

Name \_\_\_\_\_ Period \_\_\_\_\_

**Chapter 6: How Cells Harvest Chemical Energy***Guided Reading Activities***Big idea: Cellular respiration: Aerobic harvesting of energy**

Answer the following questions as you read modules 6.1–6.5:

- Plants release what gaseous by-product as a result of photosynthesis?
  - $O_2$
  - $CO_2$
  - $H_2O$
  - Solar energy
- \_\_\_\_\_ **Energy** \_\_\_\_\_ is always lost during photosynthesis and cellular respiration.
- Students frequently have the misconception that plant cells don't perform cellular respiration. Briefly explain the basis of this misconception.  
**This misconception arises because plant cells perform photosynthesis, which creates the assumption that plant cells do not perform cellular respiration.**
- True or false: Blood traveling from your leg muscles to the lungs would be high in oxygen. If false, make it a correct statement.  
**False, it would be low in oxygen.**
- How are photosynthesis and cellular respiration linked on a molecular level?  
**They are linked in that the products of one are the reactants of the other.**
- Any substance that inhibits the transportation of oxygen from the lungs affects \_\_\_\_\_.
  - photosynthesis
  - cellular respiration**
  - chloroplasts
  - none of the above

7. The overall chemical equation for cellular respiration is:  $C_6H_{12}O_6 + 6O_2 \rightarrow \rightarrow \rightarrow 6CO_2 + 6H_2O$  Briefly explain why the equation has multiple arrows.  
 The arrows represent the fact that cellular respiration consists of multiple chemical reactions.
8.  $CO_2$  is a gaseous by-product of cellular respiration that you exhale with each breath. Briefly explain where the  $CO_2$  comes from.  
 The  $CO_2$  comes from the organic molecules (food) that you consume and is a by-product of cellular respiration.
9. Fill in the following table regarding the inputs and outputs of cellular respiration.

Inputs	Outputs
$O_2 + C_6H_{12}O_6$	$CO_2 + H_2O$

10. You are taking a road trip from Chicago to Denver. The trip is going to take roughly 15 hours. At the start of your trip, you get a 96-oz Mega Gulp from 11-seven of Mountain Mist. This beverage will have roughly 1,360 kcal. How long into your trip will you have burned the calories from this drink? Refer to Figure 6.4 in your textbook on page 91.  
 It would actually take longer than your trip, a bit over 22 hours.
11. The formation of NaCl (table salt) involves an atom of Na giving an electron to an atom of Cl.
- This would be considered a redox reaction.
  - Na got oxidized.
  - Cl got reduced.
  - All of the above are true statements regarding the formation of NaCl.
12. Briefly explain why a teeter-totter is a good analogy for describing how reductions and oxidations always go together.  
 It's a good analogy because, for every reduction, there is an oxidation, and vice versa. This is similar to a teeter-totter: When one side goes up, the other has to go down.
13. True or false: The transfer of H atoms from glucose to oxygen does not represent redox reactions. If false, make it a correct statement.  
 False, it does represent redox reactions, as oxygen gas is reduced.

### Big idea: Stages of cellular respiration

Answer the following questions as you read modules 6.6–6.12:

- Which of the following is the correct order of the main stages of cellular respiration?
  - Citric acid cycle, glycolysis, oxidative phosphorylation

- b. Glycolysis, citric acid cycle, oxidative phosphorylation
  - c. Citric acid cycle, oxidative phosphorylation, glycolysis
  - d. Oxidative phosphorylation, glycolysis, citric acid cycle
2. Match the following stages of cellular respiration with the correct characteristics. Some stages may have more than one characteristic or share characteristics. For glycolysis, put **A**; for citric acid cycle, put **B**; and for oxidative phosphorylation, put **C**.
- Occurs in the cytosol:     **A**
- Occurs in the mitochondria:     **B, C**
- Involves the splitting of glucose:     **A**
- Produces molecules of NADH:     **A, B**
- Produces ATP:     **A, B, C**
- Produces CO<sub>2</sub>:     **B**
- FADH<sub>2</sub> shuttles electrons to the electron transport chain:     **C**
- Occurs in a plant cell:     **A, B, C**
- Occurs in an animal cell:     **A, B, C**
- Uses the potential energy of a H<sup>+</sup> gradient:     **C**
- Produces molecules of FADH<sub>2</sub>:     **B**
- Substrate-level phosphorylation occurs:     **A, B**
3.     **ATP synthase**     uses the energy found within a proton gradient to drive the synthesis of ATP.
4. True or false: A substance that makes the inner mitochondrial membrane leaky to H<sup>+</sup> (H<sup>+</sup> would be able to leak across the membrane at points other than ATP synthase) increases ATP production in mitochondria. If false, make it a correct statement.  
**False, it would decrease ATP production as ATP synthase efficiency would be reduced.**

5. The driving force behind oxidative phosphorylation is \_\_\_\_\_.
- a. oxygen
  - b. carbon dioxide
  - c. NADH
  - d.  $H_2O$
6. True or false: Brown fat contains mitochondria. If false, make it a correct statement.  
True
7. What initial observation led scientists to hypothesize that brown fat may be activated by cold temperatures?  
Brown fat tissue was found at higher levels when the scans were taken during cold weather.

**Big idea: Fermentation: Anaerobic harvesting of energy**

Answer the following questions as you read modules 6.13–6.14:

1. FADH<sub>2</sub> generates fewer molecules of ATP because it contributes its electrons further along the electron transport chain.
2. The only portion of cellular respiration that is cyclic is \_\_\_\_\_.
- a. glycolysis
  - b. the electron transport chain
  - c. the citric acid cycle
  - d. the oxidation of pyruvate
3. In lactic acid fermentation, \_\_\_\_\_ becomes the target of reduction by NADH.
- a. pyruvate
  - b. lactate
  - c. glucose
  - d. ATP

4. Fermentation is essentially glycolysis because glycolysis does not require oxygen to function.
5. If you opened a wine vat, would the yeast inside continue to perform alcoholic fermentation? Briefly explain your answer with some details about what would happen.  
No, because they would be exposed to atmospheric oxygen and they would preferentially perform aerobic respiration.
6. List two sources of evidence that indicate glycolysis is extremely old.  
Glycolysis is universal, and it does not occur within a membrane-bound organelle.

**Big idea: Fermentation: Connections between metabolic pathways**

Answer the following questions as you read modules 6.15–6.16:

1. What must proteins be broken down into before they can be burned as energy? Refer to Figure 6.15 on page 102 in your textbook.  
They must be broken down into amino acids.
2. Fats are hydrophobic and carbohydrates are hydrophilic. Use this information to explain why humans store the majority of their excess energy as fat and not carbohydrates.  
Because fats will not require water for storage.
3. True or false: Glycolysis and the citric acid cycle both function as metabolic interchanges where the products of their chemical reactions can also be used for biosynthesis. If false, make it a correct statement.  
True
4. A buildup of \_\_\_\_\_ initiates the inhibition of an enzyme that functions early in glycolysis.
  - a. ADP
  - b. ATP
  - c. glycerol
  - d. amino acids

**CONNECTING THE BIG IDEAS**

Use your knowledge of the information contained within this chapter's "Big Ideas" to answer this question.

A drug is administered to a person that causes the inner mitochondrial plasma membrane to become permeable to  $H^+$ . What effect will this have on oxidative phosphorylation? Are there possible repercussions for the other stages of cellular respiration?