

Photosynthesis

Plants don't have lungs. But like you, plants need air. Air contains oxygen, carbon dioxide, and other gases. Your body needs oxygen, and plants need oxygen. But what other gas is important to plants?

What You Will Learn

- Describe photosynthesis.
- Compare photosynthesis and cellular respiration.
- Describe how gas is exchanged in the leaves of plants.
- Describe two ways in which photosynthesis is important.

Vocabulary

photosynthesis	stoma
chlorophyll	transpiration
cellular respiration	

READING STRATEGY

Discussion Read this section silently. Write down questions that you have about this section. Discuss your questions in a small group.

If you guessed *carbon dioxide*, you are correct. Plants use carbon dioxide for photosynthesis (FOHT oh SIN thuh sis). **Photosynthesis** is the process by which plants make their own food. Plants capture energy from sunlight during photosynthesis. This energy is used to make the sugar glucose ($C_6H_{12}O_6$) from carbon dioxide (CO_2) and water (H_2O).

Capturing Light Energy

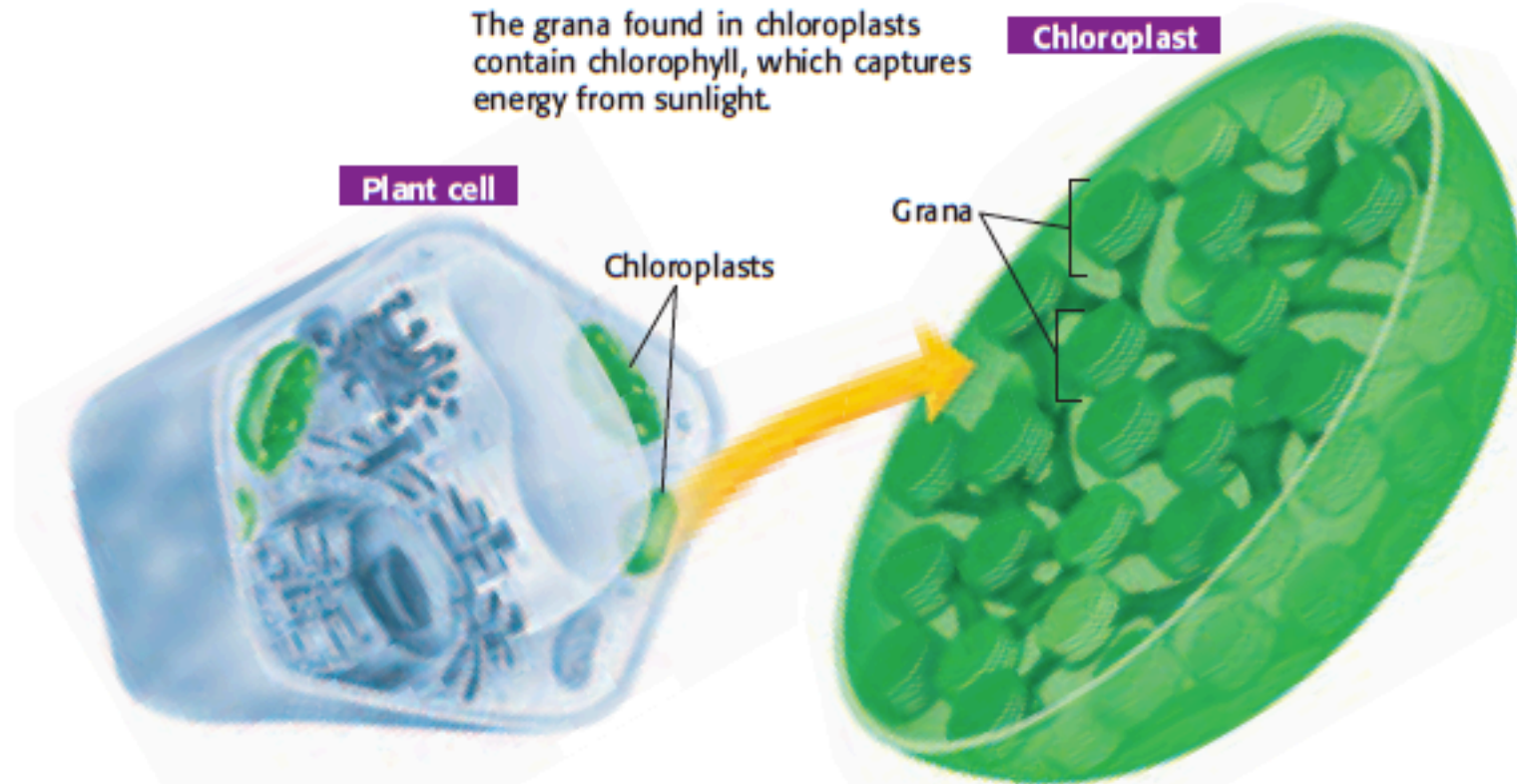
Plant cells have organelles called *chloroplasts* (KLAWR uh PLASTS), shown in **Figure 1**. Chloroplasts are surrounded by two membranes. Inside the chloroplast, another membrane forms stacks called *grana* (GRAY nuh). Grana contain a green pigment, called **chlorophyll** (KLAWR uh FIL), that absorbs light energy.

