Name_____ Class_____ Date_____

8.1 Energy and Life

Lesson Objectives

- Describe the role of ATP in cellular activities.
- Explain where plants get the energy they need to produce food.

Lesson Summary

Chemical Energy and ATP Energy is the ability to do work. Organisms need energy to stay alive.

- **Adenosine triphosphate (ATP)** is a chemical compound cells use to store and release energy.
  - An ATP molecule consists of adenine, the sugar ribose, and three phosphate groups.
  - Cells store energy by adding a phosphate group to adenosine diphosphate (ADP) molecules.
  - Cells release energy from ATP molecules by subtracting a phosphate group.
- Energy provided by ATP is used in active transport, to contract muscles, to make proteins, and in many other ways.
- Cells contain only a small amount of ATP at any one time. They regenerate it from ADP as they need it, using energy stored in food.

Heterotrophs and Autotrophs The energy to make ATP from ADP comes from food. Organisms get food in one of two ways.

- **Heterotrophs** get food by consuming (eating) other organisms.
- **Autotrophs** use the energy in sunlight to make their own food.
- **Photosynthesis** is the process that uses light energy to produce food molecules.

Chemical Energy and ATP

For Questions 1–6, complete each statement by writing the correct word or words.

1. _____ is the ability to do work.
2. The main chemical compound cells use for energy is _____ (ATP).
3. _____ is a 5-carbon sugar molecule that is part of an ATP molecule.
4. The _____ of ATP are the key to its ability to store and supply energy.
5. ATP releases energy when it _____ bonds between its phosphate groups.
6. Most cells only store enough ATP for _____ of activity.

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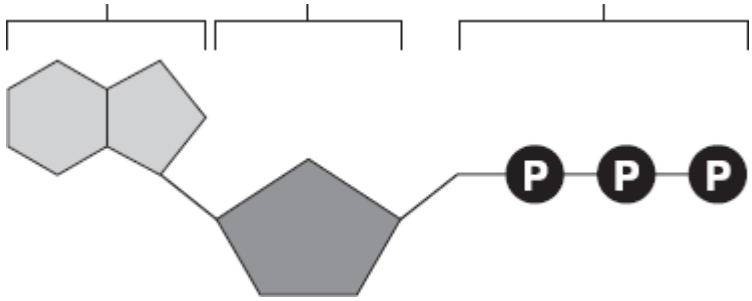
7. **THINK VISUALLY** Label each part of the diagram of an ATP molecule below.



For Questions 8–10, refer to the Visual Analogy comparing ATP to a charged battery.

8. **VISUAL ANALOGY** In the visual analogy, what chemical is represented by the low battery?

_____

_____

9. What are two ways in which the diagram shows an increase in energy?

_____

_____

10. Describe the concepts shown in the diagram.

_____

_____

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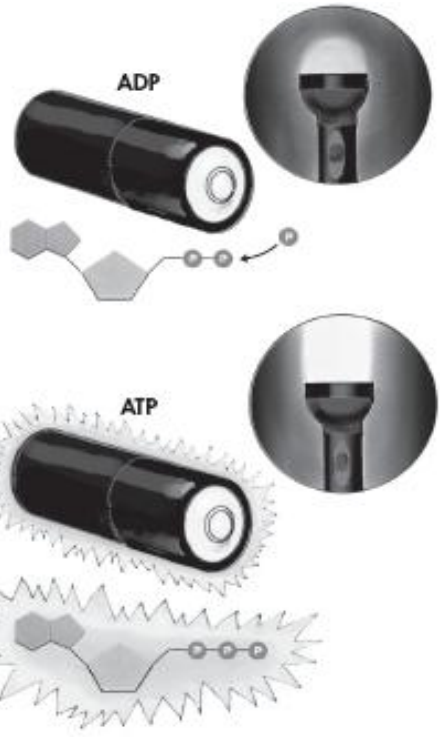

11. What are two ways in which cells use the energy temporarily stored in ATP?

_____

_____

12. Energy is needed to add a third phosphate group to ADP to make ATP. What is a cell's source of this energy?

_____

_____

Name_____ Class_____ Date_____

Heterotrophs and Autotrophs

For Questions 13–17, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ **13.** All heterotrophs must <u>eat food</u> to get energy.

