READING GUIDE

BIOENERGETICS AND OXIDATIVE PHOSPHORYLATION

Objectives

1. Explain the importance of free energy in biological systems and describe how endergonic and exergonic reactions are coupled together in biological systems
2. Diagram and describe how the mitochondria, via the electron transport chain, converts reducing power to chemical energy in the form of adenosine triphosphate (ATP), and describe how cells utilize ATP as energy
3. Describe the mechanisms by which uncoupling proteins/agents, electron transport inhibitors, and ATP synthase inhibitors function in the mitochondria

Read Chapter 6

All the chapters in the metabolism section are very well written and very concise. You'll be expected to know this subject at the level taught in these chapters.

BIOENERGETICS AND FREE ENERGY

Free energy (Fig. 6.2)

ΔG (free energy) is an important principle in chemistry, but one that does not typically come up in discussions of the biochemistry relative to medicine. So read sections I-III as review and be familiar enough with the concept of free energy to answer the following questions.

What does the sign of ΔG tell you?

What is the significance of ΔGo?

How does the concentration of reactants and products affect ΔG, as predicted by the equation at the top of the page?

Reaction coupling and the utility of cellular ATP (Fig. 6.4,5)

How do cells make energetically unfavorable (reactions with a positive DG) reactions occur?

What characteristic of ATP makes it a useful repository of cellular energy?

THE MITOCHONDRION AND CELLULAR ENERGY PRODUCTION

Big picture (Fig. 6.6,7)

What is the primary way that the mitochondrion produces useful energy?

What are the permeability characteristics of the inner mitochondrial membrane, and why is this important?

Which mitochondrial membrane contains the electron transport, or respiratory, chain?

Electron transport chain and oxidative phosphorylation (Fig. 6.8,13)

How does ΔE relate to ΔG? Does this make sense in the context of the electron transport chain releasing energy?

What property of the enzyme complexes (I-IV) in the chain allow them to readily accept and donate electrons? How do they differ from one another?

Why does the oxidation of $FADH_2$ produce less ATP than the oxidation of NADH?

How is electron transport coupled to ATP synthesis?

What do uncoupling proteins (UCP), and synthetic uncouplers, do? (Fig. 6.14)

How does ATP get out of the mitochondrial matrix? OBJ

How does NADH get from the cytosol into the mitochondria? (Fig. 6.15)

Why are inherited defects in oxidative phosphorylation usually caused by mutations in mitochondrial genes?

Summary (Fig. 6.18)