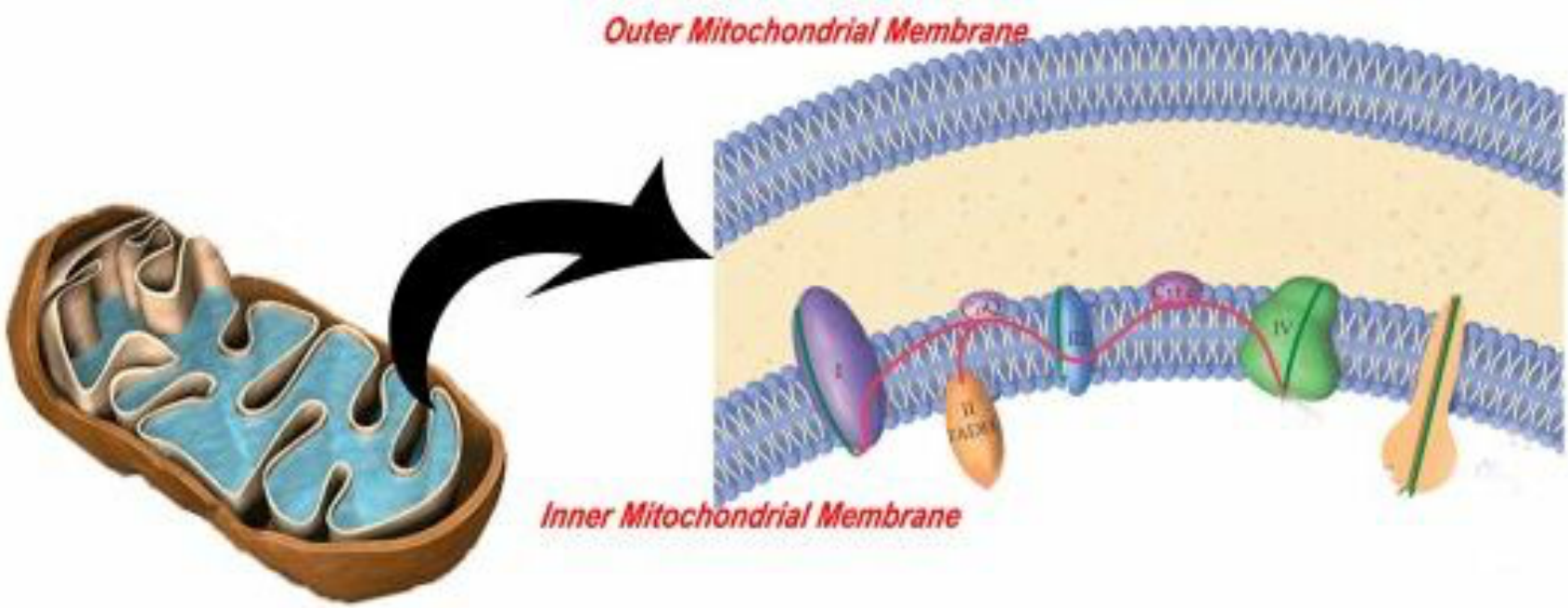
