Notes 12/7

Friday, December 07, 2007
10:02 AM

Notes 127

Audio recording started: 10:03 AM Friday, December 07, 2007

FINAL SLIDES:

The Grand Finale: ATP Synthase

Dec. 7, 2007

Announcements

- Even if you missed this lecture you are held responsible for ALL of this information.
- Final rooms are to be announced on VOH
- Lecture 1: Tues. 3 PM to 6 PM
- Lecture 2: Thurs. 3 PM to 6 PM
- Photo ID is required! We will be checking it.
- No one from Lecture 2 will be permitted into the Tues. final. No one from Lecture 1 will be permitted into the Thurs. final.
- You will be photographed during the final exam.
- No extra time if you are late. Be sure to arrive to campus very early to make sure you are on time. Sleeping in, other exams or appointments, vehicle trouble, late bus/taxi/subway/carpool, traffic, weather, construction, etc. are not permissible excuses.

What to bring

- Photo ID is mandatory. No exceptions.
- Blue or black ink pens
- Nonprogrammable calculator
- Molecular model sets
- Documentation that states any exceptions you may have for the final
  - For example, if you need to eat during the exam or take medication for medical reasons then you must have a doctor's note stating this
  - You are allowed to take the exam early because you have a professional school interview then provide your permission letter from Dr. Villa (you must have prearranged this)

What is not permitted

- Pencil or anything other than blue or black ink.
- Anything that obscures you during the exam (large hats, large hoods, large coats, sunglasses, etc.)
- Electronic devices (cell phones, PDAs, digitial recorders, head phones, scanners, computers, iPod and similar devices, cameras, tape recorders, programmable calculators, etc.)
- Anything like notes, books, booklets, dictionaries, paper, note cards, notebooks, cheat sheets, etc.
- Communicating with others other than proctors and Dr. Villa in any form is not permitted
- Distracting behavior (talking, whistling, humming, eating, tapping, unnecessary sounds, etc.)
- Food (plan to eat beforehand)

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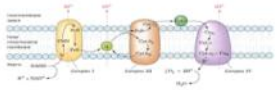
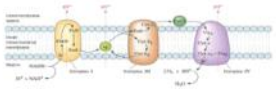
Last of the new material

Sequence of electron carriers



- NADH --> Q --> Cyt b --> Cyt c_1 --> Cyt c --> Cyt $(a + a_3)$ --> O_2
- Coenzyme q has 3 different oxidation states
- Cytochrome c can only carry 1 electron at a time
- Takes 4 electrons to fully reduce 1 molecule of O_2 to 1 molecule of water

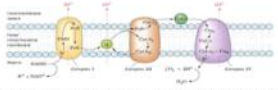
Complex I (NADH-Coenzyme Q Reductase)



Hydride = proton and 2 electrons

- Hydride ion from NADH is transferred from NADH to FMN
- 2 electrons pass from FMN to FeS centers to Q
- Q diffuses into the lipid bilayer and drives the expulsion of 4 protons (per pair of electrons)
- Q soluble in lipid bilayer

Complex II (Succinate-Coenzyme Q Reductase)

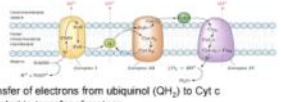


Complex 2 not shown on diagram

- Electrons from succinate pass thru FAD and several FeS centers to Q

FAD covalently linked to succinate dehydrogenase.

Complex III (Coenzyme Q-Cytochrome c Reductase)

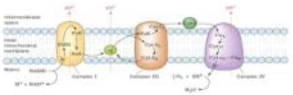


- Transfer of electrons from ubiquinol (QH_2) to Cyt c
- Coupled to transfer of protons
- How are electrons passed thru the complex?
  - Answer: Q cycle

Cytochrome c is periferal membrane protein (not in lipid bilayer)

Last of the new material

Sequence of electron carriers



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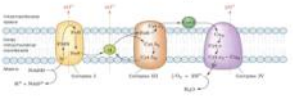

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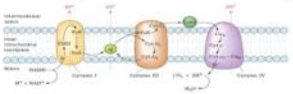

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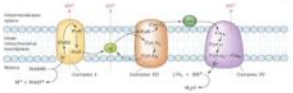


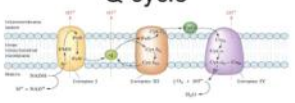
- Transfer of electrons from ubiquinol (QH_2) to Cyt c
- Coupled to transfer of protons
- How are electrons passed thru the complex?

Q cycle

- Accounts for proton translocation during electron transfer from Cyt b to Cyt c
- Ubiquinone carries two electrons
- Cyt $_{c1}$ only carries one electron
- Other electron carried by Cyt b back to Q
- Net effect: QH_2 ia oxidized to Q and two molecules of Cyt c are reduced

- Explains how 2 electrons from ubiquinone go onto cytochrome c (only can take 1 electron)

Q cycle



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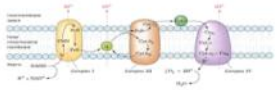
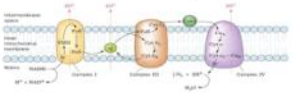
Complex IV (Cytochrome c Oxidase)



- Cyt c passes one electron to Cu_A --> Cyt a --> Cyt a_3 --> O_2
- One proton pumped per electron
- 1 electron at a time is transferred onto oxygen.
- Cyt c availability regulated transport

Complex IV (Cytochrome c Oxidase)



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- One proton pumped per electron
- Cyt c availability regulated transport

ATP Synthase (complex)

- Large enzyme complex of inner mitochondrial membrane
- Translocates protons
- Two functional domains are F_0 and F_1
- F_0
  - integral to the membrane → means it is inside the membrane
  - Proton pore
  - Can hydrolyze ATP but can't synthesize it
- F_1
  - peripheral membrane protein
  - "lollipop"
    - Atp synthisized at F_1
    - Alpha-beta dimers site of catalysis (3 of these dimers in F_1 domain)

ATP Synthase

- Large enzyme complex of inner mitochondrial membrane
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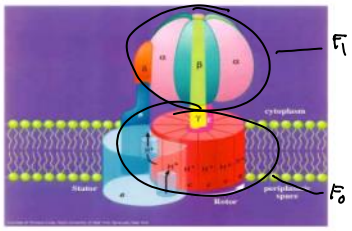
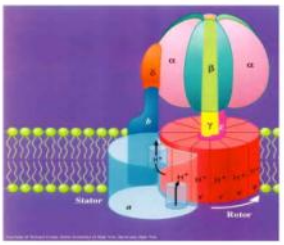
Figure 22-43 Model of the *E. coli* F_1F_0–ATPase.



Gradient in proton concentration, helps the rotor go around. The rotor pumps the shaft and this shaft causes conformational change in alpha-beta dimers which drives ATP synthase

Figure 22-43 Model of the *E. coli* F_1F_0–ATPase.



Mechanism of ATP synthesis

- Three phases
  - Translocation of protons carrited out by F_0
  - Phosphorylation of ADP to ATP by F_1
  - Coupling of dissipation of proton gradient with ATP synthesis (requires F_1 and F_0 interaction)
- ADP and Pi availability regulate oxidative phosphorylation

Animation (youtube) (link on slides)

ATP synthesis happens with high proton concentration in intermembrane space and low proton concentration in matrix. By putting high proton concentration in matrix, then ATP will actually be hydrolyzed and protons will be pumped back into intermembrane space (rotor works in opposite directly)

Mechanism of ATP synthesis

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Copy and paste this link into a web browser for the ATP Synthase video

- http://www.youtube.com/v/U2IkIabXYrws&rel=1