

# Chapter 10 Photosynthesis Answer Key

Name \_\_\_\_\_ Period \_\_\_\_\_

## Chapter 10: Photosynthesis

*This chapter is as challenging as the one you just finished on cellular respiration. However, conceptually it will be a little easier because the concepts learned in Chapter 9—namely, chemiosmosis and an electron transport system—will play a central role in photosynthesis.*

1. As a review, define the terms *autotroph* and *heterotroph*. Keep in mind that plants have mitochondria and chloroplasts and do both cellular respiration and photosynthesis!

*Autotroph:* An organism that obtains organic food molecules without eating other organisms or substances derived from other organisms. Autotrophs use energy from the sun or from oxidation of inorganic substances to make organic molecules from inorganic ones.

*Heterotroph:* An organism that obtains organic food molecules by eating other organisms or substances derived from them.

### Concept 10.1 Photosynthesis converts light energy to the chemical energy of food

2. Take a moment to place the chloroplast in the leaf by working through Figure 10.4. Draw a picture of the chloroplast and label the *stroma*, *thylakoid*, *thylakoid space*, *inner membrane*, and *outer membrane*.

See page 186 of your text for the labeled figure.

3. Use both chemical symbols and words to write out the formula for photosynthesis (use the one that indicates only the net consumption of water). Notice that the formula is the opposite of cellular respiration. You should know both formulas from memory.



4. Using  $^{18}\text{O}$  as the basis of your discussion, explain how we know that the oxygen released in photosynthesis comes from water.

Scientists confirmed van Niel's hypothesis that oxygen released from photosynthesis comes from water with the use of  $^{18}\text{O}$ , a heavy isotope, as a tracer to follow the fate of oxygen atoms during photosynthesis. The experiments showed that the  $\text{O}_2$  from plants was labeled with  $^{18}\text{O}$  only if water was the source of the tracer. If the  $^{18}\text{O}$  was introduced to the plant in the form of  $\text{CO}_2$ , the label did not turn up in the released  $\text{O}_2$ .

5. Photosynthesis is not a single process, but two processes, each with multiple steps.

a. Explain what occurs in the *light reactions* stage of photosynthesis. Be sure to use *NADP<sup>+</sup>* and *photophosphorylation* in your discussion.

The light reactions are the steps of photosynthesis that convert solar energy to chemical energy. Water is split, providing a source of electrons and protons (hydrogen ions,  $\text{H}^+$ ) and giving off  $\text{O}_2$  as a by-product. Light absorbed by chlorophyll drives a transfer of the electrons and hydrogen ions from water to an acceptor called NADP<sup>+</sup> (nicotinamide adenine dinucleotide phosphate), where they are

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**Chapter 10 Photosynthesis Answer Key** is a crucial resource for students and educators delving into one of the most vital biological processes on Earth. Understanding photosynthesis not only illuminates the mechanisms by which plants produce energy but also underscores the interconnectedness of life on our planet. In this article, we will explore the key concepts related to photosynthesis, provide answers to common questions, and highlight the importance of this process in various contexts.

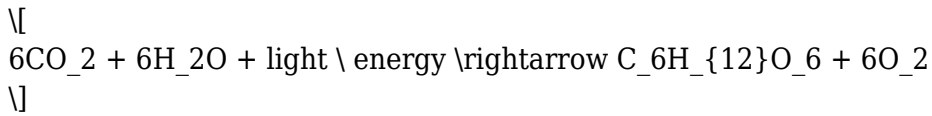
## Understanding Photosynthesis

Photosynthesis is the process by which green plants, algae, and certain bacteria convert light energy into chemical energy in the form of glucose, using carbon dioxide and water. This process is essential for life on Earth, as it provides oxygen and organic materials that form the basis of food

chains.

## The Basics of Photosynthesis

The overall equation for photosynthesis can be summarized as follows:



This equation succinctly captures the essence of photosynthesis, where carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) are transformed into glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) and oxygen (O<sub>2</sub>) using light energy, primarily from the sun.

## Two Main Stages of Photosynthesis

Photosynthesis occurs in two main stages: the light-dependent reactions and the light-independent reactions (Calvin cycle).

### 1. Light-Dependent Reactions:

- Occur in the thylakoid membranes of chloroplasts.
- Require light to initiate the process.
- Involve the absorption of light by chlorophyll, resulting in the splitting of water molecules (photolysis), which releases oxygen.
- Produce ATP and NADPH, which are energy carriers.

### 2. Light-Independent Reactions (Calvin Cycle):

- Occur in the stroma of chloroplasts.
- Do not directly require light, but utilize ATP and NADPH produced in the light-dependent reactions.
- Convert carbon dioxide into glucose through a series of enzymatic reactions.