Sunlight is made up of many different wavelengths of light. Chlorophyll absorbs many of these wavelengths. But it reflects more wavelengths of green light than wavelengths of other colors of light. So, most plants look green.

✓ Reading Check Why are most plants green? (See the Appendix for answers to Reading Checks.)

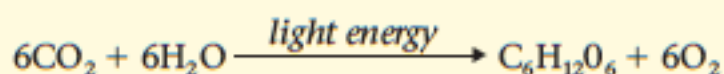
Figure 1 Chloroplast Structure

The grana found in chloroplasts contain chlorophyll, which captures energy from sunlight.



Making Sugar

The light energy captured by chlorophyll is used to help form glucose molecules. In turn, oxygen gas (O₂) is given off by plant cells. Photosynthesis is a complicated process made up of many steps. But photosynthesis can be summarized by the following chemical equation:



Six molecules of carbon dioxide and six molecules of water are needed to form one molecule of glucose and six molecules of oxygen. **Figure 2** shows where plants get the materials for photosynthesis.

Getting Energy from Sugar

Glucose molecules store energy. Plant cells use this energy for their life processes. To get energy, plant cells break down glucose and other food molecules in a process called **cellular respiration**. During this process, plant cells use oxygen. The cells give off carbon dioxide and water. Excess glucose is converted to another sugar called *sucrose* or stored as starch.

CONNECTION TO Social Studies

WRITING SKILL

Sugar Some plants make and store large amounts of sucrose, or table sugar, during photosynthesis. People harvest these plants for sucrose. Identify a plant that produces large amounts of sucrose. Then, identify how people use the plant and which countries are major growers of the plant. Write an article about your findings in your science journal.

photosynthesis the process by which plants, algae, and some bacteria use sunlight, carbon dioxide, and water to make food

chlorophyll a green pigment that captures light energy for photosynthesis

cellular respiration the process by which cells use oxygen to produce energy from food

