9.2 - Photosynthesis: An Overview

Essential Questions:

What is the overall equation for photosynthesis?

What is the role of light and chlorophyll in photosynthesis?

Learning Objectives

- Explain the role of pigments in the process of photosynthesis.
- Describe the role of electron carrier molecules.
- Identify the reactants and products of photosynthesis.

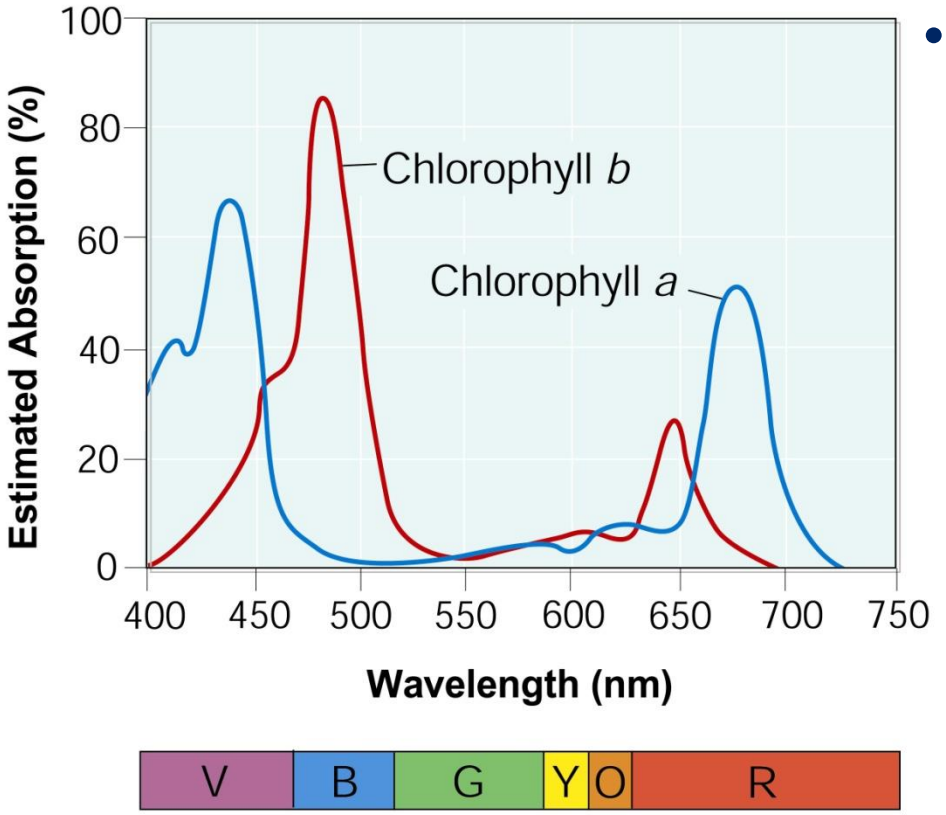
- The key cellular process identified with energy production is **photosynthesis**.

- Photosynthesis is the process in which green plants use the energy of sunlight to convert water and carbon dioxide into high-energy carbohydrates and oxygen.

Chlorophyll and Chloroplasts

- Light energy from the sun must be captured for photosynthesis to occur.
- Sunlight is "white" light—actually a mixture of different wavelengths.
- Photosynthetic organisms capture energy from sunlight with light-absorbing molecules called pigments.
    - The main pigment in plants is **chlorophyll.**
    - There are two main types of chlorophyll:
        - chlorophyll *a*
        - chlorophyll *b*

- Chlorophyll absorbs light well in the blue-violet and red regions of the visible light spectrum.



- Chlorophyll does not absorb light within the green region of the spectrum. Green light is reflected by leaves, which is why plants look green.

