

## Chapter 9 Cellular Respiration

### Section 9-1 Chemical Pathways (pages 221–225)



#### Key Concepts

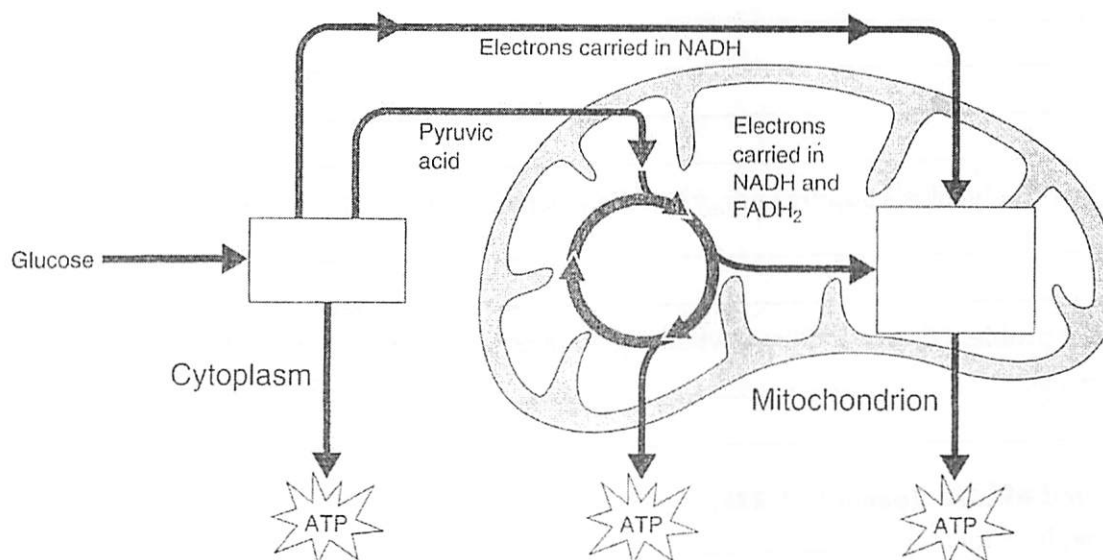
- What is cellular respiration?
- What happens during the process of glycolysis?
- What are the two main types of fermentation?

### Chemical Energy and Food (page 221)

1. What is a calorie? \_\_\_\_\_
2. How many calories make up 1 Calorie? \_\_\_\_\_
3. Cellular respiration begins with a pathway called \_\_\_\_\_.
4. Is the following sentence true or false? Glycolysis releases a great amount of energy.  
\_\_\_\_\_

### Overview of Cellular Respiration (page 222)

5. What is cellular respiration? \_\_\_\_\_
6. What is the equation for cellular respiration, using chemical formulas? \_\_\_\_\_
7. Label the three main stages of cellular respiration on the illustration of the complete process.



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

8. What would be the problem if cellular respiration took place in just one step?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. Where does glycolysis take place? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

10. Where do the Krebs cycle and electron transport take place? \_\_\_\_\_

\_\_\_\_\_

### **Glycolysis (page 223)**

11. What is glycolysis? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

12. How does the cell get glycolysis going? \_\_\_\_\_

\_\_\_\_\_

13. If the cell uses 2 ATP molecules at the beginning of glycolysis, how does it end up with a net gain of 2 ATP molecules? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

14. What is  $\text{NAD}^+$ ? \_\_\_\_\_

\_\_\_\_\_

15. What is the function of  $\text{NAD}^+$  in glycolysis? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

16. Why can glycolysis supply energy to cells when oxygen is not available? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

17. What problem does a cell have when it generates large amounts of ATP from glycolysis? \_\_\_\_\_

\_\_\_\_\_

### **Fermentation (pages 224–225)**

18. What is fermentation? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

19. How does fermentation allow glycolysis to continue? \_\_\_\_\_  
\_\_\_\_\_
20. Because fermentation does not require oxygen, it is said to be \_\_\_\_\_.
21. What are the two main types of fermentation?  
a. \_\_\_\_\_  
b. \_\_\_\_\_
22. What organisms use alcoholic fermentation? \_\_\_\_\_  
\_\_\_\_\_
23. What is the equation for alcoholic fermentation after glycolysis?  
\_\_\_\_\_
24. What happens to the small amount of alcohol produced in alcoholic fermentation during the baking of bread? \_\_\_\_\_
25. What does lactic acid fermentation convert into lactic acid? \_\_\_\_\_  
\_\_\_\_\_
26. What is the equation for lactic acid fermentation after glycolysis?  
\_\_\_\_\_
27. During rapid exercise, how do your muscle cells produce ATP? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Reading Skill Practice

When you read about complex topics, writing an outline can help you organize and understand the material. Outline Section 9-1 by using the headings and subheadings as topics and subtopics and then writing the most important details under each topic. Do your work on a separate sheet of paper.

