

OXIDATIVE PHOSPHORYLATION

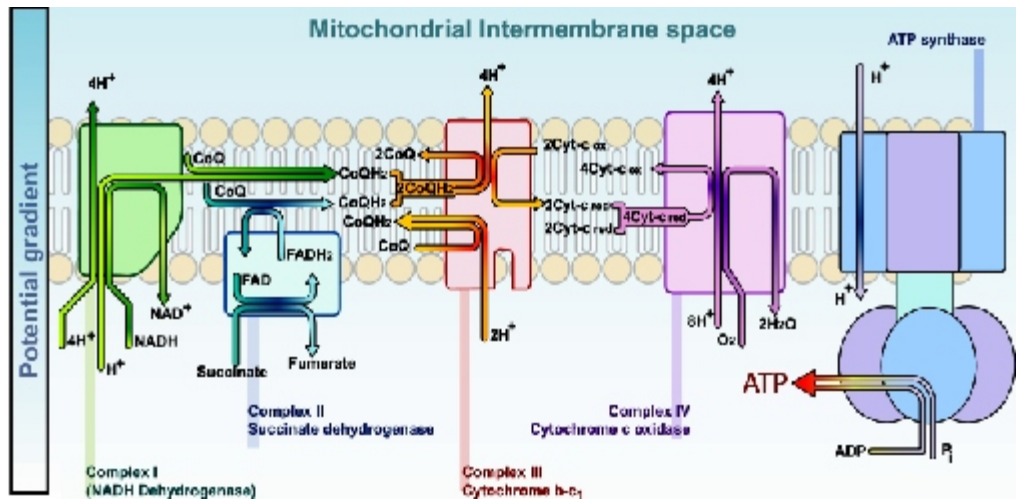
13 Nov 92, rvsd 11/12/93, 11/9/94, 11/6/95, 11/18/96, 12 Nov 99, 13 Nov 00, 9 Nov 01, 18 Nov 02, 12 Nov 03, 12 Nov 04, 9 Nov 05, 7 Nov 08, 4Nov09, 5Nov10
 BKH: pp. 423-446, BKH 5th: 415-425, 6th: 265-275, 7th: 269-287

Jagendorf:

acid causes mitochondria to make ATP:
phosphorylation powered by H⁺ gradient
 (= transmembrane proton gradient)

Function of electron transport chain:

as energetic electrons (from hydrogen atoms) are passed from component to component, the energy they give up is used to pump H⁺ out of matrix into intermembranous space



Five classes of electron carriers are **all proteins** except for coenzyme Q, membrane bound except for cyto c:

- | | | |
|----------------------------------|---|-------------|
| 1) flavoproteins | contain flavin molecule (p. 262) | Cmplx 1 |
| 2) Iron-sulfur proteins | most plentiful, iron complexed to cysteine, ferric to ferrous | Cmplx 1,2,3 |
| 3) cytochromes | porphyrin containing, with iron at center = heme (p. 270) | Cmplx 3, 4 |
| 4) copper-containing cytochromes | copper complexed with iron in heme, binds terminal oxygen | Cmplx 4 |
| 5) coenzyme Q | only non-protein redox reagent (p. 271) | 1 or 2 to 3 |

COMPLEX I (p 272, 273 for electron potential chart of complexes, **p. 275 for membrane.**)

1) NADH dehydrogenase

NADH donates 2e⁻ to flavoprotein (prosthetic group = flavin mononucleotide (FMN)), **pumps out 2H⁺** as it transfers e⁻ to Fe₂S₂ complex (reducing ferric to ferrous). Fe₂S₂ complex transfers e⁻ to Coenzyme Q. (Fe₂S₂ complex can also receive e⁻ from FADH₂ via **complex II.**)

2) Coenzyme Q:

ubiquinone, *only non-protein component*, is reduced by collecting e⁻ (originating from either FADH₂ [Passed through complex II] or NADH dehydrogenase) and H⁺. Reduced Q molecule **diffuses** to outside of membrane where it releases H⁺ into the intermembranous space. **I.e., Pumps out 2H⁺** as it transfers e⁻ to cytochrome b (complex III).

COMPLEX II

Succinate dehydrogenase (or fumarate reductase):

succinate -coenzyme Q oxidoreductase is reduced when succinate is oxidized.

FADH₂ transfers electron to Fe-S, thence to Coenzyme Q as in complex I.

COMPLEX III

3) Coenzyme Q-cytochrome c reductase

(also called cytochrome b-c₁ complex): cytochrome b accepts e⁻ fr coenzyme Q, donates to Iron-Sulfur Proteins: cysteine binds Fe, Fe reducible, accepts electrons.

Pumps out 2H⁺, then to **heme** in cytochrome c₁, all integral proteins.

COMPLEX IV

4) cytochrome c oxidase:

Cytochrome c (soluble, loosely bound to membrane, diffuses along plane of membrane) picks up electrons fr previous complex, delivers to cytochrome c oxidase: heme in **cytochromes, includes a and a₃.**

The heme in a and a₃ contain Cu complexed to the Fe, binds O₂.

This combines 2 electrons + 2H⁺ + oxygen to produce H₂O.

Only last (a₃) is terminal oxidase.



