**PHOTOSYNTHESIS**

The word photosynthesis is composed of two words “photo” mean light and “synthesis” to make or produce.

So it means to make or produce something in the presence of light.The equation of photosynthesis is as follows:

6CO2+12H2O C6H12O6+6H2O+6O2

**DEFINITION:**

Photosynthesis is defined as the conversion of light energy or mechanical energy into useful form of chemical energy.

It is oxidation reduction process in which oxidation of water and reduction of CO2 takes place to form organic compound.

**PHOTOSYNTHETIC PIGMENTS**

Light can work in chloroplast only if it is absorbed.**Pigments are the substances that absorb visible light (400-700nm in wavelength)**.Different pigments absorb light of different wavelength and the wavelength that is absorbed disappears.

Thylakoid membrane contains different kind of pigments but chlorophylls are the main P/S pigments.Other accessory pigments present in the chloroplast include yellow and red to orange carotenoids and phycobillins that broaden the absorption and utilization of light energy.

**1-Chlorophyll:**

There are several kinds of chlorophyll, chlorophyll a,b, c and d which differ in their molecular structure.Chlorophyll a occur in all photosynthetic eukaryotes and in cyanobacteria,and is considered to be essential for the type of photosynthesis carried out by organisms of these groups.The vascular plants contain another chlorophyll b.Chlorophyll b is the pigment that broaden the spectrum of light absorption.In photosynthesis when a molecule of chlorophyll b absorb light,the excited molecule transfersits energy to a molecule of chlorophyll a which then transform it into chemical energy during the course of photosynthesis.Chlorophyll c takes the place of chlorophyll b in some group of algae and chlorophyll d for chlorophyll c in some organisms.

Chlorophyll absorb mainly violet blue and orange red wavelengths. Green,yellow and indigo wavelength are least absorbed by chlorophyll and are transmitted or reflected.

Chlorophyll of each type have Mg in its structure and coordinated with the N of each pyrrole ring, that is why Mg deficiency causes yellow colour in plant.

**2-Carotenoids:**

Carotenoids are red,orange and yellow fat soluble pigments found in all chloroplasts and in cyanobacteria. Like the chlorophyll the carotenoids pigments of chloroplast are embedded in thylakoid membrane.Carotenoids are of two types:

**a**: Carotene.

**b**: Xanthophyll.

These are the lipid containing pigments.

**3-Phycobilins:**

Phycobilins are found in the chloroplast of the red algae and cyanobacteria.Unlike carotenoids phycobilins are water soluble.

Both carotenoids and phycobilins cannot replace the chlorophyll a however these pigments absorb solar energy and transfer it to chlorophyll a.The order of transfer of energy is

Carotenoids Chlorophyll b Chlorophyll a

**THE PHOTOSYSTEM**

In the chloroplast the chlorophyll and other pigments are embedded in thylakoid membrane in discrete unit of organization called**photosystem**.Each photosystem is an assembly of about 250 to400 pigment molecules.

**Reaction Centre:**

All of the pigments within photosystem are capable of absorbing photon but only one chlorophyll molecule per photosystem can actually use the energy in the photochemical reaction.This special chlorophyll molecule is called **reaction centre of the photosystem** and the other pigment molecules are called **antenna pigments** so named because they act as an antenna like network for gathering of light.The special chlorophyll molecule is a special form of chlorophyll a.

There are two different kinds of Photosystem:

In **photosystem I** the reaction centre is a form of chlorophyll a known as **P700**as it absorption peak is at 700nm.

The reaction centre of **photosystem II** also contain a special form of chlorophyll a.It’s optimum absorption peak is 680nm and accordingly it is called **P680.**

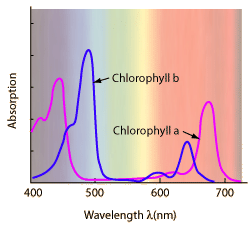
**Action and Absorption spectrum**

**Action Spectrum:**

The relative effectiveness of different wavelength of light on the rate of photosynthesis is called action spectrum.

**Absorption Spectrum:**

The proportion of visible spectrum absorbed by chlorophyll or other pigments is called absorption spectrum.



Both chlorophyll a and b absorb maximum light in the range of 400-500nm.

**CHLOROPLAST**

Chloroplasts are the only plastids which are involve in photosynthesis.They are green in colour and are involved in photosynthesis.Mostly present in leaves and may also be present in stems of Aphyllus plants.

**Ultrastructure of Chloroplast**

All the green parts of a plant have chloroplast,but the leaves are the major site of photosynthesis in most plants.Chloroplasts are mainly present in the cells of mesophyll tissue inside the leaf. Each mesophyll cell has about 20-100 chloroplasts.Chloroplast has a double membrane envelope that enclose dense fluid filled region, the **stroma** which contains most of the enzymes that are required to produce carbohydrate molecules.The thickness of each membrane is about 4-6nm.Another system of membrane is suspended in the stroma.These membranes form an elaborate interconnected set of flat,disc like sac called Thylakoids.Each thylakoid has a unit membrane and a cavity called lumen which is fluid filled.In some spaces thylakoids are stacked in column called **grana** (single granum), chlorophyll and other photosynthetic pigments are embedded in thylakoid membranes and impart green colour to the plant.

**Complexes on Thylakoid Membranes**

There are four complexes on thylakoid membrane which are functional and responsible for photosynthesis in plants.These are as follows:

1. Photosystem I.
2. Photosystem II.
3. Cytochrome b6 –f Complex.
4. ATP Synthase.