

Chapter 8**Photosynthesis****Section 8–1 Energy and Life (pages 201–203)**

This section explains where plants get the energy they need to produce food. It also describes the role of the chemical compound ATP in cellular activities.

Autotrophs and Heterotrophs (page 201)

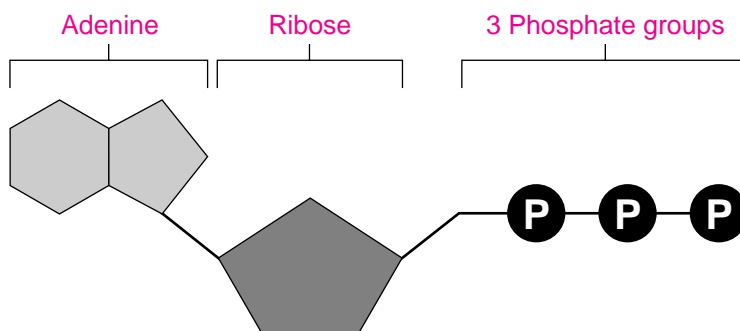
- Where does the energy of food originally come from? Energy in most food comes from the sun.
- Complete the table of types of organisms.

TYPES OF ORGANISMS

Type	Description	Examples
Autotrophs	Organisms that make their own food	Plants
Heterotrophs	Organisms that obtain energy from the food they eat	Animals, mushrooms

Chemical Energy and ATP (pages 202–203)

- What is one of the principal chemical compounds that living things use to store energy? Adenosine triphosphate, or ATP
- How is ATP different from ADP? ATP has three phosphate groups, while ADP has two phosphate groups.
- Label each part of the ATP molecule illustrated below.



- When a cell has energy available, how can it store small amounts of that energy? It can add a phosphate group to ADP molecules, producing ATP molecules.
- When is the energy stored in ATP released? It is released when ATP is converted to ADP and a phosphate group.

8. For what purpose do the characteristics of ATP make it exceptionally useful to all types of cells? All types of cells use ATP as their basic energy source.
9. What are two ways in which cells use the energy provided by ATP?
 - a. Active transport
 - b. Movement within the cell

ATP and Glucose (page 203)

10. Why is it efficient for cells to keep only a small supply of ATP on hand?
ATP is not very good for storing large amounts of energy over the long term. A single sugar molecule stores more than 90 times the chemical energy of an ATP molecule.
11. Circle the letter of where cells get the energy to regenerate ATP.
 - a. ADP
 - b. phosphates
 - c.** carbohydrates
 - d. organelles

Section 8–2 Photosynthesis: An Overview (pages 204–207)

This section describes what important experiments revealed about how plants grow. It also introduces the overall equation for photosynthesis and explains the roles light and chlorophyll have in the process.

Introduction (page 204)

1. What occurs in the process of photosynthesis? Plants use the energy of sunlight to convert water and carbon dioxide into high-energy carbohydrates—sugars and starches—and oxygen.

Investigating Photosynthesis (pages 204–206)

2. What did Jan van Helmont conclude from his experiment? He concluded that most of the mass a plant gained had come from water, because that was the only thing he had added to the pot.
3. Circle the letter of the substance produced by the mint plant in Joseph Priestley’s experiment.
 - a. carbon dioxide
 - b. water
 - c. air
 - d.** oxygen
4. What did Jan Ingenhousz show? He showed that light is necessary for plants to produce oxygen.

The Photosynthesis Equation (page 206)

5. Write the overall equation for photosynthesis using words.
carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen
6. Write the overall equation for photosynthesis using chemical formulas.
 $6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Chapter 8, Photosynthesis (continued)

7. Photosynthesis uses the energy of sunlight to convert water and carbon dioxide into oxygen and high-energy sugars.

Light and Pigments (page 207)

8. What does photosynthesis require in addition to water and carbon dioxide? It requires light and chlorophyll, a molecule in chloroplasts.
9. Plants gather the sun's energy with light-absorbing molecules called pigments.
10. What is the principal pigment of plants? Chlorophyll
11. Circle the letter of the regions of the visible spectrum in which chlorophyll absorbs light very well.
- ☒ a. blue region
 - ☐ b. green region
 - ☒ c. red region
 - ☐ d. yellow region

Reading Skill Practice

By looking at illustrations in textbooks, you can help yourself remember better what you have read. Look carefully at Figure 8-4 on page 206. What important ideas does this illustration communicate? Do your work on a separate sheet of paper.

