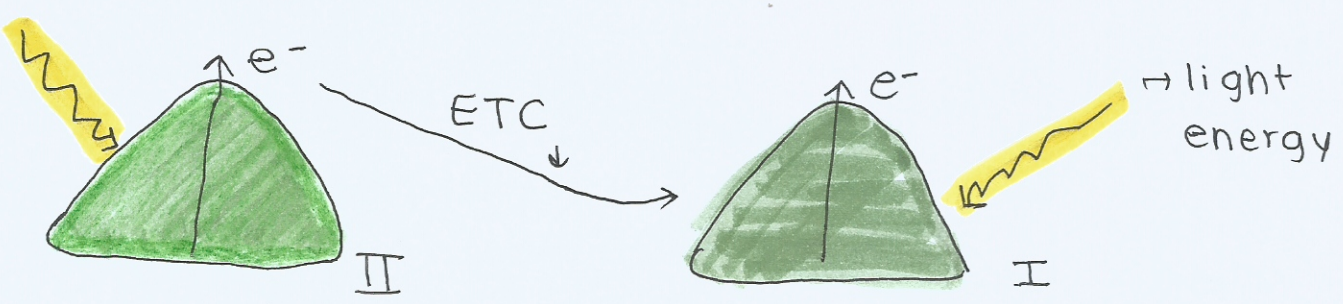
8.3 PHOTOSYNTHESIS

Location of light dependent reactions

- The light dependent reactions take place in the thylakoid space and across the thylakoid membranes.
- They increase the surface area for the reactions to occur.

Light dependent reaction

1. **Photoactivation** of pigment system II. The pigment molecules absorb light energy and boost the electrons in a molecule of chlorophyll to a higher energy level.
   These electrons are accepted by a carrier protein at the start of the electron transport chain.
2. The excited electrons from photo system II are passed through the chain and they lose energy. This is used to transport the H^+ ions in the thylakoid.
3. A proton gradient is created which serves as a store for potential energy.
4. The protons are transported back to the the stroma via the enzyme called ATP synthase. The energy released by the passage of protons down their gradient is used to catalyse the synthesis of ATP (ADP+ip). (chemiosmosis and photophosphorylation)



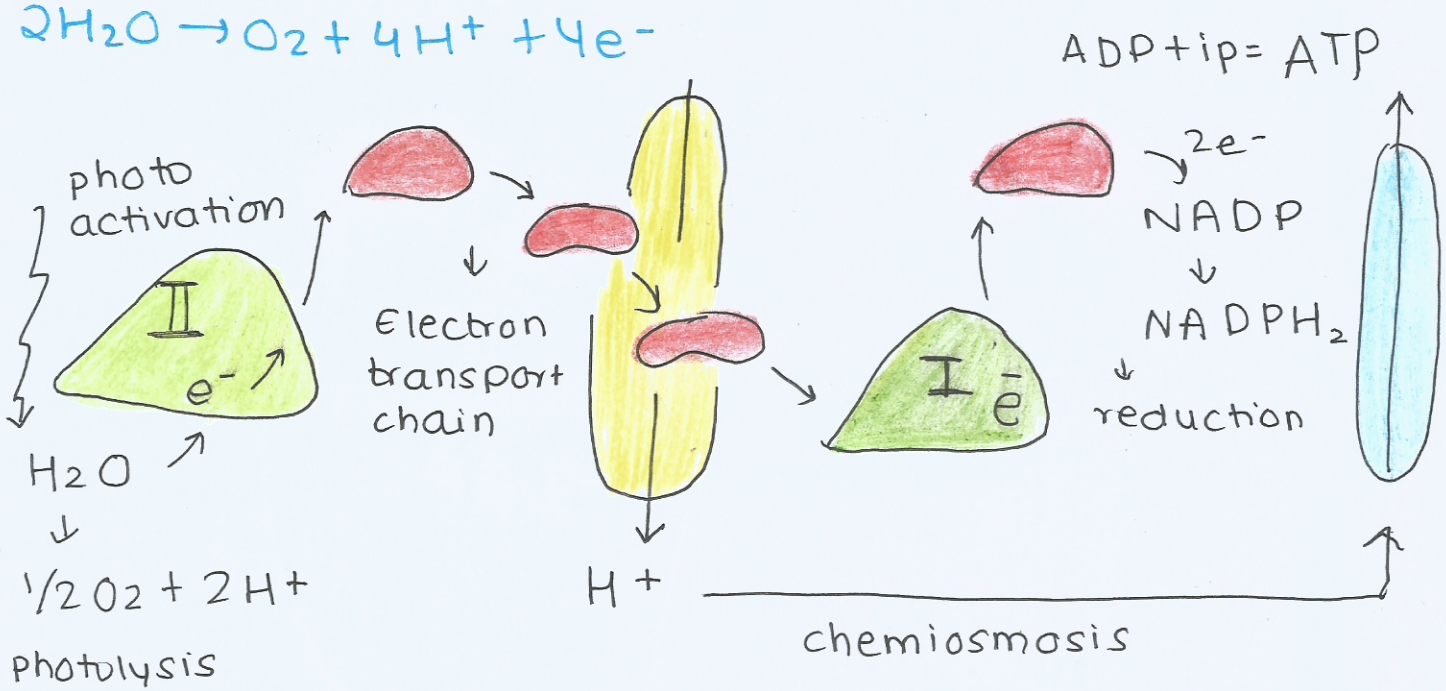
5. The excited electrons from photosystem I are transferred to a carrier molecule to reduce $NADP^+$ to form $NADPH_2$.

