

Cellular Respiration and Fermentation

Lesson Summary

Chemical Energy and Food

Chemical energy is stored in food molecules.

- Energy is released when chemical bonds in food molecules are broken.
- Energy is measured in a unit called a **calorie**. One calorie is the amount of energy needed to raise the temperature of 1 gram of water 1 degree Celsius.
- The Calorie (capital C) that is used on food labels is a kilocalorie, or 1000 calories.
- Fats store more energy per gram than do carbohydrates and proteins.
- Cells use the energy stored in chemical bonds of foods like glucose to synthesize compounds such as ATP that directly power the activities of the cell.

Overview of Cellular Respiration

Cellular respiration is the process that releases energy from food in the presence of oxygen.

- Cellular respiration captures the energy from food in three main stages:
 - Glycolysis
 - The Krebs cycle
 - The electron transport chain
- Glycolysis does not require oxygen. The Krebs cycle and electron transport chain both require oxygen.
 - Aerobic pathways are processes that require oxygen.
 - Anaerobic pathways are processes that occur without oxygen.

Comparing Photosynthesis and Cellular Respiration

Nearly all organisms break down food by the process of cellular respiration. Photosynthesis is the process the “deposits” energy while cellular respiration is the process that “withdraws” energy. The energy in photosynthesis and cellular respiration flows in opposite directions. Their equations are the reverse of each other.

- Photosynthesis removes carbon dioxide from the atmosphere, and cellular respiration puts it back.
- Photosynthesis releases oxygen into the atmosphere, and cellular respiration uses oxygen to release energy from food.

Chemical Energy and Food

For Questions 1–4, complete each statement by writing the correct word or words.

1. A calorie is a unit of _____.
2. The Calorie used on food labels is equal to _____ calories.
3. A Calorie (capitalized) is also referred to as a _____.
4. Cells use the energy stored in chemical bonds of foods to produce compounds that directly power the cell’s activities, such as _____.

Overview of Cellular Respiration (new book pg 251, old pg 222)

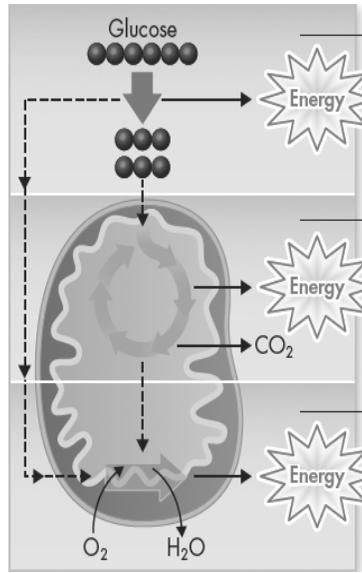
For Questions 5–10, complete each statement by writing the correct word or words from the word bank below.

<i>anaerobic</i>	<i>C₆H₁₂O₆</i>	<i>heat</i>	<i>aerobic</i>	<i>Energy</i>
<i>glycolysis</i>	<i>cytoplasm</i>	<i>energy</i>	<i>6O₂</i>	<i>mitochondria</i>
<i>6CO₂</i>	<i>90</i>	<i>Krebs cycle</i>	<i>6H₂O</i>	<i>pyruvic acid</i>

5. The equation that summarizes cellular respiration, **using chemical formulas**, is
(Reactants) _____ + _____ \longrightarrow _____ + _____ + _____ (Products)
6. If cellular respiration took place in just one step, most of the _____ would be lost in the form of light and _____.
7. Cellular respiration begins with a pathway called _____, which takes place in the _____ of the cell.
8. At the end of glycolysis, about _____ percent of the chemical energy is locked in the bonds of the _____ molecule.
9. Cellular respiration continues in the _____ of the cell with the _____ and electron transport chain.
10. The pathways of cellular respiration that require oxygen are said to be _____. Pathways that do not require oxygen are said to be _____.

11. **New pg. 252 (old pg 222)** Complete the illustration by adding labels for the three main stages of cellular respiration

Word Bank:
electron transport chain,
glycolysis, Krebs's cycle



Comparing Photosynthesis and Cellular Respiration (new pg. 253, old pg 232)

For questions 12–15, write **true** if the statement is correct. If the statement is **false**, **change the underlined word** or words to make the statement true.