_____ **14.** <u>Autotrophs</u> do not need to eat food because they make food.

_____ **15.** The energy in food originally came from <u>ATP</u>.

_____ **16.** The term photosynthesis means "<u>pulling apart</u> with light" in Greek.

_____ **17.** The energy of sunlight is stored in the chemical bonds of <u>carbohydrates</u>.

18. Complete the table comparing two types of organisms.

Autotrophs and Heterotrophs

Type	Description	Examples
Autotrophs		
Heterotrophs		

Apply the Big idea

19. Suppose that you ate a hamburger on a wheat roll with lettuce, tomatoes, and onions for lunch. As you ate, you took in food molecules from plants and animals. Explain why all the energy in the food molecules of this hamburger could be traced back to the sun.

Name_____ Class _____ Date _____

8.2 Photosynthesis: An Overview

Lesson Objectives

- Explain the role of light and pigments in photosynthesis.
- Explain the role of electron carrier molecules in photosynthesis.
- State the overall equation for photosynthesis.

Lesson Summary

Chlorophyll and Chloroplasts In eukaryotes, photosynthesis occurs in organelles called chloroplasts. Chloroplasts house light-absorbing chemicals.

- Light is a form of energy. Sunlight is a mixture of all the different colors of visible light.
- Light-absorbing molecules called **pigments** capture the sun's energy.
- **Chlorophyll** is the principal pigment in photosynthetic organisms. Chlorophyll absorbs blue-violet and red light but reflects green light.
- Chloroplasts have a complex internal structure that includes:
  - **thylakoids**: saclike photosynthetic membranes that contain chlorophyll and other pigments and are arranged in stacks called grana.
  - **stroma:** the fluid portion outside of the thylakoids.

High-Energy Electrons The energy in light raises some of the electrons in chlorophyll to higher energy levels. These high-energy electrons are used in photosynthesis.

- Electron carriers are used to transport the electrons from chlorophyll to other molecules during photosynthesis.
- **$NADP^+$** is a compound that can accept and hold 2 high-energy electrons and 1 hydrogen ion. This process converts $NADP^+$ into NADPH.

An Overview of Photosynthesis Usually summarized by a simple chemical reaction, photosynthesis is a complex process that involves two interdependent sets of reactions.

- The **light-dependent reactions** require light, light-absorbing pigments, and water to form NADPH, ATP, and oxygen.
- The **light-independent reactions** do not use light energy. They use carbon dioxide from the atmosphere, NADPH, and ATP to make energy-rich carbon compounds.

Chlorophyll and Chloroplasts

For Questions 1–6, complete each statement by writing the correct word or words.

1. The _____ of light determines its color.

2. Chemicals that absorb light are called _____.

3. Chlorophyll makes plants look green because it _____ green light.

4. Chloroplasts contain an abundance of saclike photosynthetic membranes called _____.

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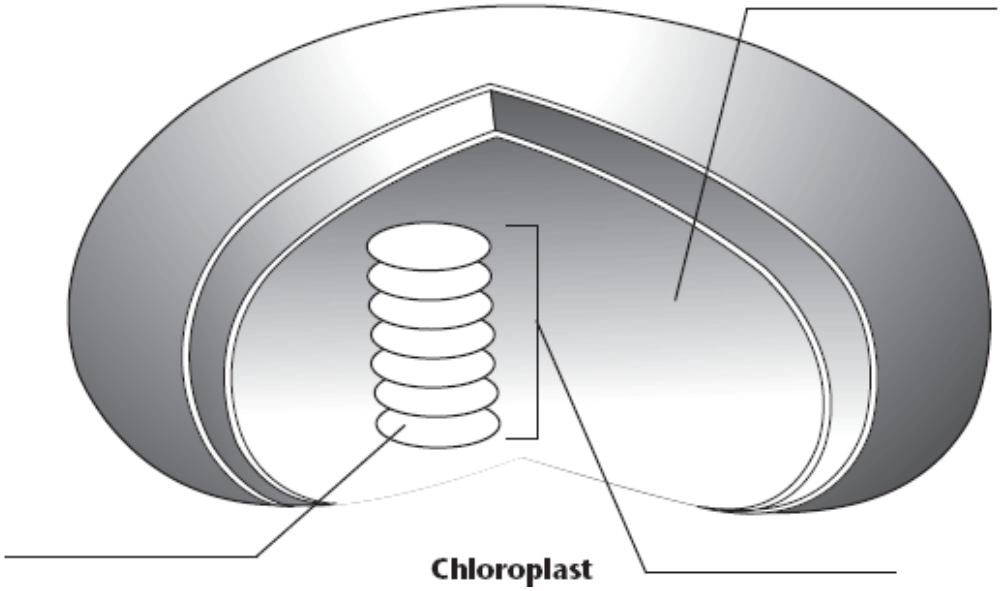
5. The _____ is the fluid portion of the chloroplast located outside the thylakoids.

