

**Chapter 9**

**Cellular Respiration**

**Section 9–1 Chemical Pathways (pages 221–225)**

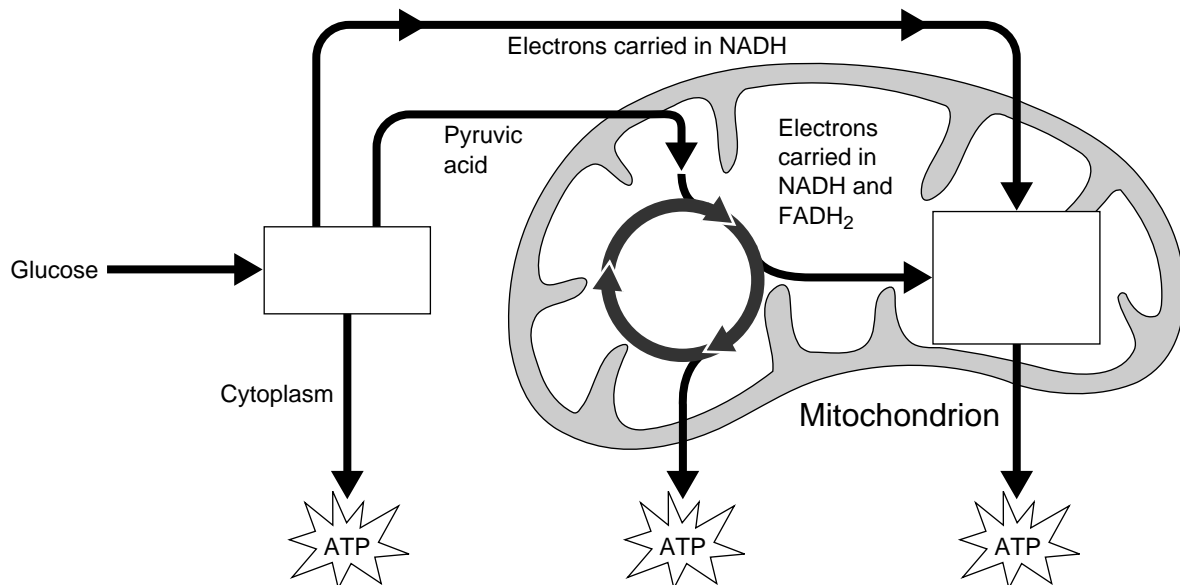
*This section explains what cellular respiration is. It also describes what happens during a process called glycolysis and describes two types of a process called fermentation.*

**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. What would be the problem if cellular respiration took place in just one step? \_\_\_\_\_  
\_\_\_\_\_
8. Label the three main stages of cellular respiration on the illustration of the complete process.



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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 NAD<sup>+</sup>? \_\_\_\_\_

\_\_\_\_\_

15. What is the function of NAD<sup>+</sup> 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? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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. \_\_\_\_\_

## Chapter 9, Cellular Respiration (continued)

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)

*This section describes what happens during the second stage of cellular respiration, called the Krebs cycle. It also explains how high-energy electrons are used during the third stage, called electron transport.*