- _____ 12. The energy flow in photosynthesis and cellular respiration occurs in the same direction.
- _____ 13. Photosynthesis deposits energy in Earth's "savings account" for living organisms.
- _____ 14. Cellular respiration removes carbon dioxide from the air.
- _____ 15. Photosynthesis takes place in nearly all life.

16. Complete the table comparing photosynthesis and cellular respiration.

A Comparison of Photosynthesis and Cellular Respiration		
Aspect	Photosynthesis	Cellular Respiration
Function	energy capture	
Location of reactions (organelle)	chloroplasts	
Reactants (what is needed)		
Products (what is made)		

17. Which of the following correctly describes how a diagram of cellular respiration would differ from a diagram of photosynthesis?

- F. The cellular-respiration diagram would show electromagnetic waves as the final product.
- G. The cellular-respiration diagram would show glucose as the main source of energy.
- H. The cellular-respiration diagram would show energy stored in large protein molecules.
- J. The cellular-respiration diagram would show water as the main source of chemical energy.

18. The table shown was made to compare and contrast photosynthesis and cellular respiration. In which rows does the table contain errors?

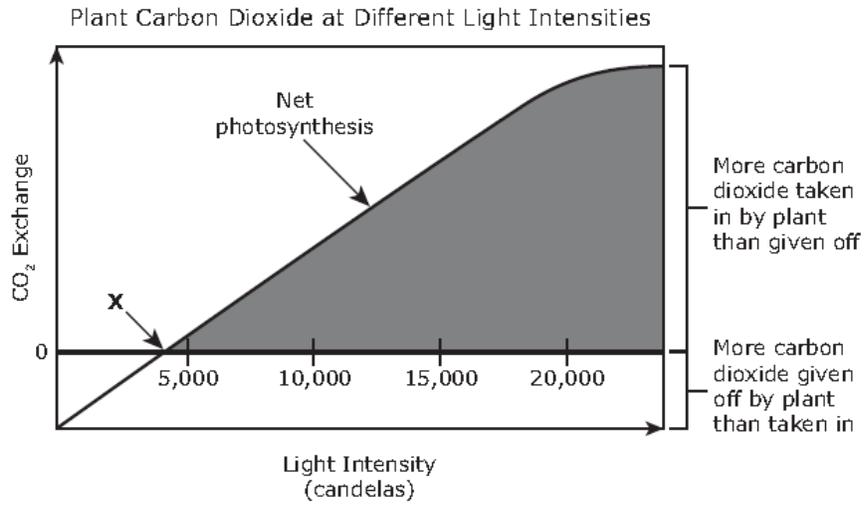
- A. Rows 1 and 4
- B. Rows 1 and 3
- C. Rows 3 and 5
- D. Rows 2 and 5

		Photosynthesis	Cellular Respiration
Row 1	CO ₂	Reactant	Product
Row 2	C ₆ H ₁₂ O ₆	Product	Reactant
Row 3	H ₂ O	Product	Reactant
Row 4	O ₂	Product	Reactant
Row 5	Energy	Released	Stored

19. Which of these statements best explains the process of energy conversion that takes place in the mitochondria?

- F Energy is required for carbon dioxide molecules to form six-carbon sugar molecules.
- G Water molecules and radiant energy are necessary for anaerobic respiration to take place.
- H Oxygen molecules release energy in the form of heat during combustion reactions.
- J The energy in the bonds of glucose molecules is transferred to the phosphate bonds in ATP.

20. Most plant leaves take in more carbon dioxide as light increases. They give off carbon dioxide if light intensity is too low. The graph shows a plant's carbon dioxide levels at different light intensities.



