Chapter 9 Review

READING TOOLBOX

1. **Describing Space** Use spatial language to describe what takes place along the electron transport chain during aerobic respiration.
2. **Concept Map** Make a concept map that shows how photosynthesis and cellular respiration are related. Try to include the following terms in your map: *glycolysis, Krebs cycle, electron transport chain, Calvin cycle, fermentation,* and *NADH.*

Using Key Terms

In your own words, write a definition for each of the following terms.

3. *ATP*
4. *Calvin cycle*
5. *aerobic*
6. *Krebs cycle*
7. *fermentation*

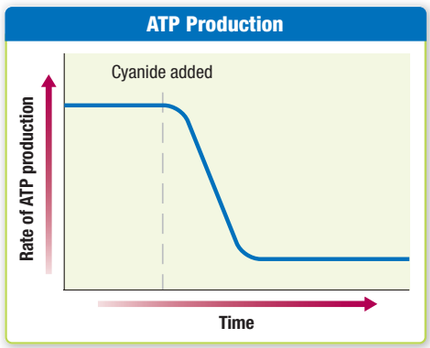
Use each of the following pairs of key terms in the same sentence.

8. *photosynthesis* and *thylakoid*
9. *pigment* and *chlorophyll*
10. *glycolysis* and *anaerobic*

Understanding Key Ideas

11. Energy flows through living systems from
    - **a.** the sun, to heterotrophs, and then to autotrophs.
    - **b.** the environment, to heterotrophs, and then to autotrophs.
    - **c.** the sun, to autotrophs, and then to heterotrophs.
    - **d.** autotrophs, to the environment, and then to heterotrophs.
12. The products of photosynthesis that begin cellular respiration are
    - **a.** ATP and water.
    - **b.** $NADP^+$ and hydrogen.
    - **c.** carbon dioxide and water.
    - **d.** organic compounds and oxygen.
13. Which of the following occurs in lactic acid fermentation?
    - **a.** Oxygen is consumed.
    - **b.** Lactic acid is converted into pyruvate.
    - **c.** NAD^+ is regenerated for use in glycolysis.
    - **d.** Electrons pass through the electron transport chain.
14. Aerobic respiration involves all of the following *except*
    - **a.** ATP.
    - **b.** glycolysis.
    - **c.** mitochondria.
    - **d.** the Krebs cycle.

Use the graph to answer the following question.



15. **Interpreting Graphics** The graph shows the rate of ATP production by a culture of yeast cells over time. At the time indicated by the dashed line, cyanide was added to the culture. Cyanide blocks the flow of electrons to O_2 from the electron transport chain in mitochondria. Explain why adding cyanide affects ATP production in the way shown by the graph.

Explaining Key Ideas

16. **Differentiate** between autotrophs and heterotrophs.
17. **Identify** the primary source of energy for humans.
18. **Predict** what might happen to photosynthesis if ATP were not produced in the light reactions.
19. **Relate** the rate of photosynthesis to light levels.
20. **Compare** the two stages of cellular respiration.

Assignment Guide

Section	Questions
1	3, 11, 12, 16, 17, 34
2	2, 4, 8, 9, 12, 18, 19, 23, 24, 25, 26, 27, 29, 32
3	1, 2, 5, 6, 7, 10, 12, 13, 14, 15, 20, 21, 22, 27, 28, 30, 31, 33

Review

Reading Toolbox

1. The electron transport chain is a series of molecules located along the *inner* mitochondrial membrane. Some of the molecules are hydrogen ion pumps, which actively transport hydrogen ions *out* of the *inner* mitochondrial compartment. Hydrogen ions accumulate in the *outer* compartment, creating a concentration gradient across the *inner* membrane. Hydrogen ions move *down* the gradient *through* a channel in ATP synthase molecules, which provides energy that is used to produce ATP.
2. See previous page for answer to concept map.

Using Key Terms

3. *Adenosine triphosphate (ATP)* is an organic molecule that acts as the main energy source for cell processes.
4. The *Calvin cycle* is a biochemical pathway of photosynthesis in which carbon dioxide is converted into glucose using ATP.
5. *Aerobic* describes a process that requires oxygen.
6. The *Krebs cycle* is a series of biochemical reactions that convert pyruvic acid into carbon dioxide and water.
7. *Fermentation* is the breakdown of carbohydrates by enzymes, bacteria, yeasts, or mold in the absence of oxygen.
8. The first stages of *photosynthesis* begin when light waves strike stacks of *thylakoids.*
9. *Chlorophyll* is the primary *pigment* involved in photosynthesis.
10. *Glycolysis* is an *anaerobic* process because it does not require the presence of oxygen.

Understanding Key Ideas

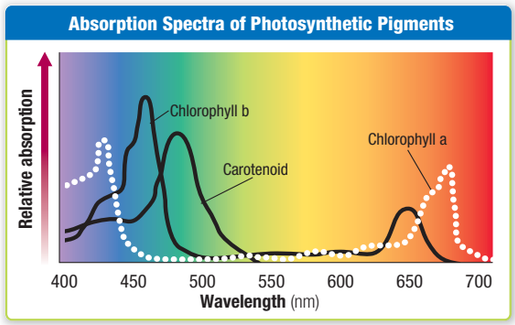
11. c 12. d 13. c 14. b
15. Blocking the flow of electrons along the electron transport chain will quickly stop the production of ATP by aerobic respiration, as indicated by the sharp drop in the curve.

