Plant cell, Photosynthesis, and Ecological biology

405 Biochem

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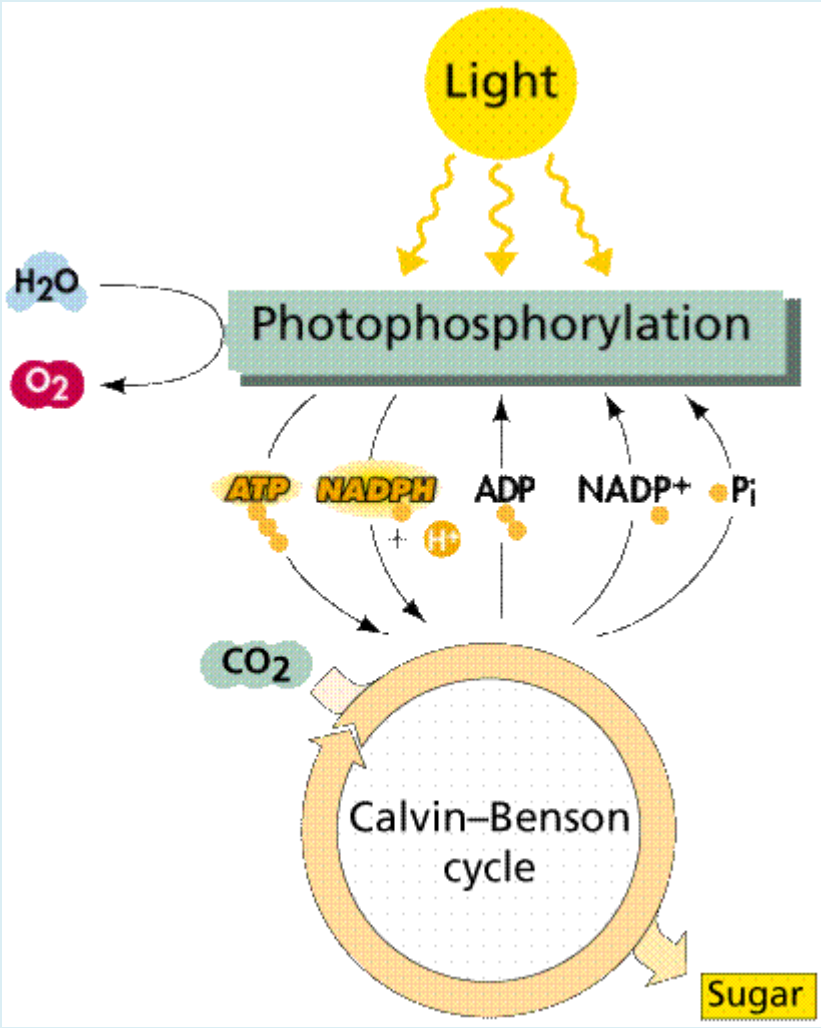
Stages of Photosynthesis

- **Photosynthesis consists of two processes**

(1)The light reactions (photolysis)

(2)The dark reactions

(Calvin cycle)



PHOTOSYNTHESIS

Light reactions

Light needed to produce organic energy molecules ATP and NADPH

Dark reactions

No light needed. Instead, DarK reactions use ATP and NADPH to produce energy mlecules

Stages of Photosynthesis

(1)The light reactions (photolysis)

- **Sunlight is a mixture of different wavelengths of light**
- **Each wavelength has a particular color and amount of energy**
- **Light reaction in photosynthesis occurs in the thylakoids (in the grana) found in chloroplasts.** So, it requires the direct energy of light to make energy carrier molecules (ATP and NADPH) that are used in the dark reactions**.**
- **The light reactions can be summarized as follows:**

1. Light energy strikes chlorophyll bodies, and electrons are excited
2. Electrons are accepted by NADP in the electron transport chain
3. Light hits a second chlorophyll molecule and splits the water molecule into hydrogen and oxygen. Oxygen is released into the atmosphere and hydrogen ions are carried by the electron transport chain
4. Energy is generated with the formation of ATP.

Stages of Photosynthesis

(1)The light reactions (photolysis)

Therefore,

the light reactions results in the production of:

