

BERG/STRYER VI STUDY GUIDE

CHAPTER 18

1. Homework 1-4, 8, 10. Understand the overview (502-5). This chapter is about energetics in the **mitochondrion**, but mitochondria are symbiotic bacteria, and parallel processes are found everywhere in prokaryotic cells. **Electron transport** directly produces a **proton gradient**. The protons flow back in through the mitochondrial **inner membrane**, driving protein-based machinery, which causes ATP to be synthesized. The electrons come from NADH and FADH₂ in the **matrix**, and the ATP is also formed in the matrix. You should be able to calculate the standard free energy change given half reaction potentials (Table 18.1) using the equation $\Delta G^{\circ} = -nF\Delta E_{\circ}'$ (507). Electrons move from higher energy (top of the table) to lower energy in the electron transport chain (ETC). You should be able to write out the components of the ETC and divide them into the four complexes. Learn this linear version:

NADH, FMN, (FeS)_n, Q, b_L, b_H, FeS, c₁, c, Cu_A, a, a₃, Cu_B, O₂.

Branch at Q: FADH₂, (FeS)_n, Q.

Complexes: **I** = NADH-Q oxidoreductase, **II** = Succinate-Q reductase, **III** = Cytochrome c oxidoreductase, **IV** = Cytochrome c oxidase. You should know the components of each complex, and understand that Q and c are "mobile" electron carriers that pick up electrons from one complex and deliver them to the next. Be able to recognize the structure of Q (ubiquinone, **coenzyme Q**, 510) and see whether it is in the quinone, semiquinone, or hydroquinone form. Be able to sketch an **iron sulfur** cluster (Fig 18.9) and know that these are "old" and high in energy. Know that cytochromes contain heme groups, and these are newer and lower in energy. Understand the Q cycle (Fig. 18.12). Know that cytochrome c oxidase absorbs 4 electrons and uses them to reduce O₂ safely (Fig. 18.14). Read about taxonomy based on cytochrome c (520).

2. When the proton gradient is high enough, protons force their way back into the matrix through the **F_o-F₁ complex** (Racker's knobs). This causes the F_o base to *rotate* while the F₁ head stands still (522ff), and the resulting conformational changes catalyze the synthesis of ATP from ADP + P_i. Know the **glycerol phosphate shuttle** (Fig. 18.35) and understand how the **malate aspartate shuttle** differs (Fig. 18.36). Understand the **ATP-ADP translocase**. Know that in most tissues oxidation of glucose yields about 30 ATP (32 in heart and liver). Read Table 18.4 and fine print. Understand coupling and **uncoupling** (532-3) and know some inhibitors of ETC (Fig 18.43) and some uncouplers (2,4-DNP, gramicidin). Why do you breathe harder after running 100 yards than you do while sitting still? Know that proton gradients ("proticity") drive many process including rotation of bacterial flagella (Fig 18.44).

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