The Workshop Project Newsletter

PROGRESSIONS:
PEER-LED TEAM LEARNING

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Module 4: Metabolism and Cellular Respiration

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I. Introduction

One of the characteristics of life that you learned about in the beginning of this class was metabolism (and excretion). In this module we will be exploring the details of metabolism, and we will build on our new understanding of biological chemistry in order to comprehend how the body—and in particular the cell—is able to take complex molecules (like are in our food), break them down, and then use them to build new structures, and generate energy to do work. Many students (and faculty, too) find it helpful to think of metabolism in a cell as an assembly line in a factory with different machines having different roles in the process.

II. Pre-Workshop Activities

Activity A. Fill in the blanks using the terms in the box:

Aerobic respiration	Dehydration synthesis	Initial reactant
Anabolism	Catabolism	Intermediates
Enzyme	Anaerobic	Metabolic pathway
Hydrolysis	ATP	Metabolism

1. A protein that acts as a catalyst, speeding up chemical reactions is known as: _____.
2. The energy currency of the cell: _____.
3. The chemical process of building glycogen from glucose molecules: _____.
4. The chemical process of breaking down glycogen to produce glucose: _____.
5. All build up reactions in the body: _____.
6. All break down reactions in the body: _____.
7. The combination of breakdown and build up reactions: _____.
8. Metabolic reactions that require the presence of oxygen: _____.
9. Metabolic reactions that take place in the absence of oxygen: _____.

Use the following set of reactions to answer questions 10, 11, & 12:

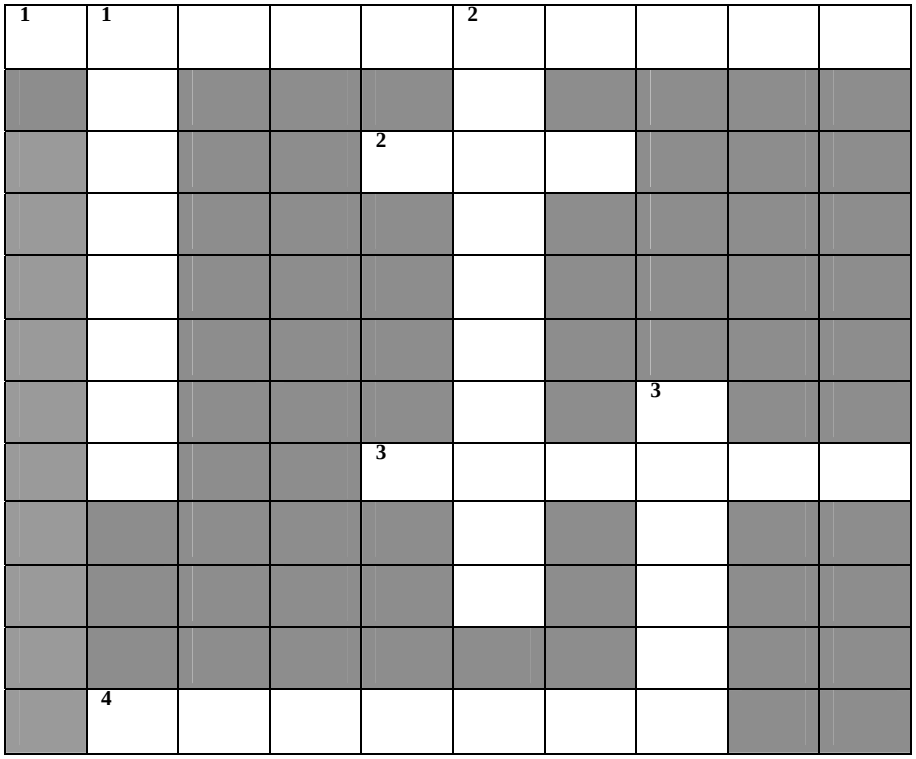
A→B→C→D→E→F (end product)

10. The above set of reactions may be described as: _____.

11. "A" would be considered: _____.

12. B, C, D, & E would be considered: _____.

Activity B. Refer to pages 82-86 to complete the following crossword puzzle:



Clues Across:

1. **The energy required to get a chemical reaction started (10)**
2. **The body's most important energy transfer molecule (3)**
3. **An enzyme that brings about the addition of a phosphate ion (6)**
4. **A pathway that takes place when oxygen is available (7)**

Clues Down:

1. **An organic cofactor such as NAD that accepts and transfers electrons (8)**
2. **Pocket within the enzyme to which the substrate binds (10)**
3. **_____ acid is formed from when oxygen is not available (6)**

Activity C. Match the following (write down the numbers in the space provided):

