Electron Transport and Oxidative Phosphorylation
Chapter 17 Learning Objectives

Key concepts: The ultimate transfer of electrons from the reducing equivalents NADH and FADH2 to oxygen through iron and hemes, is the driving force for forming ATP in mitochondria. The electron transport is coupled to the oxidative phosphorylation of ATP via the protons pumped during ETS. The linkage of these two systems is explained by the chemiosmotic hypothesis. In this theory the differences in both pH and membrane potential created on opposite sides of the inner mitochondrial membrane drives the phosphorylation of ATP by the Fo/F1 subunits of ATP synthetase. There are several poisons of the ETS, ox phos and uncouplers which can alter the oxygen consumption of mitochondria.

By the end of the chapter you should be able to:
Define electron transport system, oxidative phosphorylation and coupling

Know the locations of the participants of the system/pathways

1. Predict the flow of electrons under standard state conditions when given a redox half equation and know how to calculate the standard state free energy change given the proper equation and half reactions. Be able to predict the spontaneity of a reaction given the reduction potential - Calculate the change in reduction potential or the Gibbs free energy.

2. List the components of the respiratory chain and the electron carrying molecules. Know the differences between the hemes.

3. Outline the pathway of electron transport in mitochondria in terms of the transfer of electrons from the reducing equivalents to oxygen

4. Recognize the various states of oxidation and reduction for the stable radicals involved in the ETS

5. Know the main flow of electrons through the Q cycle.

6. Explain the chemiosmotic theory for the production of ATP - know what causes this phenomena

7. Describe the mechanism of action of an uncoupler or inhibitor of either the ETS or Ox phos

8. Recognize the site of inhibition of rotenone, carbon monoxide antimycin A and oligomycin. Also know the effects these inhibitors have on the rate of respiration of mitochondria

9. Define brown fat, its apparent physiological role and the mechanism by which that role is fulfilled

10. Describe and understand the mechanism that the F_0F_1 complex forms ATP

11. Understand the difference between the iron sulfur centers, cytochromes and copper in electron transfer

12. Describe the translocators and shuttles or reducing equivalents in mitochondria, including ATP and ADP

13. Estimate the net potential yield of ATP for each of the entry points into the electron transport system, and know why there are discrepancies

14. Know why it is important to have a controlled reduction of oxygen, the consequences of not having this happen and how the body overcomes the formation of free radicals.