ATP Production

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ILOS

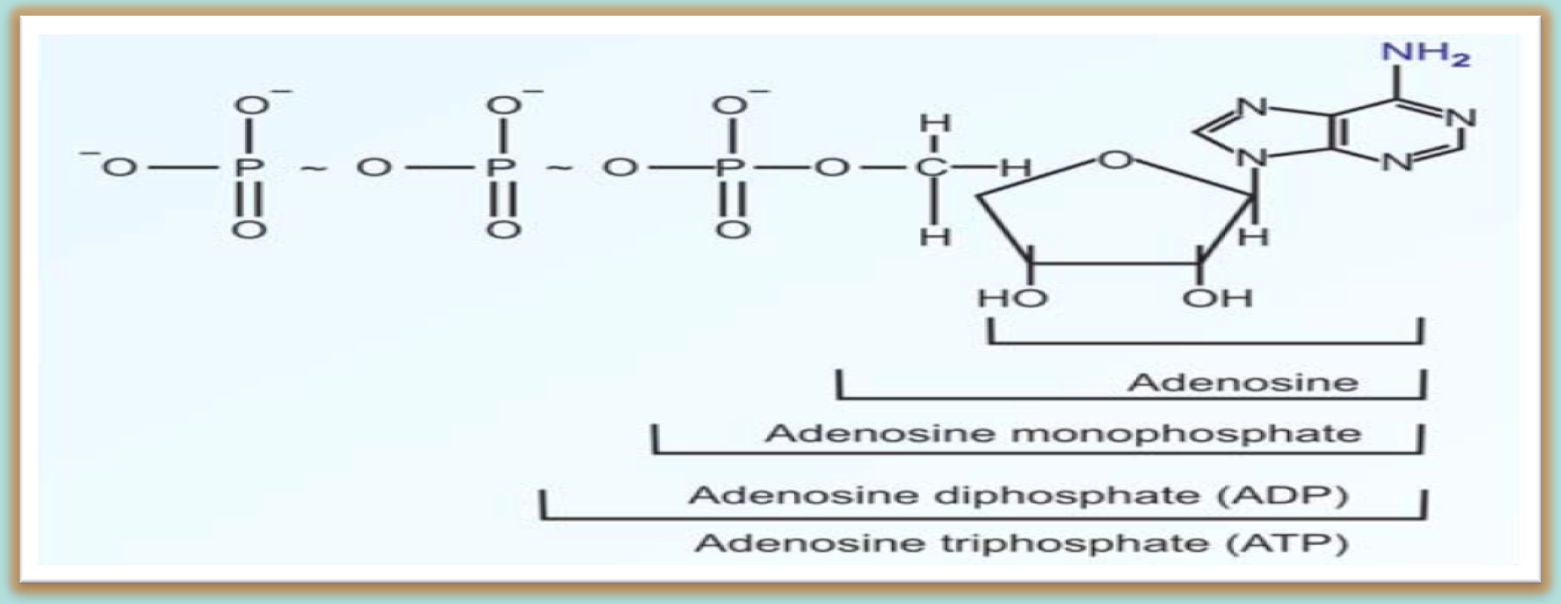
- Describe function of ATP and structure.
- Describe the pathways of ATP production (Glycolysis , Krebs cycle , electron transport chain),and sites
- Describe the mechanism of ETC.

Introduction

The body needs energy on a daily basis to continue to live and complete its tasks properly, so the body begins to obtain food, break it down, obtain energy and store it in the form of compounds, the most important of which is called ATP

