LIFE SCIENCES 11
PHOTOSYNTHESIS

Learning Outcomes

- **I can identify the organelle responsible for photosynthesis and describe its composition.**
- **I can write the chemical equation for photosynthesis.**
- **I can describe the two parts of photosynthesis and identify where in the chloroplast each occurs**

- the transformation of solar energy into the chemical energy of carbohydrates
- two types of pigments used to absorb light energy
  - chlorophyll a and b
    - green coloured pigment
    - absorb violet, blue and red
  - carotenoids
    - yellow and orange pigments
    - absorb light in the violet-blue-green range

Chloroplasts

- structure responsible for photosynthesis
- double-membrane organelle
- chlorophyll contained in the thylakoids → flattened sacs that found within a chloroplast that can form stacks (called granum)
- thylakoids located in the central space inside a chloroplast called the stroma
  - stroma contains an enzyme-rich solution that produces glucose
  - glucose can be stored in plants as starch

Photosynthesis

$$CO_2 + H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + O_2$$

1. Light-Dependent Reaction (1st Stage)
   - solar capture step
   - chlorophyll used to absorb light energy to energize electrons
   - takes place in the thylakoids

- Photosystem II
  - light energy used to split a water molecule

    $H_2O \rightarrow 2\ H^+ + 2\ e^- + ½\ O_2$

    - H+ ions stay in the thylakoid space
  - electron carried by electron carrier molecules in membrane of thylakoid releasing energy
    - energy used to move H+ from stroma into the thylakoid space
    - creates a higher concentration of H+ inside the thylakoid
    - as H+ move out of thylakoid through a membrane protein, ADP is converted into ATP

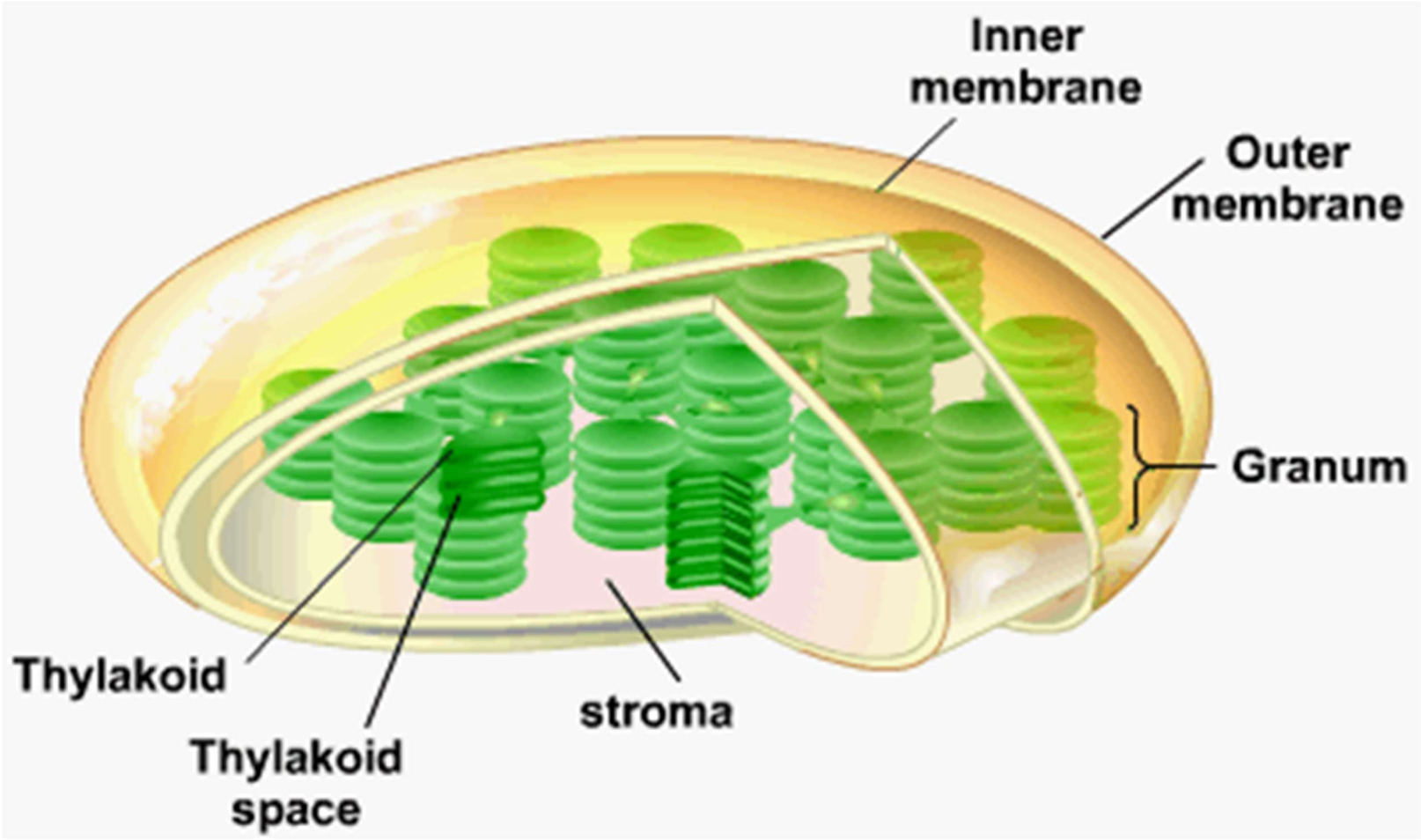
      $ADP + P \rightarrow ATP$

- Photosystem I
  - electron is reenergized and transported by another series of electron carrier molecules
  - electron is used to attach a H+ from the stroma to NADP+ to make NADPH