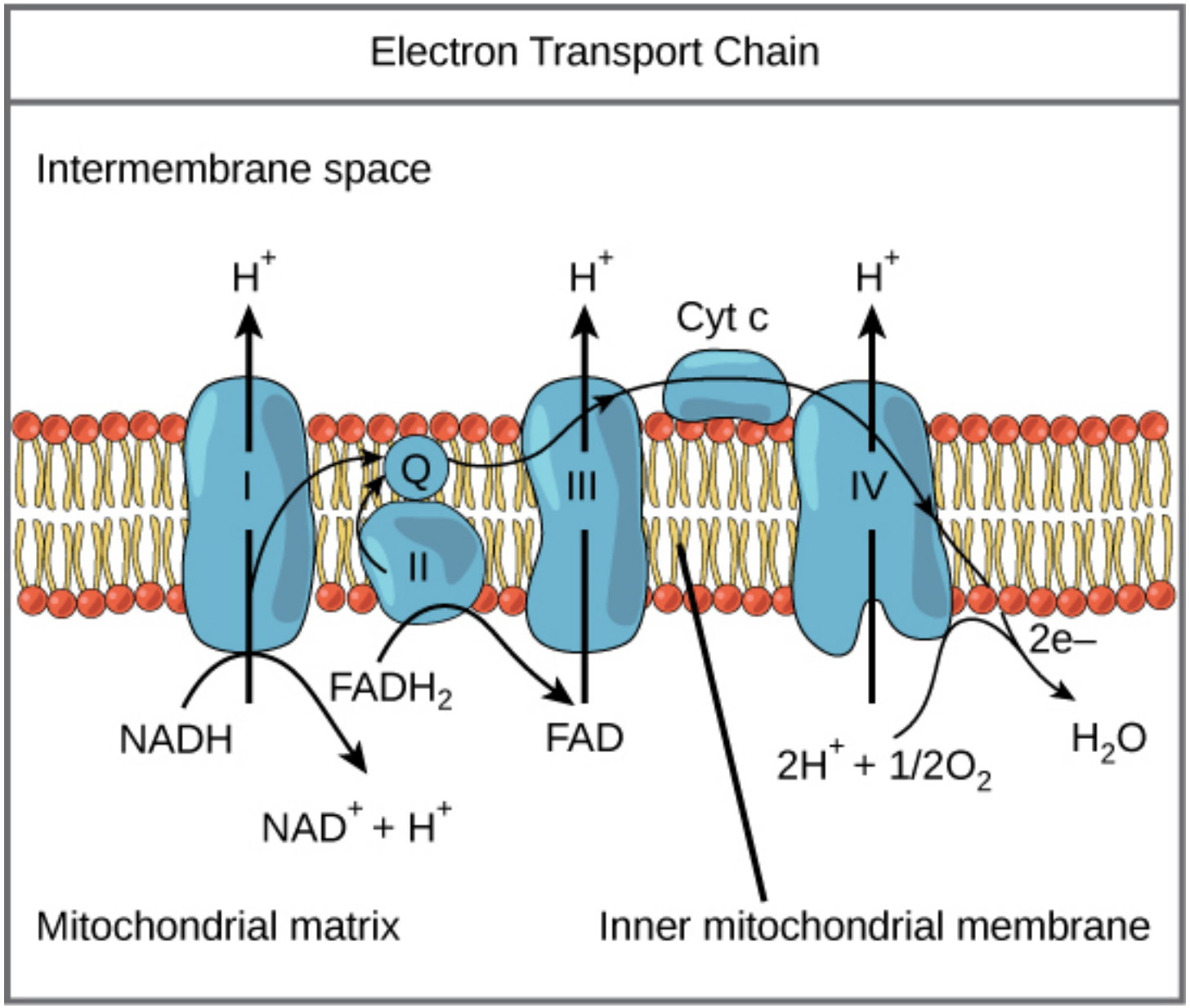
Aerobic Respiration

