Unit 3: Cellular Energetics

Learning Targets and Homework Assignments

Topic	Objective	Got it?
3.1	**Describe** the properties of enzymes.	
3.2	**Explain** how enzymes affect the rate of biological reactions.	
3.3	**Explain** how changes to the structure of an enzyme may affect its function.	
	Explain how the cellular environment affects enzyme activity.	
3.4	**Describe** the role of energy in living organisms.	
3.6	**Describe** the processes that allow organisms to use energy stored in biological macromolecules.	
	Explain how cells obtain energy from biological macromolecules in order to power cellular functions.	
3.7	**Explain** the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments.	

Instructions for completing all HW assignments:

Answers to homework questions should be neatly written out, **by hand**, in your composition/graph-grid notebook. Begin each assignment on a clean page by writing your name and date in the top corner. Title the assignment, number and paraphrase each question, skip a line and then write your response. You will be submitting these homework pages on Schoology at the end of the unit. Your understanding of the material in these assignments will be assessed periodically throughout the unit in small Schoology homework checks.

HW #1: Enzyme Kinetics: Read Chapter 8: pp. 142-159

1. Define and give an example of each of the following:

metabolic pathway	catabolism	anabolism
Definition:	Definition:	Definition:
Example:	Example:	Example:

2. What is activation energy?
3. Study figures 8.14 and 8.15. What happens to the graph of an exergonic reaction when an enzyme is added? Draw and label a graph of the change in energy for an exergonic reaction with and without an enzyme.
4. Draw a sketch of an enzyme, labeling the active site and cofactor locations.
   a. Since most active sites are composed of only a few amino acid residues, explain why the rest of the protein in an enzyme is necessary.
5. Referring to Figure 8.17 in your textbook, use your own words to write a list of steps involved in an enzyme-catalyzed anabolic reaction.
6. Describe how temperature, pH, and enzyme concentration can affect the reaction rate of enzymes.

HW #2: Enzyme regulation: Read Chapter 8: pp. 142-159

1. Define: Phosphorylation, Energy coupling, ATP, NAD and NADH, FAD and FADH
2. For each of the questions below, compare/contrast competitive and non-competitive inhibition.
   - Where does the inhibitor bind to the enzyme?
   - How does the inhibitor affect average reaction rate?
   - How does the inhibitor affect maximum reaction rate?
   - What is the impact on the amount of substrate consumed?
3. Explain how a mutation (a change in directions for amino acid sequence in proteins) can affect the function of an enzyme, e.g., a membrane transport protein.
4. What are cofactors and why are they necessary for some enzymes to operate efficiently?
5. **Think About It** - You observe that an enzyme's reaction rate doubles every 10°C from 0°C to 40°C. Will this trend continue? Explain and justify your conclusion.

HW #3: Respiration: Read Chapter 9: pp. 162-168, and 170-175.

1. Define: Oxidation, Reduction, Electron Transport chain, Respiration, Glycolysis, Aerobic, Anaerobic

2. Study Fig. 9.4. How does NAD+ serve as an electron carrier? Why is this an important job?

3. Draw a mitochondrion and label the locations of the following processes: glycolysis, fermentation, Krebs cycle, ETC, H^+ gradient, ATP formation

4. **Study diagrams 9.11 and 9.12.** Sum up the purpose of the Krebs cycle in one sentence.

5. Explain why the Krebs cycle happens in the mitochondrial matrix and not in other parts of the mitochondria.

6. Why is it advantageous that the inner mitochondrial membrane has so many folds (cristae)?

HW #4: Respiration Summary:

Read Chapter 9, pages 172-179. Pay attention to figures 9.13, 9.14, 9.16, and 9.17.

1. Define the following: Cytochrome, Oxidative phosphorylation

2. Why is generation of ATP during glycolysis and the Krebs cycle called substrate-level phosphorylation?

3. Why does $FADH_2$ produce less ATP than NADH?

4. Describe how an ATP synthase protein works. How does it produce ATP?

5. DO THE MATH for OXIDATIVE PHOSPHORYLATION! Remember that you get 3 ATP for each NADH molecule and 2 ATP for each FADH2 molecule.

Source of NADH or FADH2 from <u>one molecule of glucose</u>	**# of ATP made**
2 NADH in glycolysis	____
2 NADH from pyruvic acid breakdown	____
6 NADH from Krebs Cycle	____
2 $FADH_2$ from Krebs Cycle	____
Subtotal for electron transport	**34**
ATP used to bring NADH into mitochondria	**-2**
Average # of ATP from oxidative phosphorylation:	**32**

Do the math for respiration for 1 glucose	
ATP from substrate-level phosphorylation:	
glycolysis	____
Krebs cycle	____
ATP from oxidative phosphorylation	____
Total ATP	____

6. Why is it beneficial for cells to use aerobic respiration instead of anaerobic respiration?

   ATP made during anaerobic respiration (glycolysis + fermentation)? _____
   During aerobic respiration (glycolysis + Krebs + electron transport)? _____
   Therefore, aerobic respiration is _____ times more efficient than anaerobic respiration!

7. Focus on Figure 9.20. Explain why your body doesn't need separate pathways for metabolizing fats and proteins. In other words, describe how fats and proteins are metabolized using glycolysis, pyruvate breakdown, Krebs cycle, and electron transport.