Energy Generation - Mitochondria

TEXT: Chapter 13, pp: 407-430

A. Mitochondria.

**Vocabulary Terms:**

Mitochondria, Mitochondrion, Outer membrane, Inner membrane, Intermembrane Space, Matrix

*Take Home Message:* Mitochondria produce most of the animal cells ATP, using energy derived from the oxidation of sugars and fatty acids. Mitochondria are bounded by two membranes - the outer and inner membranes - which define two subcompartments, the intermembrane space and the matrix. The mitochondrial matrix and inner membranes are the major sites of oxidative phosphorylation.

B. Oxidative Phosphorylation.

**Vocabulary Terms:**

Glycolysis, pyruvate, Oxidative phosphorylation, ATP (Adenosine Triphosphate, ADP (Adenosine Diphosphate), NAD+ (Nicotine Adenosine Dinucleotide), NADH (reduced Nicotine Adenosine Dinucleotide), FAD+ (Flavin Adenosine Dinucleotide), FADH₂ (reduced Flavin Adenosine Dinucleotide), Acetyl Coenzyme A (Acetyl CoA), Pyruvate Dehydrogenase Complex, Citric Acid Cycle (Krebbs Cycle).

*Take Home Message:* Pyruvate generated from the hydrolysis and modification of glucose (Glycolysis) in the cytosol is imported into the matrix of the mitochondria. Here, a variety of enzymes covert pyruvate to acetyl CoA. Acetyl CoA is then oxidized through the Citric Acid Cycle to generate large amounts of NADH and FADH₂. In the inner membrane, high energy electrons donated from NADH and FADH₂ are passed along the electron transport chain to O₂.

C. The Electron Transport Chain.

**Vocabulary Terms:**

Chemiosmotic Hypothesis, (Mitchell’s Hypothesis, Chemiosmotic coupling, Electron Transport Chain (Respiratory Chain), Respiratory Chain Complexes, NADH Dehydrogenase, Cytochrome b-c₁, Cytochrome Oxidase, Hydride Ions, Electrochemical Proton Gradient (Proton Motive Force), Mobile electron carrier, Ubiquinone, Cytochrome c, Redox Potential, Redox Pairs, ATP Synthase, F₁ ATPase, Fₒ
**Take Home Message:** In the inner mitochondrial membrane, the high energy electrons donated by NADH and FADH\(_2\) are transferred down the electron transport chain from one respiratory chain complex to the next. During electron transfer, protons are pumped out of the matrix by the respiratory chain complexes, generating an electrochemical proton gradient, composed of a membrane potential and pH gradient across the inner membrane. The electrochemical proton gradient is used as a Proton Motive Force to (1) drive the synthesis of ATP, through the phosphorylation of ADP by ATP synthase and (2) drive the active transport of metabolites into and out of the mitochondrial matrix. This keeps the cytosol highly charged with ATP, driving many of the cell’s energy requiring reaction.