

**Chapter 8**

# Photosynthesis

## Section 8–1 Energy and Life (pages ~~201-203~~ 218-227)

*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~~ 219)

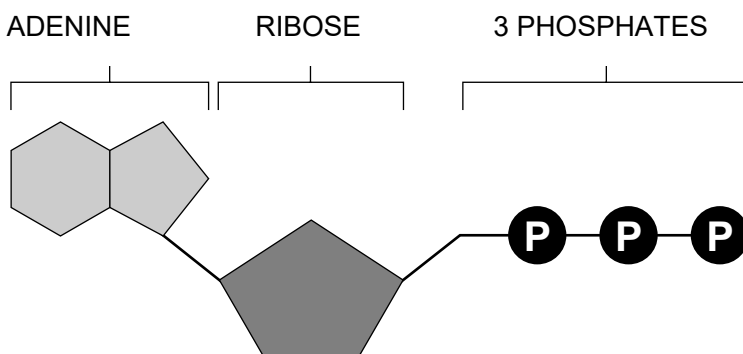
- Where does the energy of food originally come from? THE ORIGINAL SOURCE OF ENERGY FOR ALL LIVING ORGANISMS IS THE SUN.
- Complete the table of types of organisms.

**TYPES OF ORGANISMS**

| Type         | Description   | Examples       |
|--------------|---|----------------|
| AUTOTROPHS   | Organisms that make their own food                  | PLANTS, ALGAE  |
| HETEROTROPHS | Organisms that obtain energy from the food they eat | ANIMALS, FUNGI |

### Chemical Energy and ATP (pages ~~202-203~~ 221)

- What is one of the principal chemical compounds that living things use to store energy? ATP
- How is ATP different from ADP? ATP HAS 3 PHOSPHATES (HIGH ENERGY MOLECULE)  
ADP HAS 2 PHOSPHATES (LOWER ENERGY MOLECULE)
- Label each part of the ATP molecule illustrated below.



- When a cell has energy available, how can it store small amounts of that energy? ENERGY IS STORED IN THE PHOSPHATE BONDS OF THE ATP MOLECULE
- When is the energy stored in ATP released? WHEN A PHOSPHATE BOND IS BROKEN.

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8. For what purpose do the characteristics of ATP make it exceptionally useful to all types of cells? ATP CAN BE MADE FROM GLUCOSE IF NEEDED IT IS ABUNDANT IN EVERY CELL TYPE.
9. What are two ways in which cells use the energy provided by ATP?
- MUSCLE CONTRACTION
  - ACTIVE TRANSPORT OF MOLECULES ACCROSS THE CELL MEMBRANE

### ATP and Glucose (~~page 203~~)

10. Why is it efficient for cells to keep only a small supply of ATP on hand?
- A single molecule of the sugar glucose stores more than 90 times the chemical energy of a molecule of ATP.
- Therefore, it is more efficient for cells to keep only a small supply of ATP on hand.
- Cells can regenerate ATP from ADP as needed by using the energy in foods like glucose.
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~~)xx 222-227)

*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~~) 222-227)

1. What occurs in the process of photosynthesis? LIGHT ENERGY IS TRAPPED AND CONVERTED INTO CHEMICAL ENERGY IN THE BONDS OF GLUCOSE.

#### Investigating Photosynthesis (~~pages 204–206~~)x USE YOUR teacher's POWER POINT!!)

2. What did Jan van Helmont conclude from his experiment? \_\_\_\_\_
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? \_\_\_\_\_

#### The Photosynthesis Equation (~~page 206~~)x 222)

5. Write the overall equation for photosynthesis using words.
- CARBON DIOXIDE AND WATER, IN THE PRESENCE OF LIGHT, ARE CONVERTED INTO GLUCOSE AND OXYGEN.
6. Write the overall equation for photosynthesis using chemical formulas. 6CO<sub>2</sub> + 6 H<sub>2</sub>O ---> C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6 O<sub>2</sub>

## Chapter 8, Photosynthesis (continued)

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

### Light and Pigments (page ~~207~~ 223)

8. What does photosynthesis require in addition to water and carbon dioxide? SUNLIGHT!
- 
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.