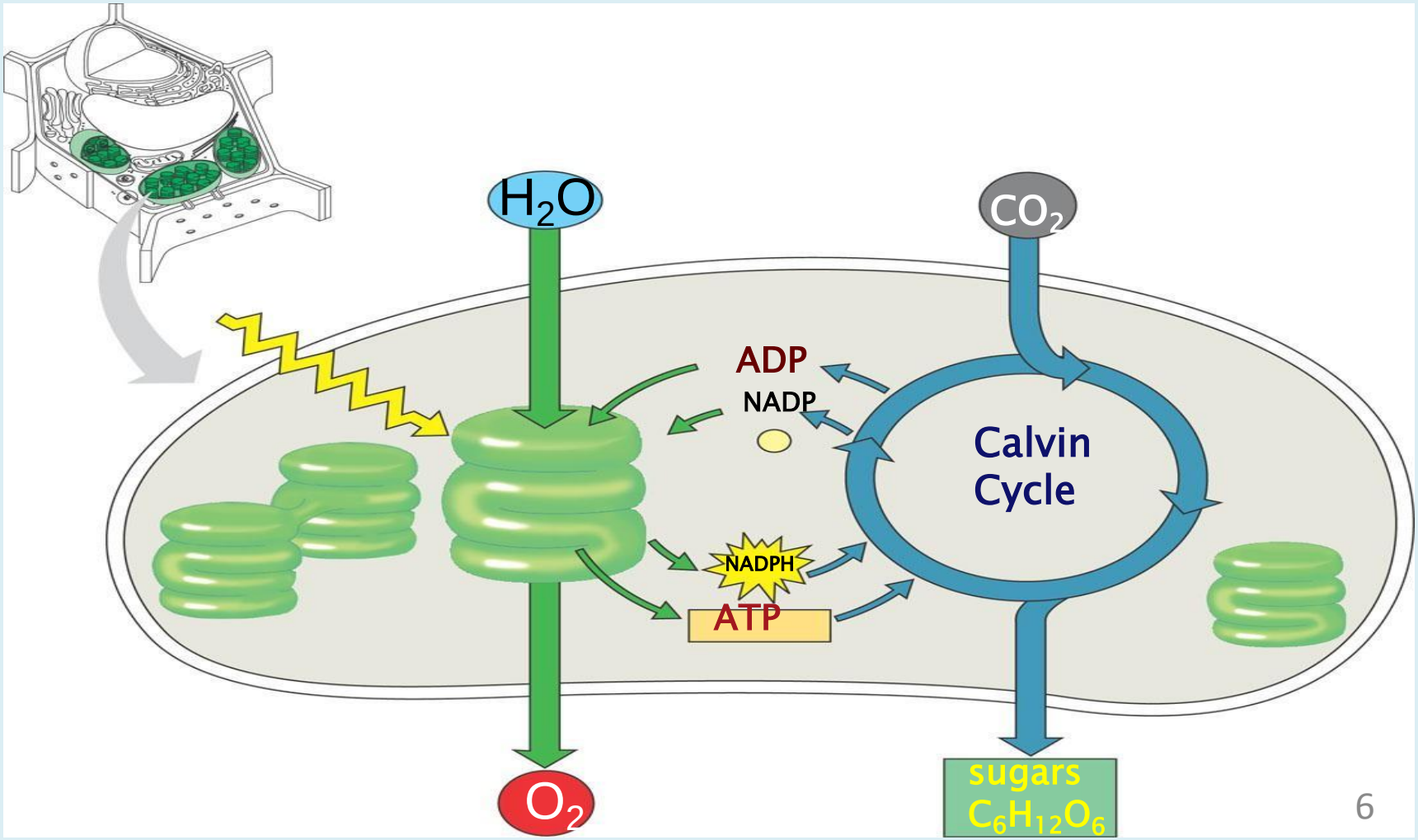
a) ATP, a high-energy molecule, and NADPH for use in the dark-reactions; and

b) Oxygen, which is released into the atmosphere

As illustrated in the following figure:

- Overall reactions of photosynthesis can be summarized as :

$$6\ CO_2 + 6\ H_2O + \text{Light energy} \rightarrow C_6H_{12}O_6 + 6\ O_2$$



Stages of Photosynthesis

- **Photosynthesis consists of two processes**

During the light reaction, there are two possible routes for electron flow (photophosphorylation):

a. **Cyclic Electron Flow (Cyclic photophosphorylation)**
b. **Noncyclic Electron Flow (Noncyclic photophosphorylation)**

Photophosphorylation is the process of converting energy from a light-excited electron into the pyrophosphate bond of an ADP molecule.

Stages of Photosynthesis

Photosystems

- Photosystems are arrangements of chlorophyll and other accessory pigments packed into thylakoids.

- Many Prokaryotes have only one photosystem, Photosystem II (so numbered because, while it was most likely the first to evolve, it was the second one discovered).

- Eukaryotes have Photosystem II plus Photosystem I.

- Photosystem I uses chlorophyll a, in the form referred to as P700. Photosystem II uses a form of chlorophyll a known as P680. Both "**active**" forms of chlorophyll a **''reaction centers''** function in photosynthesis due to their association with proteins in the thylakoid membrane.

Cyclic Electron Flow (Cyclic photophosphorylation)

- Uses Photosystem I only
- P700 reaction center of chlorophyll a
- Uses Electron Transport Chain (ETC)
- Generates ATP only

$ADP + Pi \rightarrow ATP$

Noncyclic Electron Flow

- Uses Photosystem I & II
- P700 & P680 reaction centers of chlorophyll a
- Uses Electron Transport Chain (ETC)
- Generates:

$ADP + Pi \rightarrow ATP$

$NADP^+ + H \rightarrow NADPH$

Oxygen comes from the splitting of H_2O,

$H_2O \rightarrow 1/2\ O_2 + 2H^+$