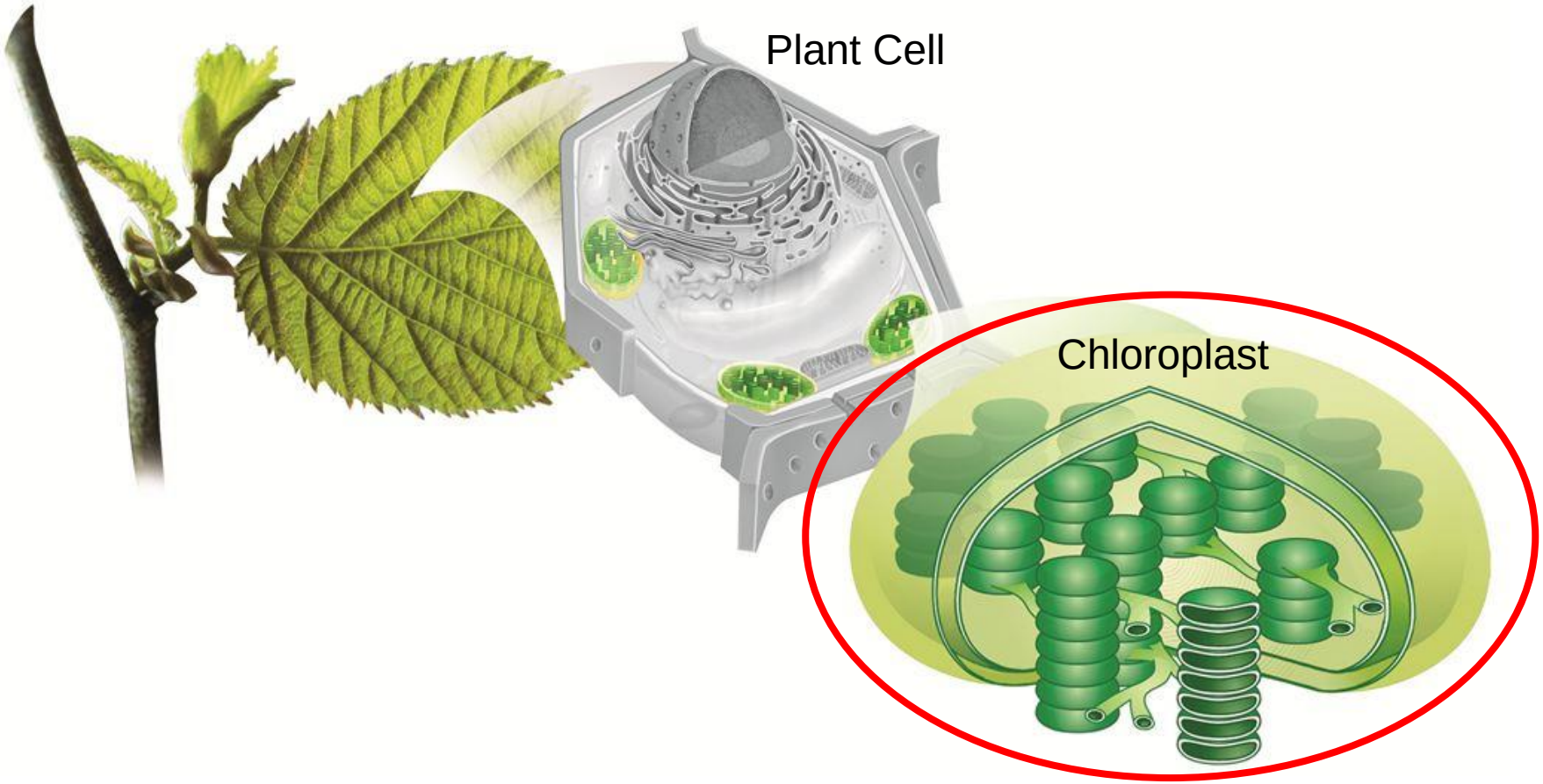
- Light is a form of energy, so any compound that absorbs light also absorbs energy from that light.

- When chlorophyll absorbs light, much of the energy is transferred directly to electrons in the chlorophyll molecule, raising the energy levels of these electrons.

- These high-energy electrons are what make photosynthesis work.

