TN Biology I: Standard 3 – Flow of Matter & Energy *(Includes coverage of Ch. 4 in textbook)*

Chapter 4: Cells and Energy

- ATP = adenosine triphosphate (a high energy molecule); ADP = adenosine diphosphate (low energy). ADP is converted into ATP by the addition of 1 P atom.
- Cells use ATP for all "active" processes, such as building molecules and active transport
- ATP is produced by breaking down food – the number of ATPs made is dependent upon the type of food molecules broken down (ex. carbohydrate, lipid, or protein)
- Cells will first use (1) carbohydrates, then (2) lipids, then (3) proteins for making ATP energy.
- The break down of 1 glucose yields about 36 ATP molecules.
- Chemosynthesis is the process by which chemical energy is used to make energy-storing sugars.
- Photosynthesis is a process that captures energy from sunlight to make energy-storing sugars

$$sunlight + 6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

- Chlorophyll (found in chloroplasts) functions in photosynthesis, absorbing blue /red light and reflecting green light.
- Grana are stacks of thylakoid membranes found within chloroplasts. Stroma is the fluid.
- The light-dependent reactions occur in the thylakoid membranes and require water and sunlight. Oxygen molecules are released and energy carriers (ATP, NADPH) are produced.
- Light-independent reactions (Calvin cycle) occur in the stroma and use energy (ATP, NADPH) from the light-dependent reactions to make sugars. These reactions use CO_2 molecules and produce glucose.
- Be familiar with Figures 4.7 and 4.9 in your textbook
- Aerobic = requires oxygen; anaerobic = does not require oxygen
- Cellular respiration takes place in the mitochondria and releases chemical energy from sugars to make ATP when oxygen is present (this is an aerobic process).

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

- Glycolysis occurs in the cytoplasm, precedes cellular respiration, and is an anaerobic process. It makes 2 (net) ATP, 2 NADH and 2 3-C molecules that will then enter into cellular respiration.
- Krebs cycle occurs in the mitochondrial matrix and is the first step of cellular respiration. It takes the 3-C molecules from glycolysis, releases CO_2, and produces 2 ATP, 8 NADH, and 2 $FADH_2$ molecules.
- The electron transport chain (ETC) is the second (and final) step of cellular respiration and it occurs in the inner mitochondrial membrane. It uses energy carriers (NADH, $FADH_2$) to make ATP. In this process, oxygen is used up and water is created as a byproduct.
- Be familiar with Figures 4.14 and 4.15 in your textbook
- In both photosynthesis and cellular respiration, ATP synthase (an enzyme in the membrane of the chloroplasts and mitochondria) generates ATP from ADP molecules.
- Fermentation is an anaerobic process that occurs in the cytoplasm and does not make ATP, but allows glycolysis to continue.
- Lactic acid fermentation is used by animals and some microorganisms. It produces 2 lactic acid molecules, recycling NAD+ back to glycolysis, allowing the process to continue.
- Alcoholic fermentation is used by yeasts and some plants. It produces 2 alcohol, 2 CO_2, and like lactic acid fermentation, it also recycles NAD+ back to glycolysis, allowing it to continue.