### 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? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

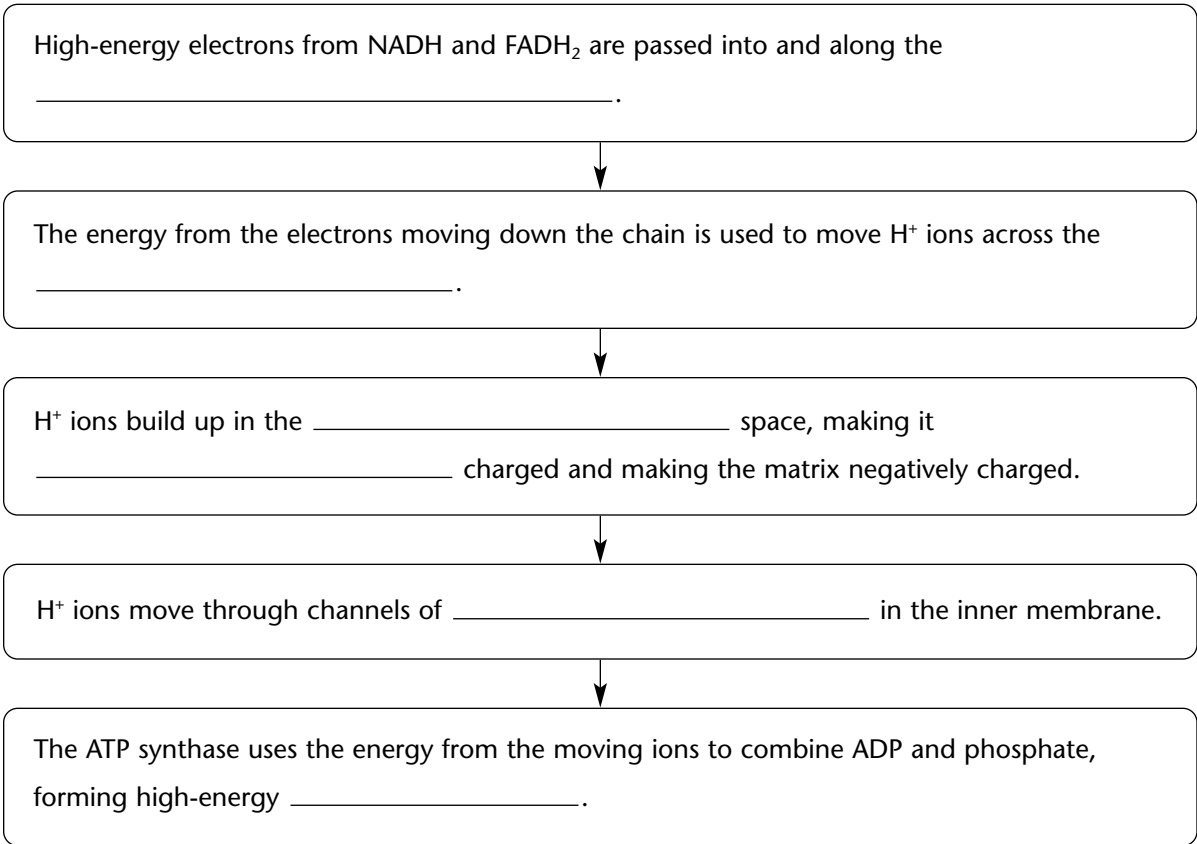
5. Why is the Krebs cycle also known as the citric acid cycle? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. When does the Krebs cycle begin? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. What happens to each of the 3 carbon atoms in pyruvic acid when it is broken down? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
8. What 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 CO<sub>2</sub> are released? \_\_\_\_\_
11. What is the energy tally from 1 molecule of pyruvic acid during the Krebs cycle? \_\_\_\_\_  
\_\_\_\_\_
12. When electrons join NAD<sup>+</sup> 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? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Chapter 9, Cellular Respiration (continued)

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  $H^+$  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? \_\_\_\_\_
22. Complete the flowchart about electron transport.



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### The Totals (page 229)

23. What is the total number of ATP molecules formed during cellular respiration? \_\_\_\_\_
24. Why can 18 times as much ATP be generated from glucose in the presence of oxygen than when oxygen is not available? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
25. What happens to the 62 percent of the total 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 the three sources of ATP a human body uses at the beginning of a race? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
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? \_\_\_\_\_  
\_\_\_\_\_

**Chapter 9, Cellular Respiration** (continued)

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

**WordWise**

Match each definition in the left column with the correct term in the right column. Then, write the number of each term in the box below on the line under the appropriate letter. When you have filled in all the boxes, add up the numbers in each column, row, and diagonal. All the sums should be the same.

**Definition**

- A. The process in which cells convert NADH to NAD<sup>+</sup> by passing high-energy electrons back to pyruvic acid
- B. The second stage of cellular respiration
- C. An electron carrier
- D. The stage of cellular respiration in which a molecule of glucose is broken into two molecules of pyruvic acid
- E. The process that releases energy by breaking down food molecules in the presence of oxygen
- F. The amount of energy needed to raise the temperature of 1 gram of water 1 Celsius degree
- G. A process that does not require oxygen
- H. A process that requires oxygen
- I. A series of carrier proteins in the inner membrane of mitochondria

**Term**

- 1. Krebs cycle
- 2. anaerobic
- 3. calorie
- 4. electron transport chain
- 5. cellular respiration
- 6. fermentation
- 7. glycolysis
- 8. NAD<sup>+</sup>
- 9. aerobic

A _____	B _____	C _____	=	_____
D _____	E _____	F _____	=	_____
G _____	H _____	I _____	=	_____
=	=	=	=	_____

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