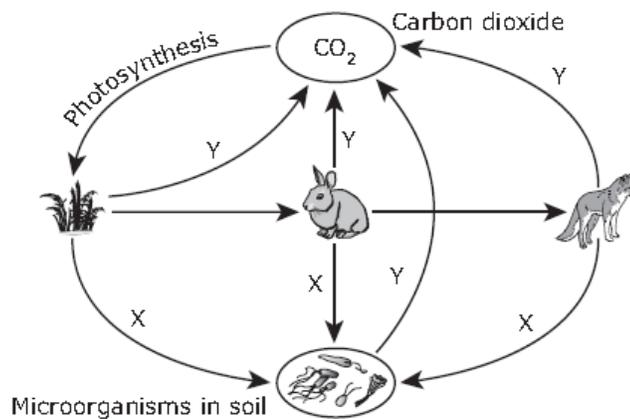
At point X, the rate of which process is equal to the rate of photosynthesis?

- A Cellular respiration
- B Transpiration
- C Growth
- D Reproduction

21. Cells can generate as many as 36 to 38 molecules of adenosine triphosphate (ATP) from the metabolism of one molecule of glucose. Which cellular process results in this amount of ATP production?

- F Anaerobic cellular respiration
- G Protein synthesis
- H Aerobic cellular respiration
- J Photosynthesis

22. The diagram shows the flow of organic molecules through an ecosystem. One process that occurs in this ecosystem is labeled X, and another process that occurs is labeled Y.



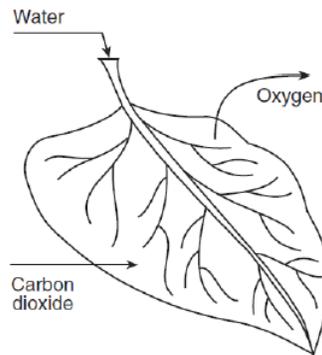
Which two processes are identified by the labels X and Y?

- A X: Respiration Y: Predation
- B X: Adaptation Y: Decomposition
- C X: Fermentation Y: Nitrogen fixation
- D X: Decomposition Y: Respiration

23. Which statement best describes the relationship between the products of photosynthesis and the reactants in cellular respiration?

- A The products of photosynthesis serve as the reactants in cellular respiration to provide chemical energy.
- B The products of photosynthesis combine with the reactants in cellular respiration to remove ATP from cells.
- C The products of photosynthesis inhibit the reactants in cellular respiration in the presence of light.
- D The products of photosynthesis change the structure of the reactants in cellular respiration in the presence of light.

24. The arrows in the diagram below represent the movement of materials. This movement of materials indicated by the arrows is most directly involved in the processes of

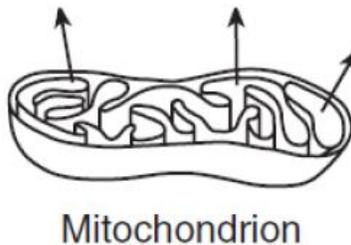


- A respiration and replication
- B photosynthesis and excretion
- C digestion and recycling
- D circulation and coordination

25. Which statement best describes cellular respiration?

- A It occurs in animal cells but not in plant cells.
- B It converts energy in glucose into a more usable form of energy.
- C It uses carbon dioxide and produces oxygen.
- D It stores energy in food molecules.

26. The diagram below represents a structure involved in cellular respiration. The release of which substance is represented by the arrows?

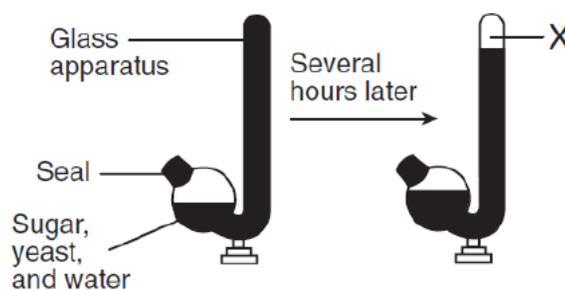


- A glucose
- B carbon dioxide
- C oxygen
- D DNA

27. Energy from organic molecules can be stored in ATP molecules as a direct result of the process of

- A cellular respiration
- B cellular reproduction
- C diffusion
- D digestion

28. An investigation was carried out and the results are shown below. Substance X resulted from a metabolic process that produces ATP in yeast (a single-celled fungus).



Which statement best describes substance X?

- A It is oxygen released by protein synthesis.
- B It is glucose that was produced in photosynthesis.
- C It is starch that was produced during digestion.
- D It is carbon dioxide released by respiration.