6. The visible light absorbed by chlorophyll _____ the energy level of the chlorophyll's electrons.

7. **THINK VISUALLY** Label the internal parts of the chloroplast below.



High-Energy Electrons

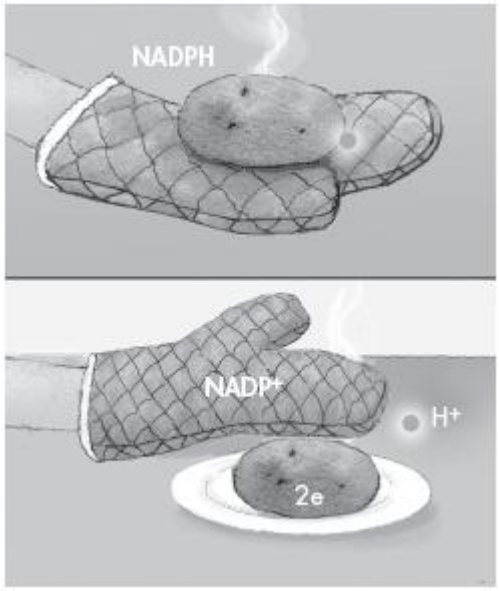
For Questions 8–9, refer to the Visual Analogy comparing electron carriers to oven mitts.

8. **VISUAL ANALOG** In the visual analogy of carrying electrons, what represents the high-energy electrons?

_____

_____

_____



9. Write another analogy that describes the process of electron carriers.

_____

_____

_____

_____

_____

_____

10. Where do the high-energy electrons carried by NADPH come from?

_____

_____

Name _____ Class _____ Date _____

An Overview of Photosynthesis

For Questions 11–13, write the letter of the correct answer on the line at the left.

_____ **11.** What are the reactants of the photosynthesis reaction?

A. chlorophyll and light
C. carbohydrates and oxygen
B. carbon dioxide and water
D. high-energy electrons and air

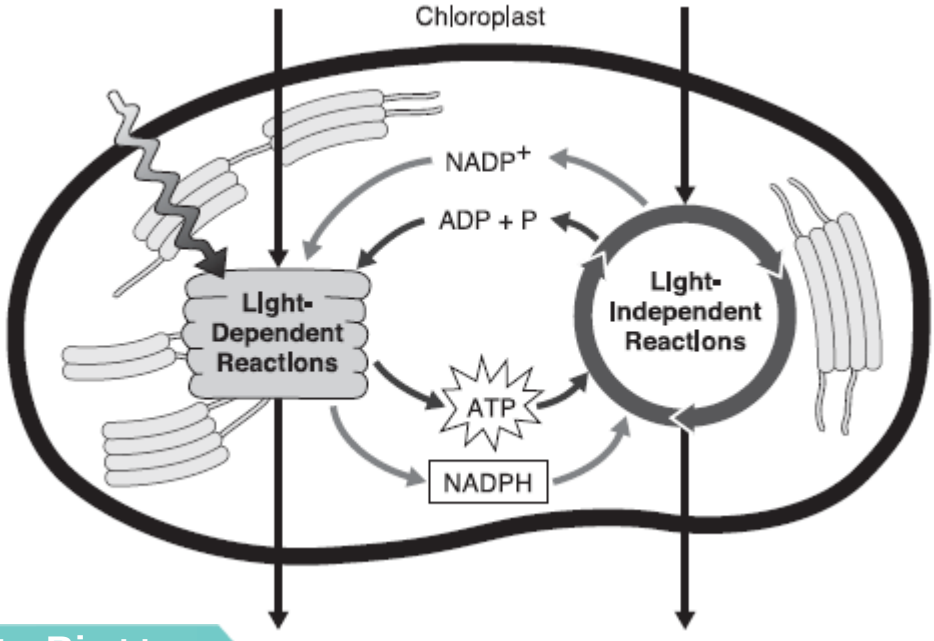
_____ **12.** What are the products of the light-dependent reactions?

