TOPIC 8.3: PHOTOSYNTHESIS

Stages of Photosynthesis

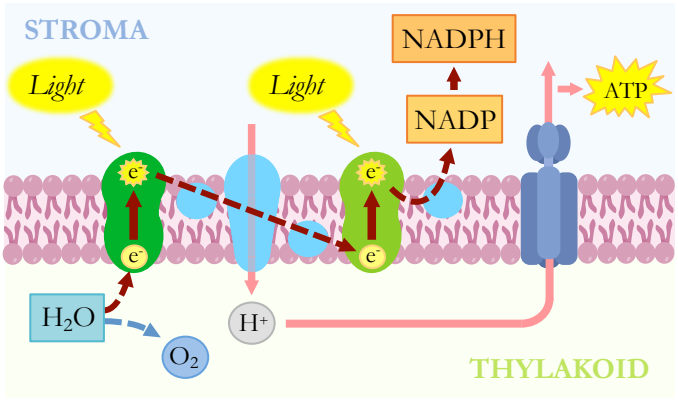
Photosynthesis is a two-step process:

- The light dependent reactions occur in the thylakoids and convert light energy into chemical energy (ATP + NADPH)
- The light independent reactions occur in the stroma and use this chemical energy to make organic compounds

Light Dependent Reactions

Non-Cyclic Photophosphorylation

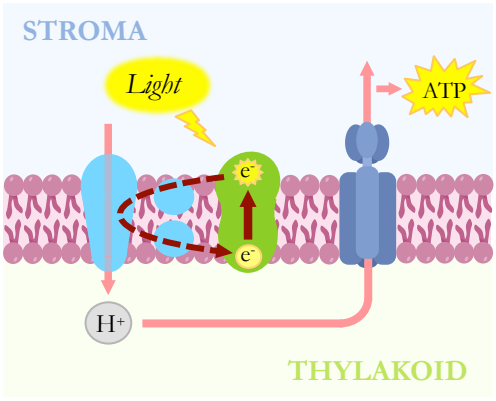
- Chlorophyll in Photosystems I and II absorb light, which triggers the release of energised electrons *(photoactivation)*
- The electrons from PS I reduce NADP (forms NADPH)
- The electrons from PS II move through an electron transport chain before replacing the electrons from PS I
- The transport chain produces ATP *(photophosphorylation)*
- Electrons lost from PS II are replaced by water *(photolysis)*



Photosystem II (P680) Photosystem I (P700)

Cyclic Photophosphorylation

- Only chlorophyll in Photosystem I are activated by light
- The electrons move through an electron transport chain before returning to their original location (i.e. cyclic)
- The transport chain produces ATP *(photophosphorylation)*
- Cyclic photophosphorylation does not produce NADPH
- Hence, while cyclic photophosphorylation can produce usable energy (ATP), it cannot produce organic molecules



Photosystem I (P700)

Light Independent Reactions

Step 1: Carbon Fixation

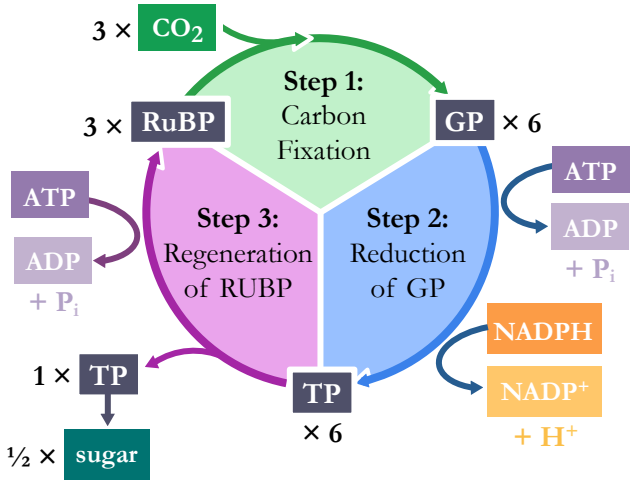
- *Rubisco* catalyses the carboxylation of RuBP (requires CO_2)
- This forms two 3C compounds called GP

Step 2: Reduction of GP

- GP is phosphorylated by ATP and reduced by NADPH
- This converts each GP molecule into a TP molecule

Step 3: Regeneration of RuBP

- One molecule of TP is used to form half a sugar *(two complete cycles are needed to form a glucose molecule)*
- The remaining TP molecules are used to reform RuBP



Lollipop Experiment

The light independent reactions were elucidated by Melvin Calvin (i.e. Calvin cycle) using a 'lollipop'-shaped apparatus

- Radioactive CO_2 was incorporated to identify the different carbon compounds *(involves chromatography and autoradiography)*