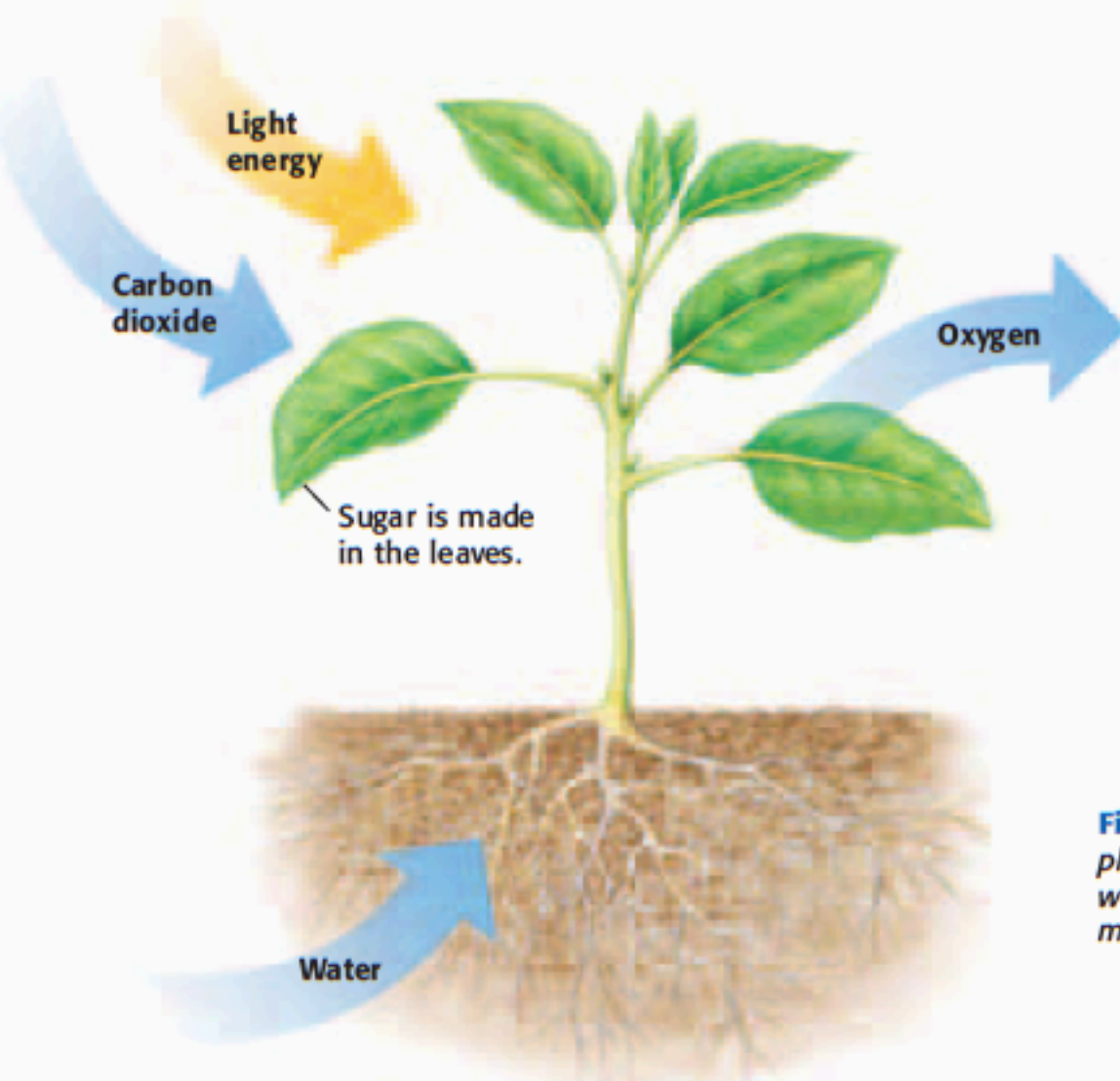
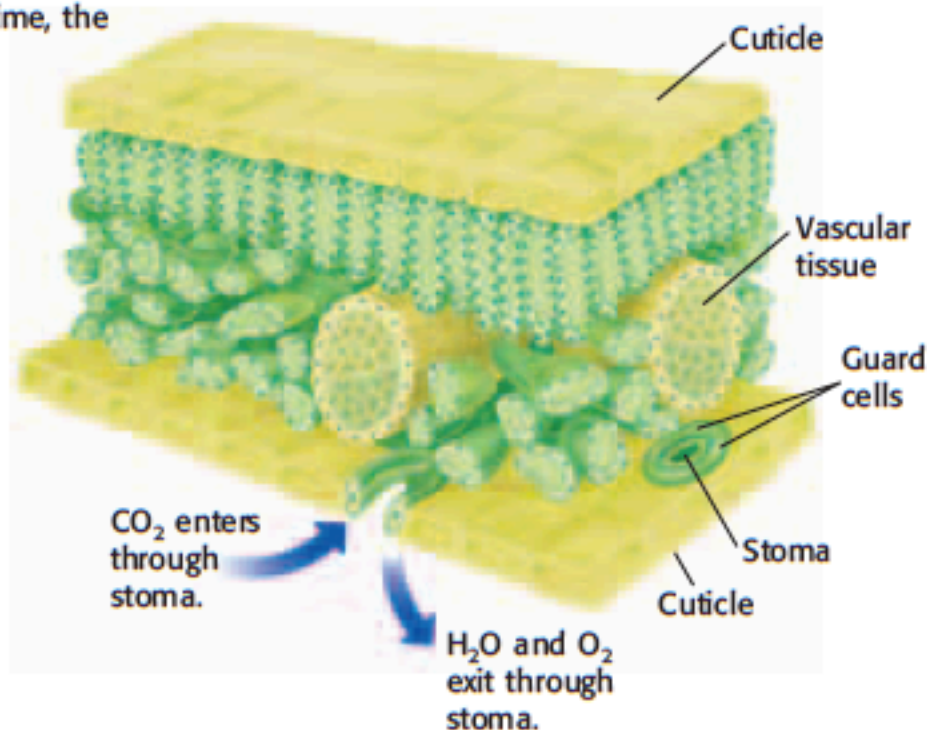
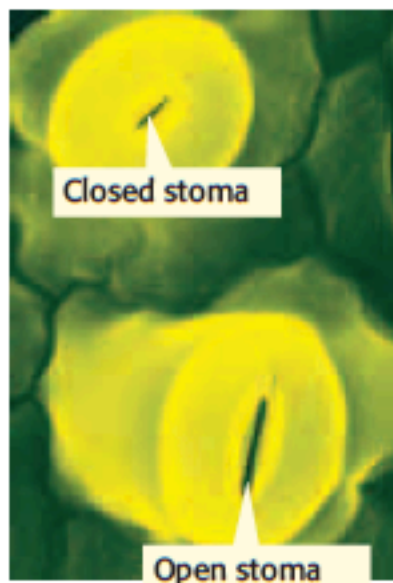


