

A Summary of the Two Parts of Photosynthesis

Photosynthesis takes place in two stages: the light-dependent reactions and the Calvin cycle (Figure 7.9). The **light-dependent reactions** take place in the thylakoid membrane, where chlorophyll absorbs light energy and then converts it into chemical energy with the help of water. In the light-dependent reactions water is broken down, and oxygen is released as a byproduct. The Calvin cycle takes place in the stroma. During the **Calvin cycle**, the chemical energy produced in the light-dependent reactions drives the synthesis of sugar molecules from carbon dioxide. The two reactions use carrier molecules to transport the energy from one stage to another. The carriers, NADPH and ATP, move energy from the light-dependent reactions to the Calvin cycle. NADP⁺ is an electron carrier similar to NAD⁺, which is used in aerobic cellular respiration.

NADPH and ATP can be thought of as being “full” because they bring energy produced in the light-dependent reactions to the Calvin cycle. After the energy is released, the “empty” energy carriers, NADP⁺ and ADP + P_i, return to the light-dependent reactions to obtain more energy (Figure 7.9).

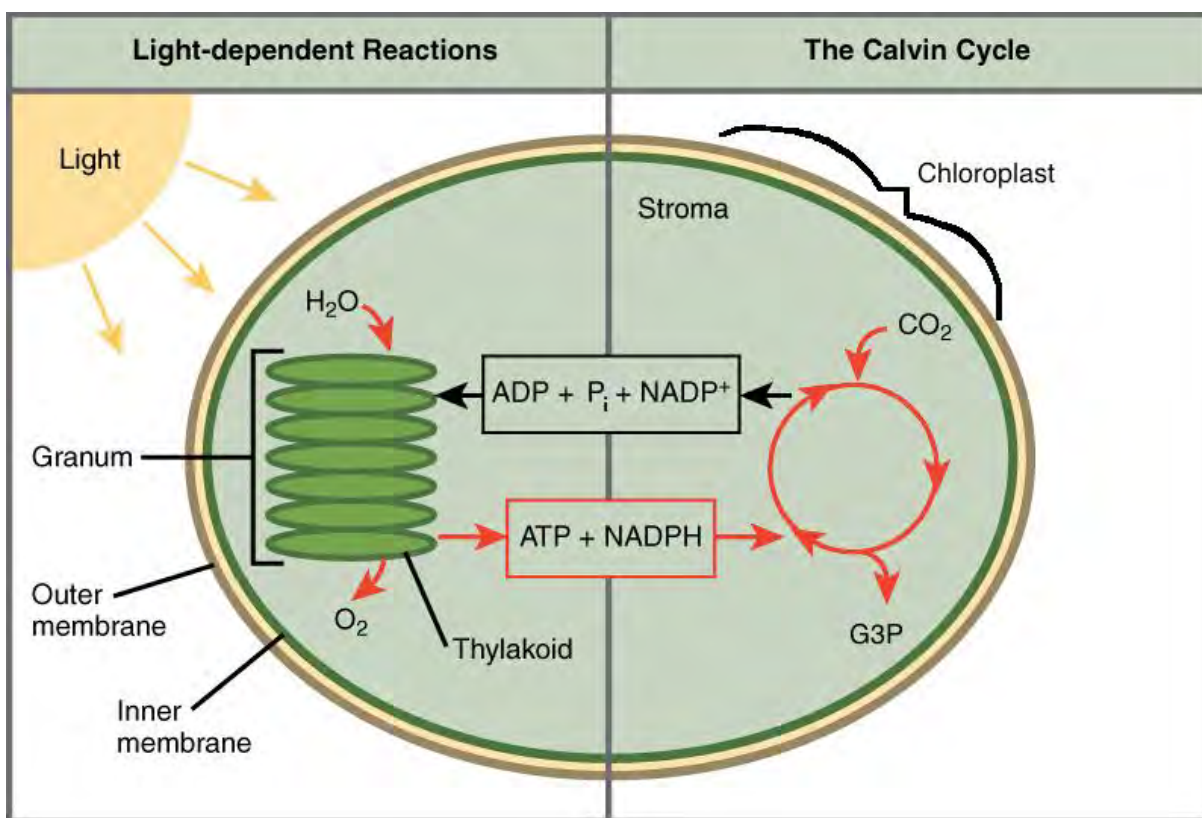


Figure 7.9 Photosynthesis takes place in two stages: light-dependent reactions and the Calvin cycle. (credit: Kahn Academy / original work by Clark et al. / [Biology 2E OpenStax](https://openstax.org/))