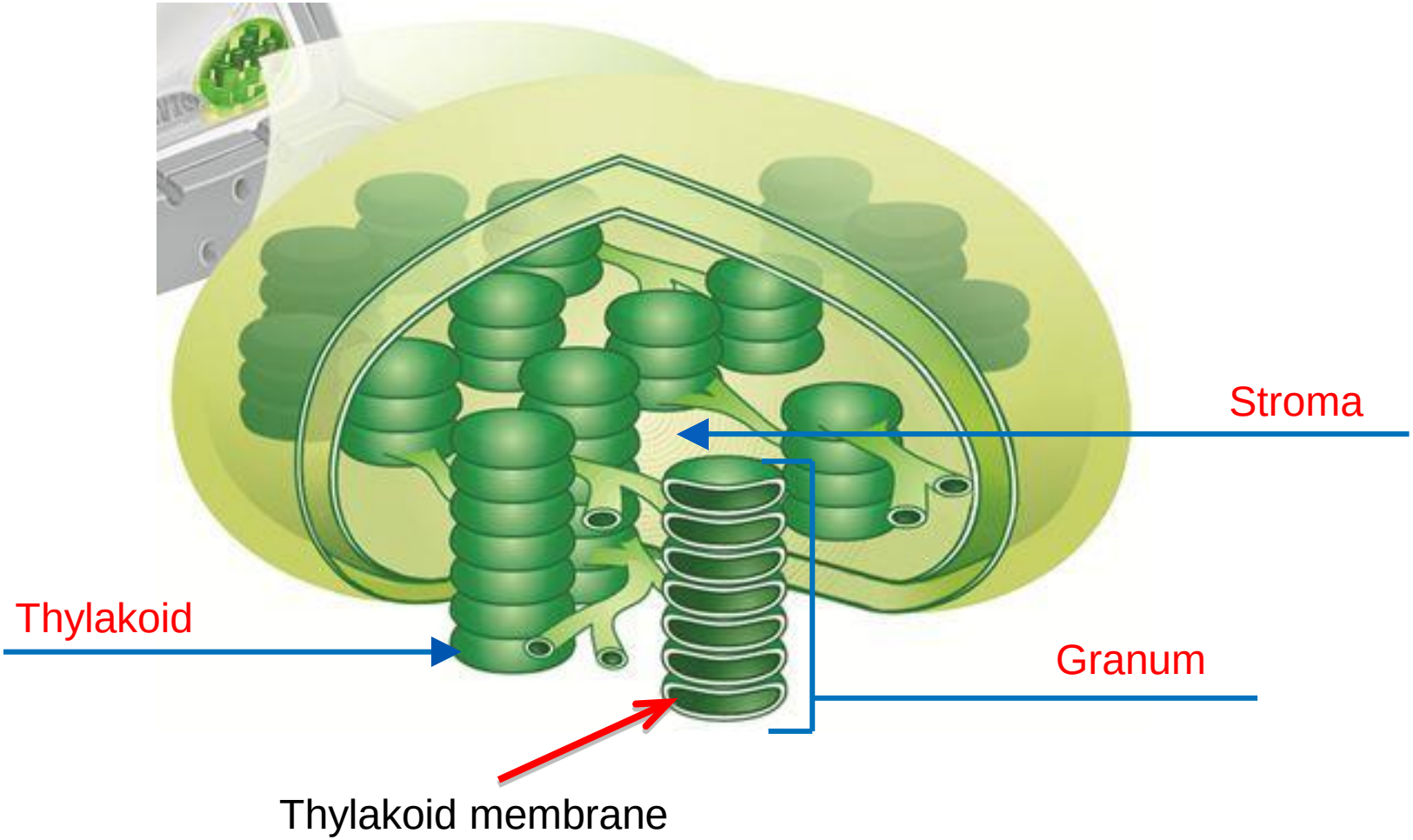
Chloroplasts

Photosynthesis takes place inside organelles called chloroplasts.



