

8.1 Energy and Life

Chemical Energy and ATP

Energy is the ability to do work. Organisms need energy to stay alive.

- ▶ _____ is a chemical compound cells use to store and release energy.
 - An ATP molecule consists of _____, the sugar ribose, and three phosphate groups.
 - Cells store energy by adding a phosphate group to adenosine _____ (ADP) molecules.
 - Cells release energy from ATP molecules by _____ a phosphate group.
- ▶ Energy provided by ATP is used in _____, to contract muscles, to make proteins, and in many other ways.
- ▶ Cells contain only a small amount of ATP at any one time. They regenerate it from ADP as they need it, using energy stored in food.

Heterotrophs and Autotrophs

The energy to make ATP from ADP comes from food. Organisms get food in one of two ways.

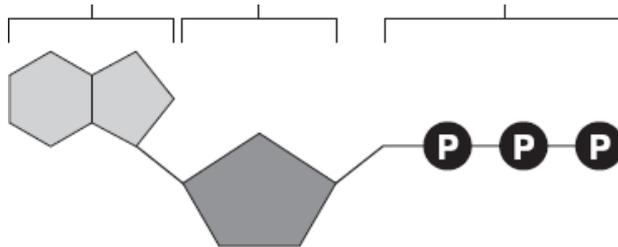
- ▶ _____ get food by consuming (eating) other organisms.
- ▶ _____ use the energy in sunlight to make their own food.
- ▶ _____ is the process that uses light energy to produce food molecules.

Chemical Energy and ATP

For Questions 1–6, complete each statement by writing the correct word or words.

1. _____ is the ability to do work.
2. The main chemical compound cells use for energy is _____ (ATP).
3. _____ is a 5-carbon sugar molecule that is part of an ATP molecule.
4. The _____ of ATP are the key to its ability to store and supply energy.
5. ATP releases energy when it bonds between its phosphate groups.
6. Most cells only store enough ATP for _____ of activity.

7. Label each part of the diagram of an ATP molecule below.



Heterotrophs and Autotrophs

For Questions 13–17, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 13. All heterotrophs must eat food to get energy.
- _____ 14. Autotrophs do not need to eat food because they make food.
- _____ 15. The energy in food originally came from ATP.
- _____ 16. The term photosynthesis means "pulling apart with light" in Greek.
- _____ 17. The energy of sunlight is stored in the chemical bonds of carbohydrates.

8.2 Photosynthesis: An Overview

Chlorophyll and Chloroplasts

In eukaryotes, photosynthesis occurs in organelles called chloroplasts. Chloroplasts house light-absorbing chemicals.

- ▶ Light is a form of energy. Sunlight is a mixture of all the different colors of _____.
- ▶ Light-absorbing molecules called _____ capture the sun's energy.
- ▶ _____ is the principal pigment in photosynthetic organisms. Chlorophyll absorbs blue-violet and red light but reflects green light.
- ▶ Chloroplasts have a complex internal structure that includes:
 - _____: saclike photosynthetic membranes that contain chlorophyll and other pigments and are arranged in stacks called grana.
 - _____: the fluid portion outside of the thylakoids.

High-Energy Electrons

The energy in light raises some of the electrons in chlorophyll to higher energy levels. These high-energy electrons are used in photosynthesis.

- ▶ _____ are used to transport electrons from chlorophyll to other molecules during photosynthesis.
- ▶ _____ is a compound that can accept and hold 2 high-energy electrons and 1 hydrogen ion. This process converts NADP^+ into NADPH.

An Overview of Photosynthesis

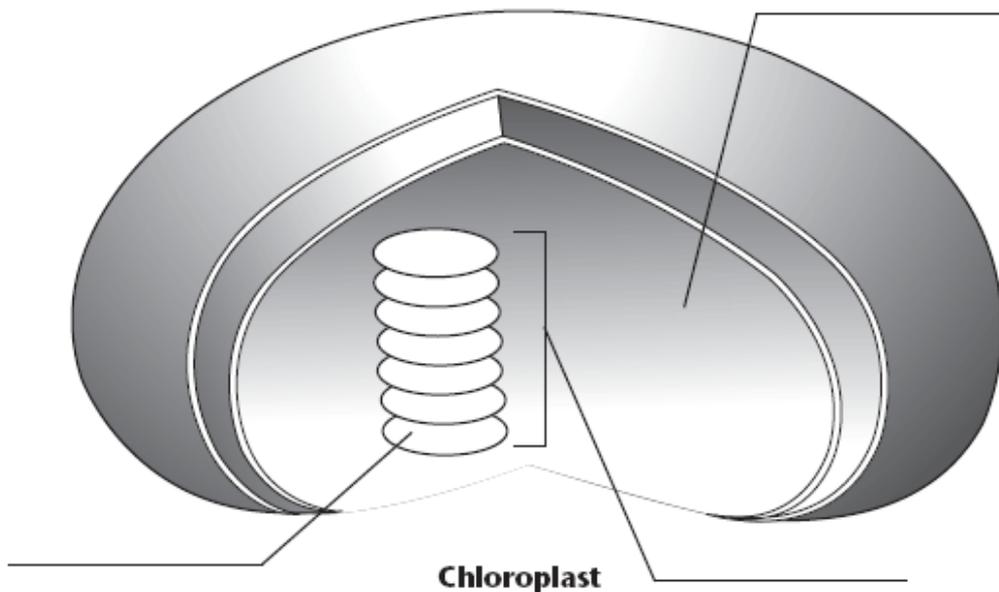
Usually summarized by a simple chemical reaction, photosynthesis is a complex process that involves two interdependent sets of reactions.