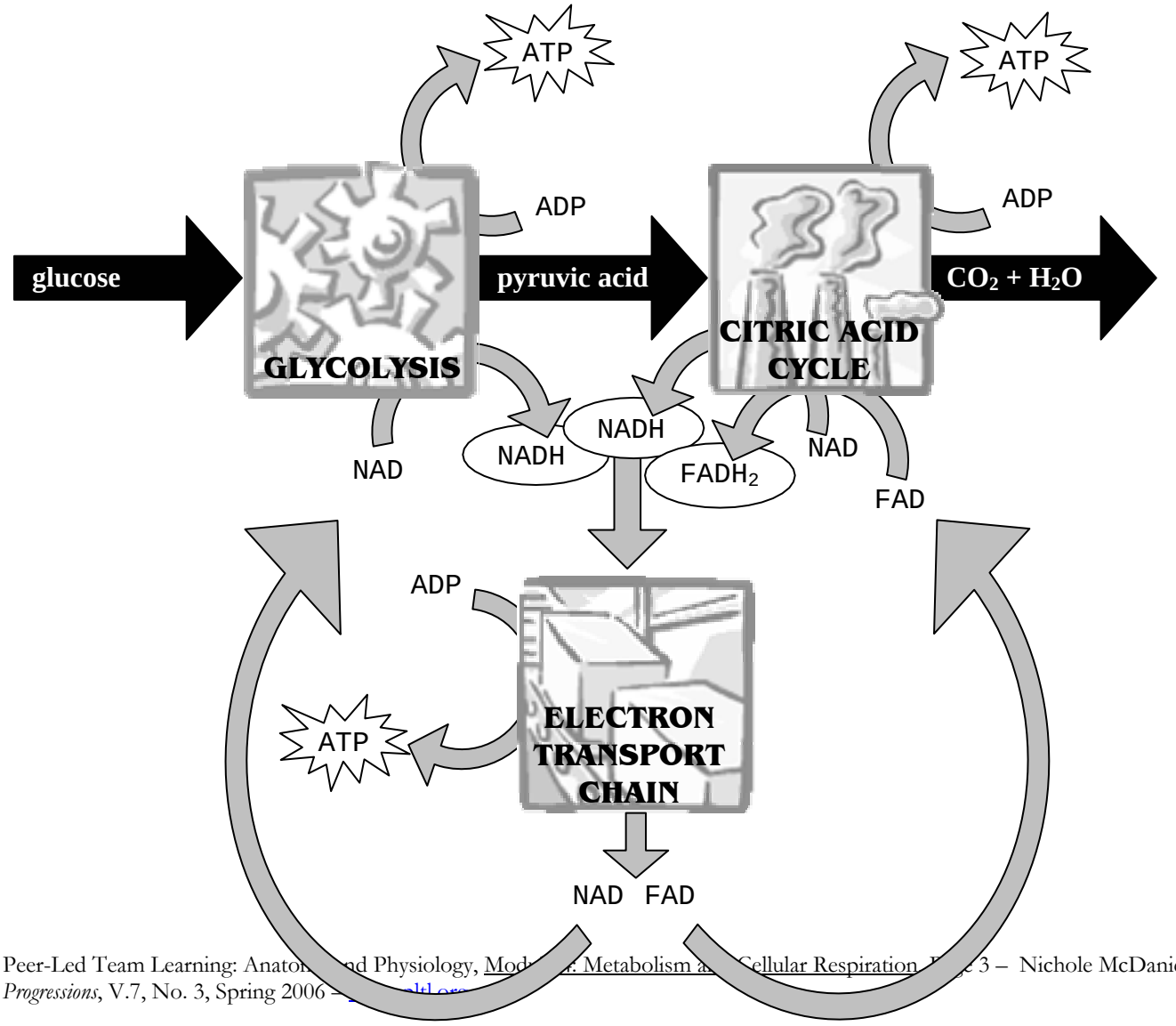
1.	Glycolysis	---	Cell's ATP factories
2.	Anaerobic fermentation	---	Electron transfer molecules
3.	Mitochondria	---	Conversion of pyruvic acid to lactic acid
4.	NAD, FAD	---	Sugar-splitting

III. Workshop Activities

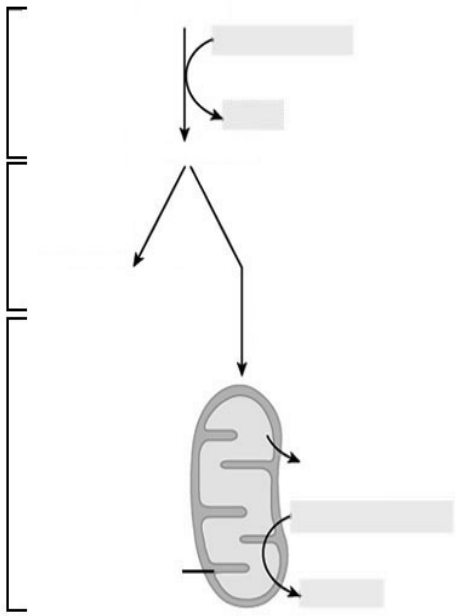
Activity A

1. On the diagram below write the name of the part of the cell in which each process is occurring (circle the process).
2. Add the pathway of fermentation to the diagram and indicate (by circling) which parts of the pathway require oxygen and which ones don't.
3. What do you think the significance is of the star shapes around ATP? What about the circles around NADH and $FADH_2$?

4. What happens to the CO_2 that is formed from the citric acid cycle?



Activity B. Label the following figure:



Write down five sentences to describe the figure above. Share your statements with two people near you. What did you find/describe in common? What was unique?

Activity C: Work in pairs to answer the following questions. Use the cellular respiration diagram on the previous page for help.

Enzymes break chemical bonds in order to release electrons for energy. Coenzymes then pick up the electrons and carry them to another part of the cell for the energy to be converted into ATP. Why can't the enzymes bind the electrons directly and by-pass the coenzymes? (hint: definition of enzymes)

Maria and Anthony both accidentally eat something containing a poison that blocks enzymes in the liver that break down lactic acid. Maria runs for help and Anthony sits down and starts crying. Who will have the lowest blood pH? Who will experience the effects of the poison first? Explain your answers.

After glycolysis and the citric acid cycle, only a very few molecules of ATP have been formed. How is most of the energy stored at this point? What happens to it next?

A drug that inhibits mitochondrial function would block which steps in cellular respiration? How would the cell generate ATP? What do you think the side-effects of such a drug would be?

In most cells, there is plenty of glucose and lots of ADP. NAD and FAD are in more limited supply. Given that, what is one of the important things that both fermentation and the electron transport chain have in common?

What kinds of cellular activities might ATP be used for (i.e. what kinds of things does the cell do that probably require energy)? You can use your textbook to look for ideas.

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