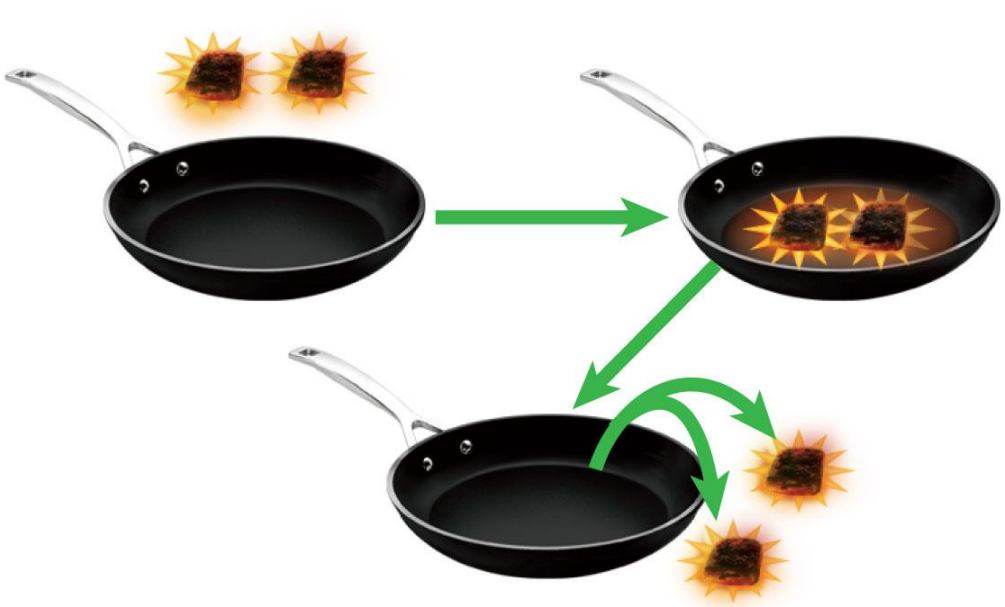
Chloroplast Structure

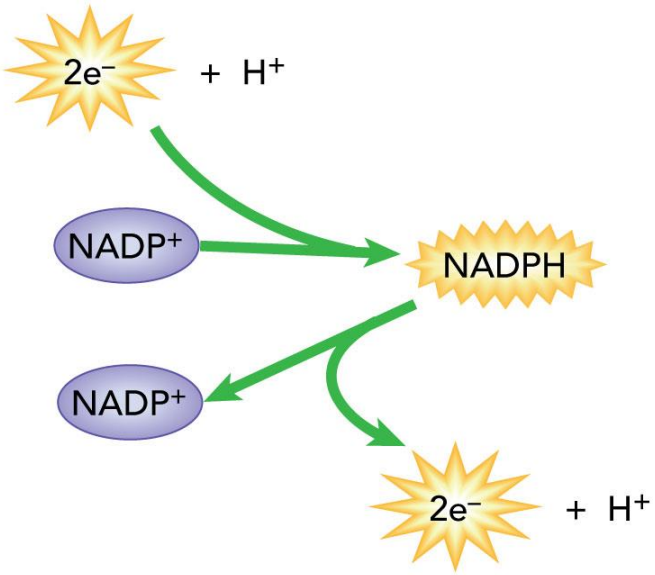
In plants, photosynthesis takes place inside chloroplasts.



Electron Carriers

The high-energy electrons produced by chlorophyll are highly reactive and require a special “carrier.”





Electron Carrier

- An electron carrier is a compound that can accept a pair of high-energy electrons and transfer them, along with most of their energy, to another molecule.

- NADPH can carry the high-energy electrons that were produced by light absorption in chlorophyll to chemical reactions elsewhere in the cell.

An Overview of Photosynthesis

Photosynthesis uses the energy of sunlight to convert water and carbon dioxide (low-energy reactants) into high-energy sugars and oxygen (products).

