**UNIT :- 2**

**CARBON ASSIMILATION / FIXATION** 1. Carbon fixation or сarbon assimilation is the [conversion](https://en.wikipedia.org/wiki/Redox) (changing) process of fixing atmospheric [carbon dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide) (inorganic carbon) to [organic compounds](https://en.wikipedia.org/wiki/Organic_compound) by living [organisms](https://en.wikipedia.org/wiki/Organism). 2. The most prominent example is [photosynthesis](https://en.wikipedia.org/wiki/Photosynthesis), although [chemosynthesis](https://en.wikipedia.org/wiki/Chemosynthesis) is another form of carbon fixation that can take place in the absence of sunlight. 3. The plants (autotrophs) use the atmospheric carbon dioxide (CO2) of the air and fixes it in the form of carbohydrates. 4. The [autotrophs](https://en.wikipedia.org/wiki/Autotroph) are the organisms which uses the sunlight and manufacture food in the form of carbohydrate (C6H12O6) and fixing the atmospheric carbon. 5. So the carbon assimilation may be defined as the process by which the atmospheric carbon is converted into carbon compounds, such as carbohydrates, in plants usually by photosynthesis.

**PHOTOCHEMICAL REACTION** 1. It is a [chemical reaction](https://www.britannica.com/science/chemical-reaction) initiated by the absorption of solar [energy](https://www.britannica.com/science/energy) from the molecules in the form of [light](https://www.britannica.com/science/light). 2. The [molecules](https://www.britannica.com/science/molecule) absorbing light, function as the creation of unstable [excited states](https://www.britannica.com/science/excited-state) whose chemical and physical properties differ greatly from the original molecules. 3. These light absorbing molecules can change to new structures, when combine with other molecules, or transfer [electrons](https://www.britannica.com/science/electron), [hydrogen](https://www.britannica.com/science/hydrogen) [atoms](https://www.britannica.com/science/atom), [protons](https://www.britannica.com/science/proton-subatomic-particle), or their electronic [excitation](https://www.britannica.com/science/excitation) energy to other molecules. 4. The excited states are stronger reactants than the original [ground states](https://www.britannica.com/science/ground-state). 5. In photochemical reaction, many times reactions go with heat. 6. As the molecules absorb light and heated, they start to move around and so hit other molecules from which can then react. 7. As the light is absorbed by the molecule in form of energy it becomes active due to [activation energy](https://kids.kiddle.co/Activation_energy) of the light, and start the reaction. 8. A molecule or an [atom](https://kids.kiddle.co/Atom) absorbs light at a certain [wavelength](https://kids.kiddle.co/Wavelength). 9. If light is given at a certain wavelength, then the molecule or atom becomes excited. It is then easier for the molecule to react.

**EXAMPLES OF PHOTOCHEMICAL REACTION**  Many processes in nature are of photochemical reaction, which is the study of [chemical reactions](https://kids.kiddle.co/Chemical_reaction) that go with light. There are many natural examples of such photochemical reactions. Some of them are :- **I.** [**Photosynthesis**](https://kids.kiddle.co/Photosynthesis), 1. It is a very important process through which plants form carbohydrates and [oxygen](https://kids.kiddle.co/Oxygen) from [carbon dioxide](https://kids.kiddle.co/Carbon_dioxide) and [water](https://kids.kiddle.co/Water). 2. In [photosynthesis](https://www.britannica.com/science/photosynthesis), the [plants](https://www.britannica.com/plant/plant) absorb the sunlight and convert the energy of sunlight into stored [chemical energy](https://www.britannica.com/science/chemical-energy) by forming [carbohydrates](https://www.britannica.com/science/carbohydrate) from atmospheric [carbon dioxide](https://www.britannica.com/science/carbon-dioxide) and [water](https://www.britannica.com/science/water) and releasing molecular [oxygen](https://www.britannica.com/science/oxygen) as a byproduct. 3. In photosynthesis, light energy from sunlight is captured by the chlorophyll present in the thylakoids of the chloroplast. 4. The photons present in the sunlight particles in form of energy, make easy the conversion of water and carbon dioxide into sucrose or starch. 5. The photons in the light energy split the water into H+ and OH- ions. The process is called is photolysis of water and initiates the process of photosynthesis 6. In the whole process of photosynthesis, there is a production of ATP that drives the entire process.