The function of ATP and structure

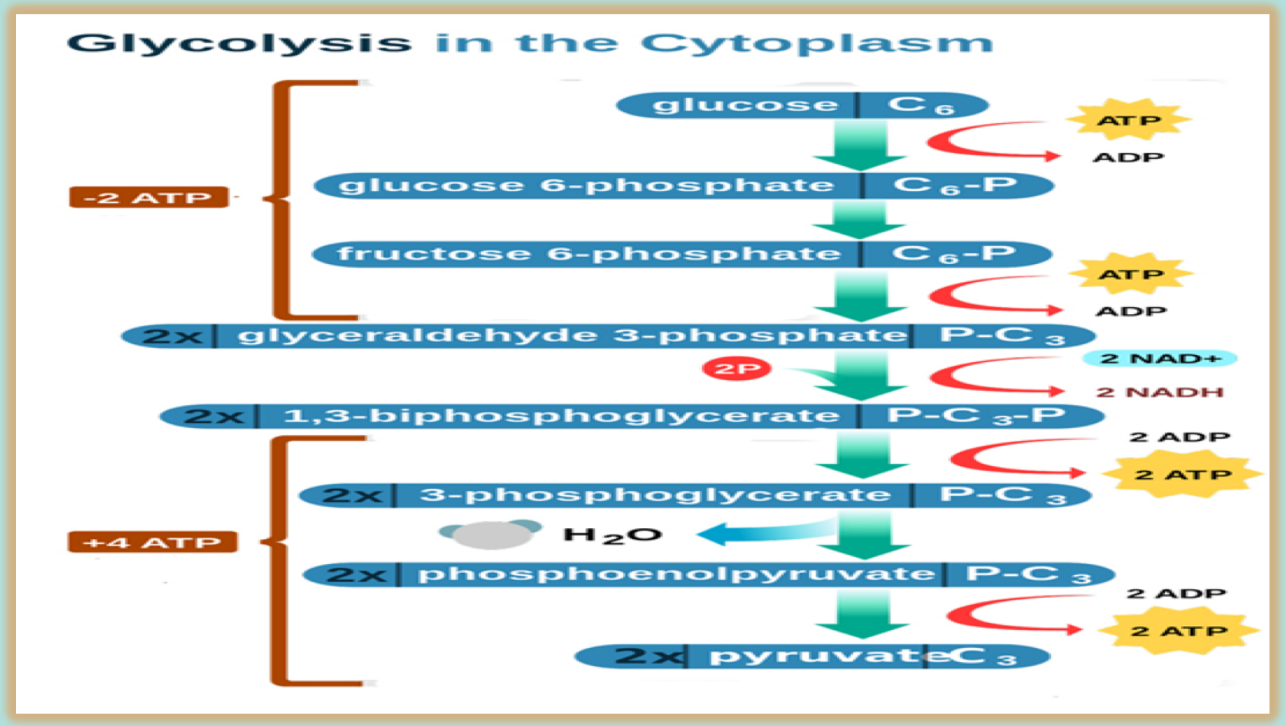
Adenosine Triphosphate (ATP) is the universal currency of energy within the living cells. ATP captures the chemical energy released by the combustion of nutrients and transfers it to synthetic reactions that require energy. That Use for Other energy requiring processes are, biosynthesis of macromolecules, muscle contractions, cellular motion using kinesin, dyenin, AND different cellular processes.



the pathways of ATP production (Glycolysis , Krebs cycle , electron transport chain), and sites

