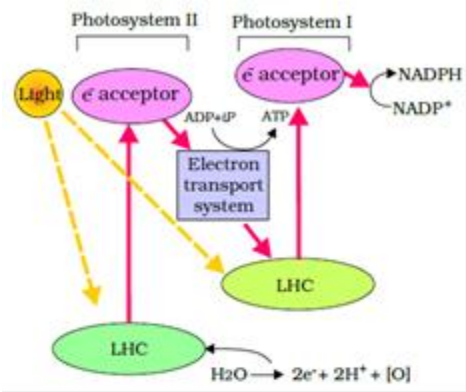
The Electron Transport

- Membrane of Thyllakoid contains both PS I and PS II while Stroma Lamella contains only PS I.
- Occur in membrane thylakoid/Grana consisting of both PS I and PS II.
- Light of 680nm wavelength is absorbed by LHC of PS II.
- Electrons becomes excided and jump to next orbitals (farther from nucleus) and finally accepted by electron acceptor of PS II.
- Electrons moves through Electron Transport System (ETS) downhill (releasing ATP) to LHC of PS I.
- Electrons of PS I reaction centre also gets excited (at 700nm) & moves uphill to PS I electron acceptor of greater redox potential.
- Finally pass on downhill to $NADP^+$ where it gets redused to NADPH + H^+
- Electrons are passed downhill energy is released.
- The whole scheme of transfer of electron is called **Z-scheme** due to its shape.



Splitting of Water

$$2H_2O \rightarrow 4H^+ + O_2 + 4e^-$$

- Photolysis of water release electrons that replaces electron of PS II. PS I electrons are replaced by PS II electrons.
- Each molecule of water release $2H^+$, [O] and 2 e^-
- Only PS II (located on inner side of thylakoid membrane) is associated with splitting of water.
- The protons get accumulated in the lumen of the thylakoid and the oxygen gets into the atmosphere.

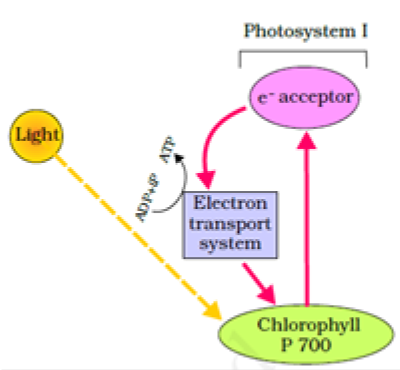
Photophosphorylation: The process in which ATP is synthesised from ADP and inorganic phosphate (P) by cell organelle (chloroplast) with the help of light.

Non-cyclic Photophosphorylation

Both the photosystems (PS-I and PS-II) cooperate.
The electron released from PS-II does not return to it
Both NADPH and ATP are formed during this reaction.