Figure 2 During photosynthesis, plants take in carbon dioxide and water and absorb light energy. They make sugar and release oxygen.

Figure 3 Gas Exchange in Leaves

When light is available for photosynthesis, the stomata are usually open. At nighttime, the stomata close to conserve water.



stoma one of many openings in a leaf or a stem of a plant that enable gas exchange to occur (plural, *stomata*)

transpiration the process by which plants release water vapor into the air through stomata

Gas Exchange

Many above-ground plant surfaces are covered by a waxy cuticle. The cuticle protects the plant from water loss. How does a plant get carbon dioxide through this barrier? Carbon dioxide enters the plant's leaves through stomata (singular, *stoma*). A **stoma** is an opening in the leaf's epidermis and cuticle. Each stoma is surrounded by two *guard cells*. The guard cells act like double doors, opening and closing the stoma. You can see stomata in **Figure 3**.

When stomata are open, carbon dioxide enters the leaf. The oxygen produced during photosynthesis exits the leaf through the stomata. Water vapor also exits the leaf in this way. The loss of water from leaves is called **transpiration**. Most of the water absorbed by a plant's roots replaces the water lost during transpiration. Sometimes, more water is lost through a plant's leaves than is absorbed by the plant's roots. When this happens, the plant wilts.

CONNECTION TO Chemistry

Transpiration Wrap a plastic bag around the branch of a tree or a portion of a potted plant. Secure the bag closed with a piece of tape or a rubber band, but be sure not to injure the plant. Record what happens over the next few days. What happened to the bag? How does this illustrate transpiration?

ACTIVITY

The Importance of Photosynthesis

Plants and other photosynthetic organisms, such as some bacteria and many protists, form the base of nearly all food chains on Earth. An example of one food chain is shown in **Figure 4**. During photosynthesis, plants store light energy as chemical energy. Some animals use this chemical energy when they eat plants. Other animals get energy from plants indirectly. These animals eat animals that eat plants. Most organisms could not survive without photosynthetic organisms.

