Unit 2 Notes

- I. Energy Flow & Organisms
 - A. First Law of Thermodynamics: Energy cannot be created or destroyed, but it may change form.
 - 1. Organisms can't make their own energy, but must harvest it from another source (sun, other organisms).
 - 2. After harvesting the energy, it is changed into a storable form, and eventually changed again to make free energy.
 - B. Second Law of Thermodynamics: Systems tend to change in ways that increase disorder (entropy).
 - 1. To maintain order in a system (organism, building, etc.), free energy must be used.
 - a. Because energy conversions are not 100% efficient, each time energy changes form to provide free energy, some escapes (usually as heat).
 - b. To remain ordered, organisms and ecosystems must continually receive new energy to replace the energy that has become unusable (10% rule).
- II. Metabolism and Energy Transfer
 - A. Enzymes are proteins that act as catalysts.
 - 1. Activation energy is normally prevents chemical reactions in living things.
 - 2. By decreasing activation energy, enzymes make rapid chemical reactions possible.
 - a. One or more reactants (substrates) fit into an enzyme's active site (groove in tertiary structure).
 - b. Interaction with the substrate(s) causes the enzyme to change shape, putting stress on chemical bonds.
 - c. The reaction occurs, the product(s) are released, and the enzyme is ready for another reaction.

- 3. An enzyme works best at a certain temperature, pH, and salinity. (out of range \rightarrow denature)
- B. Metabolism, all the chemical activities that take place in an organism, consists of two basic classes of reactions.
 - 1. Synthesis (anabolic) reactions use free energy to form large, complex molecules from small, less complex ones.
 - 2. Decomposition (catabolic) reactions break large molecules into smaller molecules, releasing free energy (& heat).
 - 3. Synthesis and decomposition reactions are coupled.
- C. ATP is a molecule that serves as "energy currency."
 - 1. As various food molecules are decomposed, free energy and heat are released.
 - 2. The free energy is stored by synthesizing ATP from ADP and an inorganic phosphate molecule (P_i). (ADP + P_i + free energy \rightarrow ATP)
 - 3. The free energy stored in ATP is released when the bond between the second and third phosphate group is broken. (ATP \rightarrow ADP + P_i + free energy)
 - 4. ATP is formed and consumed rapidly 10 million molecules are consumed and regenerated per second per cell.
 - 5. ATP is used as an energy carrier in all known living cells.

III. Digestion

- A. There are two main categories of digestion (processes that break down food).
 - 1. Physical digestion breaks big pieces of food into smaller pieces of the same food, increasing surface area.
 - 2. Chemical digestion breaks complex food molecules into smaller, more simple ones.
 - a. Most animals and fungi rely on extracellular digestion.
 - i. Complex animals use a specialized "external" digestive cavity separated into specialized regions which vary according to the species' diet.
 - ii. Fungi digest food outside of themselves and then absorb the nutrients.
 - b. Most plants, bacteria, and protists use intracellular digestion.
- B. Human digestion follows a specific series of steps.
 - 1. Food is physically (teeth) and chemically (saliva w/ amylase (carbohydrates → maltose)) digested in the mouth and formed into a bolus.
 - 2. As the bolus is swallowed, the epiglottis covers the trachea to prevent choking.
 - 3. Peristalsis moves the bolus down the esophagus, through the cardiac sphincter, and into the stomach.
 - 4. Food is digested further in the stomach for 2 4 hours.
 - a. Food entering the stomach stimulates the release of the hormone gastrin which causes the secretion of HCl (pH drops → amylase is denatured).
 - b. The low pH causes inactive pepsinogen to become the active, protein digesting enzyme pepsin.
 - c. Food is turned into "soupy" chyme and passed through the pyloric sphincter.

- 5. The chyme is pushed into the small intestine.
 - a. The duodenum (1st part of the S.I.) receives pancreatic juice and bile salts.
 - i. Bile salts (from the liver / gall bladder) emulsify fat droplets (physical digestion).
 - ii. The pancreatic juice raises the pH and supplies trypsin (peptide enzyme), lipase (fat enzyme), and, amylase (carbo. enzyme).
 - b. As nutrients pass through the S.I., more proteinases, lipases, and carbohydrases are secreted, eventually digesting food into monomers.
 - c. The monomers are small enough to be absorbed into the bloodstream by villi (fingerlike projections rich in capillaries).
- 6. Undigested material passes to the large intestine.
 - a. Water is absorbed (usually...).
 - b. Bacteria produce vitamins (B & K) which you absorb.
 - c. The remainder (feces) is stored in the rectum and then eliminated through the anus.