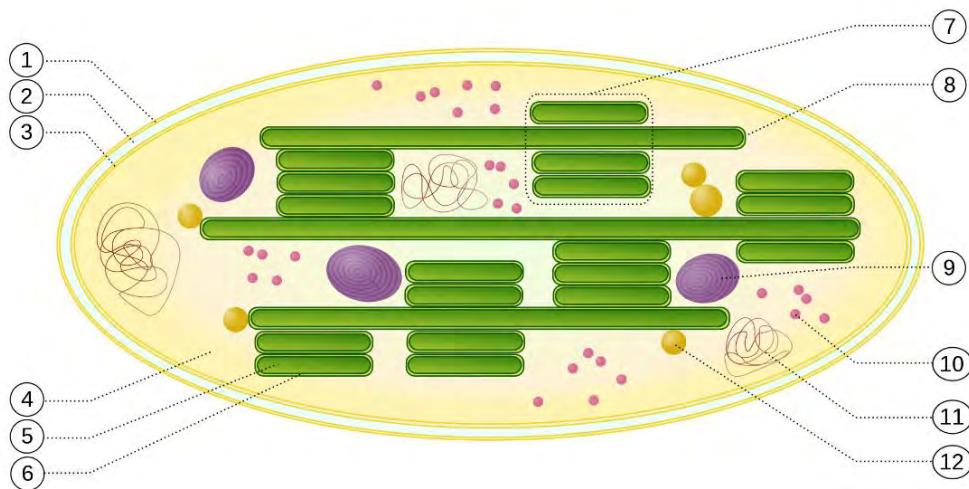
CONCEPTS IN ACTION - Click the [link](#) to learn more about photosynthesis.

Section Summary

The process of photosynthesis transformed life on earth. By harnessing energy from the sun, photosynthesis allows living things to access enormous amounts of energy. Only autotrophs can perform photosynthesis. These organisms require pigments, such as chlorophyll, to absorb light and convert it into chemical energy. Photosynthesis uses light energy, carbon dioxide, and water to synthesize carbohydrates, such as glucose, and releases oxygen. Eukaryotic autotrophs, such as plants and algae, have organelles called chloroplasts in which photosynthesis takes place.

Exercises

1. On a hot, dry day, plants close their stomata to conserve water. What impact will this have on photosynthesis?
2. What two products result from photosynthesis?
 - a. water and carbon dioxide
 - b. water and oxygen
 - c. glucose and oxygen
 - d. glucose and carbon dioxide
3. Which statement about thylakoids in eukaryotes is *not* correct?
 - a. Thylakoids are assembled into stacks.
 - b. Thylakoids lack membranes.
 - c. The space surrounding thylakoids is called stroma.
 - d. Thylakoids contain pigments such as chlorophyll.
4. Heterotrophs directly obtain their energy from:
 - a. the sun
 - b. the sun and eating other organisms
 - c. eating other organisms
 - d. consuming water
5. Why are carnivores, such as lions, dependent on photosynthesis to survive?
6. Label the following diagram.



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Answers

1. Levels of carbon dioxide (a reactant) will fall, and levels of oxygen (a product) will rise. As a result, the rate of photosynthesis will slow down.
2. (c)
3. (b)
4. (c)
5. Because lions eat animals that eat plants.
6.

1. outer membrane	5. thylakoid lumen (inside	9. starch
2. intermembrane space	of thylakoid)	10. ribosome
3. inner membrane	6. thylakoid membrane	11. plastid DNA
4. stroma (aqueous fluid)	7. granum (stack of	12. drops of lipids
	thylakoids)	
	8. thylakoid	

Glossary

Calvin cycle: the second stage of photosynthesis where chemical energy produced in the light-dependent reactions drives the synthesis of sugar molecules

chemoautotrophs: an organism capable of producing its own food by extracting energy from inorganic chemical compounds

chlorophyll: the green pigment that captures the light energy that drives the reactions of photosynthesis

chloroplast: the organelle where photosynthesis takes place

granum: a stack of thylakoids located inside a chloroplast

guard cells: specialized plant cells that control the opening and closing of the stomata

heterotroph: an organism that consumes other organisms for food

light-dependent reaction: the first stage of photosynthesis where visible light is absorbed to form two energy-carrying molecules (ATP and NADPH)

mesophyll: the middle layer of cells in a leaf

photoautotroph: an organism capable of synthesizing its own food molecules (storing energy), using the energy of light

photosynthesis: a multi-step chemical reaction that requires light energy, carbon dioxide, and water and produces sugar and oxygen

pigment: a molecule that is capable of absorbing light energy

stoma: the opening that regulates gas exchange and water regulation between leaves and the environment; plural: stomata

stroma: the fluid-filled space surrounding the grana inside a chloroplast where the Calvin cycle reactions of photosynthesis take place

thylakoid: a disc-shaped membranous structure inside a chloroplast where the light-dependent reactions of photosynthesis take place using chlorophyll embedded in the membranes