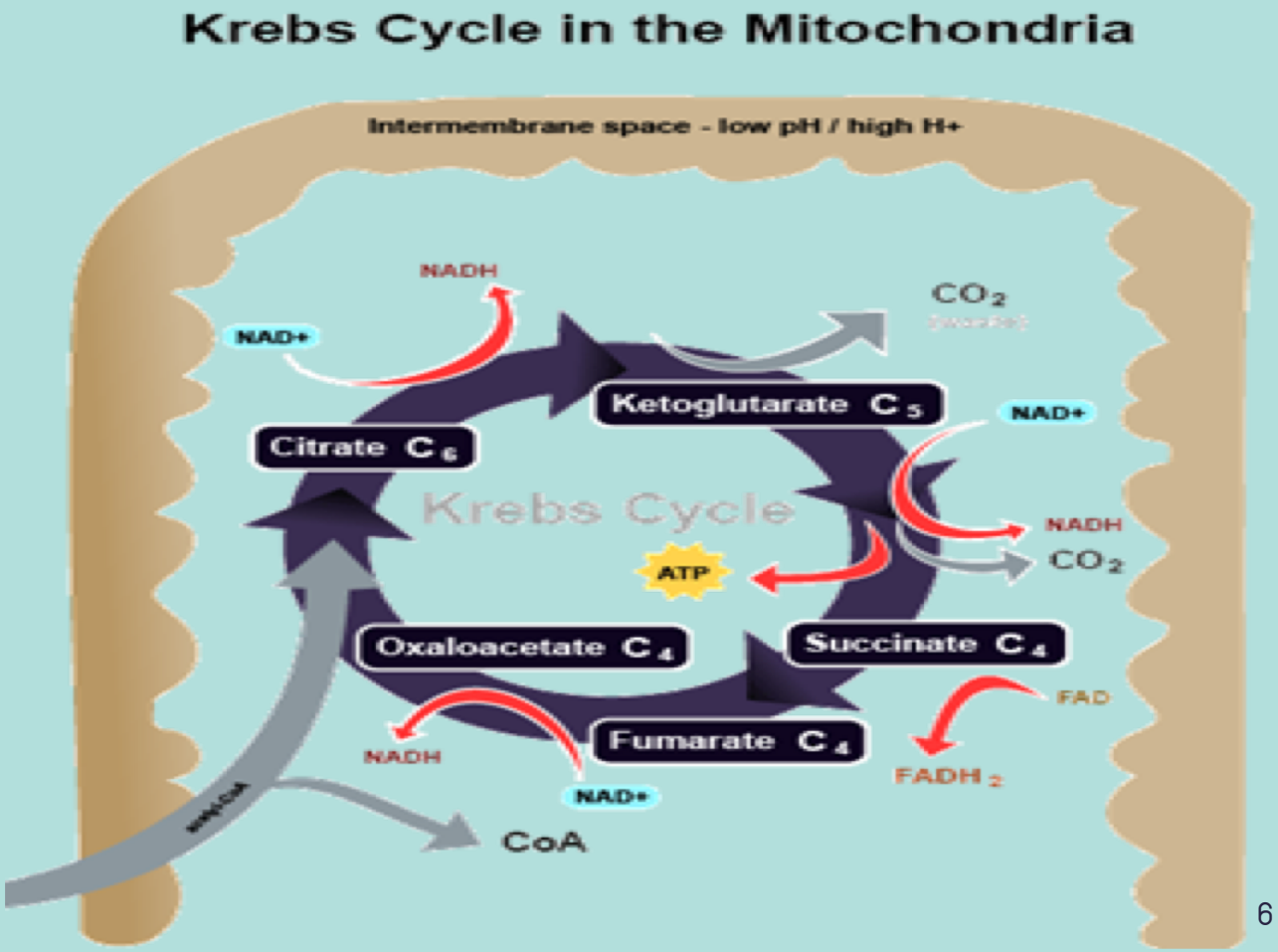
- Glycolysis path way

Occur in cytoplasm and spend 2 ATP to gain 4 ATP and 2NADH this process can be aerobic or anaerobic that production the ATP by Substrate level phosphorylation enzyme This path way ends with the conversion of glucose into two pyruvate .



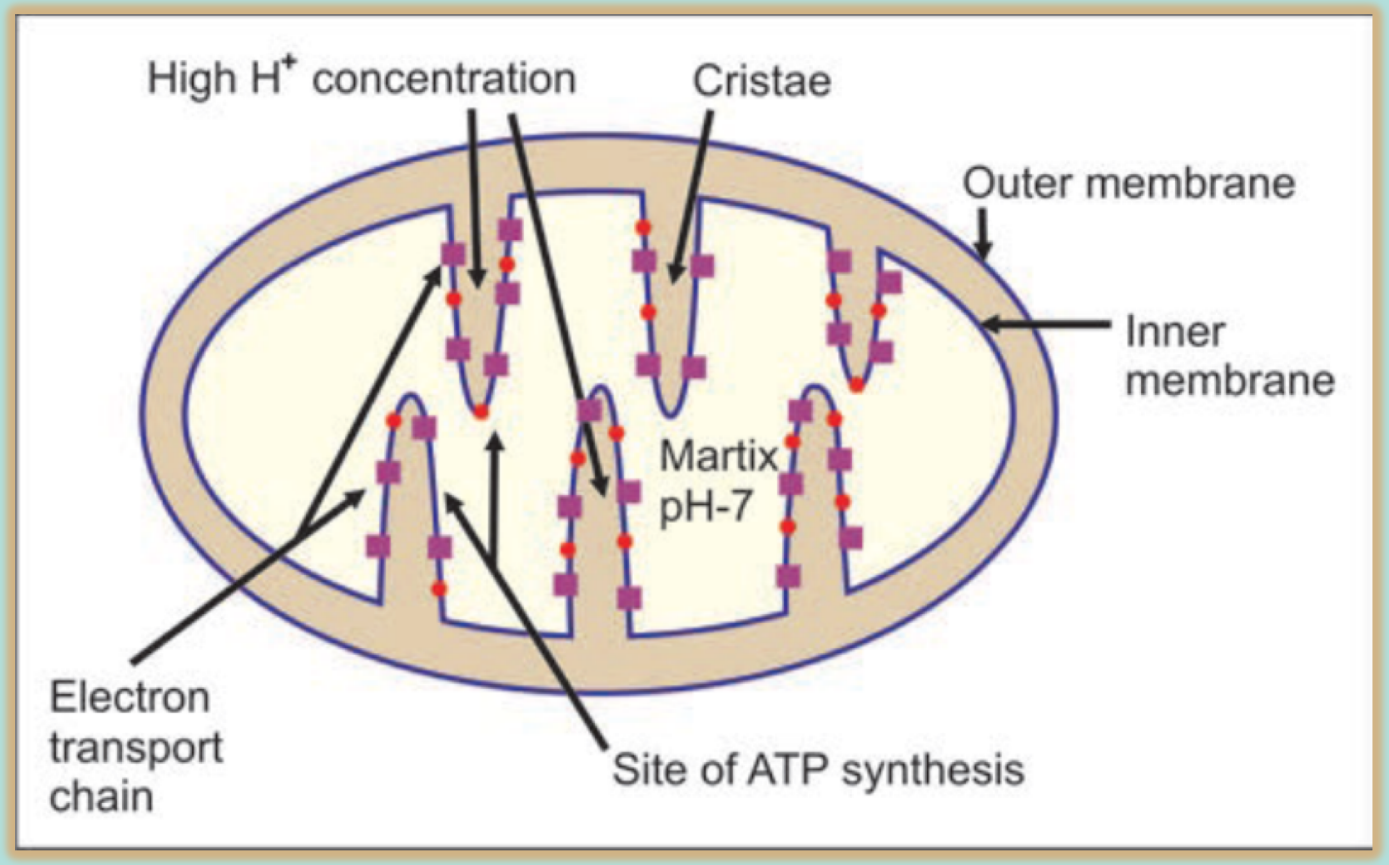
- TCA(Krebs cycle) pathway

This pathway occur in mitochondria matrix that molecules for each glucose molecule that is broken down. Additionally, one other reaction – the breakdown of pyruvate to produce acetate and gain 2NADH that goes into the Krebs



