

PHOTOSYNTHESIS

10 APRIL 2013

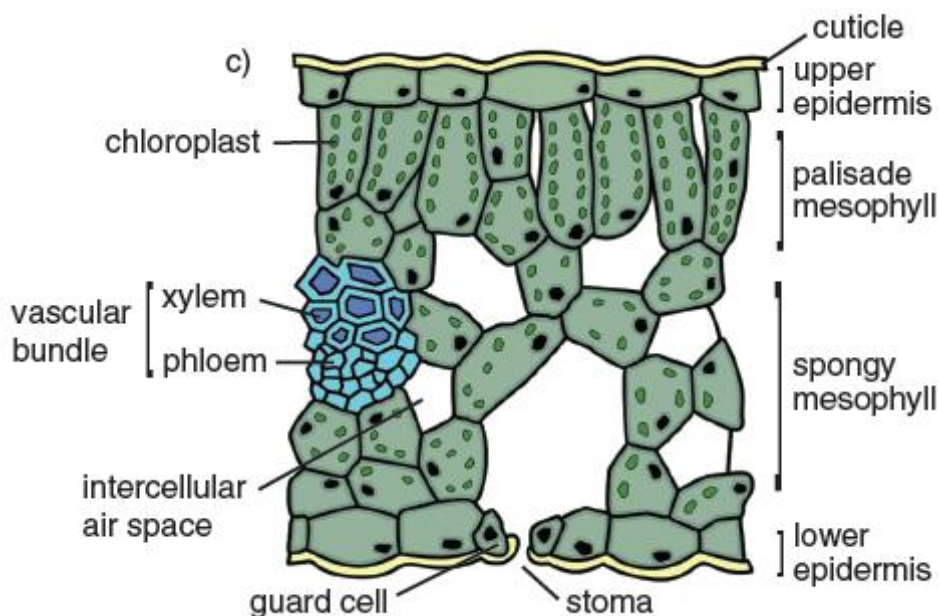
Lesson Description

In this lesson, we:

- Review the structures of the leaf
- 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
- Study the role of carbon dioxide enrichment, optimum light and optimum temperatures in greenhouse systems to improve crop yields
- Look at the role of ATP in plants and animals

Key Concepts

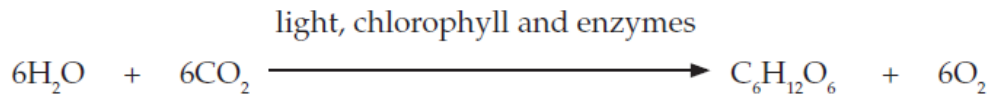
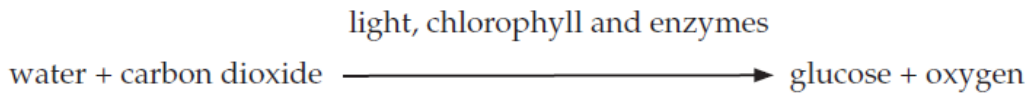
Structures of the Leaf



(Solutions for all Life Sciences, Grade 11, Macmillan, p119)

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 (CO_2) and water (H_2O) 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, Grade 11, Macmillan, p121)

Light and Dark Phases

- **Light phase** – this occurs in the grana of the chloroplast. It contains chlorophyll that absorbs the light energy.
- Some of the light energy is used to make **ATP** (Adenosine triphosphate).
- The rest of the energy is used to split water molecules and make energy-rich Hydrogen atoms. Oxygen is released.
- The ATP and the hydrogen are used in the dark phase.
- **Dark phase** – this occurs in the stroma of the chloroplast.
- Glucose molecules are produced from the carbon dioxide, ATP and energy-rich hydrogen atoms.
- The light energy absorbed in the light phase is stored in the bonds of the glucose molecule