21. **Define** the role that oxygen plays in the electron transport chain.

22. **Compare** the efficiency of glycolysis with the efficiency of aerobic respiration.

Using Science Graphics

The graph shows the colors of light that three different photosynthetic pigments absorb. Use the graph to answer the following questions.



23. According to the graph, chlorophyll *b* absorbs the most light at which wavelength?
    - **a.** 430 nm
    - **b.** 460 nm
    - **c.** 530 nm
    - **d.** 650 nm

24. **Analyzing Data** Why do the leaves of most plants appear green?

25. **Recognizing Relationships** How is the color of fall leaves related to the pigments in chloroplasts?

Critical Thinking

26. **Evaluating Viewpoints** State whether you think the following viewpoint can be supported, and justify your answer. "If Earth's early atmosphere had been rich in oxygen, photosynthetic organisms would not have been able to evolve."

27. **Evaluating Differences** Compare the energy flow in photosynthesis to the energy flow in cellular respiration.

28. **Comparing Functions** Explain why cellular respiration is more efficient when oxygen is present in cells than when oxygen is not present in cells.

29. **Inferring Relationships** What combination of environmental factors affects the rate of photosynthesis?

30. **Evaluating Results** Some yeast cells can use fermentation or cellular respiration. These yeast cells consume glucose much more slowly if oxygen is present than if oxygen is absent. Explain this observation.

31. **Inferring Relationships** How does cellular respiration depend on photosynthesis?

Writing Skills

32. **Organizing Information** Many plants have pores called *stomata* that take in CO_2 at night and release it during the day. These plants are called *CAM plants,* and some examples include cactuses and pineapple trees. Write a report about these types of plants, and summarize why this adaptation is an advantage for plants living in a hot, dry climate.

Alternative Assessment

33. **Finding and Communicating Information** Use the library or Internet resources to research how exercise physiologists regulate the diet and training of athletes. Find out how diets vary according to the needs of each athlete. Research the relationship between exercise and metabolism. Present your findings to your class.

34. **Using Graphing Skills** Create a poster that illustrates how an organism's metabolism is part of Earth's carbon cycle. Make drawings, create images on a computer, or use photos from magazines or online resources to illustrate your poster. Display your poster in the classroom.

Explaining Key Ideas

16. Autotrophs make their own organic compounds, usually using energy harvested from the sun. Heterotrophs get organic compounds by consuming autotrophs or feeding off other organisms that have consumed autotrophs.
17. The primary source of energy for humans is autotrophs. However, the ultimate source of energy for all organisms is the sun.
18. Without ATP, the Calvin cycle would not function and photosynthesis would cease.
19. The rate of photosynthesis increases as light intensity increases until all the pigments in a chloroplast are being used. At the saturation point, the rate levels off because the pigments cannot absorb any more light.
20. In glycolysis, organic compounds are converted to pyruvate, producing a small amount of ATP. In aerobic respiration, pyruvate is broken down and a large amount of ATP is formed.
21. Oxygen is the final electron acceptor at the end of electron transport.
22. Glycolysis alone can net 2 ATP molecules. Aerobic respiration is more efficient, producing up to 36 molecules of ATP.

Interpreting Graphics

23. b
24. Chlorophyll is the most abundant pigment in most plants. Chlorophyll absorbs mostly blue and red light and reflects green and yellow light.
25. When chlorophyll fades in the fall, the colors of the carotenoids (yellow, orange, and red) are exposed.

Critical Thinking

26. Students should acknowledge that photosynthetic organisms today carry out photosynthesis in the presence of oxygen.
27. Energy from the sun excites electrons in the pigments of the thylakoid membranes. Excited electrons are passed along the electron transport chain, setting up a concentration gradient of hydrogen ions. The gradient is used to make ATP. The process is similar in cellular respiration, but NADH is the original source of electrons, and the initial energy source is glucose rather than the sun.
28. If oxygen is present, aerobic respiration can occur. Aerobic respiration produces much more ATP than anaerobic processes.
29. Factors include light intensity, water availability, carbon dioxide concentration, and temperature.
30. Fermentation is a much less efficient process than aerobic respiration, and yeast cells must consume more glucose when O_2 is absent in order to make the amount of ATP they need for survival.
31. Photosynthesis supplies both the organic compounds and the oxygen that are used in aerobic respiration.

Writing Skills

32. CAM and C_4 plants have an advantage over C_3 plants in hot, dry conditions because they are adapted for taking up CO_2 while minimizing water loss through evaporation.

Alternative Assessment

33. Diet depends on the energy requirements of the athlete's sport. Some sports, such as weight lifting, involve mainly anaerobic metabolism. Others, such as jogging and swimming, involve aerobic respiration.
34. Students should include examples of autotrophs and heterotrophs, and should illustrate the processes of photosynthesis and cellular respiration.