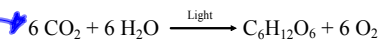


Photosynthesis

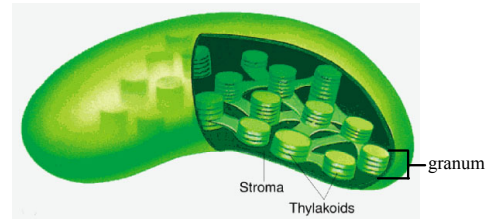
- the process in which light energy is converted into chemical energy in plants



- takes place in 2 phases

- light reactions → *light dependent*
- the Calvin cycle → *light independent, Dark reactions*

Chloroplasts



Thylakoids - flattened sac-like membranes that are arranged in stacks

Grana - stacks of thylakoids

Stroma - fluid filled space outside the grana

Pigments called Chlorophyll are located in the thylakoids that absorb light

- chlorophyll a
- chlorophyll b

- absorb most strongly in the violet-blue range of the spectrum so they reflect green very strongly

Also have other pigments such as Carotenoids which have a red / orange color

Phase one : Light dependent reactions

- take place in the thylakoids of the chloroplasts

- light is captured by the chlorophyll and this starts the electron transport chain

NEED LIGHT

Electron Transport *Light reaction*

- Photosystem I → protein complexes that contain light-absorbing pigments

- Photosystem II

- Ferredoxin - protein that is the final electron acceptor in the chain *chain ends here*

- NADP⁺ - electron carrier

- NADPH - energy storage molecule



1. light energy excites electrons in photosystem II. It also splits a water molecule releasing an electron into the electron transport

- ② - a H^+ ion (proton) is released into the thylakoid space
- ③ - O_2 is released as a waste product

* BREAKDOWN OF WATER IS EXTREMELY IMPORTANT *

2. The excited electrons move from photosystem II to an electron acceptor in the thylakoid membrane

3. The electron-acceptor molecule passes the electrons along a series of electron carriers to photosystem I

4. In the presence of light, photosystem I passes the electrons to a protein called FERRODOXIN.

5. Ferredoxin transfers the electrons to a carrier called NADP⁺ causing the formation of NADPH (an energy storage molecule)



Chemiosmosis

- The mechanism by which ATP is produced as a result of the flow of electrons down a concentration gradient
- The breakdown of water causes H^+ ions to accumulate in the thylakoid space.
- There is a high concentration of H^+ in the thylakoid space and a low concentration of H^+ in the stroma
- H^+ move out to the stroma through an enzyme called ATP Synthase. As the H^+ moves through these channels **ATP is produced**

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http://glencoe.mcgraw-hill.com/sites/0078695104/student_view0/unit2/chapter8/concepts_in_motion.html#

Phase two : Calvin Cycle

- takes place in the stroma **Dark reactions**
- also called the light independent reactions **produce**
- energy is stored in organic molecules such as glucose

Step 1 = called carbon fixation

- 6 CO_2 molecules combine with six 5-carbon compounds to form 12 3-carbon molecules **$CO_2 \rightarrow 3\text{-PGA}$**
called 3-phosphoglycerate or 3-PGA

Step 2 =

- chemical energy stored as ATP and NADPH (from step 1) is transferred to the 3-PGA molecules to form high energy molecules called glyceraldehyde 3-phosphates (G3P) **$3\text{-PGA} \rightarrow G3P$**

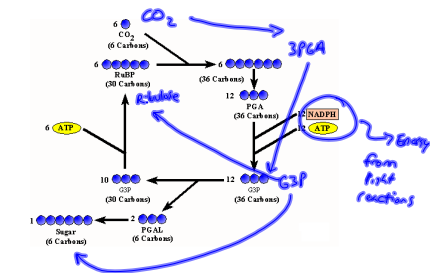
Step 3 =

- 2 G3P leave the cycle to be used for glucose production **$G3P \rightarrow \text{glucose}$**

Step 4 =

- An enzyme called RUBISCO converts remaining G3P molecules into 5-carbon molecules called RIBULOSE (RuBP)
- the RuBP molecules combine with more CO_2 to start the cycle over again **$G3P \xrightarrow{\text{RUBISCO}} \text{R:ubulose}$**

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Alternative Pathways

- Environments where the amount of water and/or carbon dioxide is low can affect the ability of a plant to successfully complete photosynthesis

- This calls for alternative ways to gather energy

C₄ Plants

- occurs in plants such as sugar and corn
- fix CO_2 into 4-carbon molecules instead of 3-carbon molecules during the Calvin cycle

CAM Plants

- Crassulacean acid metabolism
- occurs in water conserving plants that live in the desert, salt marshes, or other environments where water is limited
- Allow CO_2 to enter leaves at night, when the atmosphere is cooler and more humid
- CO_2 is fixed in organic compounds and released to the Calvin cycle during the day

Photosynthesis takes place in the....

- A. mitochondria
- B. cell wall
- C. vacuole
- D. chloroplast

What is the pigment that makes plants green?

- A. carotenoids
- B. chlorophyll
- C. iodine
- D. crayons

This is the first step in the light reactions (electron transport chain)

- A. In the presence of light, photosystem I accepts an electron as H_2O is broken down
- B. Ferredoxin accepts an electron
- C. $NADP^+$ accepts an electron to create NADPH
- D. In the presence of light, photosystem II accepts an electron as H_2O is broken down

This is the second step in the light reactions (electron transport chain)

- A. In the presence of light, photosystem I accepts an electron
- B. Ferredoxin accepts an electron
- C. $NADP^+$ accepts an electron to create NADPH
- D. In the presence of light, photosystem II accepts an electron as H_2O is broken down

This is the final electron acceptor in the electron transport chain

- A. NAD^+
- B. photosystem I
- C. photosystem II
- D. ferredoxin

This is an energy storing molecule that results from the light reactions

- A. NADPH
- B. H^+
- C. $NADP^+$
- D. H_2O

The disc shaped parts in the chloroplasts are called....

- A. grana
- B. stroma
- C. thylakoids
- D. chlorophyll

A stack of thylakoids is called a....

- A. stroma
- B. grana
- C. chloroplast
- D. mitochondria

What is the enzyme that H^+ ions diffuse through to make ATP?

What is the equation for photosynthesis?