- electron transport chain

ETC in mitochondria membrane that major pathways in ATP production That convert each of NADH and FADH2 to ATP (NADH=3ATP, FADH2=2ATP)



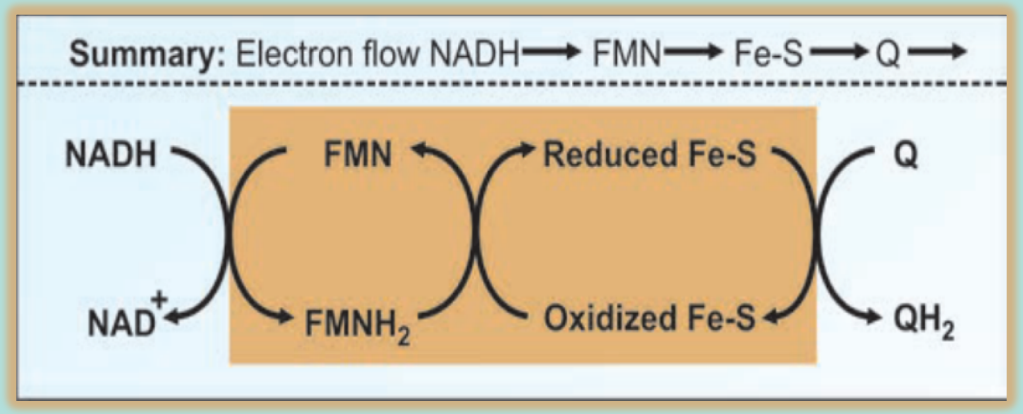
the mechanism of ETC

In the electron transport chain, or respiratory chain, the electrons are transferred from NADH to a chain of electron carriers. The electrons flow from the more electronegative components to the more electropositive components.) are located in chain (ETC transport All the components of electron).

- the inner membrane of mitochondria
- There are four distinct multi-protein complexes; these are named as complex-I, II, III and IV. two mobile These are connected by . cytochrome Cand Q enzyme –co carriers.

ETC Complex-I

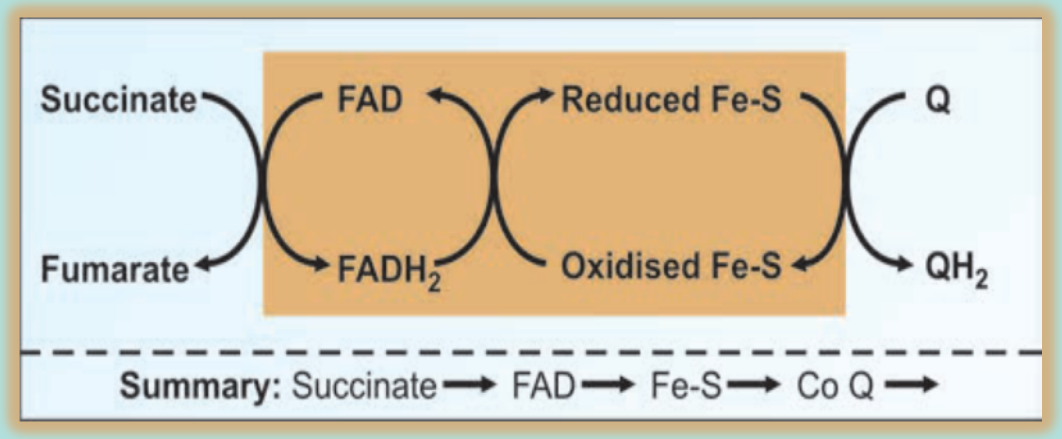
It is also called NADH-co Q reductase or NADH Dehydrogenase NADH + H+ + FMN → FMNH2 + NAD+



Complex II or called Succinate-Q Reductase.