A. chloroplasts and light
C. oxygen and ATP
B. proteins and lipids
D. water and sugars

_____ **13.** Where do the light-independent reactions occur?

A. stroma
C. chlorophyll
B. thylakoids
D. mitochondria

14. Complete the illustration by writing the reactants and products of the light-dependent and light-independent reactions. Also, fill in the energy source that excites the electrons.



Apply the Big idea

15. Solar power uses cells or panels to absorb the sun's energy. That energy is then used to create electricity. How does this compare to the light dependent reactions of photosynthesis?

_____

_____

_____

_____

_____

Name _____ Class _____ Date _____

Chapter Vocabulary Review

For Questions 11–16, complete each statement by writing the correct word or words.

11. The light-_____ reactions occur in thylakoid membranes.

12. Carbon dioxide is used to make sugars in the light-_____ reactions.

13. The light-independent reactions are also called the _____.

14. _____ spins to provide the energy for adding a phosphate group to ADP.

15. Electron _____ move high-energy electrons between photosystems.

16. An animal that obtains food by eating other organisms is called a(n)_____.

Crossword Puzzle *Complete the puzzle by entering the term that matches the description.*

Across

4. energy carrier cells use to transport high-energy electrons

6. cluster of pigments and proteins that absorbs light

7. a saclike photosynthetic membrane found in chloroplasts

8. energy carrier made as a result of photosystem II

9. process of using the sun's energy to make food

10. man who worked out the light-independent reactions

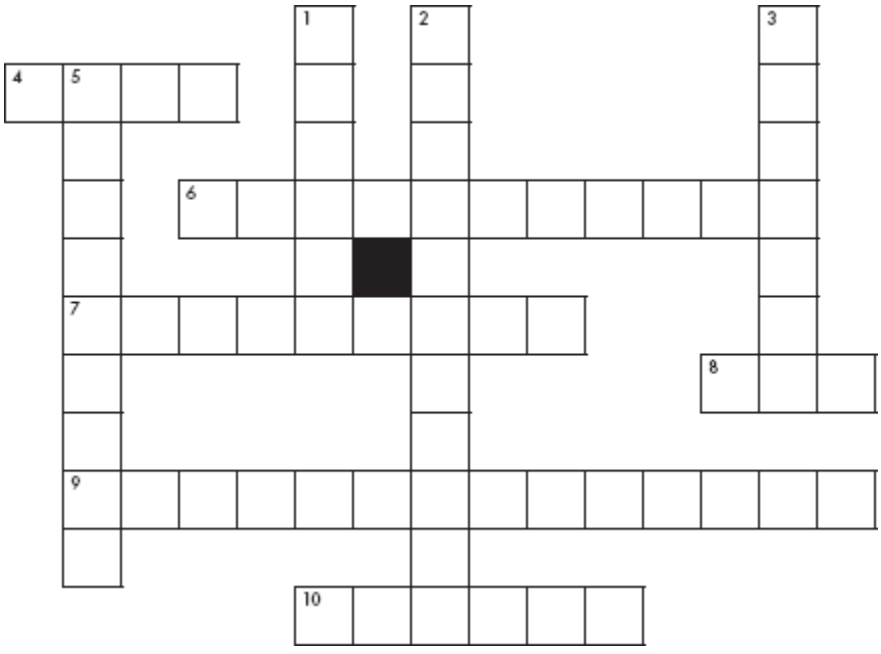
Down

1. liquid part of the inside of a chloroplast

2. chemical that absorbs light for photosynthesis

3. light-absorbing chemical

5. organism that makes its own food



Name _____ Class _____ Date _____

9.1 Cellular Respiration: An Overview

Lesson Objectives

- Explain where organisms get the energy they need for life processes.
- Define cellular respiration.
- Compare photosynthesis and cellular respiration.

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**, the amount of energy needed to raise the temperature of 1 gram of water 1 degree Celsius.
- Fats store more energy per gram than do carbohydrates and proteins.

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 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 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 _____.