Note **poisons** of Electron transport chain:

- | | | |
|----------------------------|------------------------|--------------------|
| Rotenone and amytal | inhibit FMN to FeS | NADH dehydrogenase |
| antimycin a | inhibits b to c-1 | |
| cyanide | stops a to a-3 | cytochrome oxidase |
| CO | inhibits a-3 to oxygen | |

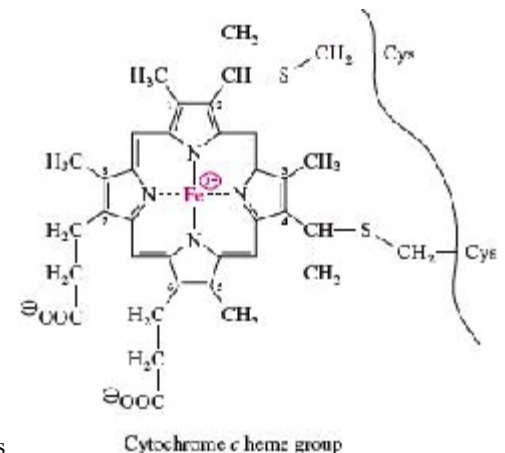
ATP synthase: (p 281)

F₀ is integral a decimer complex imbedded in the inner membrane, a H⁺ tunnel.

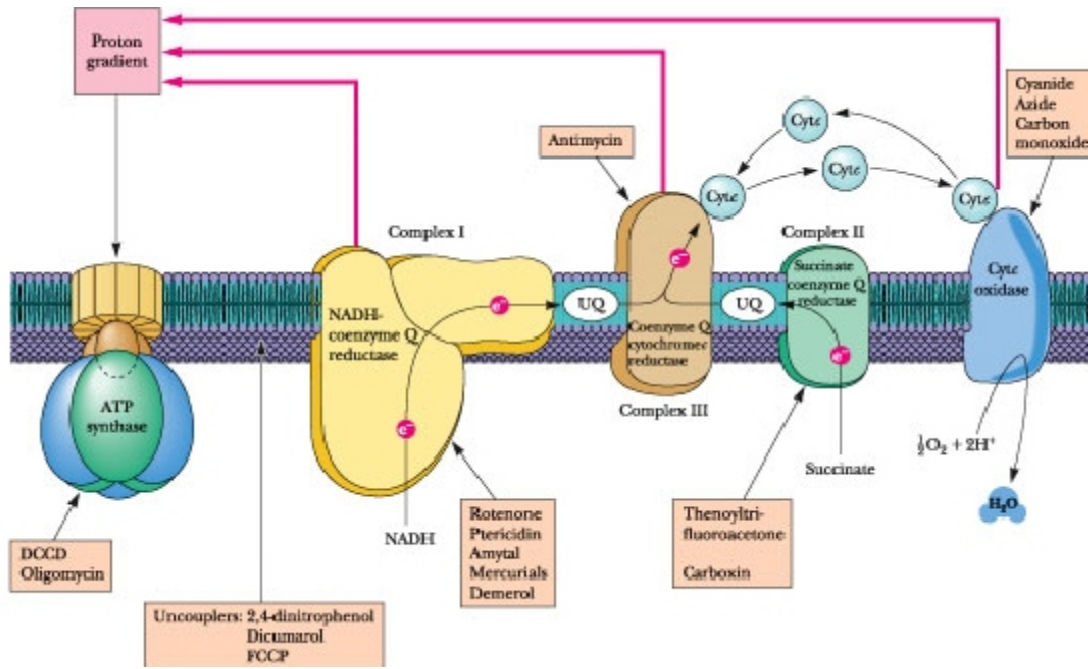
On matrix side, a tetramer neck attaches, then the **F₁ hexamer complex** attaches to that.

As H⁺ passes through the system, it activates the F₁ complex, which then phosphorylates ADP.

Excellent video of ATP synthase action: <http://www.youtube.com/watch?v=PjdPTY1wHdQ>



Cytochrome system with sites of action of electron transport poisons:



TAPES ON THE CATABOLISM OF GLUCOSE (ETC)

David B. Fankhauser, Prof of Biology and Chemistry

8 November 1995

The following tapes are available for use in Clermont College's library, or for checking out over night. They are sequential, and follow logically one after the other. I suggest you make a party of it... Pull together a study group and view and discuss the information in the tapes. Let me know how useful you find them.

Biochemistry Video Tapes:

VIDT	QH 633 .C45 1992 pt.1	Cell and Energy	(Series Title-Cellular Respiration)
VIDT	QH 633 .C45 1992 pt.2	Glycolysis 1	(Series Title-Cellular Respiration)
VIDT	QH 633 .C45 1992 pt.3	Glycolysis 2	(Series Title-Cellular Respiration)
VIDT	QH 633 .C45 1992 pt.4	The Krebs Cycle	(Series Title-Cellular Respiration)
VIDT	QH 633 .C45 1992 pt.5	Oxidative Phosphorylation	(Series Title-Cellular Respiration)
VIDT	QH 633 .C45 1992 v.6	Metabolism and Nutrition	(Series Title-Cellular Respiration)

Tapes on Molecular Biology:

VIDT	QH 450.2 .T73 1991	Translating the Code: Protein Synthesis
VIDT	QD 435 .D4 1987	DNA and Protein Synthesis (Series Title-Biochemical Basis of Biology)

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