

PHOTOSYNTHESIS

09 APRIL 2014



Lesson Description

In this lesson, we will:

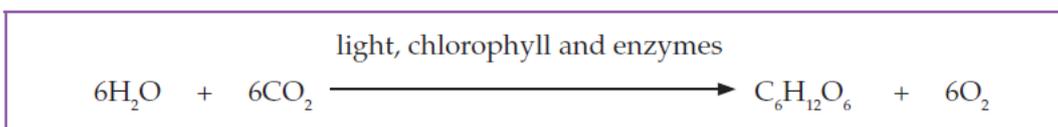
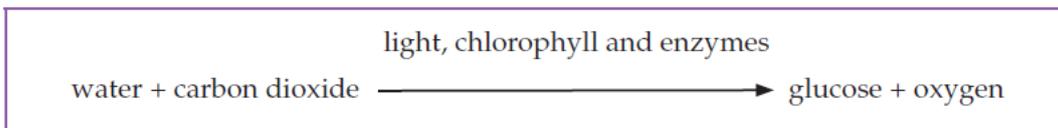
- Study the process of photosynthesis looking at the light and dark phases
- Look at the importance of photosynthesis
- Look at the effects of varying amounts of light, carbon dioxide and temperature on the rate of photosynthesis
- Look at the role of ATP in plants and animals



Summary

Process of Photosynthesis

- Photosynthesis is a process whereby light is converted into chemical energy.
- Sunlight is changed into the chemical energy of sugars and other organic compounds.
- This process consists of a series of chemical reactions that require carbon dioxide (CO₂) and water (H₂O) and store chemical energy in the form of sugar.
- Photosynthesis occurs in the chloroplast. It is an anabolic process and requires enzymes.



(Solutions for all Life Sciences, Macmillan, p121)

Light and Dark Phases

- **Light phase** – this occurs in the grana of the chloroplast. It contains chlorophyll that absorbs the light energy.
- Light is absorbed and changed into chemical potential energy which is stored in the energy carrier ATP.
- Water is broken down into oxygen and hydrogen ions. The oxygen is set free into the atmosphere. The hydrogen ions combine with hydrogen carriers and NADP – a co-enzyme to form NADPH₂.
- Energy is used to bond on a phosphate group to ADP to form ATP.
- **Dark phase** – this occurs in the stroma of the chloroplast.
- CO₂ from the air comes in through the stomata.
- NADPH₂ gives out hydrogen.
- ATP provides energy needed for the reaction
- Through a series of reactions CO₂ is reduced by hydrogen to form C₆H₁₂O₆.
- H₂O is formed and may be used in the formation of cytoplasm.