Photosynthesis uses light energy to convert carbon dioxide and water into sugars and oxygen. This takes place in chloroplasts.

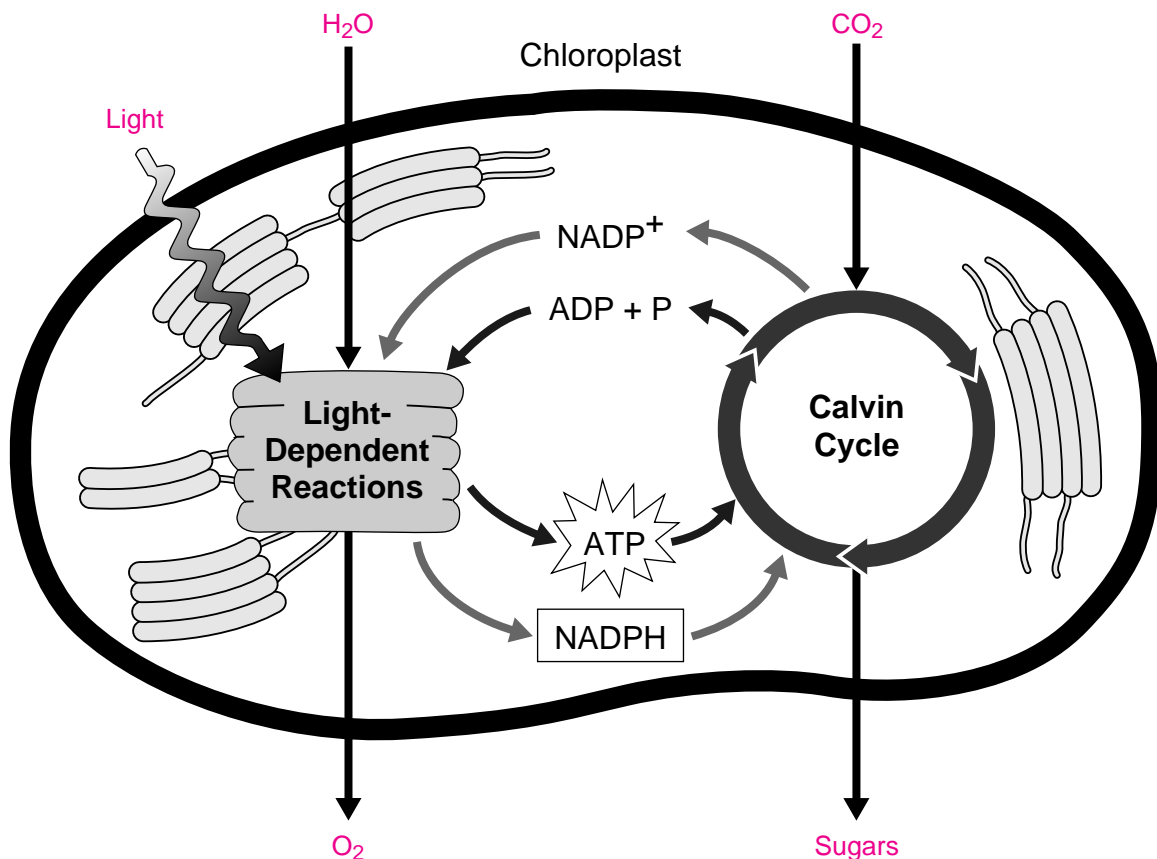
Section 8-3 The Reactions of Photosynthesis (pages 208-214)

This section explains what happens inside chloroplasts during the process of photosynthesis.

