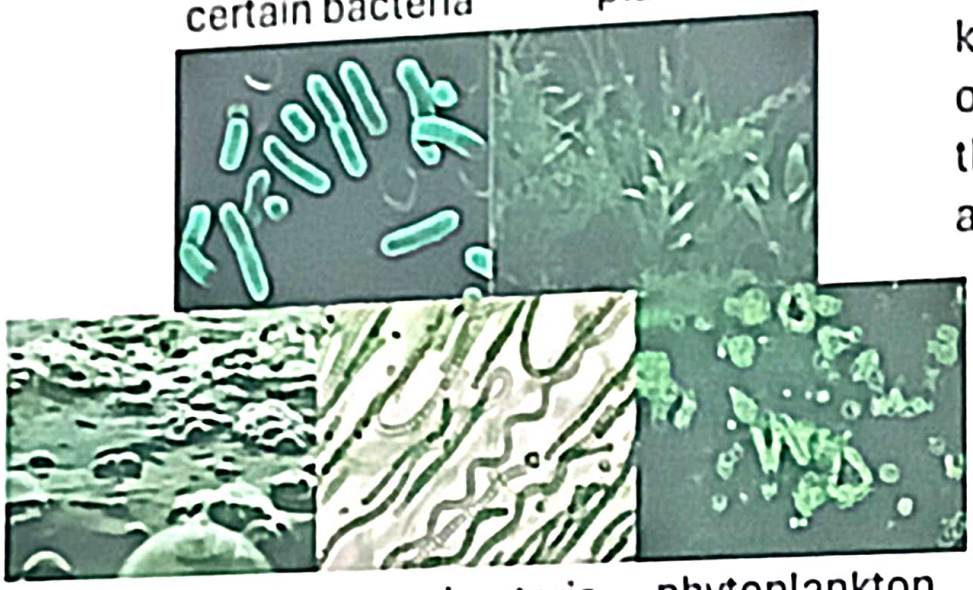
Photosynthesis:

Photosynthesis is an autotrophic mode of nutrition by plants and some bacteria.

Photosynthesis is the physio-chemical process by which plants can convert light energy into chemical energy, in the form of carbohydrate from simple inorganic substances like atmospheric carbon dioxide and water

Photosynthesis is carried out by:

certain bacteria plants



most algae cyanobacteria phytoplankton

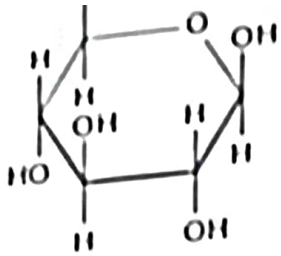
These organisms are known as photoautotrophs or **producers** meaning they make their own food and energy from the sun.

Consumers such as herbivores and carnivores depend on the products of photosynthesis that producers make to live.

Glucose

During photosynthesis, plants produce glucose molecules when they convert light energy into chemical energy. The chemical energy is stored in the bonds of glucose.

Glucose ($C_6H_{12}O_6$) is a sugar and its molecular structure looks like this.



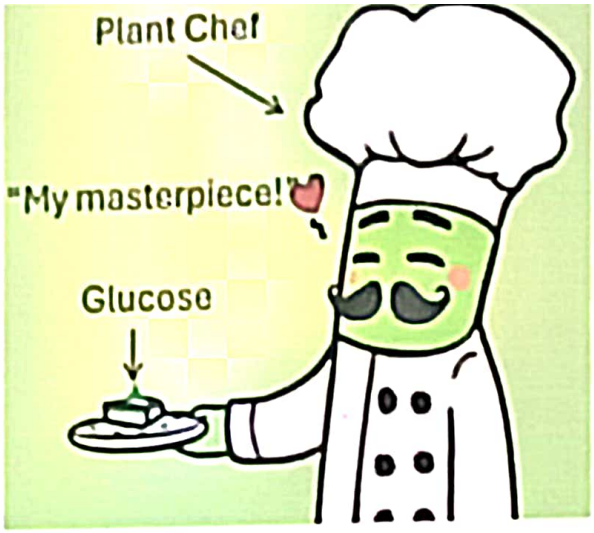
Plants produce sugars as a source of food. However, they produce way more than they need to survive. This is a great benefit for all the species that depend on glucose for energy.

All biological energy comes from glucose.

Plants also use the glucose they produce for energy. When plants produce excess glucose they store it in their leaves.

When animals digest plants, they break down the glucose bonds to release stored energy to power their bodies.

Glucose in Plants



Why do plants make glucose?

What do plants do with glucose?

Glucose molecules can be broken apart for energy to power reactions.