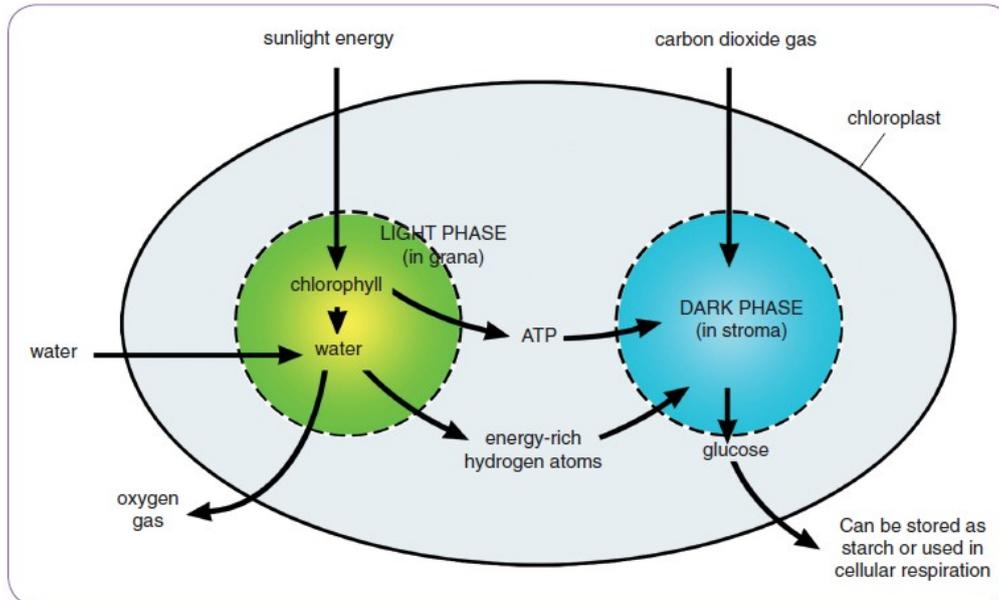


Fig. 4.4 The light phase and the dark phase of photosynthesis

(Solutions for all Life Sciences, Macmillan, p125)

Factors Affecting the Rate of Photosynthesis

- Light intensity – the greater the intensity of light, the greater the rate of photosynthesis
- Concentration of carbon dioxide – an increase in carbon dioxide will increase the rate of photosynthesis
- Temperature – enzymes work optimally at 37°C. Lower temperatures mean lower rate of photosynthesis

Role of ATP

- ATP is an energy-rich molecule that is used by cells for various life processes. Some examples of ATP use are:
 - Synthesis of macromolecules (giant molecules like proteins, fats and nucleotides)
 - Contraction of the muscle cells
 - Beating of cilia and flagellae
 - Active transport – movement of substances across cell membranes from a low to a high concentration.

Importance of Photosynthesis

- Production of oxygen
- Absorption of carbon dioxide
- Production of food

**Test Yourself****Question 1**

The role of chlorophyll during photosynthesis is

- A. Catalyst in the combination of CO_2 and H_2O
- B. As one of the products
- C. As one of the reactants
- D. To convert light energy into other forms of energy.

Question 2

The oxygen set free during photosynthesis comes from the breakdown of

- A. Glucose
- B. Carbon dioxide
- C. Phosphoglyceric acid
- D. Water

Question 3

Which one of the following is an energy carrier in living organisms?

- A. Light
- B. Glucose
- C. Chlorophyll A
- D. Adenosine triphosphate

Question 4

The dark phase of photosynthesis takes place

- A. Equally efficiently in light and darkness.
- B. Only when it is dark, never when it is light.
- C. Partially in the light and partially in the dark.
- D. Only when it is light and never in the dark.

Question 5

Which of the following is essential before a cell can photosynthesise?

- A. ATP energy
- B. Heat energy
- C. Radiant energy
- D. Chemical potential energy

Question 6

What is the most essential requirement for a cell when it uses radiant energy for the production of food?

- A. A large amount of oxygen
- B. A large vacuole
- C. Certain pigments
- D. Stored food

Question 7

The visible product of photosynthesis is

- A. Glucose
- B. Cellulose
- C. Starch
- D. Fructose

Question 8

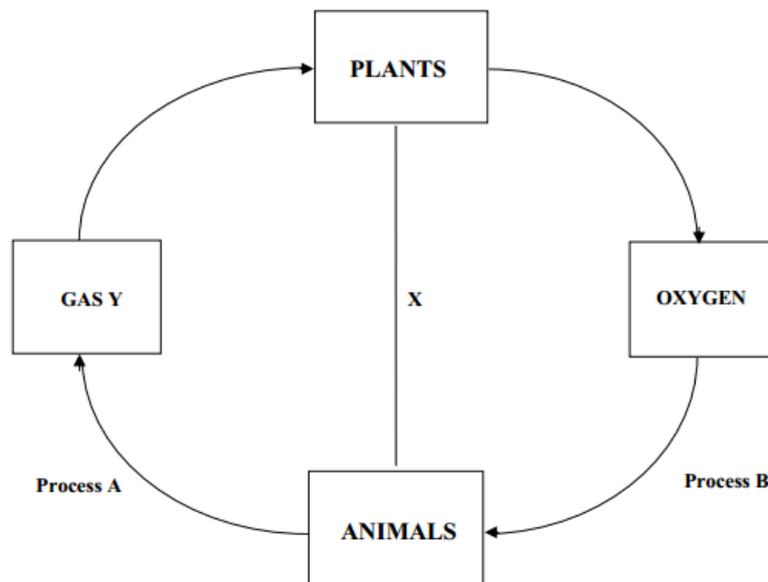
The light reaction of photosynthesis results in the formation of