The electrons lost from photosystem I are replaced by the de-energized electrons from photosystem II.

6. The electrons lost from photosystem II are replaced by the electrons released from water.

Photolysis occurs where water is split into H^+ ions that are used in chemiosmosis and releases oxygen as a by-product.

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



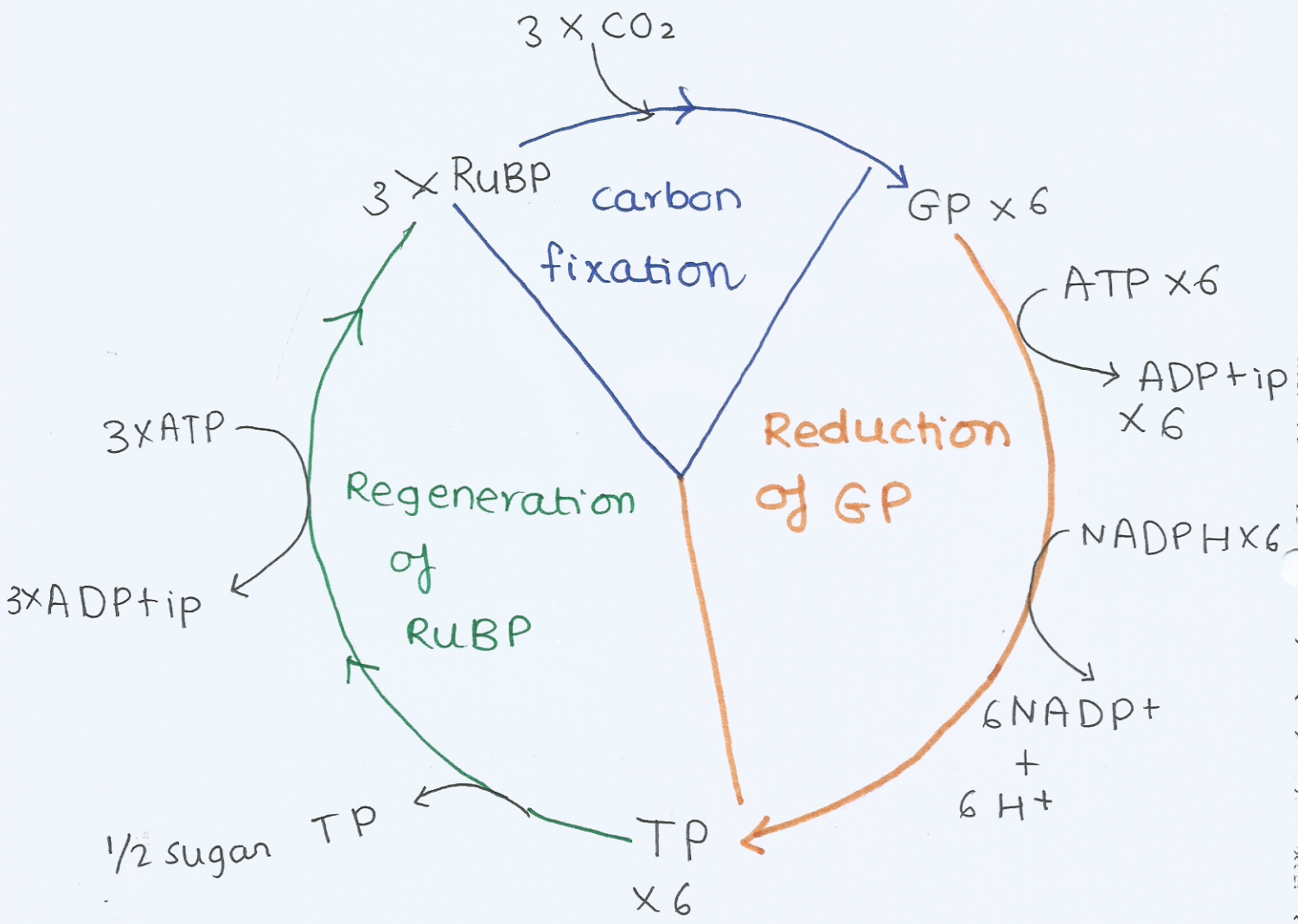
- Overview of light dependent reaction.