    $NADP^+ + H^+ + 2\ e^- \rightarrow NADPH$

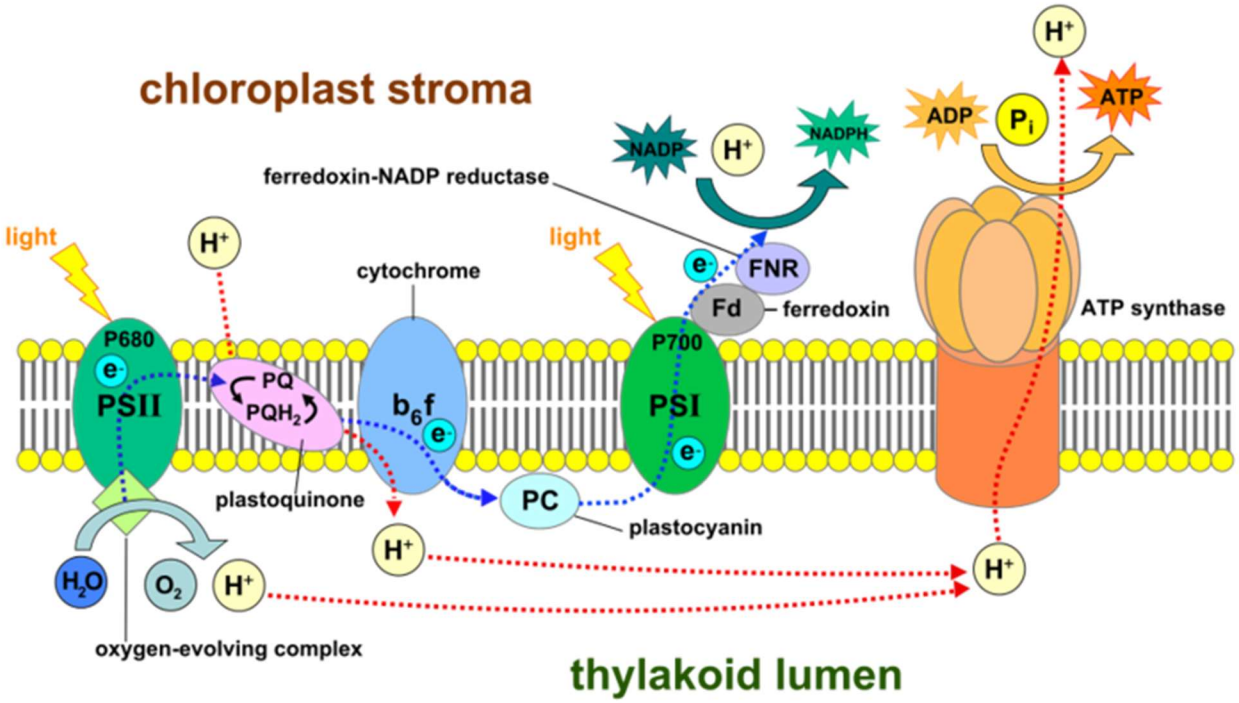
2. Calvin Cycle (2nd Stage)
   - called synthesis step
   - light-independent reaction because it does not require light
   - CO_2 taken up by a 5-carbon sugar to produce a 6-carbon molecule
   - 6-carbon molecule breaks down to from two 3-carbon molecules that are then used to produce one glucose molecule ($C_6H_{12}O_6$)
   - requires energy that is supplied by the ATP and NADPH from the light-dependent reactions

CHLOROPLASTS

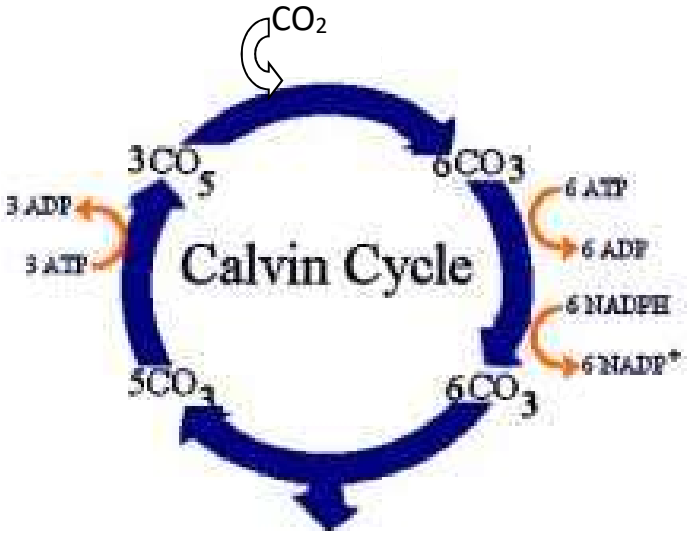


LIGHT REACTIONS

Photosystem II and I



Calvin Cycle



$C_6H_{12}O_6$

Photosystems & Calvin Cycle