- A. O₂
- B. NADPH and H⁺
- C. ATP
- D. All of these



Improve your Skills

Question 1



(http://chemactive.com/worksheets/gcse/biology/photosynthesis_questions.pdf)

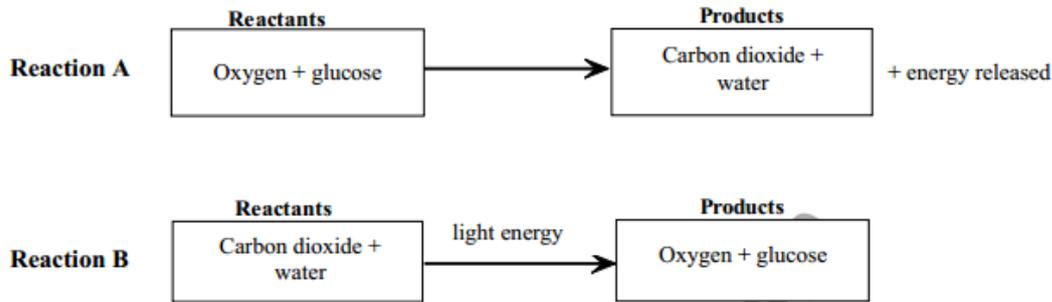
- 1.1 What is gas Y? (1)
- 1.2 Where does gas Y enter the plant? (1)

notes for...

- 1.3 What do plants use gas Y for? (1)
- 1.4 In which process do animals use oxygen? (1)
- 1.5 Name process A and B. (1)
- 1.6 What does the arrow labelled X represent? (1)
- [6]**

Question 2

Look at these two reactions which take place in living organisms.



- 2.1 Which of the two reactions takes place in plants and animals? (1)
- 2.2 Which of the two reactions takes place only in plants? (1)
- 2.3 Which reaction represents photosynthesis? (1)
- 2.4 Name one substance used up in reaction A. (1)
- 2.5 Which of the two reactions can only take place in daylight? Give a reason for your answer. (2)
- 2.6 What is the source of the water in reaction B? (1)
- 2.7 What is the source of the glucose in reaction A? (1)
- [8]**

Question 3

- 3.1 Scientists on another planet have made an exciting discovery about a new photosynthetic plant. The plant appears black instead of green. What does the plant's color tell you about its photosynthesis? (3)
- 3.2 Jan Van Helmont hypothesized that in order for a tree to grow and gain mass, it must find food somewhere else. He carefully weighed a tree and the soil that he wanted to plant the tree in. Time passed, and the tree grew. After five years, he reweighed the tree, which had grown quite large, and the soil. To his surprise, the soil weighed basically the same amount, suggesting to Jan that the plant couldn't be gaining mass from the soil. If you were Jan, what would you do next to try to figure out what the plant was consuming for food? (3)
- 3.3 Photosynthesis is often described in two steps: the light reactions and the dark reactions. Given what you have learned about photosynthesis and the ways that plants have adapted to optimize it, why is dividing photosynthesis into these categories misleading? (3)
- 3.4 Are plants more important to people, or are people more important to plants? Explain. (3)
- 3.5 Why can't we humans perform photosynthesis? (3)

notes for...



Links

- MindsetLearnXtra - <https://www.mindset.co.za/learn/xtra>
- Photosynthesis <http://biology.clc.uc.edu/courses/bio104/photosyn.htm>
- Biology4kids.com http://www.biology4kids.com/files/plants_photosynthesis.html
- The photosynthetic process http://www.biology4kids.com/files/plants_photosynthesis.html
- Centre for Bioenergy and Photosynthesis
<http://photoscience.la.asu.edu/photosyn/education/learn.html>