- ▶ The _____ require light, light-absorbing pigments, and water to form NADPH, ATP, and oxygen.
- ▶ The _____ do not use light energy. They use carbon dioxide from the atmosphere, NADPH, and ATP to make energy-rich carbon compounds.

Chlorophyll and Chloroplasts

For Questions 1–6, complete each statement by writing the correct word or words.

1. The _____ of light determines its color.
2. Chemicals that absorb light are called _____.
3. Chlorophyll makes plants look green because it _____ green light.
4. Chloroplasts contain an abundance of saclike photosynthetic membranes called _____.
5. The _____ is the fluid portion of the chloroplast located outside the thylakoids.
6. The visible light absorbed by chlorophyll _____ the energy level of the chlorophyll's electrons.
7. Label the internal parts of the chloroplast below.



8.3 The Process of Photosynthesis

The Light-Dependent Reactions: Generating ATP and NADPH

Photosynthesis begins with these reactions, which occur in thylakoid membranes.

- ▶ _____ are clusters of proteins and chlorophyll in thylakoid membranes.
- ▶ High-energy electrons form when pigments in photosystem II absorb light. The electrons pass through _____, a series of electron carrier proteins.
 - The movement of electrons through an electron transport chain causes a thylakoid to fill up with hydrogen ions and generates _____ and _____.
 - _____ is a membrane protein through which excess hydrogen ions escape a thylakoid in a process that makes ATP.

The Light-Independent Reactions: Producing Sugars

They occur in the stroma of thylakoids and are commonly called the _____.

- ▶ Six carbon dioxide molecules from the atmosphere enter the Calvin cycle and combine with 5-carbon compounds already present. They produce _____ 3-carbon molecules.
- ▶ Two 3-carbon molecules are removed from the cycle. They are used by the plant to build _____, lipids, amino acids, and other compounds.
- ▶ The remaining ten 3-carbon molecules are converted back to 5-carbon molecules and begin a new cycle.

Factors Affecting Photosynthesis

Many factors influence the rate of photosynthesis.

- ▶ _____, _____, and availability of water affect photosynthesis.
- ▶ _____ and CAM plants have a modified type of photosynthesis that enables the plants to conserve water in dry climates.

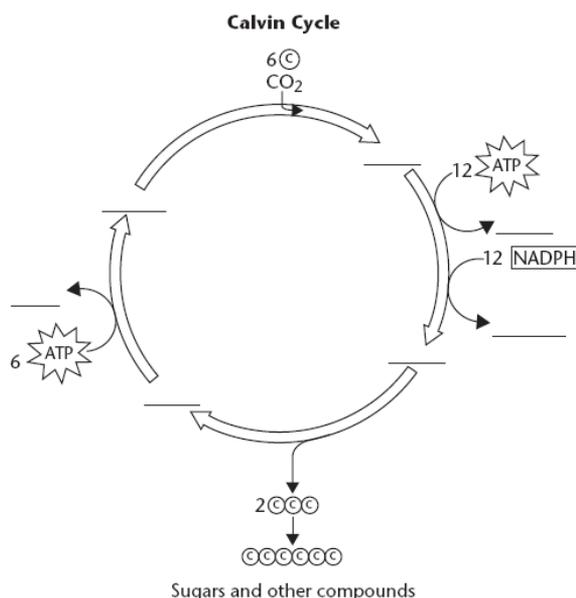
The Light-Dependent Reactions: Generating ATP and NADPH

For Questions 1–5, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. Photosystems are clusters of chlorophyll and proteins.
- _____ 2. The light-dependent reactions begin when photosystem I absorbs light.
- _____ 3. Electrons from water molecules replace the ones lost by photosystem II.
- _____ 4. ATP is the product of photosystem I.
- _____ 5. ATP and NADPH are two types of protein carriers.

The Light-Independent Reactions: Producing Sugars

10. Complete the diagram of the Calvin cycle by filling in the missing labels.



An Overview of Photosynthesis

For Questions 11–13, write the letter of the correct answer on the line at the left.

- _____ 11. What are the reactants of the photosynthesis reaction?
A. chlorophyll and light
B. carbon dioxide and water
C. carbohydrates and oxygen
D. high-energy electrons and air
- _____ 12. What are the products of the light-dependent reactions?
A. chloroplasts and light
B. proteins and lipids
C. oxygen and ATP
D. water and sugars
- _____ 13. Where do the light-independent reactions occur?
A. stroma
B. thylakoids
C. chlorophyll
D. mitochondria
14. Complete the illustration by writing the reactants and products of the light-dependent and light-independent reactions. Also, fill in the energy source that excites the electrons.