Light independent reaction:

They use chemical energy derived from light dependent reaction to form organic molecules.

The reactions are collectively known as the calvin cycle.
It consists of:-

- Carboxylation of RuBP
- Reduction of glycerate-3-phosphate
- Regeneration of ribulose biphosphate



, Overview of calvin cycle.

1. Carbon fixation:

- The 5-C compound ribulose biphosphate combines with CO_2 to form glycerate-3-phosphate. It is catalysed by an enzyme called rubisco.

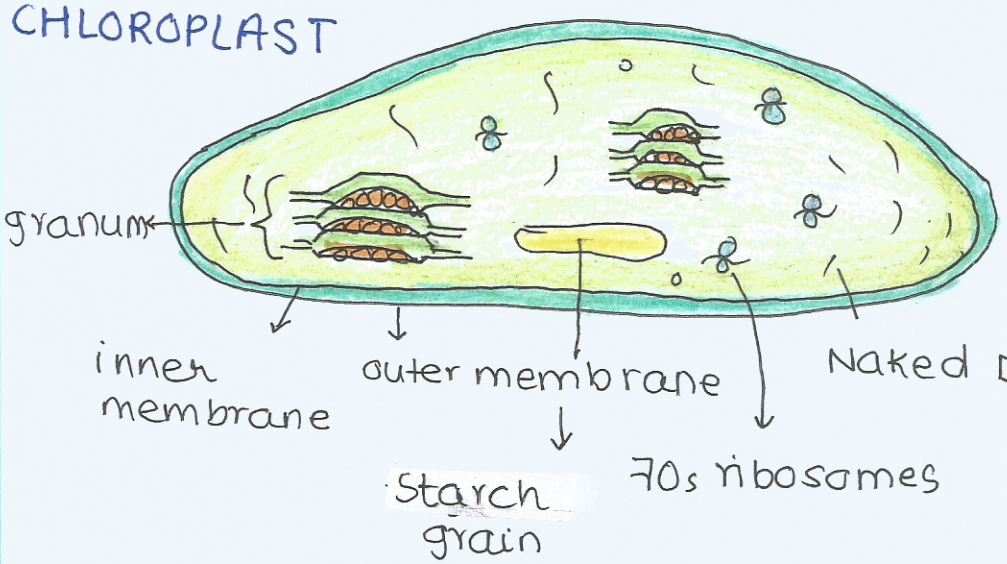
2. Reduction of glycerate-3-phosphate:

- ATP and NADPH + H^+ from the light dependent reaction convert the GP into triose phosphate by reduction of G.P.

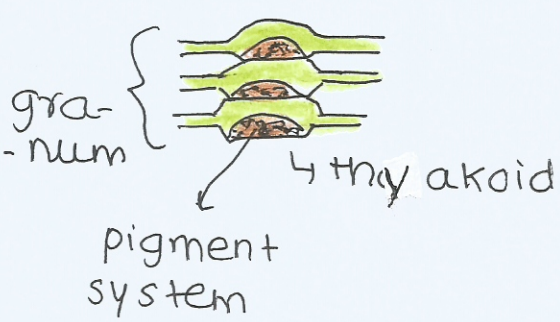
3. Regeneration of RuBP:

- Triose phosphate is produced but only 5 molecules are needed to form RuBP again for the Calvin cycle to continue. It also produces carbohydrates (the 1 molecule of TP left).

CHLOROPLAST



STRUCTURE AND FUNCTION



Functions:

- Stroma: Has the appropriate pH & enzymes
- thylakoid: Has the electron transport chain and ATP synthase for photophosphorylation.
- granum: They increase the SA:Volume ratio and small internal volumes quickly accumulate ions.
- photosystems: pigments in the thylakoid membrane to maximise light absorption.