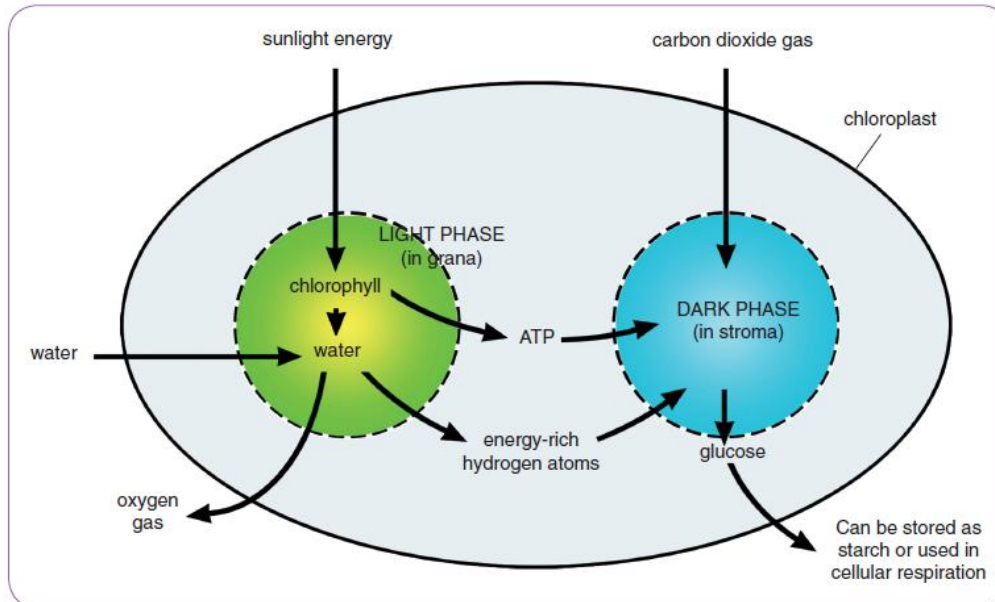


Fig. 4.4 The light phase and the dark phase of photosynthesis

(Solutions for all Life Sciences, Grade 11, Macmillan, p125)

Importance of Photosynthesis

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

Factors affecting the Rate of Photosynthesis

- Light intensity – the greater the intensity of light, the greater the rate of photosynthesis

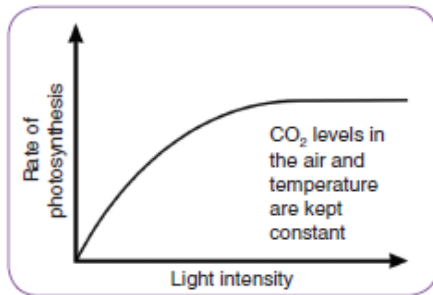


Fig. 4.12a) Effect of light intensity on the rate of photosynthesis

(Solutions for all Life Sciences, Grade 11, Macmillan, p135)

- Concentration of carbon dioxide – an increase in carbon dioxide will increase the rate of photosynthesis

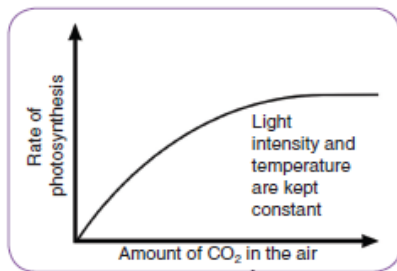


Fig. 4.12b) Effect of the amount of carbon dioxide on the rate of photosynthesis

(Solutions for all Life Sciences, Grade 11, Macmillan, p135)

- Temperature – enzymes work optimally at 37°C. Lower temperatures mean lower rate of photosynthesis

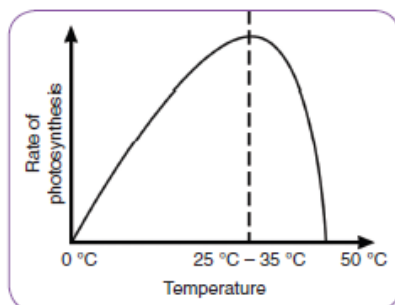


Fig. 4.12c) Effect of temperature on the rate of photosynthesis

(Solutions for all Life Sciences, Grade 11, Macmillan, p135)

Improve Crop Yields

- An improved rate of photosynthesis will increase the amount of crop mass. The following methods can be used to increase crop mass:
- Glass roof and walls of greenhouses trap light and increase temperature inside the greenhouse increasing photosynthesis.
- Gas cylinders are used to release extra carbon dioxide into the greenhouse. An increase in carbon dioxide increases the rate of photosynthesis.
- There is an improvement in water availability inside a green house
- Insects are more easily controlled inside a greenhouse

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.

Questions

Question 1

(Adapted from *Solutions for all Life Sciences, Grade 11, Macmillan, p141*)

- a.) Give the correct word or term for each of the following:
- the light-independent stage of photosynthesis
 - the green pigment found in a chloroplast
 - the molecule that is an important energy carrier in a cell
 - the liquid inside chloroplasts
 - the by-product of photosynthesis (5)
- b.) List the raw materials that a photosynthesising plant gets from its environment. (3)
- c.) Complete the table below that compares the light phase and the dark phase of photosynthesis. (4)

	Light phase	Dark phase
Takes place in the	grana of the chloroplasts	
Raw materials from the environment		
Energy-rich products		glucose

- d.) Draw a fully labelled diagram of the apparatus that you would use in an investigation to Find out which gas is needed for the process of photosynthesis. (6)

- e.) What are each of the following chemicals used for in investigations relating to photosynthesis?
- Sodium bicarbonate
 - Iodine
 - Sodium hydroxide
- (3)

Question 2

A farmer has been growing roses in his greenhouses for years. The temperatures of the greenhouses range from 16°C to 22°C. The farmer decides that he wants to change the amount of carbon dioxide in the greenhouses because he has heard that this will make a difference to the growth of the roses.

- Should the farmer increase or decrease the amount of carbon dioxide in the greenhouses if he wants the roses to grow better? (1)
- State **one** way that the farmer can increase the amount of carbon dioxide in the greenhouses without burning anything organic. (1)
- When is the best time to supply additional carbon dioxide? Why? (2)

The farmer is impressed with the difference the increased carbon dioxide has made but he wants more growth. He imagines bigger and better roses and wants to produce roses that will win all the prizes at the flower shows.

- Name **two** other factors that can be changed to increase the growth. (2)