Photosynthesis

- Green plants prepare their food by the process of **photosynthesis.**
- Photosynthesis is the process of synthesizing food from CO_2 and water in the presence of sunlight.
- The equation for photosynthesis is

$$\text{Carbon dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Carbohydrate} + \text{Oxygen}$$

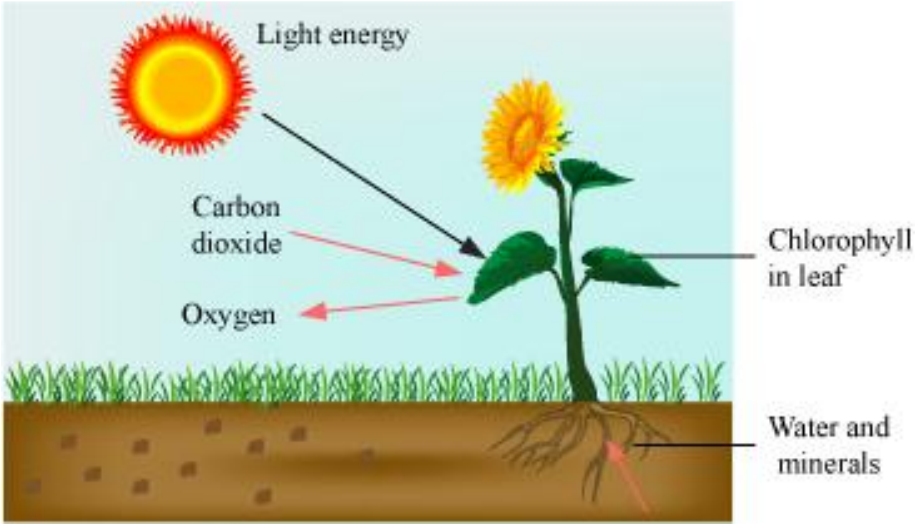
- Leaves are the sites for the synthesis of food.
- The green pigment called chlorophyll is present in leaves.
- Two phases of photosynthesis
  - Photochemical Phase
  - Biosynthetic Phase
- **Reactions involved in Photolysis:-**

(i) $NADP^+ + e^- + H^+ \xrightarrow{\text{enzyme}} NADPH$

(ii) $2O \rightarrow O_2$

(iii) $ADP + Phosphate \rightarrow ATP$ (Phosphorylation)

- **Biosynthetic Phase - The reactions that does not require light(happens during day time as well).**
- Chlorophyll traps solar energy that is used to prepare food from CO_2 and water. Thus, plants convert solar energy into chemical energy.
- Sun is the ultimate source of energy.
- Green plants absorb CO_2 from atmosphere through tiny pores called stomata.
- Stomata are present on the surface of leaves.
- Water and minerals are absorbed by roots from soil and are transported to leaves via tiny vessel-like structures present in roots, stems, the branches and the leaves.
- Chlorophyll, sunlight, CO_2 and water are essential raw materials for photosynthesis.
- Carbohydrates and oxygen are the end products of photosynthesis.
- The presence of starch in the leaves indicates the occurrence of photosynthesis.



Photosynthesis

- **Algae** contain chlorophyll and prepare its own food by the process of photosynthesis.
- **End Results of Photosynthesis**
  - Glucose
  - Water
  - Oxygen

- **Site and phases of photosynthesis**
  - Photosynthesis takes place in chloroplasts.
  - The light phase of photosynthesis takes place in grana.
  - Light reaction is called so because the reaction is light driven.
  - The dark phase of photosynthesis takes place in stroma part of chloroplast.
  - Dark reaction is indirectly dependent on light as during dark reaction, the energy produced (during light reaction) is used.

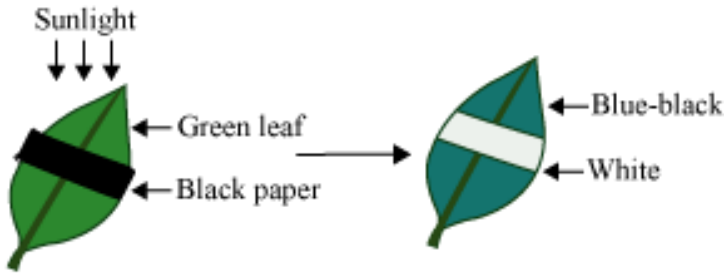
- **Factors affecting photosynthesis**
  - Several factors such as light, CO_2, temperature, and water affect the process of photosynthesis.
  - **Law of Limiting Factors (Stated by Blackman) -** The Blackman's law of limiting factors states that when a chemical process is affected by more than one factor, then its rate will be determined by factor which is nearest to its minimal value (factor which directly affects the process if its quantity is changed).
  - **Light –** There is a linear relationship between incident light and rate of photosynthesis at low light intensities. While the rate does not increase further at higher light intensities (as other factors become limiting).

- **Carbon dioxide –** It is the major limiting factor. Concentration of CO_2 upto 0.05% increases the rate of photosynthesis. However, beyond this value, it is harmful.
- **Temperature –** The rate is maximum at an optimum temperature, which differs in different plants.
- **Water –** Water is the main reactant in the process of photosynthesis and its scarcity affects a lot.

1. Sunlight is essential for photosynthesis

Place a healthy green potted plant in a dark room for 1-2 days. This is done to ensure that the plant consumes all its reserve food and the leaves do not contain any starch. Then, cover a portion of a leaf of this plant on both sides with two uniform pieces of black paper, fixed in position with two paper clips.

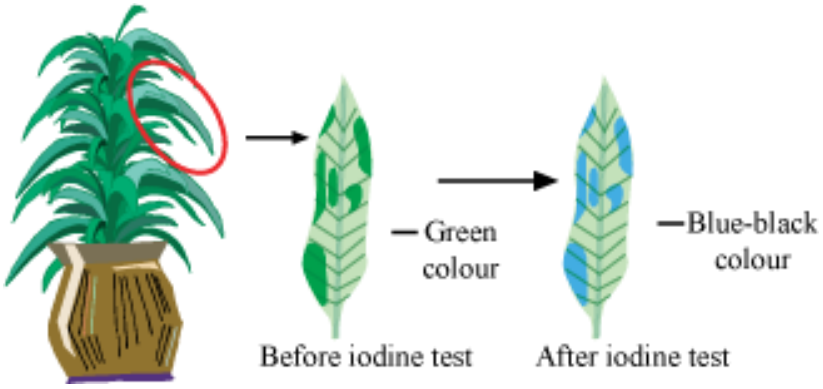
Now, expose this plant to bright light. After a few hours, remove the leaf and decolorized it with alcohol and test the presence of food (starch) with iodine solution.



You will observe that the portion of the leaf covered with black paper does not show any presence of starch (food).

2. Chlorophyll is essential for photosynthesis

Place a variegated plant (i.e. a plant which has both green and non-green areas, for e.g. croton or money plant) in a dark room for 2 − 3 days. This is done to ensure that all the reserve food (starch) is utilized.



Place this plant in sunlight for six hours to allow photosynthesis to take place.

Then, pluck a leaf from this plant and trace the green areas on a sheet of paper.

Now, decolourize the leaf using alcohol and dip it in a dilute solution of iodine for a few minutes. Wash this leaf with water and compare it with the tracings of the leaf done earlier.

It will be observed that only the green areas of the leaf could photosynthesize.

Importance of Photosynthesis:

- Provides food
- Provides oxygen

Carbon Cycle:
A series of chemical reactions in which carbon as a chemical gets consumed by living organisms and again gets restored in the atmosphere by various means.