Name _____ Class _____ Date _____

Overview of Cellular Respiration

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

5. The equation that summarizes cellular respiration, using chemical formulas, is _____.

6. If cellular respiration took place in just one step, most of the _____would be lost in the form of light and _____.

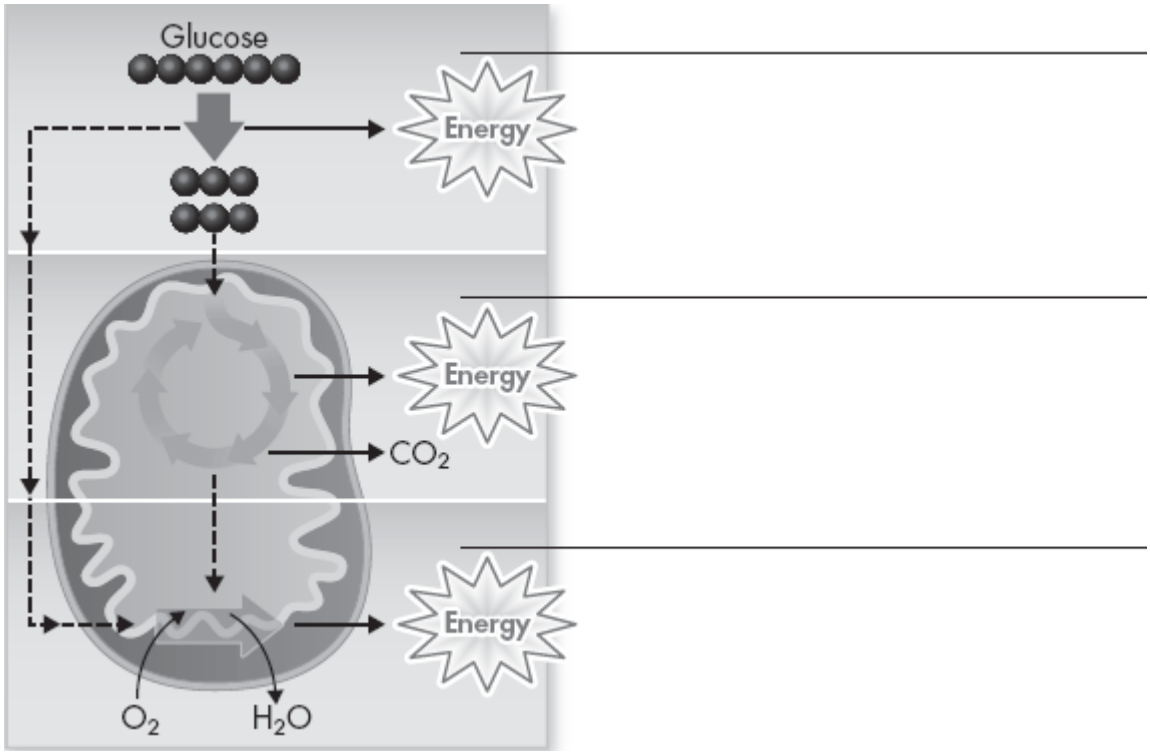
7. Cellular respiration begins with a pathway called _____, which takes place in the _____of the cell.

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. **THINK VISUALLY** Complete the illustration by adding labels for the three main stages of cellular respiration.



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Comparing Photosynthesis and Cellular Respiration

For Questions 12–15, write True if the statement is true. 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	chloroplasts	
Reactants		
Products		

Apply the Big idea

17. How does an understanding of the process of cellular respiration support the theory that the cell is the basic functional unit of life?

Name _____ Class _____ Date _____

9.3 Fermentation

Lesson Objectives

- Explain how organisms get energy in the absence of oxygen.
- Identify the pathways the body uses to release energy during exercise.

Lesson Summary

Fermentation **Fermentation** releases energy from food molecules by producing ATP without oxygen. Cells convert NADH to the electron carrier NAD^+. This allows glycolysis to produce a steady stream of ATP. There are two forms of fermentation. Both start with the reactants pyruvic acid and NADH.

- alcoholic fermentation produces ethyl alcohol and carbon dioxide
  - occurs in yeast and a few other microorganisms
  - produces alcoholic beverages and causes bread dough to rise
- lactic acid fermentation produces lactic acid
  - occurs in most organisms, including humans
  - used to produce beverages such as buttermilk and foods such as cheese, yogurt, and pickles

Energy and Exercise The body uses different pathways to release energy.

