

Biochemistry of photosynthesis

[Science](#), [Chemistry](#)



Biochemistry of Photosynthesis Overall Word Equation: Water + Carbon Dioxide → Carbohydrates + Oxygen (requires light + chlorophyll)

1. Light Dependent Stage/ photochemical reaction/ light reactions: Word Equation: Water → Hydrogen ions + Oxygen (requires light + chlorophyll)

Site: On the Thylakoid membrane of the chloroplast

Major events:

- Light absorption by Chlorophyll in the thylakoids absorbs light. The energy absorbed is used for photolysis (splitting of water molecules).
- Photolysis of water (Photodissociation)
 - o The light energy absorbed splits H₂O molecules into H⁺ ions and O₂

$$2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2$$
 - o O₂ is released as a gas to the atmosphere (as a by-product)
 - o H⁺ ions are accepted by NADP to form NADPH₂ - NADPH₂ acts as a reducing agent by donating H⁺ ions in Calvin Cycle.
 - Generation of ATP (Adenosine triphosphate)
 - o The light energy absorbed is used to form ATP (photophosphorylation)
 - o In this way, light energy is converted to chemical energy stored in ATP
 - o Used to drive the reactions in Calvin Cycle

Products formed in this stage:

- Photolysis of water molecules to give H⁺ ions and O₂
- ATP molecules: as energy source for subsequent synthesis of carbohydrates in light dependent reactions.

The flow of electrons in Photosynthesis [pic]

Photosystem: Consists of chlorophyll molecules & accessory pigments e. g. carotenoid accessory pigments trap light energy and pass to the chlorophyll.

Results of chromatography:

2. Light independent stage/ carbon fixation/ dark reactions

Word Equation: Carbon dioxide + Hydrogen ions → Carbohydrates + Water (requires enzymes)

Site: In the stroma of chloroplast with the presence of enzymes for dark reactions

- Requires the products of light dependent stage (ATP, NADPH₂), takes place whether or not light is present.
- Details of this stage were analysed by Melvin Calvin and his co-workers and the process is

called the Calvin Cycle. [pic] Major events occurring in Calvin Cycle: 1. Carbon dioxide fixation and formation of 3-C compound 2. Reduction of 3-C compound and formation of TP (Triose Phosphate) 3. Regeneration of carbon acceptor [pic] Pi: Inorganic phosphate (PO_3) Role/ functions of the different substances in photosynthesis 1. Photolysis: - H_2O molecules ($2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + 4\text{e}^- + \text{O}_2(\text{g})$) - H^+ : Taken up by NADP to form NADPH₂ - e^- : Captured by the excited chlorophyll molecules to fill up their positively charged holes - O_2 : Released as a by-product 2. 5C-compound (ribulose biphosphate) at the beginning of the Calvin cycle - Acts as a carbon dioxide acceptor 3. Triose phosphate (TP) in carbon fixation - Some of the triose phosphate are used to regenerate the 5-C compound (RuBP) - Some act as the raw material for the production of glucose and other carbohydrates. 4. ATP (Supplies energy for o Reduction of a 3-C compound into 6-C sugar (glucose) o Conversion of triose phosphate into ADP 5. NADP - Act as the hydrogen acceptor. It takes up H^+ ions from photolysis of water and e^- from electron transport system to form NADPH₂ which is an importance reducing agent used in carbon fixation 6. CO_2 - Essential raw material for the synthesis of carbohydrates in carbon fixation 7. 1st stable product of photosynthesis: PGA (a 3-C compound) 8. 1st carbohydrates formed: Triose phosphate