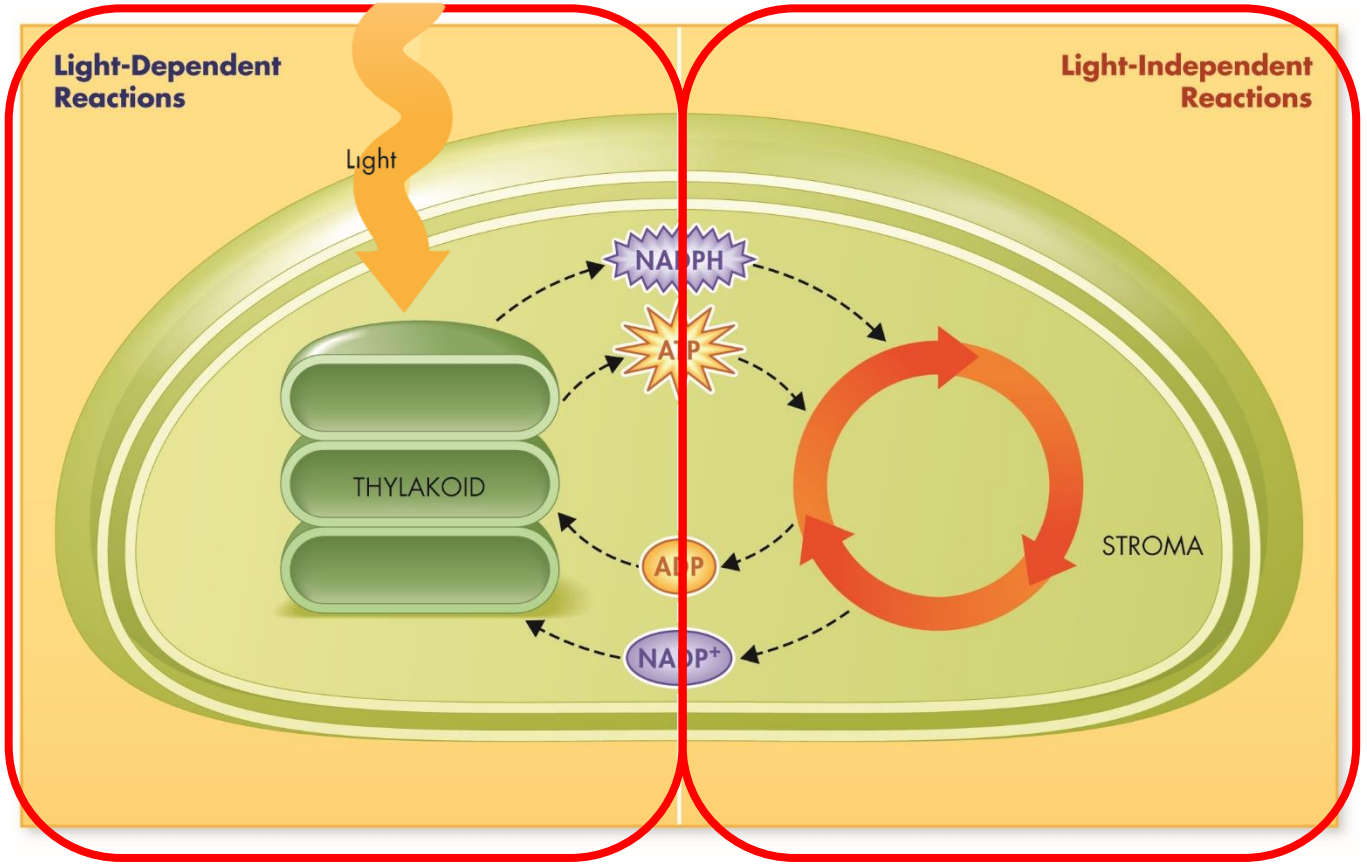
$$\text{Carbon dioxide} + \text{Water} \xrightarrow{\text{light}} \text{Sugars} + \text{Oxygen}$$