Inside a Chloroplast (page 208)

1. Chloroplasts contain saclike photosynthetic membranes called thylakoids.
2. What is a granum? A granum is a stack of thylakoids.
3. The region outside the thylakoid membranes in the chloroplasts is called the stroma.
4. What are the two stages of photosynthesis called?
- a. Light-dependent reactions
 - b. Light-independent reactions, or Calvin cycle

5. Complete the illustration of the overview of photosynthesis by writing the products and the reactants of the process, as well as the energy source that excites the electrons.



NADPH (page 209)

6. When sunlight excites electrons in chlorophyll, how do the electrons change? The electrons gain a great deal of energy.
7. What is a carrier molecule? A carrier molecule is a compound that can accept a pair of high-energy electrons and transfer them along with most of their energy to another molecule.
8. Circle the letter of the carrier molecule involved in photosynthesis.
 a. H₂O c. CO₂
 b. NADP⁺ d. O₂
9. How does NADP⁺ become NADPH? NADP⁺ becomes NADPH when it accepts a pair of high-energy electrons.

Chapter 8, Photosynthesis *(continued)***Light-Dependent Reactions** (pages 210–211)

10. Circle the letter of each sentence that is true about the light-dependent reactions.
- ☒ a. They convert ADP into ATP.
 - ☒ b. They produce oxygen gas.
 - c. They convert oxygen into carbon dioxide.
 - ☒ d. They convert NADP^+ into NADPH.
11. Where do the light-dependent reactions take place? Within the thylakoid membranes of chloroplasts
12. Circle the letter of each sentence that is true about the light-dependent reactions.
- ☒ a. High-energy electrons move through the electron transport chain from photosystem II to photosystem I.
 - b. Photosynthesis begins when pigments in photosystem I absorb light.
 - ☒ c. The difference in charges across the thylakoid membrane provides the energy to make ATP.
 - d. Pigments in photosystem I use energy from light to reenergize electrons.
13. How does ATP synthase produce ATP? ATP synthase allows H^+ ions to pass through the thylakoid membrane. As the ions pass through, ATP synthase rotates, binding ADP and a phosphate group together to produce ATP.

The Calvin Cycle (pages 212–213)

14. What does the Calvin cycle use to produce high-energy sugars?
The Calvin cycle uses ATP and NADPH from the light-dependent reactions to produce high-energy sugars.
15. Why are the reactions of the Calvin cycle also called the light-independent reactions? The Calvin cycle does not require light.
16. Circle the letter of each statement that is true about the Calvin cycle.
- a. The main products of the Calvin cycle are six carbon dioxide molecules.
 - ☒ b. Carbon dioxide molecules enter the Calvin cycle from the atmosphere.
 - ☒ c. Energy from ATP and high-energy electrons from NADPH are used to convert 3-carbon molecules into similar 3-carbon molecules.
 - ☒ d. The Calvin cycle uses six molecules of carbon dioxide to produce a single 6-carbon sugar molecule.

Factors Affecting Photosynthesis (page 214)

17. What are three factors that affect the rate at which photosynthesis occurs?

a. Availability of water

b. Temperature

c. Intensity of light

18. Is the following sentence true or false? Increasing the intensity of light decreases the rate of photosynthesis. false

WordWise

Answer the questions by writing the correct vocabulary terms from Chapter 8 in the blanks. Use the circled letter from each term to find the hidden word. Then, write a definition for the hidden word.

1. What is the process called by which plants use the sun's energy to make high-energy sugars?

p h o t o s y n t h e s i s

2. What is the stage of photosynthesis called in which plants use the energy that ATP and NADPH contain to build high-energy sugars?

C a l v i n c y c l e

3. What are the reactions of the first stage of photosynthesis called?

l i g h t - d e p e n d e n t
r e a c t i o n s

4. What is the region called where the Calvin cycle takes place?

s t r o m a

5. What is an organism called that obtains energy from the food it consumes?

h e t e r o t r o p h

6. What is one of the principle chemical compounds that living things use to store energy?

a d e n o s i n e
t r i p h o s p h a t e

7. What is an organism called that makes its own food?

a u t o t r o p h

Hidden word: pigment

Definition: A pigment is a light-absorbing molecule.