## Key Terms and Concepts

Understanding the terminology associated with photosynthesis is essential for grasping its complexities. Here are some key terms:

- **Chlorophyll:** The green pigment found in plants that absorbs light energy.
- **Thylakoids:** Membrane-bound structures within chloroplasts where light-dependent reactions occur.
- **Stroma:** The fluid-filled space surrounding the thylakoids in chloroplasts, where the Calvin cycle takes place.

- **ATP (Adenosine Triphosphate):** The energy currency of the cell, produced during light-dependent reactions.
- **NADPH:** An electron carrier that provides reducing power for the Calvin cycle.

## Importance of Photosynthesis

Photosynthesis plays a fundamental role in maintaining life on Earth. Here are several reasons why it is so important:

1. **Oxygen Production:** Photosynthesis is responsible for the release of oxygen into the atmosphere, which is essential for the survival of most living organisms.
2. **Food Supply:** Plants convert light energy into chemical energy, providing food for herbivores, which in turn support carnivores, forming the basis of food webs.
3. **Carbon Dioxide Regulation:** Photosynthesis helps regulate atmospheric CO<sub>2</sub> levels, mitigating the effects of climate change.
4. **Energy Source:** Fossil fuels, derived from ancient photosynthetic organisms, continue to be a primary energy source for human civilization.

## Common Questions and Answers on Photosynthesis

As educators and students study photosynthesis, several common questions frequently arise. Here are answers to some of those questions:

### 1. What factors affect the rate of photosynthesis?

The rate of photosynthesis can be influenced by several factors:

- **Light Intensity:** Increased light intensity generally increases the rate of photosynthesis, up to a certain point.
- **Carbon Dioxide Concentration:** Higher CO<sub>2</sub> levels can enhance photosynthesis, provided other conditions are optimal.
- **Temperature:** Photosynthesis is temperature-dependent, with most plants having an optimal range. Extremely high or low temperatures can inhibit the process.
- **Water Availability:** Water is a raw material for photosynthesis; thus, its scarcity can limit the process.

## 2. How do plants adapt to different environments for photosynthesis?

Plants have evolved various adaptations to optimize photosynthesis in diverse environments:

- C4 Photosynthesis: Some plants, like maize and sugarcane, utilize C4 pathways to efficiently capture carbon dioxide in high-temperature conditions.
- CAM Photosynthesis: Succulents and desert plants open their stomata at night to reduce water loss while still capturing carbon dioxide for photosynthesis.
- Leaf Structure: The arrangement and thickness of leaves can vary to maximize light absorption while minimizing water loss.

## 3. What is the significance of chlorophyll in photosynthesis?

Chlorophyll plays a critical role in photosynthesis by:

- Absorbing light energy, primarily in the blue and red wavelengths.
- Converting light energy into chemical energy during the light-dependent reactions.
- Providing the green color to plants, which is indicative of healthy photosynthesis.

## Conclusion

In summary, the **Chapter 10 Photosynthesis Answer Key** serves as a guide to understanding the essential process of photosynthesis, encompassing its mechanisms, significance, and the factors influencing its efficiency. This knowledge not only aids students in their academic pursuits but also highlights the fundamental role photosynthesis plays in sustaining life on Earth. As we face global challenges such as climate change and food security, a deeper understanding of photosynthesis becomes increasingly vital for fostering sustainable practices and innovations in agriculture and energy production. By appreciating the intricacies of this process, we can better appreciate the delicate balance of ecosystems and our own reliance on the green plants that surround us.

## Frequently Asked Questions

### What is the main process of photosynthesis described in Chapter 10?

The main process of photosynthesis involves the conversion of light energy into chemical energy, primarily through the conversion of carbon dioxide and water into glucose and oxygen using sunlight.

### Which organelle is primarily responsible for photosynthesis?

Chloroplasts are the organelles primarily responsible for photosynthesis in plant cells.

## **What are the two main stages of photosynthesis mentioned in Chapter 10?**

The two main stages of photosynthesis are the light-dependent reactions and the Calvin cycle (light-independent reactions).

## **How does light intensity affect the rate of photosynthesis according to Chapter 10?**

Light intensity affects the rate of photosynthesis by increasing it up to a certain point; beyond that point, other factors become limiting.

## **What role does chlorophyll play in photosynthesis as outlined in Chapter 10?**

Chlorophyll plays a crucial role in photosynthesis by absorbing light energy, primarily in the blue and red wavelengths, which is necessary for the light-dependent reactions.

## **What products are generated during the light-dependent reactions of photosynthesis?**

The light-dependent reactions generate ATP, NADPH, and oxygen as products.

## **What factors can limit the rate of photosynthesis as discussed in Chapter 10?**

Factors that can limit the rate of photosynthesis include light intensity, carbon dioxide concentration, temperature, and water availability.

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