**Chapter Review**

**Chapter 3: Bioenergetics and Metabolism**

3.1

The behavior of cells is governed by the first and second laws of thermodynamics. Gibbs free energy combines the effects of entropy and enthalpy to predict the direction of biochemical reactions, which proceed in the energetically favorable direction. ATP serves as a store of free energy, which can be used to drive energy-requiring reactions within cells.

3.2

The breakdown of glucose provides a major source of cellular energy. Glycolysis is the initial stage of glucose breakdown in all cells. In aerobic cells, the oxidation of glucose is then completed by the Krebs cycle, yielding 36 to 38 molecules of ATP. Most of this ATP is derived from electron transport reactions in which electrons from NADH and FADH2 are transferred through a series of carriers in the inner mitochondrial membrane of eukaryotic cells. The energy-yielding reactions of electron transport are coupled to the generation of a proton gradient across the inner mitochondrial membrane and the energy stored in this gradient is harvested by ATP synthase, which couples ATP synthesis to the energetically favorable return of protons to the mitochondrion.

3.3

Energy from sunlight is absorbed by chlorophylls, exciting electrons to a higher energy state. These high-energy electrons are then transferred through a series of membrane carriers, coupled to the synthesis of ATP and the reduction of NADP+ to NADPH. The ATP and NADPH produced by these reactions are then used to synthesize glucose from CO2 and H2O.

3.4

Biosynthetic reactions are driven by energy and reducing power, usually in the form of ATP and NADPH. Additional energy is required to drive the polymerization of simple sugars, amino acids, and nucleotides to form polysaccharides, proteins, and nucleic acids, respectively.