Electron Transport & Oxidative Phosphorylation




Outer Mitochondrial Membrane
Inner Mitochondrial Membrane

Electron Transport Chain



The Electron Transport Chain

- the final stage of aerobic cellular respiration
- takes place on the inner membrane of the mitochondria
- ETC extracts the potential energy from NADH & $FADH_2$

The Electron Transport Chain

- electrons are transferred from NADH & $FADH_2$ (produced in earlier stages) to final electron acceptor of oxygen

- ETC made up of 4 protein complexes (**I**, II, **III**, **IV**) & 2 mobile electron shuttles

- **electrons are pulled along protein complex because each electron carrier is more electronegative then the previous carrier *(i.e., NADH has the weakest hold on electrons, Oxygen the strongest)***

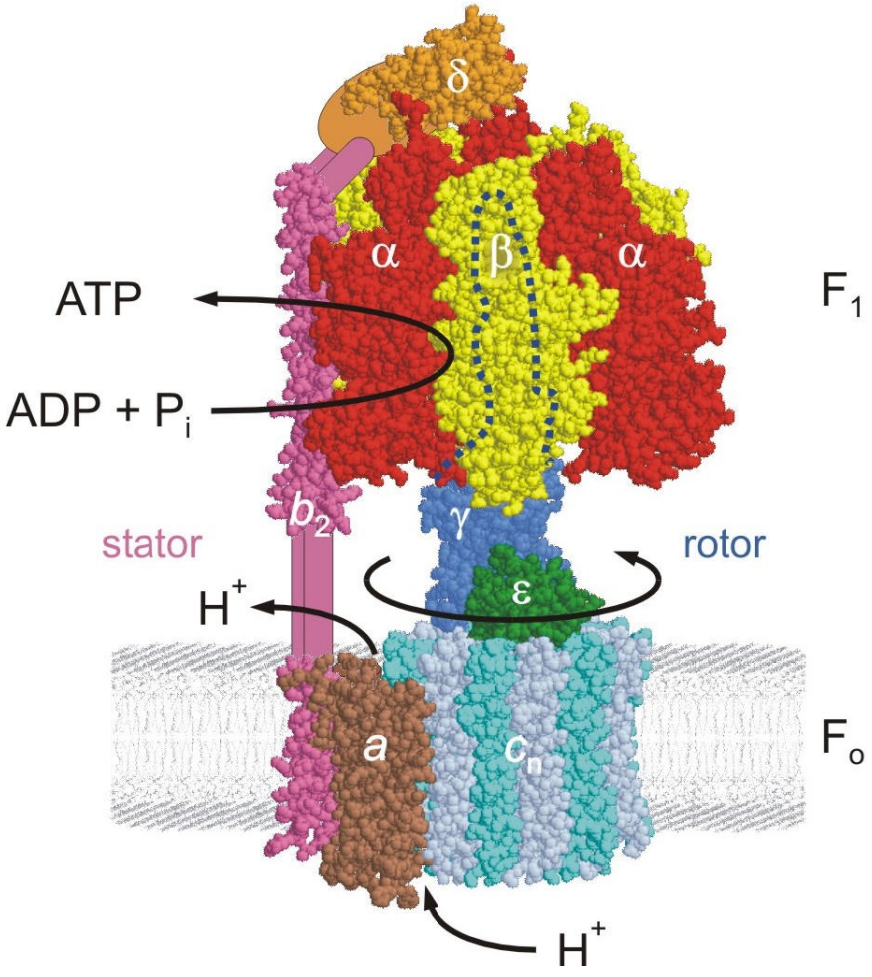
- NADH enters the ETC at **complex I**

- $FADH_2$ enters at **complex II** (which is why each NADH produces more ATP than $FADH_2$ - 3 versus 2)

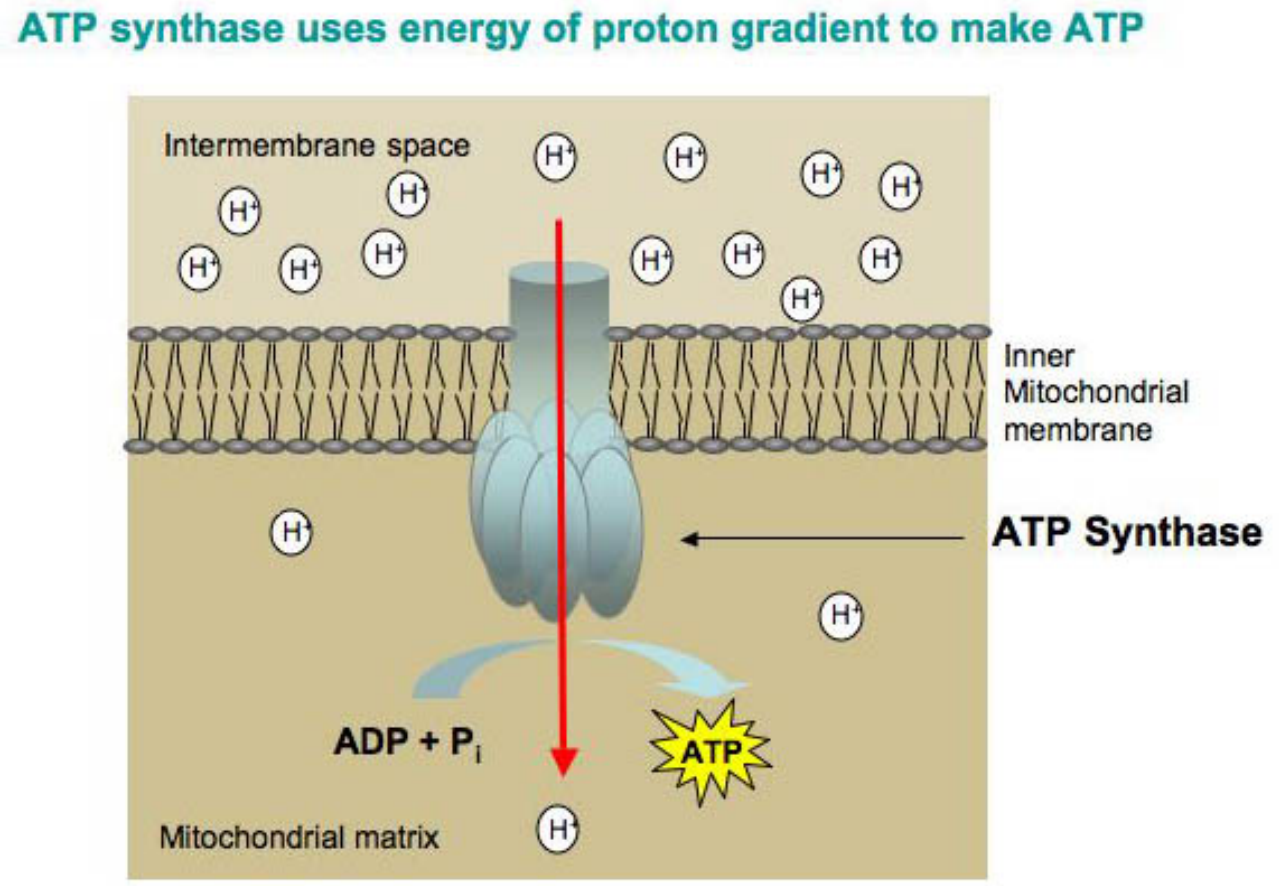
- water is produced when oxygen accepts electrons in the final step