$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

Photosynthesis and Light

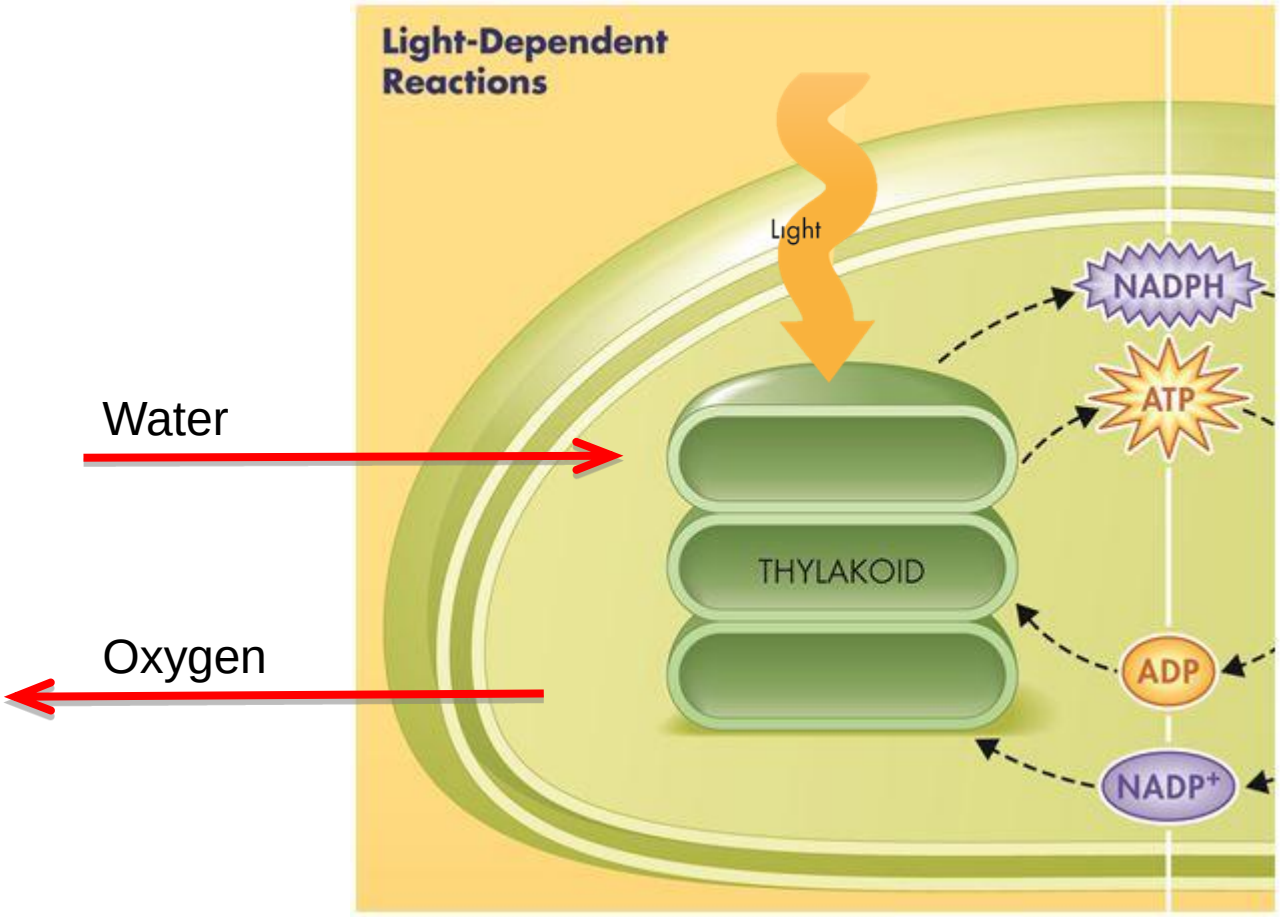
Photosynthesis involves two sets of reactions:

