7.3 Citric Acid Cycle (Krebs or TCA)

Pyruvate
3-carbon

CO_2

NAD^+ → $NADH$

Acetyl CoA
(2 carbon)

Pyruvate
3 carbon

CO_2

NAD^+ → $NADH$

Acetyl CoA
(2 carbon)

LINK REACTION

- ATP generated is substrate-level phosphorylation (one per cycle)
- $NAD^+ \rightarrow NADH$ (3)
  $FAD \rightarrow FADH_2$ (1)

FLAVIN adenine dinucleotide

→ ETC

8 steps - enzyme-catalyzed

Oxaloacetate

Citrate

A cycle!!

CO_2

CO_2

Step 5
GTP or ATP ✡ Guanosine Tri-phosphate

Big Idea

⇒ MOST of the ATP generated by Respiration comes during Oxidative Phosphorylation.

⇒ the Citric Acid Cycle generates the NADH and $FADH_2$ that moves through the ETC to generate the energy to phosphorylate ADP to ATP

7.4 Oxidative Phosphorylation

ETC is a place

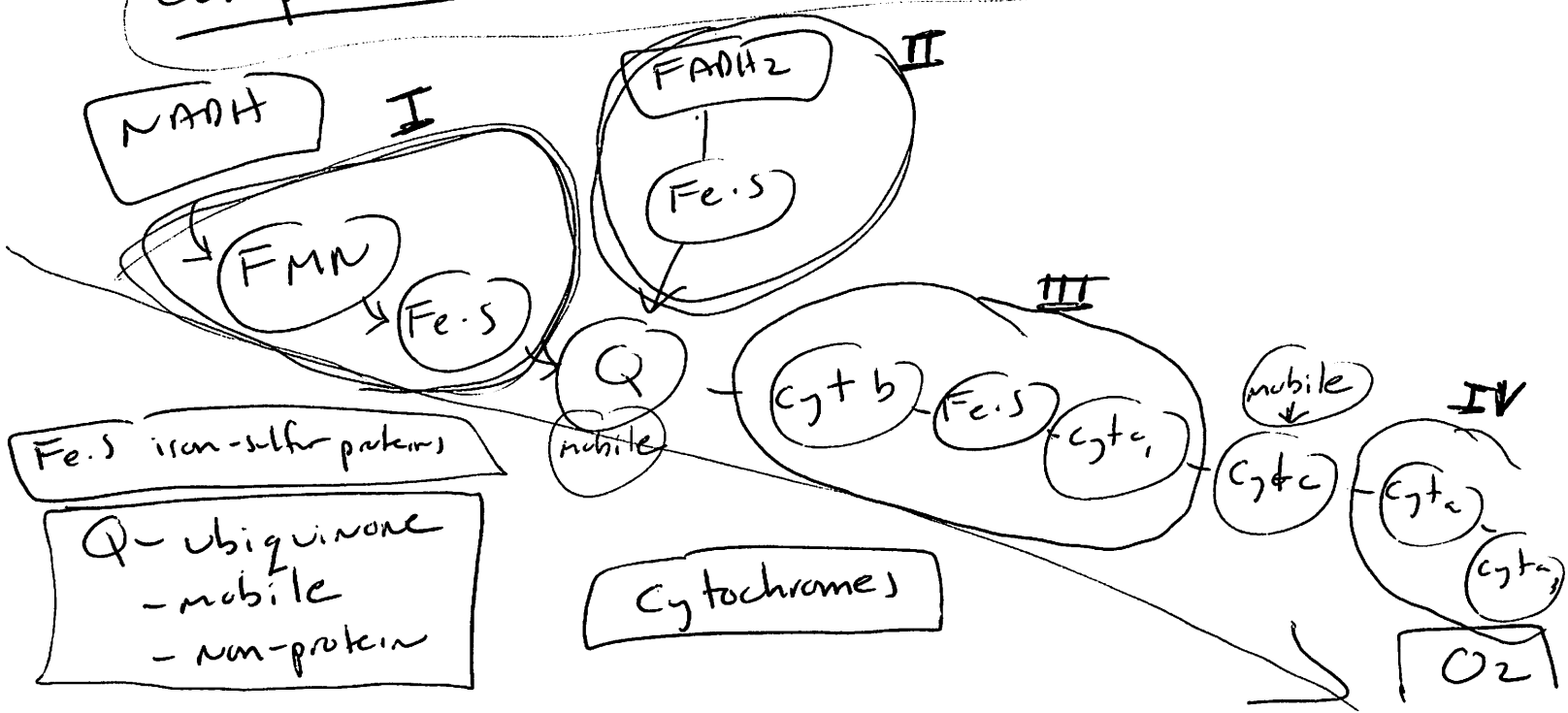
⇒ most proteins embedded in inner membrane of mitochondria in eukaryotes (plasma membrane in prokaryotes)

✡ CRISTAE ⇒ folds ⇒ increases SURFACE AREA

⇒ Proteins with "prosthetic groups" (non-protein components)

⇒ Electronegativity increases as you go down the ETC culminating in O_2

Complexes I, II, III, IV



Chemi-osmosis

★ energy stored in the form of a hydrogen ion gradient across a membrane that is used to drive the synthesis of ATP

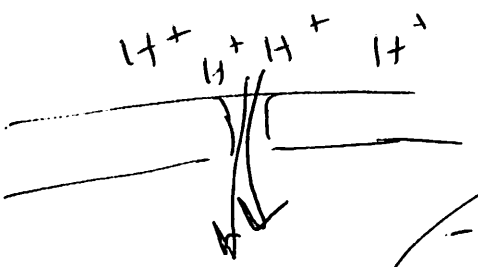
ATP Synthase – large enzyme

4 parts

- rotor
- stator
- internal rod
- catalytic knob

} polypeptide subunits.

↳ Chemiosmosis is an **energy-coupling** mechanism.



Proton-motive force

- also used in photosynthesis
- prokaryotes use it to rotate flagella & move molecules across membrane

Final Tallys

Lots of issues!!

Gly- 2 ATP
Citric- 2 ATP
Ox Phos- 28 ATP
32 ATP.

Efficiency - 34%

→ 66% lost as heat from 1 mol glucose.

Fermentation & Anaerobic Respiration

If no O_2, then

Anaerobic respiration

uses the ETC but does not use O_2 as final receptor of e^- (like sulfate reducing bacteria)

Fermentation

Does not use the ETC

Fermentation

* BTW - OXIDATION DOES NOT HAVE to involve oxygen, merely the transfer of electrons.

⇒ Pyruvate acts as an electron acceptor to oxidize NADH back to NAD+ so glycolysis can continue

Alcoholic

Ethanol
CO_2
2 NAD +
2 ATP

Acetaldehyde is the electron acceptor.

LACTIC ACID

LACTATE
2 NAD +
2 ATP

Obligate Anaerbues

only fermentation
or
Anaerobic respiration

facultative Anaerobes

either fermentation
or
Aerobic respiration.

i.e. muscle cells act like them

De-amination

- Amino groups removed before proteins can enter glycolysis or citric acid cycle through a "side door"

Beta Oxidation

- breaks down fatty acids into acetyl CoA
- also generates NADH and $FADH_2$

⇓

Fats Produce twice the ATP **per gram** than **Carbs**

✱ Intermediate compounds can **exit** the catabolic pathways and be used for Bio-synthesis (ANAbolic pathways)

i.e **dihydroxyacetone phosphate** ⇒ **FAT**