- For short, quick bursts of energy, the body uses ATP already in muscles as well as ATP made by lactic acid fermentation.
- For exercise longer than about 90 seconds, cellular respiration is the only way to continue generating a supply of ATP.

Fermentation

For Questions 1–6, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ **1.** Glycolysis provides the pyruvic acid molecules used in fermentation.

_____ **2.** Fermentation allows glycolysis to continue by providing the NADPH needed to accept high-energy electrons.

_____ **3.** Fermentation is an aerobic process.

_____ **4.** Fermentation occurs in the mitochondria of cells.

_____ **5.** Alcoholic fermentation gives off carbon dioxide and is used in making bread.

_____ **6.** Most organisms perform fermentation using a chemical reaction that converts pyruvic acid to lactic acid.

Name _____ Class _____ Date _____

7. Compare and contrast fermentation and cellular respiration by completing the compare/contrast table. Write your answers in the empty table cells.

Aspect	Fermentation	Cellular Respiration
Function		
Reactants		
Products		

8. Compare and contrast alcoholic fermentation and lactic acid fermentation by completing the compare/contrast table. Write your answers in the empty table cells.

Type of Fermentation	Summary Equation	Use in Industry
Alcoholic		
Lactic acid		

9. What causes humans to become lactic acid fermenters?

_____

_____

_____

Name _____ Class _____ Date _____

Energy and Exercise

10. What are three main sources of ATP available for human muscle cells?

11. During a race, how do your muscle cells produce ATP after the store of ATP in muscles is used?

12. Why does a sprinter have an oxygen debt to repay after the race is over?

13. A runner needs more energy for a longer race. How does the body generate the necessary ATP?

14. Why are aerobic forms of exercise so beneficial for weight control?

Apply the Big idea

15. Compare and contrast the role of fermentation and cellular respiration in the actual production of ATP. In your response, consider which process produces ATP and which process contributes to its production.

Name _____ Class _____ Date _____

Chapter Vocabulary Review

For Questions 1–7, match the term with its definition.

Term	Definition
_____ **1.** anaerobic	**A.** Innermost compartment of a mitochondrion
_____ **2.** glycolysis	**B.** Process that forms either lactic acid or ethyl alcohol when no oxygen is present
_____ **3.** Krebs cycle	**C.** Stage of cellular respiration that starts with pyruvic acid and produces carbon dioxide
_____ **4.** calorie	**D.** Process in which glucose is broken down into two molecules of pyruvic acid
_____ **5.** matrix	**E.** "In air"
_____ **6.** aerobic	**F.** "Without air"
_____ **7.** fermentation	**G.** Amount of energy needed to raise the temperature of 1 gram of water 1°C

For Questions 8–10, write the letter of the correct answer on the line at the left.

_____ **8.** Which is the process that releases energy by breaking down food molecules in the presence of oxygen?

A. cellular respiration **C.** glycolysis

B. electron transport **D.** photosynthesis

_____ **9.** Which is the electron carrier that accepts electrons during glycolysis?

A. ADP **C.** NAD^+

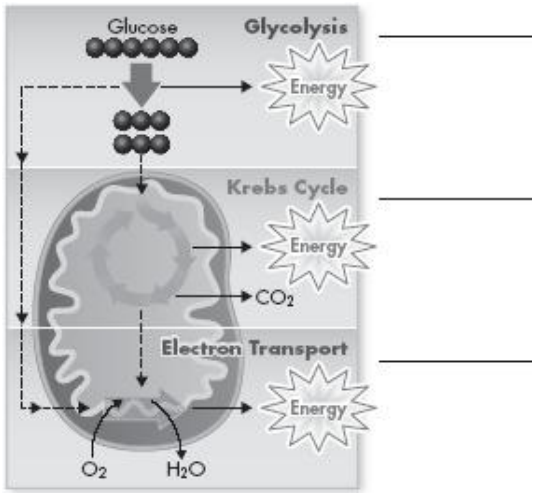
B. ATP **D.** $NADP^+$

_____ **10.** When comparing cellular respiration and photosynthesis, these two processes are best described as

A. energy-releasing processes. **C.** opposite processes.

B. energy-storing processes. **D.** similar processes.

11. Complete the illustration by adding the words "aerobic" or "anaerobic" on the lines provided.



_____

_____

_____