Light 4H2O 4 H+ + 4OH-

**II. Ozone**, 1. In [atmospheric chemistry](https://kids.kiddle.co/Atmospheric_chemistry" \o "Atmospheric chemistry), the photo chemical (light) reaction is very important. 2. This is because there is much more [UV light](https://kids.kiddle.co/Ultraviolet) at the top of the [atmosphere](https://kids.kiddle.co/Atmosphere). This allows reactions that don't happen on the ground. 3. [Ozone](https://www.britannica.com/science/ozone) protects Earth’s surface from [ultraviolet (UV) rays](https://www.britannica.com/science/ultraviolet-radiation), which is formed in the [stratosphere](https://www.britannica.com/science/stratosphere) (layer of earth atmosphere). [Ozone](https://kids.kiddle.co/Ozone) can split in an [oxygen](https://kids.kiddle.co/Oxygen) molecule and one oxygen atom. 4. This is a photochemical separation of molecular oxygen (O2) into individual oxygen atoms, which is followed by subsequent (later) reaction of those oxygen atoms with molecular oxygen to produce ozone (O3).

O3 O2 + O

**FACTORS EFFECTING PHOTOCHEMICAL REACTION**  The rate of the photochemical reaction is changed in the concentration of the reactant or product per unit time. The Factors affecting the rate of reaction are :- **1. Concentration of Reactants** The rate of reaction increases with increase in concentration of the reactants. **2. Temperature** If the temperature varies the rate of reaction is effected. Generally increase in temperature increases the rate of reaction. If the temperature increases, the reactant molecules acquire higher energy and can easily form the products. **3. Light** There are certain reactions which are accelerated by the absorption of light by the reactants. Such reactions are known as photochemical reactions. These reactions do not occur if the reactants are shielded from light. The reactant hydrogen and chlorine does not take place to produce hydrogen chloride product in the dark. The plants prepare starch from carbon dioxide and water in the presence of sunlight by the process of photosynthesis. This reaction is slow in dim sunlight but it is much faster in bright sunlight. **4. Catalyst** A catalyst is a substance, added to a reaction mixture to change the rate of chemical reaction. In this the mass and the chemical composition of the catalyst remain unchanged at the end of the reaction.

**5. Chemical Equilibrium** In reversible chemical reactions, there is a point when forward and backward reactions continue at a same time at the same rate. This is called Chemical Equilibrium. For instance when hydrogen and iodine are taken, hydrogen molecule combines with iodine molecule to form hydrogen iodide.

H2(g) + I2(g)  ←→ 2HI(g)

Since the reaction is reversible in nature, the molecules of hydrogen iodide formed begin to dissociate (separate) to form hydrogen and iodine.

**PHOTOSYNTHETIC ELECTRON TRANSPORT** 1. In photosynthetic electron transport, the electron is released due to the photolysis of water. 2. This excited electron is accepted by Photosystem/Pigment – II (PS – II) and flows to Photosystem/Pigment – I (PS - I). 3. The electron passes through a chain and retain to their original state. 4. The chain consist of series of several carriers, which accepts electron from one another as a donor and receptor molecule. 5. So these carriers are known as electron acceptor. 6. The electron is transferred to these carriers through a series of chain called electron transport chain (ETC). 7. The carriers of this electron transport chain are :- Plastoquinone (PQ) Cytochrome (Cyt) Plastocyanin (PC) Ferrodoxin (FD) 8. By moving step – by – step through these carriers, electrons are moved in a specific direction. 9. The photosynthetic electron transport is of Z – shape. So called Z – scheme.

**e- PQ** **FD**

**e**- **e- FMN/FAD**

**Cyt.b6** **ADP + ip NADP**

**ATP NADPH2**

**ADP + ip** **e-** **CYCLIC**

**ATP PHOTOPHOSPHORYLATION**

**Cyt.f**

**NON - CYLIC e-**

**PHOTOPHOSPHORYLATION** **PC**

**e-**

**P680 nm. P700 nm. PS – II PS – I**

e- light

light 4H2O 4H+ + 4OH- 4OH- 2H2O2 (Unstable) 2H2O2 2H2O + O2

**Plastoquinone (PQ)** :- This is a derivative of benzoquinone (C6H4O2). It is found in chloroplast associated with PS – II. It accepts electron from PS – II, So called primary acceptor. **Cytochrome (Cyt)** :- It is made of protein coupled with porphyrine group. These are the most important constituent of ETS (electron transport system) of both chloroplast and mitochondria. It accepts electron from PQ or FD. It is of two types Cyt. b6 and Cyt. f are found associated with PS – II and PS – I . **Plastocyanin (PC)** :- It is a copper containing protein. It accepts electron from cytochrome and supplies to PS – I. **Ferrodoxin (FD)** :- It is a non – heme iron protein. It reduces NADP in photosynthesis. It locates close to PS – II.

**PHOTO SYSTEM/PIGM**