The electrons from FADH2 enter the ETC at the level of coenzyme Q

Complex II: Succinate → FAD → Fe-S → CoQ →



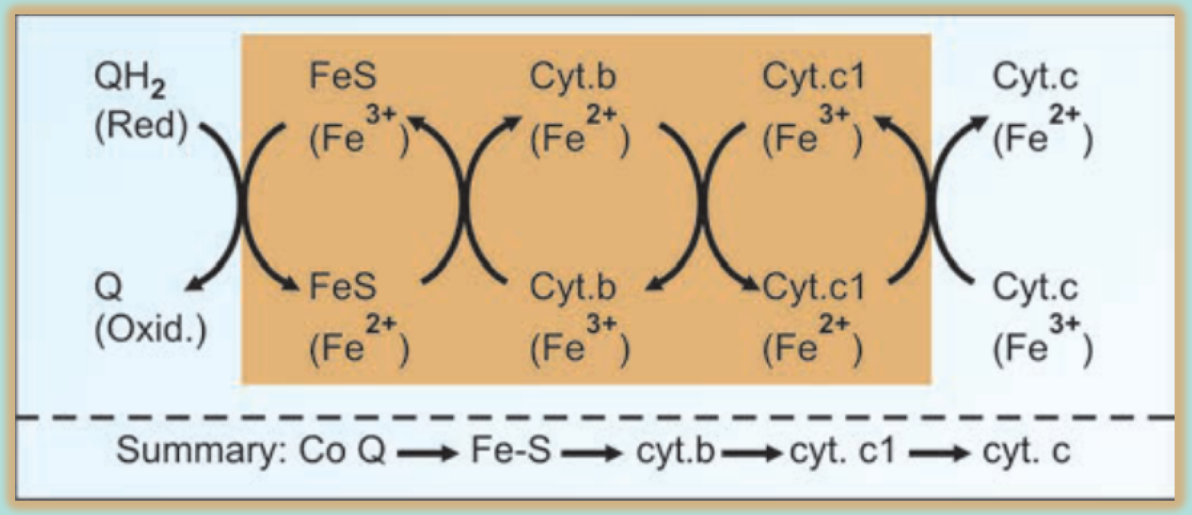
Coenzyme Q

i. The ubiquinone (Q) is reduced successively to semiquinone (QH) and finally to quinol (QH2).
ii. It accepts a pair of electrons from NADH or FADH2 through complex-I or complex-II respectively

Complex III or Cytochrome Reductase

i. This is a cluster of iron-sulphur proteins, cytochrome b and cytochrome c1, both contain heme prosthetic group.
ii. During this process of transfer of electron, theiron in heme group shuttles between Fe3+ and Fe2+ forms.
iii. The free energy change is –10 kcal/mol; and 4 protons are pumped out

Complex III: CoQ → Fe-S → cyt.b → cyt.c1 → cyt. c



Cytochrome c

It is a peripheral membrane protein containing one heme prosthetic group. The term cytochrome is derived from Greek , meaning cellular colors. Cytochrome c collects electrons from Complex III and delivers them to Complex IV.

Complex IV or Cytochrome Oxidase

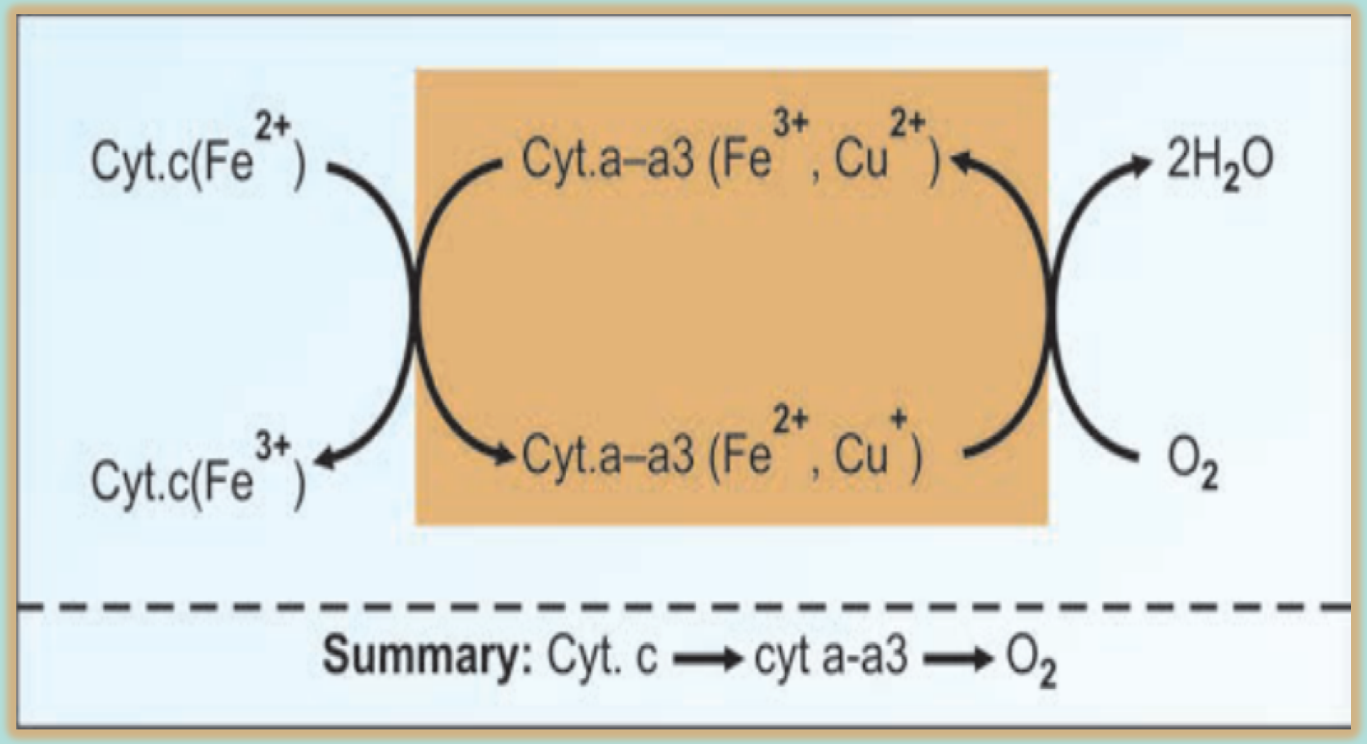
i. It contains different proteins, including cytochrome A and cytochrome A3. The Complex IV is tightly bound to the mitochondrial membrane.

