



## 1 Light Reactions

Occurs in the thylakoids in the chloroplasts.

Partial reaction:  $6\text{H}_2\text{O} \rightarrow 6\text{O}_2$

Sunlight excites electrons off chlorophylls near PSII. The electrons then travel through a proton pump, powering the transport of two protons ( $\text{H}^+$ ) into the thylakoid space. The electrons continue to PSI, where they are energized by sunlight again. The reenergized electrons are picked up by  $\text{NADP}^+$  (which becomes  $\text{NADPH}\cdot\text{H}^+$ ) and are carried away for use in the cell, such as in the Calvin cycle.

The electrons lost by the original chlorophyll are replaced from water. PSII catalyzes the breakdown of water into protons ( $\text{H}^+$ ) and oxygen gas, which is toxic to the plant. This process is called photolysis.

ATP is made when two protons diffuse through the ATP synthase from the inside of the thylakoids to the outside.

## 2 Calvin Cycle (or Light-Independent Reactions)

Occurs in the stroma of the chloroplast. Partial reaction:  $6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6$

Three carbon dioxide molecules are combined at great cost of ATP and  $\text{NADPH}\cdot\text{H}^+$  into half a glucose molecule. (Two cycles are needed to synthesize one glucose).

The enzyme Rubisco (ribulose biphosphate carboxylase) is the first enzyme in the reaction.