

# Chapter 9

## Energy in a Cell

### Reinforcement and Study Guide

#### Section 9.1 The Need for Energy

*In your textbook, read about cell energy.*

Use each of the terms below just once to complete the passage.

energy  
ATP

phosphate  
chemical bonds

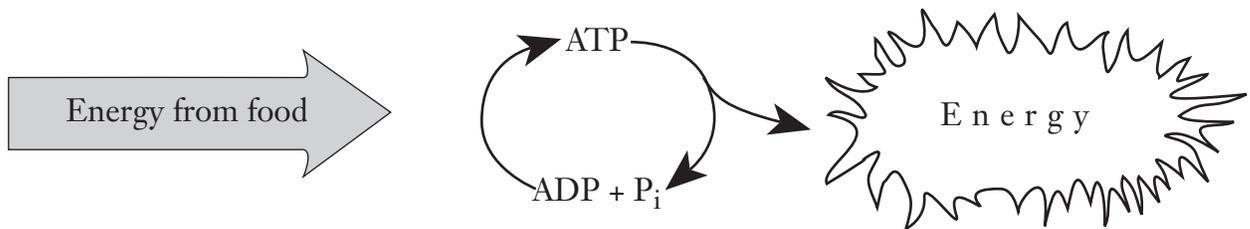
adenine  
work

charged  
ribose

To do biological **(1)** \_\_\_\_\_, cells require energy. A quick source of energy that cells use is the molecule **(2)** \_\_\_\_\_. The **(3)** \_\_\_\_\_ in this molecule is stored in its **(4)** \_\_\_\_\_. ATP is composed of a(n) **(5)** \_\_\_\_\_ molecule bonded to a(n) **(6)** \_\_\_\_\_ sugar. Three **(7)** \_\_\_\_\_ molecules called **(8)** \_\_\_\_\_ groups are attached to the sugar.

*In your textbook, read about forming and breaking down ATP and the uses of cell energy.*

Examine the diagram below. Then answer the questions.



**9.** How is energy stored and released by ATP?

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**10.** How do cells use the energy released from ATP?

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**Worksheet**  
**12****Photosynthesis****Basic Concepts***Use with Chapter 9, Section 9.2*

1. Describe what happens when sunlight strikes chlorophyll.

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2. What happens as an electron moves down an electron transport chain?

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3. What is produced from the splitting of water during the light-dependent reactions?  
What is this process called?

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4. What is the importance of the oxygen produced during the light-dependent reactions?

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5. What products of the light-dependent reactions are used in the light-independent reactions?

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6. When does carbon fixation occur?

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7. What is the source of energy for converting PGA into PGAL during the light-dependent reactions?

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8. What is the final product of the light-dependent reactions? What kinds of substances are formed from it?

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# Chapter 9

## Energy in a Cell

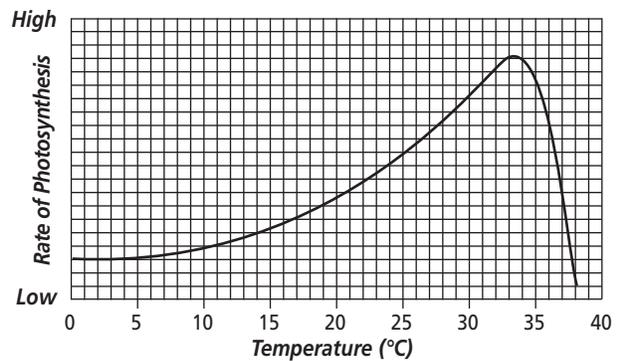
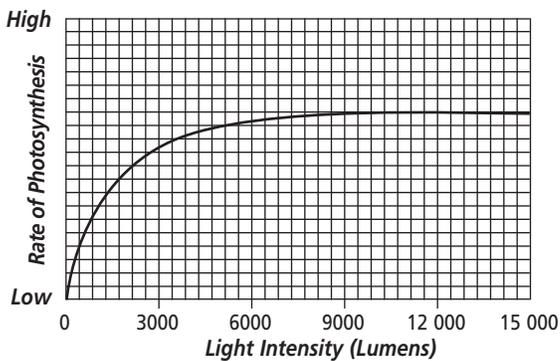
### Problem Solving

Use with Chapter 9, Section 9.2

### Two Factors Affecting Photosynthesis

The rate at which photosynthesis occurs is not always the same. The intensity of light, temperature, supply of carbon dioxide, supply of water, and availability of minerals are important factors that affect the rate of photosynthesis in land plants. The rate also varies by species and a plant's health and maturity. The two graphs below show the effects of

light intensity and temperature on the rate of photosynthesis in land plants. These two factors affect many enzymes that control photosynthetic reactions. Study the graphs and answer the questions that follow. (Light intensity is measured in lumens, the SI unit of light flow.)