## Section 9-2 The Krebs Cycle and Electron Transport (pages 226-232)

### Key Concepts

- What happens during the Krebs cycle?
- How are high-energy electrons used by the electron transport chain?

### Introduction (page 226)

1. At the end of glycolysis, how much of the chemical energy in glucose is still unused?

\_\_\_\_\_

2. Because the final stages of cellular respiration require oxygen, they are said to be \_\_\_\_\_.

\_\_\_\_\_

### The Krebs Cycle (pages 226-227)

3. In the presence of oxygen, how is the pyruvic acid produced in glycolysis used?

\_\_\_\_\_

\_\_\_\_\_

4. What happens to pyruvic acid during the Krebs cycle? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. Why is the Krebs cycle also known as the citric acid cycle? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6. When does the Krebs cycle begin? \_\_\_\_\_

\_\_\_\_\_

7. What happens to each of the 3 carbon atoms in pyruvic acid when it is broken down?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

8. What happens to the carbon dioxide produced in breaking down pyruvic acid?

\_\_\_\_\_

9. How is citric acid produced? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

10. During the energy extraction part of the Krebs cycle, how many molecules of  $\text{CO}_2$  are released? \_\_\_\_\_

\_\_\_\_\_

11. What is the energy tally from 1 molecule of pyruvic acid during the Krebs cycle?

\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

12. When electrons join  $\text{NAD}^+$  and FAD during the Krebs cycle, what do they form?

\_\_\_\_\_

13. Why is the 4-carbon compound generated in the breakdown of citric acid the only permanent compound in the Krebs cycle?

\_\_\_\_\_

\_\_\_\_\_

### **Electron Transport (pages 228–229)**

14. What is the electron transport chain?

\_\_\_\_\_

15. What does the electron transport chain use the high-energy electrons from the Krebs cycle for?

\_\_\_\_\_

16. How does the location of the electron transport chain differ in eukaryotes and prokaryotes?

\_\_\_\_\_

\_\_\_\_\_

17. Where does the electron transport chain get the high-energy electrons that are passed down the chain?

\_\_\_\_\_

\_\_\_\_\_

18. Is the following sentence true or false? Hydrogen serves as the final electron acceptor of the electron transport chain.

\_\_\_\_\_

19. What is the energy of the high-energy electrons used for every time 2 high-energy electrons move down the electron transport chain?

\_\_\_\_\_

20. What causes the  $\text{H}^+$  ions in the intermembrane space to move through the channels in the membrane and out into the matrix?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

