**Behavior, Origins of Life, and Enzymes Unit Learning Objectives**

**Behavior**

* Organisms respond to changes in the environment through behavioral and physiological mechanisms
  + Examples include: photoperiodism and phototropism, hibernation and migration, nocturnal vs. diurnal behaviors, circadian rhythms, etc.
* Timing and coordination of behaviors are regulated by various mechanisms.
  + Examples include: innate vs. learned behaviors, courtship, niche and resource partitioning, pollination, etc.

**Origins of Life**

* Living systems depend on properties of water that result from its polarity and hydrogen bonding.
* There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.
  + Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized. In turn, these molecules served as building blocks for more complex molecules like amino acids and nucleotides.
  + Organic molecules formed with the ability to replicate, store and transfer information.
  + The RNA World hypothesis proposes that RNA could have been the earliest genetic material.
* Geologic evidence provides support for the models of the origin of life on Earth.
  + Earth formed approximately 4.6 billion years ago (bya), and the environment was too hostile for life until 3.9 bya, while the earliest fossil evidence for life dates to 3.5 bya. Taken, together this evidence provides a plausible range of dates when the origin of life on Earth could have occurred.
* Molecular and genetic evidence from extant and extinct organisms indicates that all organisms on Earth share a common ancestral origin of life.
  + Scientific evidence includes molecular building blocks that are common to all life forms: proteins, carbohydrates, lipids, nucleic acids, and water.
  + Scientific evidence includes a common genetic code.
* Cell membranes are selectively permeable due to their structure. Cell membranes separate the internal environment of the cell from the external environment.
  + Cell membranes consist of a structural framework of phospholipid molecules, embedded proteins, cholesterol, glycoproteins, and glycolipids.
  + Phospholipids give the membrane both hydrophilic and hydrophobic properties. The hydrophilic phosphate portions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid portions face each other within the interior of the membrane itself.

**Enzymes**

* The shape of enzymes, active sites and interaction with specific molecules are essential for basic functioning of the enzyme.
  + For an enzyme-mediated chemical reaction to occur, the substrate must be complementary to the surface properties (shape and charge) of the active site. In other words, the substrate must fit into the enzyme’s active site.
  + Cofactors and coenzymes affect enzyme function; this interaction relates to a structural change that alters the activity rate of the enzyme. The enzyme may only become active when all the appropriate cofactors or coenzymes are present and bind to the appropriate sites on the enzyme.
* Other molecules and the environment in which the enzyme acts can enhance or inhibit enzyme activity. Molecules can bind reversibly or irreversibly to the active or allosteric sites, changing the activity of the enzyme.
* The change in function of an enzyme can be interpreted from data regarding the concentrations of product or substrate as a function of time. These representations demonstrate the relationship between an enzyme’s activity, the disappearance of substrate, and/or presence of a competitive inhibitor.