1. What does the graph on the left tell about the effect of light intensity on the rate of photosynthesis?

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2. What happens when light intensity rises above 9000 lumens?

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3. What adaptive advantages would a plant have if its photosynthetic rate kept increasing with light intensity above 9000 lumens?

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4. What does the graph on the right tell about the effect of temperature on the rate of photosynthesis?

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5. What happens when the temperature rises above 33°C?

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6. What might cause this change?

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7. What light intensity and temperature levels allow the highest photosynthesis rate?

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**Worksheet**  
**13****Cellular Respiration****Basic Concepts***Use with Chapter 9, Section 9.3*

1. What is the source of energy for the first step of glycolysis?

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2. In glycolysis, what carbon compound is broken down? What carbon compound is the end product?

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3. In glycolysis, what is the ratio of glucose molecules to the net number of ATP molecules at the end of the process? Explain your response.

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4. Which of the processes shown in the transparency is anaerobic? Which of the processes is aerobic?

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5. Where does the breakdown of pyruvic acid occur?

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6. What is the end product of the breakdown of pyruvic acid?

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7. How is the breakdown of pyruvic acid related to the citric acid cycle?

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8. As citric acid breaks down, what substance is released?

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9. What happens to the NADH and FADH<sub>2</sub> molecules produced during cellular respiration?

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**Worksheet**  
**15****Photosynthesis and  
Cellular Respiration****Reteaching Skills***Use with Chapter 9, Section 9.3*

1. In what organelles do photosynthesis and cellular respiration take place?

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2. Trace the path of oxygen, water, carbon dioxide, and glucose in the transparency.

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3. Which organelle requires sunlight to function?

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4. In what ways are photosynthesis and cellular respiration alike?

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5. In what ways are photosynthesis and cellular respiration different?

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6. What is the source of energy used by mitochondria?

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7. Which two cycles are linked by the production and utilization of carbon dioxide?  
Where do these cycles occur?

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8. Explain how the equations for photosynthesis and cellular respiration compare.

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Chapter  
**9****Energy in a Cell, *continued*****Reinforcement and Study Guide****Section 9.2 Photosynthesis: Trapping the Sun's Energy**

*In your textbook, read about trapping the sun's energy.*

**Determine if the statement is true. If it is not, rewrite the italicized part to make it true.**

1. Photosynthesis is the process plants use to trap the sun's energy to make *glucose*.  
\_\_\_\_\_
2. ATP molecules are made during the *light-independent* reactions of photosynthesis.  
\_\_\_\_\_
3. *Carbon dioxide* gas is produced during photosynthesis.  
\_\_\_\_\_
4. The light-dependent reactions of photosynthesis take place in the membranes of the thylakoid discs in *mitochondria*.  
\_\_\_\_\_
5. The thylakoid membranes contain chlorophyll and other pigments that *absorb* sunlight.  
\_\_\_\_\_

*In your textbook, read about the light-dependent reactions of photosynthesis.*

**Number the following steps of the light-dependent reactions in the order in which they occur.**

- \_\_\_\_\_ 6. The energy lost by electrons as they pass through the electron transport chain is used to make ATP.
- \_\_\_\_\_ 7. The electrons pass from the chlorophyll to an electron transport chain.
- \_\_\_\_\_ 8. Sunlight strikes the chlorophyll molecules in the thylakoid membranes.
- \_\_\_\_\_ 9. NADP<sup>+</sup> molecules change to NADPH as they carry the electrons to the stroma of the chloroplast.
- \_\_\_\_\_ 10. The sunlight's energy is transferred to the chlorophyll's electrons.
- \_\_\_\_\_ 11. The electrons are passed down a second electron transport chain.