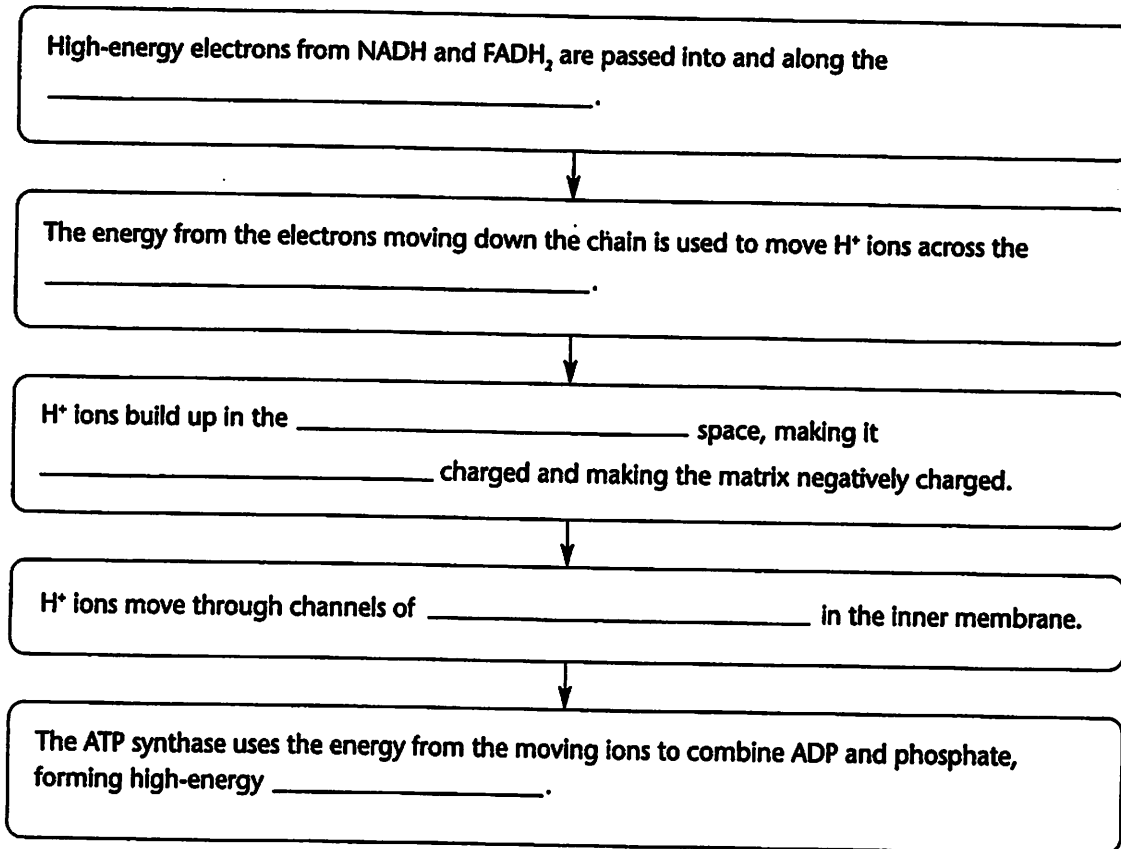
\_\_\_\_\_

21. On average, how many ATP molecules are produced as each pair of high-energy electrons moves down the electron transport chain?

\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

22. Complete the flowchart about electron transport. (Review Figure 9-7 on page 228 of your textbook.)



### The Totals (page 229)

23. How many ATP molecules are formed during cellular respiration? \_\_\_\_\_
24. Why is more ATP generated from glucose in the presence of oxygen?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

25. What happens to the energy of glucose that is not used to make ATP molecules?

\_\_\_\_\_

26. What are the final waste products of cellular respiration? \_\_\_\_\_

### Energy and Exercise (pages 230-231)

27. What are three sources of ATP a human body uses at the beginning of a race?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

28. When a runner needs quick energy for a short race, what source can supply enough ATP for about 90 seconds? \_\_\_\_\_

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

31. Why are aerobic forms of exercise so beneficial for weight control? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **Comparing Photosynthesis and Cellular Respiration (page 232)**

32. If photosynthesis is the process that "deposits" energy in a "savings account," then what is cellular respiration? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

33. How are photosynthesis and cellular respiration opposite in terms of carbon dioxide? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

34. How are photosynthesis and cellular respiration opposite in terms of oxygen? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

## Chapter 9 Cellular Respiration

### Vocabulary Review

**Matching** In the space provided, write the letter of the definition that best matches each term.

- |                               |  |
|-------------------------------|--|
| _____ 1. calorie              | a. electron carrier  |
| _____ 2. glycolysis           | b. pathway that releases energy from food in the absence of oxygen                                     |
| _____ 3. cellular respiration | c. requires oxygen   |
| _____ 4. $\text{NAD}^+$       | d. process in which one molecule of glucose is broken in half, producing two molecules of pyruvic acid |
| _____ 5. fermentation         | e. does not require oxygen   |
| _____ 6. anaerobic            | f. amount of energy needed to raise 1 gram of water 1 degree Celsius                                   |
| _____ 7. aerobic              | g. process that releases energy by breaking down food molecules in the presence of oxygen              |

**Answering Questions** In the space provided, write an answer to each question.

8. What is the first stage of cellular respiration? \_\_\_\_\_
9. What is the second stage of cellular respiration? \_\_\_\_\_
10. What is the third stage of cellular respiration? \_\_\_\_\_
11. How many ATP molecules can the cell produce from a single molecule of glucose through glycolysis? \_\_\_\_\_
12. How many ATP molecules can the cell produce from a single molecule of glucose through the complete process of cellular respiration? \_\_\_\_\_

**Completion** Write an equation for each of the pathways below.

13. lactic acid fermentation after glycolysis \_\_\_\_\_
14. alcoholic fermentation after glycolysis \_\_\_\_\_
15. cellular respiration \_\_\_\_\_