- Light-dependent reactions
- Light-independent reactions



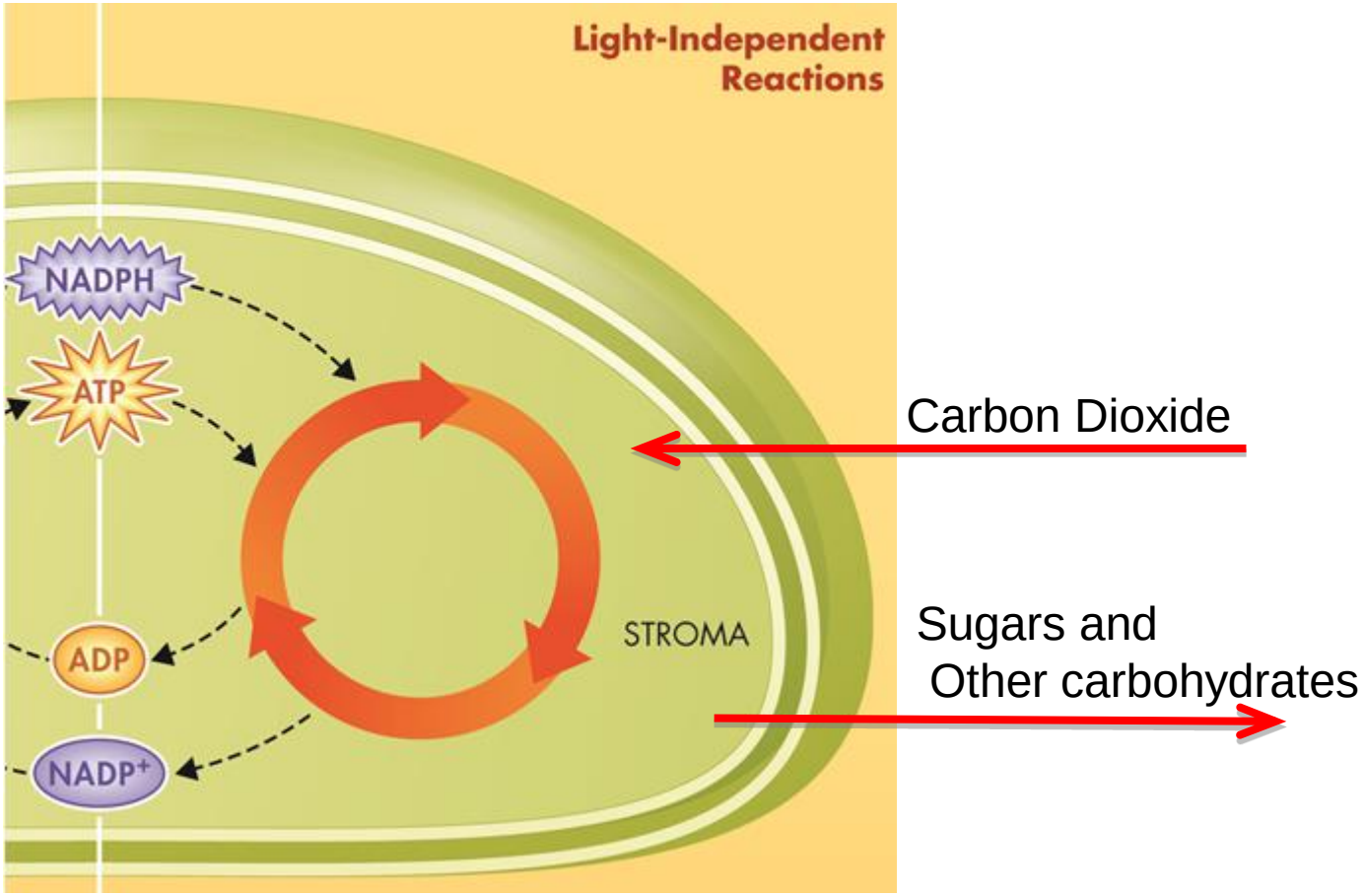
Light-Dependent Reactions

Light-dependent reactions require the direct involvement of light and light-absorbing pigments.



Light-Independent Reactions

Light-independent reactions use ATP and NADPH molecules produced in the light-dependent reactions to produce high-energy sugars from carbon dioxide



Interdependence of Reactions

Light-dependent and light-independent reactions have an interdependent relationship.