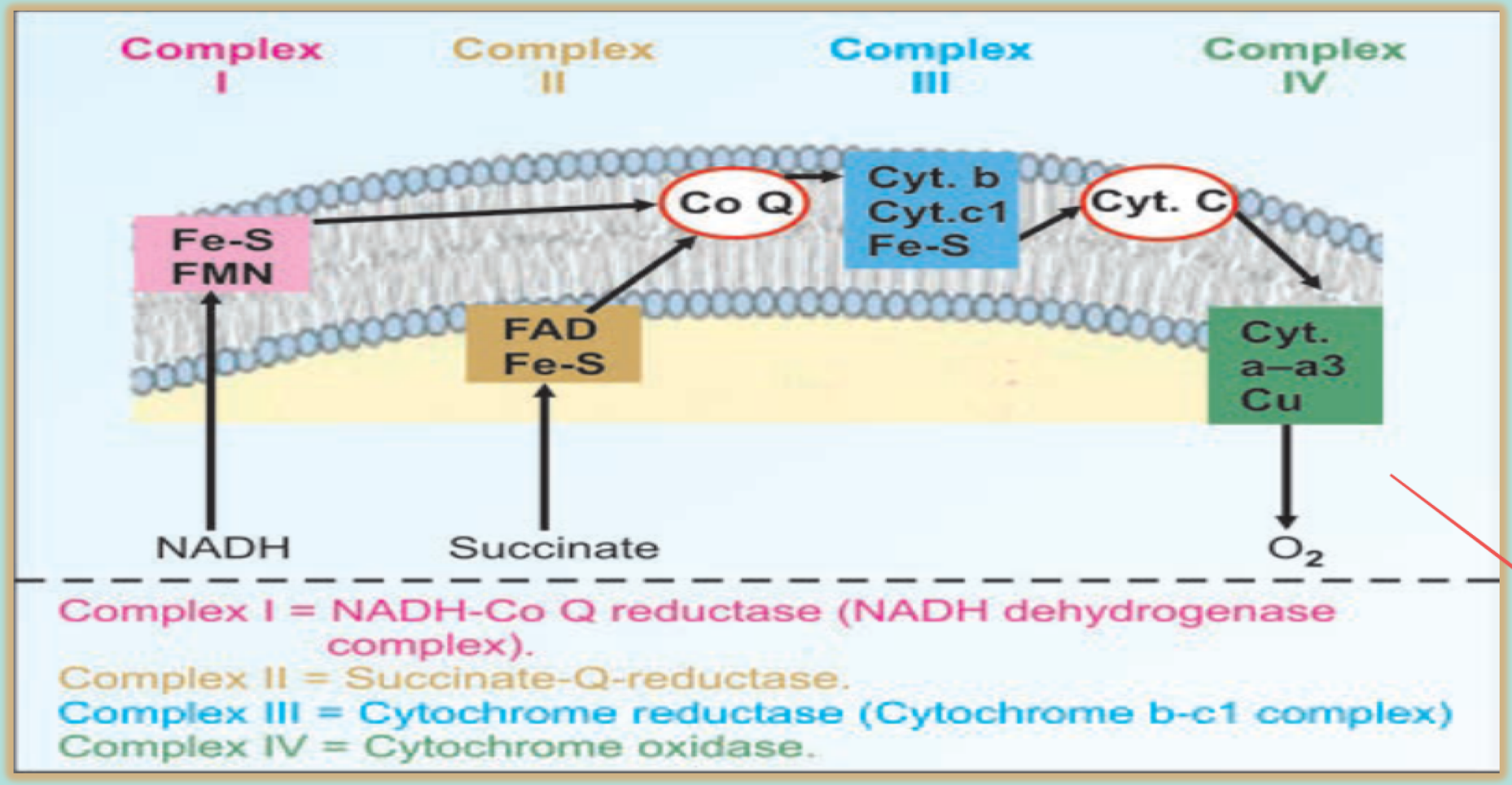
ii.Four electrons are accepted from cytochrome c, and passed on to molecular oxygen