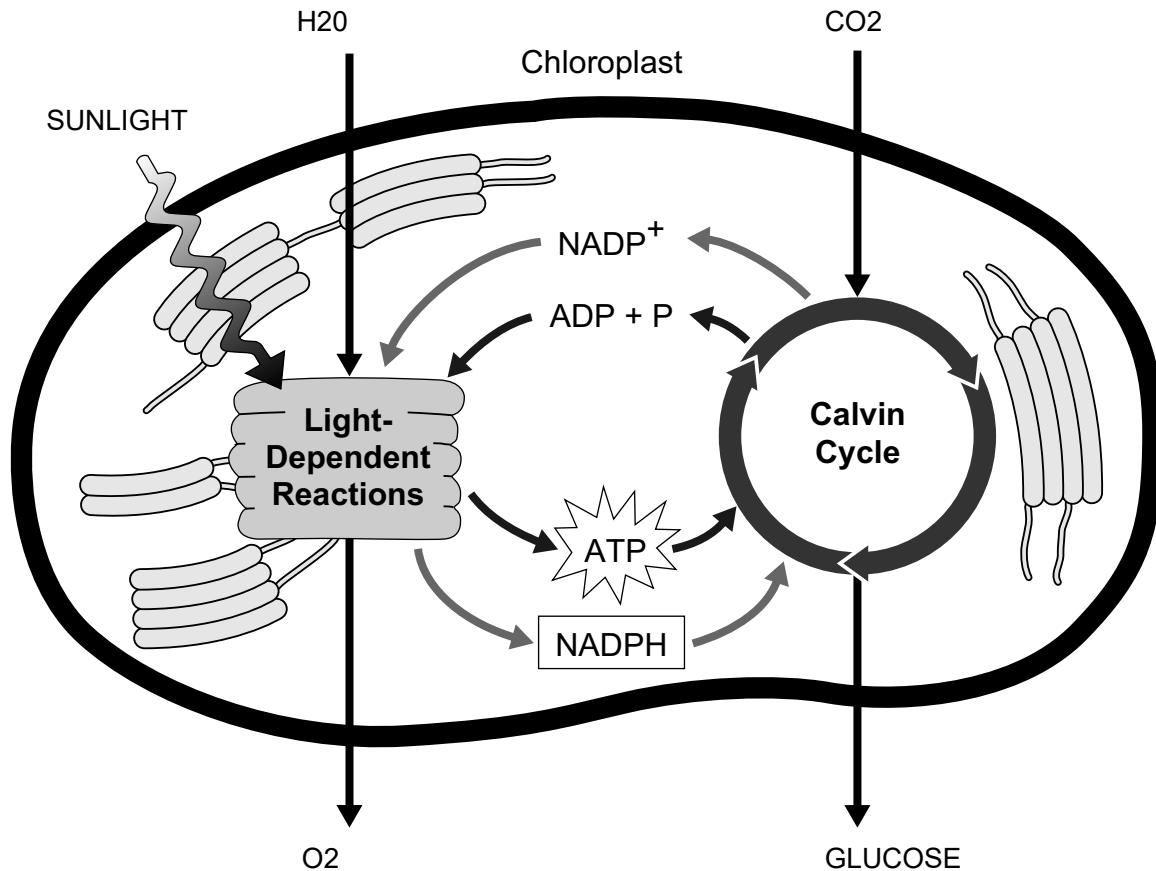
## Section 8-3 The Reactions of Photosynthesis (pages ~~208-214~~ 223-227)

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

### Inside a Chloroplast (page ~~209~~ 223)

1. Chloroplasts contain saclike photosynthetic membranes called THYLAKOIDS.
2. What is a granum? A GRANUM IS ONE STACK OF THYLAKOID MEMBRANES; GRANA ARE SEVERAL GRANUM.
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 -REACTIONS
- b. 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 ~~200~~ 224)

6. When sunlight excites electrons in chlorophyll, how do the electrons change? EXCITED ELECTRONS TRANSFER ENERGY TO ELECTRON CARRIERS SUCH AS NADP+ AND FAD+ WHICH IN TURN BECOME NADPH AND FADH.
7. What is a carrier molecule? A MOLECULE THAT TRAPS EXTRA ENERGY FROM EXCITED ELECTRONS AND MOVES THAT ENERGY TO THE ELECTRON TRANSPORT CHAIN (DARK REACTION) TO FUEL THE MAKING OF GLUCOSE IN PLANTS.
8. Circle the letter of the carrier molecule involved in photosynthesis.
 

|                            |                    |
|----------------------------|--------------------|
| a. H <sub>2</sub> O        | c. CO <sub>2</sub> |
| <b>b. NADP<sup>+</sup></b> | d. O <sub>2</sub>  |
9. How does NADP<sup>+</sup> become NADPH? NADP+ ACCEPTS EXTRA ENERGY FROM EXCITED ELECTRONS POWERED BY SUNLIGHT.

## Chapter 8, Photosynthesis (continued)

### Light-Dependent Reactions (pages ~~210-211~~ 223-224)

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.~~ ~~oxygen! OXYGEN!~~
- d. They convert NADP<sup>+</sup> into NADPH.

11. Where do the light-dependent reactions take place? IN 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 ADDS AN EXTRA PHOSPHATE GROUP TO ADP TO MAKE ATP.

### The Calvin Cycle (pages 212–213)

14. What does the Calvin cycle use to produce high-energy sugars?

CO<sub>2</sub>, ATP, NADPH AND FADH

15. Why are the reactions of the Calvin cycle also called the light-independent reactions?

BECAUSE IT HAPPENS IN THE DARK, IN THE STROMA OF CHLOROPLASTS

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?

- AMOUNT OF SUNLIGHT \_\_\_\_\_
- TIME OF EXPOSE TO SUNLIGHT \_\_\_\_\_
- AMOUNT OF WATER AND CARBON DIOXIDE IN ATMOSPHERE \_\_\_\_\_

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

## 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:** \_\_\_\_\_ MOLECULE THAT ABSORBS LIGHT AT DIFFERENT WAVELENGTHS. \_\_\_\_\_