Plants, animals, and most other organisms rely on cellular respiration to get energy. Cellular respiration requires oxygen. Oxygen is a byproduct of photosynthesis. So, photosynthesis provides the oxygen that animals and plants need for cellular respiration.

✓ Reading Check What are two ways in which photosynthesis is important?

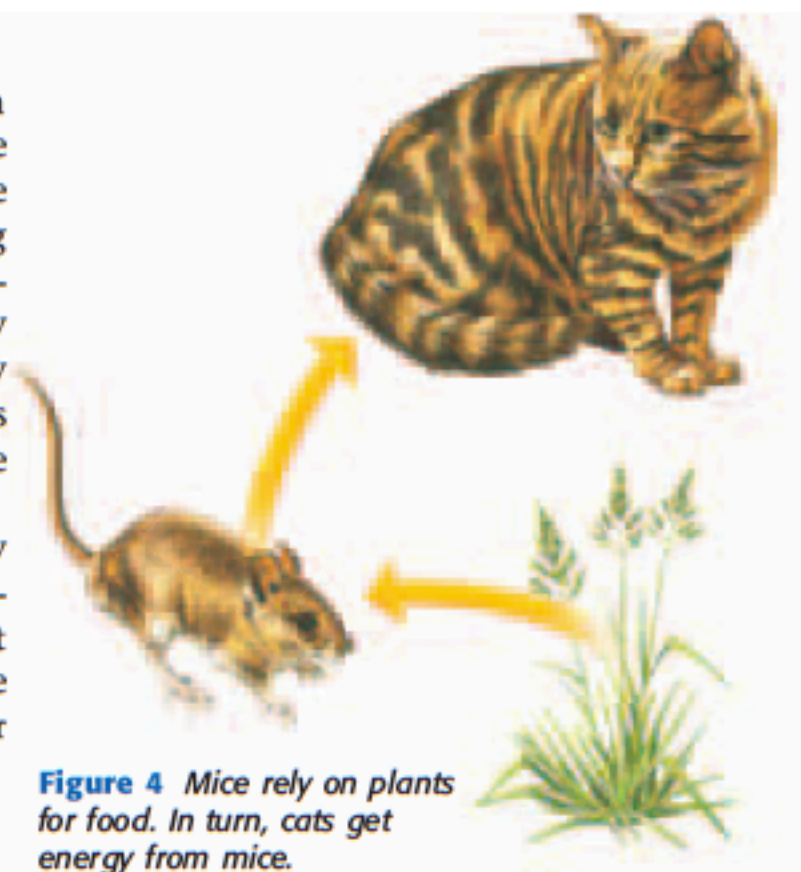


Figure 4 Mice rely on plants for food. In turn, cats get energy from mice.

SECTION Review

Summary

- During photosynthesis, plants use energy from sunlight, carbon dioxide, and water to make food.
- Plants get energy from food by cellular respiration, which uses oxygen and releases carbon dioxide and water.
- Transpiration, or the loss of water through the leaves, happens when stomata are open.
- Photosynthesis provides oxygen. Most animals rely on photosynthetic organisms for food.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *photosynthesis*, *chlorophyll*, and *cellular respiration*.

Understanding Key Ideas

2. During photosynthesis, plants
 - a. absorb energy from sunlight.
 - b. use carbon dioxide and water.
 - c. make food and oxygen.
 - d. All of the above
3. How is cellular respiration related to photosynthesis?
4. Describe gas exchange in plants.

Math Skills

5. Plants use 6 carbon dioxide molecules and 6 water molecules to make 1 glucose molecule. How many carbon dioxide and water molecules would be needed to make 12 glucose molecules?

Critical Thinking

6. **Predicting Consequences** Predict what might happen if plants and other photosynthetic organisms disappeared.
7. **Applying Concepts** Light filters let through certain colors of light. Predict what would happen if you grew a plant under a green light filter.

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