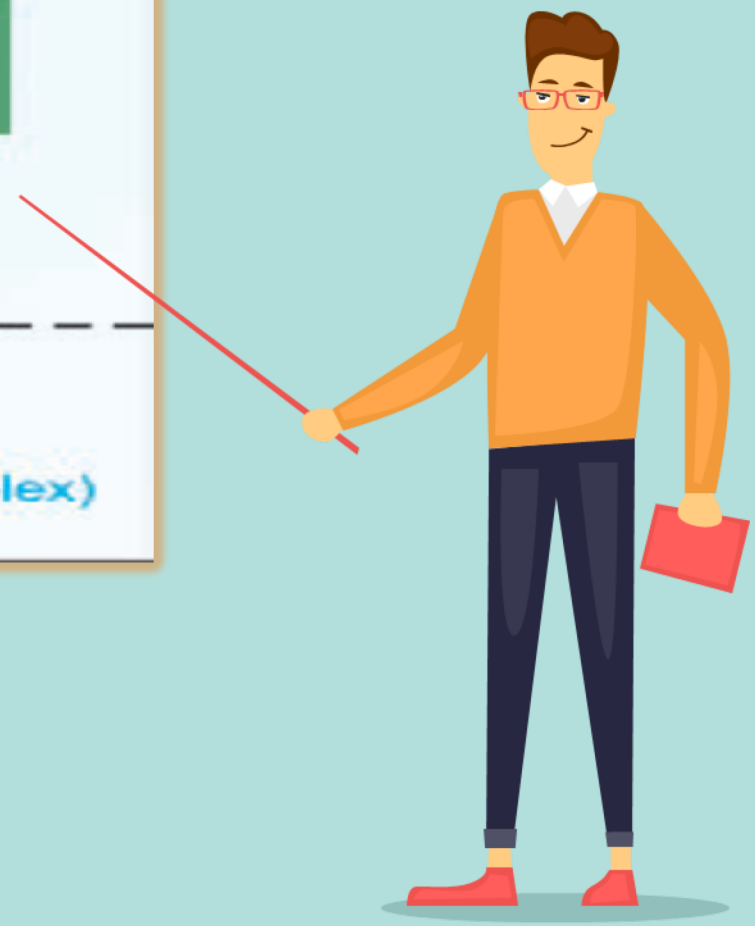
4 H+ + O2 + 4 Cyt.C-Fe++ → 2 H2O + 4 Cyt.C+++

iii. 2 protons are pumped out to the intermembrane space.

Complex IV: Cyt. c →□cyt a-a3 →□O2

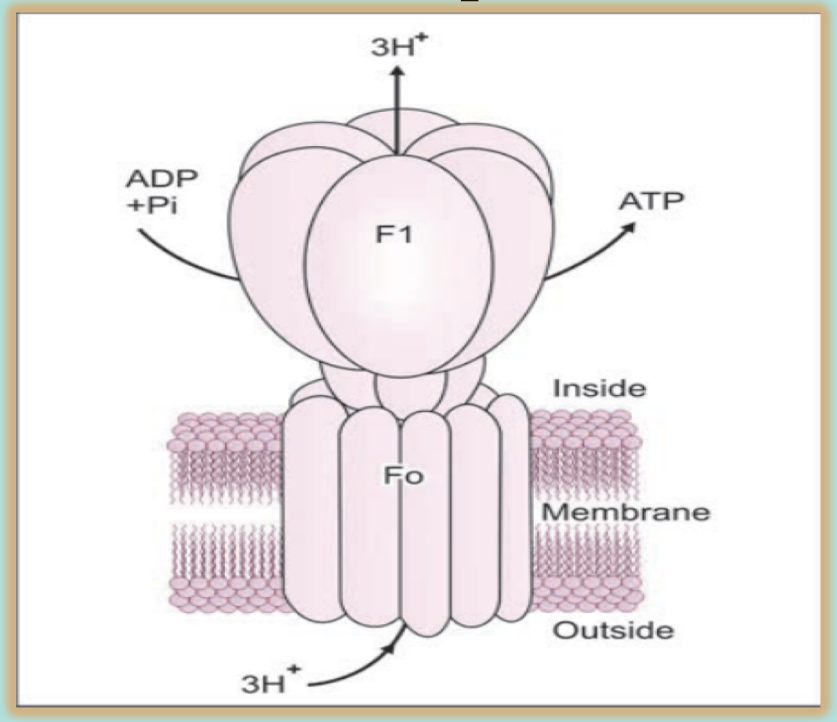



Complex I
Complex II
Complex III
Complex IV
Fe-S
FMN
Co Q
Cyt. b
Cyt.c1
Fe-S
Cyt. C
FAD
Fe-S
Cyt.
a–a3
Cu
NADH
Succinate
O_2
Complex I = NADH-Co Q reductase (NADH dehydrogenase complex).
Complex II = Succinate-Q-reductase.
Complex III = Cytochrome reductase (Cytochrome b-c1 complex)
Complex IV = Cytochrome oxidase.