Plants can also convert glucose into carbohydrate chains called **polysaccharides.**

poly = many

saccharide = carbohydrate

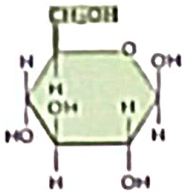
Glucose is a simple sugar because it is one of the smallest units of carbohydrates.

Glucose is a monosaccharide.

mono = one

saccharide

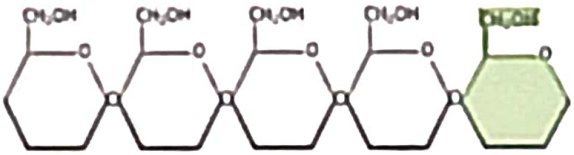
Glucose



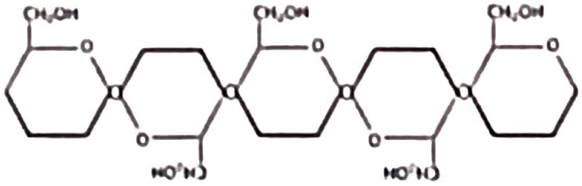
There are 2 polysaccharide chains in plants: **Cellulose**

Starch

Cellulose is the structural component of cell walls.



Starch is a long-term energy store that the plant can use later.

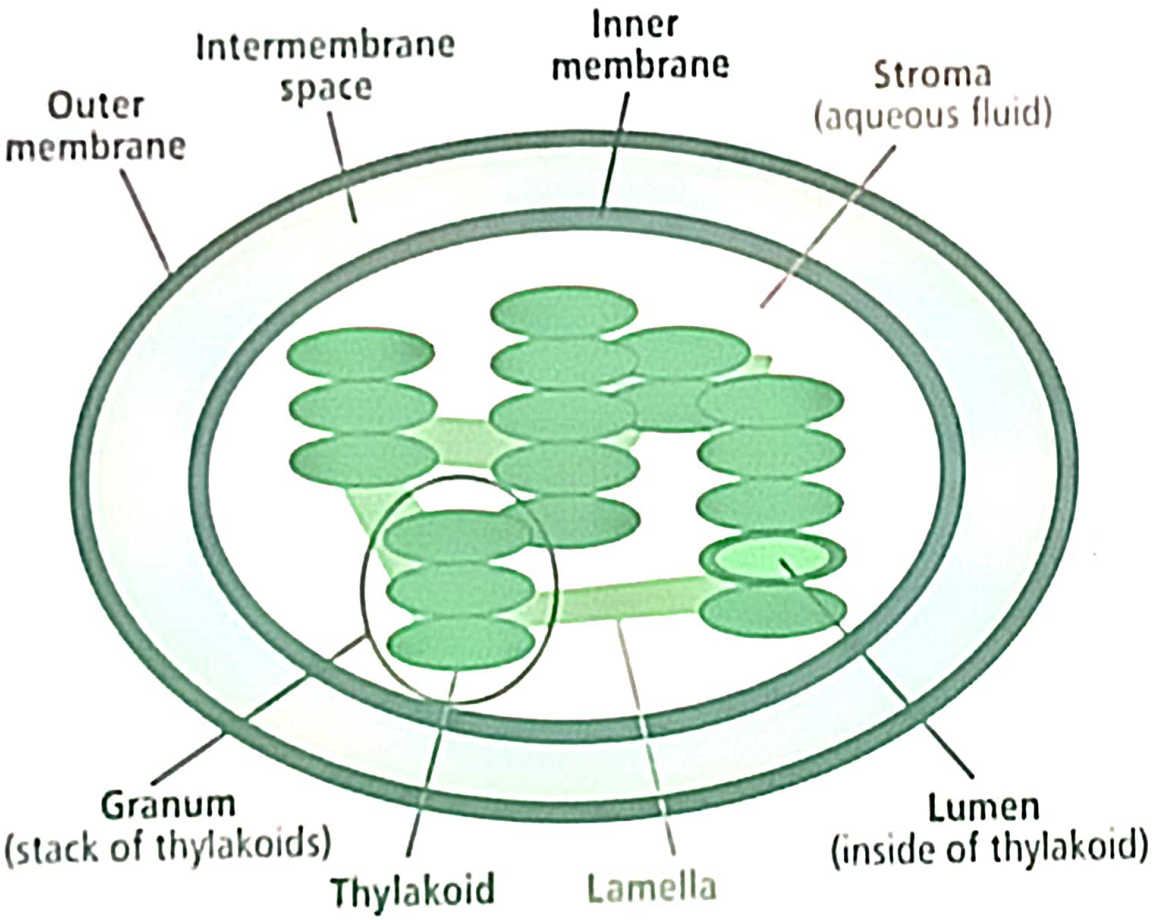


Sites of photosynthesis

- Leaves are considered to be the sites of photosynthesis. Hence, they are called as food factories of the plant.
- Leaves possess small pores called as stomata on both their surfaces. Stomata are the structures which help in the exchange of gases. Opening and closing of the stomata are brought about by the guard cells present in them.
- Leaves are rich in plastids. Green coloured plastids are chloroplasts rich in chlorophyll pigment. Chlorophyll is responsible for trapping the energy from sunlight.

