

# OXIDATIVE PHOSPHORYLATION

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 BKH: pp. 423-446, BKH 5<sup>th</sup>: 415-425, 7<sup>th</sup>: 265-275, 7<sup>th</sup>: 269-287

Jagendorf showed acid would cause mitochondria to make ATP:

**phosphorylation powered by H<sup>+</sup> 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<sup>+</sup> 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<sup>-</sup> to flavoprotein (prosthetic group = flavin mononucleotide (FMN)), pumps out 2H<sup>+</sup> as it transfers e<sup>-</sup> to Fe<sub>2</sub>S<sub>2</sub> complex (reducing ferric to ferrous). Fe<sub>2</sub>S<sub>2</sub> complex transfers e<sup>-</sup> to Coenzyme Q. (Fe<sub>2</sub>S<sub>2</sub> complex can also receive e<sup>-</sup> from FADH<sub>2</sub> via **complex II**)

### 2) Coenzyme Q:

**ubiquinone**, only non-protein component, is reduced by collecting e<sup>-</sup> (originating from either FADH<sub>2</sub> [Passed through complex II] or NADH dehydrogenase) and H<sup>+</sup>. Reduced Q molecule **diffuses** to outside of membrane where it releases H<sup>+</sup> into the intermembranous space.

**I.e., Pumps out 2H<sup>+</sup>** as it transfers e<sup>-</sup> to cytochrome b (complex III).

## COMPLEX II

### Succinate dehydrogenase (or fumarate reductase):

succinate -coenzyme Q oxidoreductase is reduced when succinate is oxidized. FADH<sub>2</sub> 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-c<sub>1</sub> complex): cytochrome b accepts e<sup>-</sup> fr coenzyme Q, donates to Iron-Sulfur Proteins: cysteine binds Fe, Fe reducible, accepts electrons.

**Pumps out 2H<sup>+</sup>**, then to **heme** in cytochrome c<sub>1</sub>, all integral proteins.

## COMPLEX IV

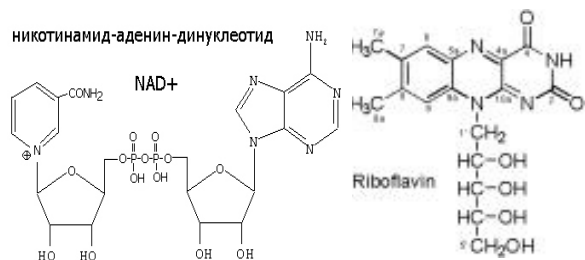
### 4) cytochrome c oxidase:

**Cytochrome c** (soluble, loosely bound to membrane, can diffuse along plane of membrane) picks up electrons fr previous complex, delivers to cytochrome c oxidase: heme in **cytochromes**, includes **a and a<sub>3</sub>**. The heme in a and a<sub>3</sub> contain Cu complexed to the Fe, binds O<sub>2</sub>. This combines 2 electrons + 2H<sup>+</sup> + oxygen to produce H<sub>2</sub>O.

Only last (a<sub>3</sub>) is terminal oxidase.

Note **poisons** of Electron transport chain:

<b>Rotenone and amytal</b>	inhibit FMN to FeS
<b>antimycin a</b>	inhibits b to c-1
<b>cyanide</b>	stops a to a-3
<b>CO</b>	inhibits a-3 to oxygen



## ATP synthase: (p 281)

F<sub>0</sub> is integral complex of the inner membrane, a H<sup>+</sup> tunnel.

On matrix side, a tetramer neck attaches, then the F<sub>1</sub> **hexamer complex** attaches to that.

As H<sup>+</sup> passes through the system, it activates the F<sub>1</sub> complex, which then phosphorylates ADP.

**OVERVIEW ILLUSTRATION ON PAGE 284** (Dynamics of electron chemical proton gradient)

## TAPES ON THE CATABOLISM OF GLUCOSE (ETC)

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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)
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### 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)