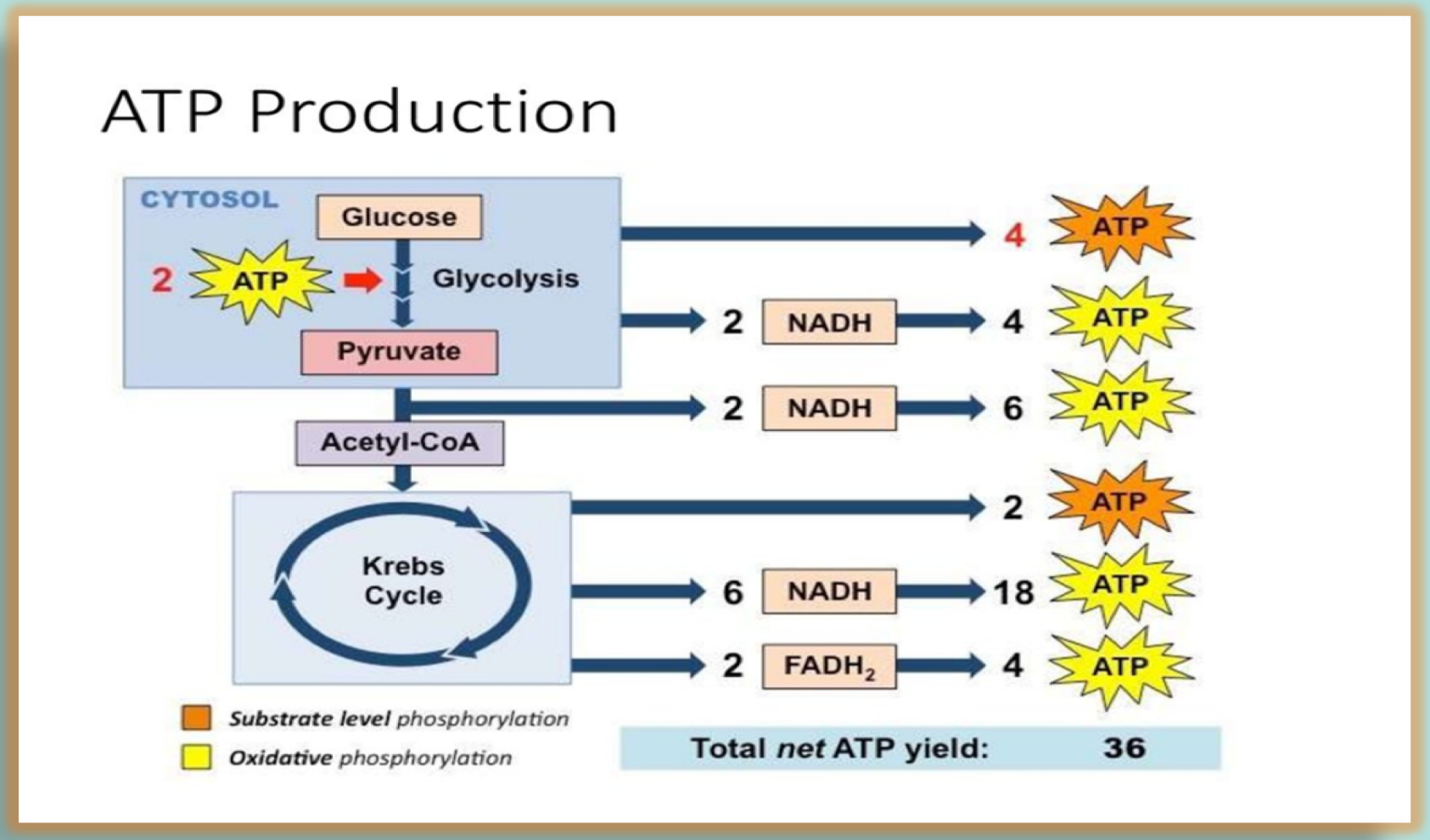


ATP SYNTHASE (COMPLEX V)

It is a protein assembly in the inner mitochondrial Membrane. It is sometimes referred to as the 5th Complex Proton pumping ATP synthase (otherwise called F1-Fo ATPase) is a multi-subunit trans membrane protein. It has two functional units, named as F1 and Fo. It looks like a lollipop since the membrane embedded Fo component and F1 are connected by a protein stalk.



Summary


ATP Production
CYTOSOL
Glucose
2
ATP
Glycolysis
Pyruvate
Acetyl-CoA
Krebs Cycle
4
ATP
2
NADH
4
ATP
2
NADH
6
ATP
2
ATP
6
NADH
18
ATP
2
FADH2
4
ATP
Substrate level phosphorylation
Oxidative phosphorylation
Total net ATP yield:
36

References

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