- **Basic raw materials for photosynthesis**
  Photosynthesis requires carbon dioxide, sunlight, water and chlorophyll as its basic raw materials.

Structure of chloroplast



Overall reaction of photosynthesis

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light Energy}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Photosynthesis involves two types of reactions namely, light reactions and dark reactions.

- Light reactions are light dependent reactions.
- These reactions happen only in the presence of sunlight.
- The photosynthetic pigments trap the energy from the sunlight.
- Site for light reactions are thylakoids of grana in chloroplas

1. Absorption of light energy and excitement of chlorophyll molecule.
2. Photolysis of Water and Evolution of Oxygen.

The energy absorbed by chlorophyll is used in the break down of water into its component ions.

*Photolysis of water molecules results in the release of oxygen as a by-product.

$$H_2O \rightarrow 2H^+ + 2e^- + \tfrac{1}{2}O_2$$

3. Formation of NADPH(nicotinamide adenine dinucleotide hydrogen phosphate) + H+:

Hydrogen ions liberated in the photolysis of water reduce NADP and form NADPH + H+.

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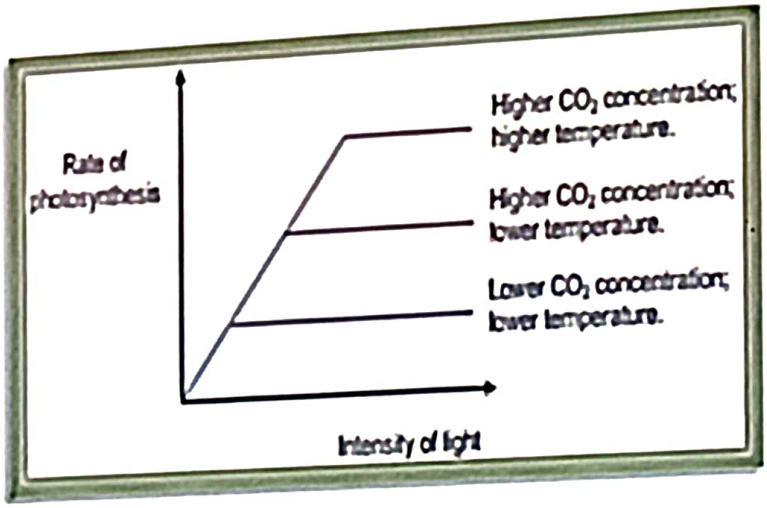
- **Dark reactions**

- Dark reactions are independent of light. Energy rich molecules like ATP and $NADPH_2$ are utilised in these reactions.

- Dark reactions involve Calvin cycle during which carbon dioxide is reduced to carbohydrate.

-C3 pathway is also known as Calvin cycle.C3 pathway involves set of carbon reactions which are catalysed by the enzyme.

Rate of photosynthesis depends on many factors like light, carbon dioxide, water and chlorophyll.



- **a) Light**
- Quality of the light also influences the rate of photosynthesis.
- Photosynthetic rate is higher in red and blue light. It is very poor in green light.

- **b) Carbon dioxide:**
- Carbon dioxide plays an important role in providing carbon for the process of photosynthesis.
- Increased concentration of carbon dioxide content enhances the rate of photosynthesis.
- But too much of its concentration proves to be toxic to the plants.
- Carbon dioxide is reduced to carbohydrate in the dark reaction.

- **c) Water:** Water being a universal solvent, almost all the minerals present in the soil dissolve in it.
- It plays a vital role in the process of photosynthesis.
- Water serves as a source for oxygen which is released as a by-product.

- **D) Temperature:** Temperature has an impact on the rate of photosynthesis. The rate of photosynthesis increases as the temperature rises.
- During photosynthesis, a temperature of more than 40 °C slows down the process. Because it is an enzyme-controlled process, this is the case.
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LIGHT REACTIONS	DARK REACTIONS
These are light dependent reactions.	These are light independent reactions.
Splitting of water molecules releases oxygen as a by-product.	Carbon dioxide is reduced to carbohydrates.
Grana of chloroplasts are the sites of these reactions.	Stroma of chloroplasts are the sites of these reactions.
ATP and $NADPH_2$ are the energy rich compunds synthesised in these reactions.	Energy rich compounds are utilised in the synthesis of carbohydrates.