NOTE: ETC does not directly produce any ATP… for ATP production go to ATP Synthase

ATP Synthase Complex



Oxidative Phosphorylation

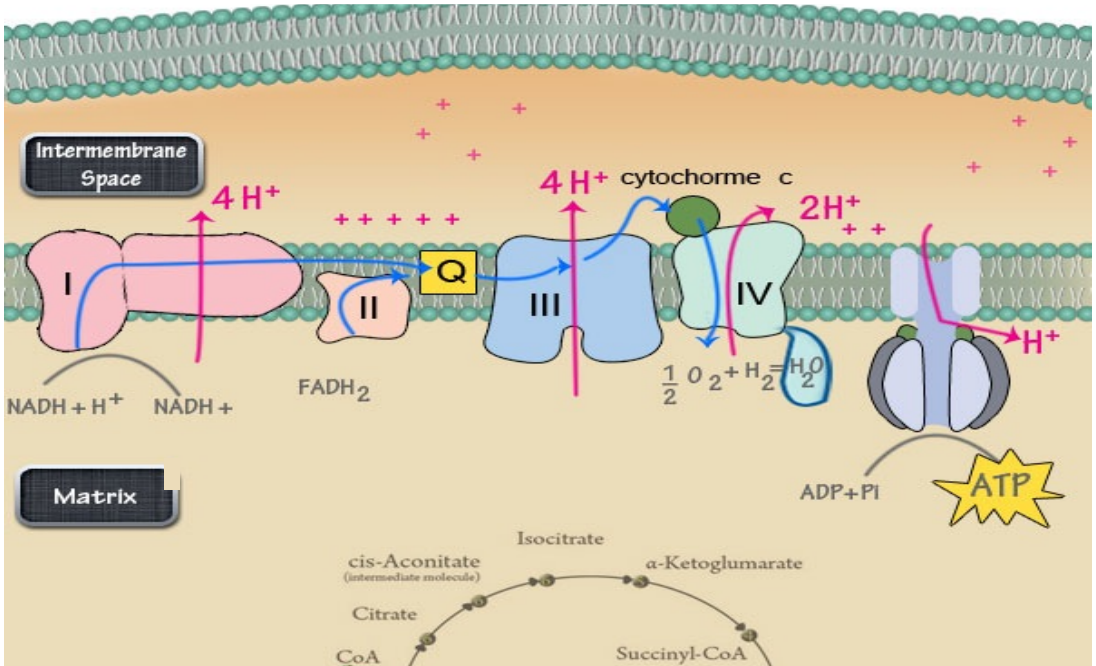


Adding it all up…

For every NADH that is oxidized…

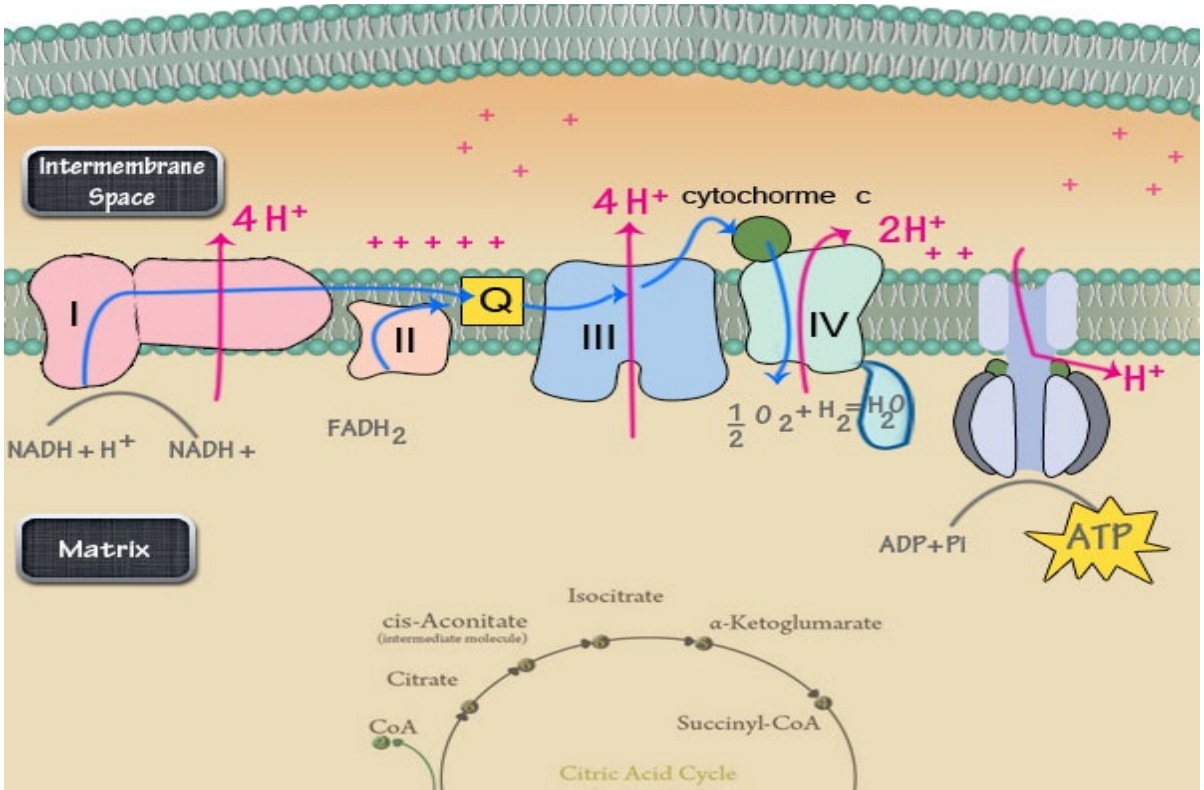
- 10 H+ ions are pumped into the inner membrane space
- 3-4 H+ ions are needed to flow through ATP synthase to make 1 ATP

1 NADH results in a maximum of 3 ATP



…keep adding…

- $FADH_2$ bypasses complex I, so fewer H+ are pumped across
- 1 $FADH_2$ results in a maximum of 2 ATP



Theoretical Energy Yield

Glycolysis:	Substrate-level phosphorylation	2 ATP	
	2 NADH	→	6 ATP
Pyruvate Oxidation:	2 NADH	→	6 ATP
Krebs Cycle:	Substrate-level phosphorylation	2 ATP	
	6 NADH	→	18 ATP
	2 $FADH_2$	→	4 ATP
TOTAL:			**38 ATP**

$C_6H_{12}O_6 + 6O_2 + 38\ ADP + Pi \longrightarrow 6CO_2 + 6\ H_2O + 38\ ATP$