**Answer the following questions.**

12. How are the electrons that are lost by the chlorophyll molecules replaced?  
\_\_\_\_\_  
\_\_\_\_\_

13. How do plants produce oxygen during photosynthesis?  
\_\_\_\_\_  
\_\_\_\_\_

Chapter  
**9****Energy in a Cell, *continued*****Reinforcement and Study Guide****Section 9.2 Photosynthesis: Trapping the Sun's Energy**

*In your textbook, read about the light-independent reactions.*

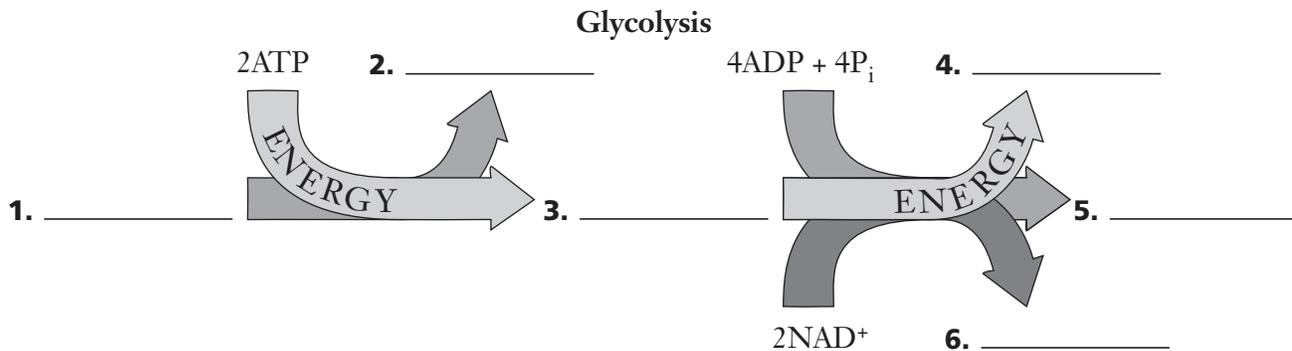
**Circle the letter of the choice that best completes the statement or answers the question.**

- 14.** The Calvin cycle includes
- a. the light-dependent reactions.
  - b. an electron transport chain.
  - c. the light-independent reactions.
  - d. photolysis.
- 15.** The Calvin cycle takes place in the
- a. mitochondria.
  - b. stroma.
  - c. nucleus.
  - d. thylakoid membrane.
- 16.** What product of the light-dependent reactions is used in the Calvin cycle?
- a. oxygen
  - b. carbon dioxide
  - c. NADPH
  - d. chlorophyll
- 17.** What gas is used in the first step of the Calvin cycle?
- a. oxygen
  - b. carbon dioxide
  - c. hydrogen
  - d. water
- 18.** A carbon atom from carbon dioxide is used to change the five-carbon sugar RuBP into
- a. ATP.
  - b. two molecules.
  - c. PGA.
  - d. a six-carbon sugar.
- 19.** How many molecules of the three-carbon sugar PGA are formed?
- a. two
  - b. one
  - c. six
  - d. three
- 20.** ATP, NADPH, and hydrogen ions are used to convert PGA into
- a. PGAL.
  - b. glucose.
  - c. RuBP.
  - d. carbon dioxide.
- 21.** How many rounds of the Calvin cycle are needed to form one glucose molecule?
- a. one
  - b. six
  - c. two
  - d. three
- 22.** What two molecules leave the Calvin cycle and are combined to form glucose?
- a. RuBP
  - b. PGA
  - c. PGAL
  - d. CO<sub>2</sub>
- 23.** Which molecule from the Calvin cycle is used to replenish the five-carbon sugar, RuBP, which is used at the beginning of the cycle?
- a. NADP
  - b. CO<sub>2</sub>
  - c. PGA
  - d. PGAL

**Chapter**  
**9**
**Energy in a Cell, continued**
**Reinforcement and Study Guide**
**Section 9.3 Getting Energy to Make ATP**

*In your textbook, read about the cellular respiration and fermentation.*

Fill in the names of the molecules to complete the glycolysis reaction. Use these choices: 2PGAL, 4ATP, glucose, 2ADP, 2 pyruvic acid, 2NADH + 2H<sup>+</sup>. Then answer the questions.



7. What happens to pyruvic acid before entering the citric acid cycle?  
\_\_\_\_\_
8. What happens to the electrons carried by the NADH and FADH<sub>2</sub> molecules produced during the citric acid cycle?  
\_\_\_\_\_  
\_\_\_\_\_
9. During which stages of cellular respiration are ATP molecules formed?  
\_\_\_\_\_
10. Why is oxygen necessary for cellular respiration?  
\_\_\_\_\_
11. How is fermentation different from cellular respiration?  
\_\_\_\_\_  
\_\_\_\_\_

*In your textbook, read about comparing photosynthesis and cellular respiration.*

Answer the following question.

12. Describe two ways in which cellular respiration is the opposite of photosynthesis.  
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\_\_\_\_\_  
\_\_\_\_\_