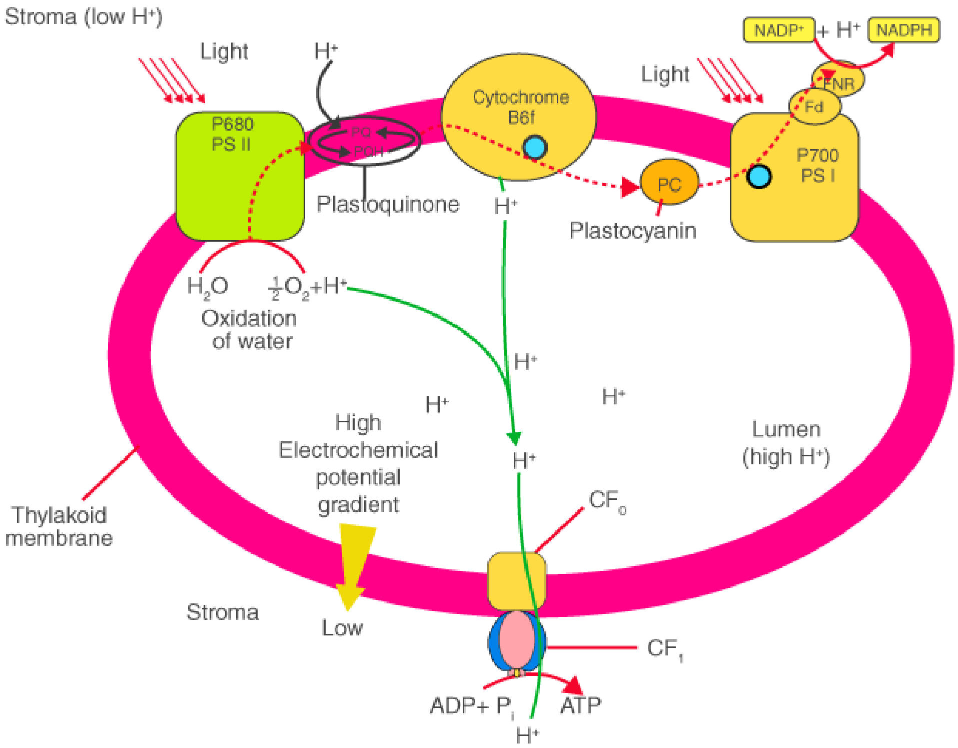
Cyclic photophosphorylation

- Occur when non-cyclic photophosphorylation do not occur due to certain condition.
- Occur in Stromal Lamella where only PS I is functional as it lacks PS II & NADP reductase enzyme.
- Occur only when light beyond 680 nm wavelengths are available for excitation.
- Light of 700nm wavelength is absorbed by chlorophyll a.
- Electrons accepted by electron acceptor of PS I.
- Excited e^- do not pass on to $NADP^+$ but recycled back to PS I through ETS.
- Only ATP is synthesised.



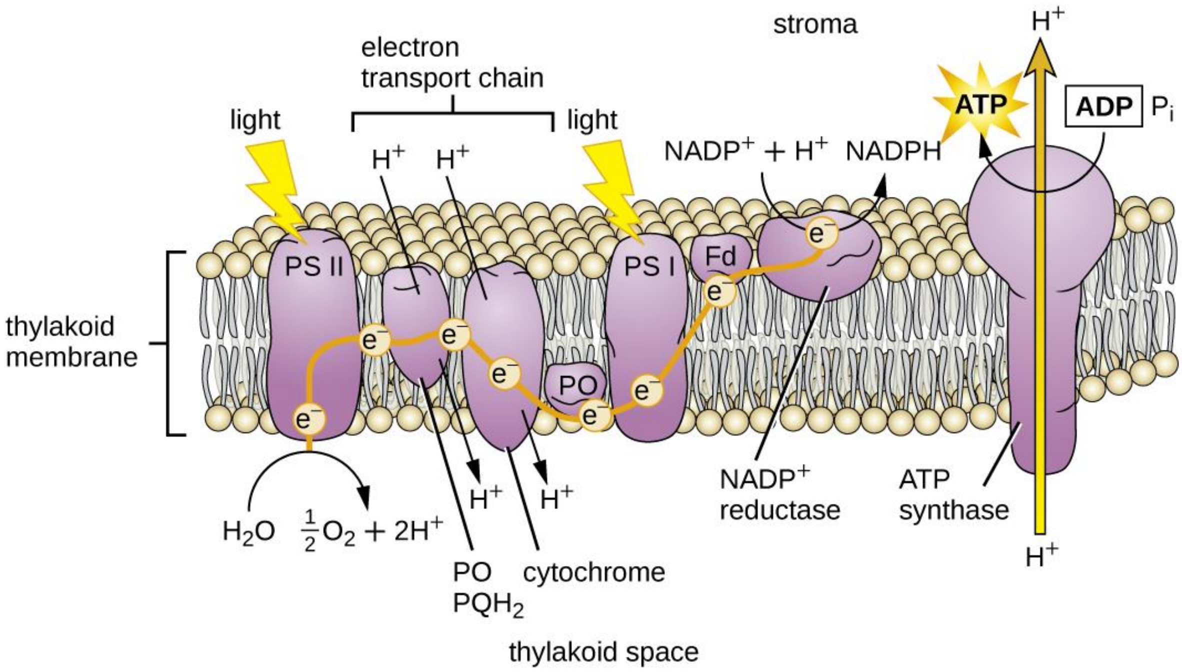
Chemiosmotic Hypothesis - Proposed by Mitchell in 1961.

- Water Oxidised and split into O_2 (goes to atmosphere), H^+ (accumulate in lumen) & e^- (move to PS II to replace lost e^-).
- Proton gradient develop across membrane. Lumen -high H^+ & stroma – low H^+.
- The primary acceptor of electron of PS II (located outer side of the membrane) transfers e^- to the proton (H^+) carrier and not to the electron carrier.
- While transporting an electron **Plastoquinone** takes a proton (H^+) from the stroma & release into lumen.
- Electron from Plastoquinone is passed on to **Cytochrome B6f** which deliver further to **plastocyanin** & finally to **PS I which** replaces excited PSI reaction center electron.



ATP synthesis through chemiosmosis

- Ferredoxin (Fd) protein carries e⁻ from PS I and transfer to another protein that catalyses transportation of e- to **NADP⁺** where it gets redused to **NADPH + H⁺** with the help of enzyme **NADP reductase** (located stromal side).



- Transportation of protons takes place across the membrane when the electron moves through photosystems.
- Gradient is broken down due by movement of H⁺ across the membrane to the stroma through trans-membrane channel of **F0 of ATPase.** One part of this enzyme is embedded in membrane to form trans-membrane channel. The other portion is called **F1** that protrudes on the outer surface of membrane which makes the energy packed ATP.
- ATP and NADPH produced due to movement of electron is used immediately to fix CO2 to form sugar.
- The product of light reaction used to drive the process leading to synthesis of sugar are called **biosynthetic phase** of photosynthesis.