

4-H Virtual Forest User's Guide

Photosynthesis

Concept

This module will illustrate the process of photosynthesis. Specifically, students will explore how light energy, water, and carbon dioxide are converted into sugars and oxygen. Students will learn about the fate of these “by-products” in the environment, and complete an interactive learning activity to demonstrate that they have learned the photosynthetic process.

This module supports the following Science SOLs:

Living Systems and Processes

- 4.2 a) the survival of plants and animals depends on photosynthesis
- 2.5 a) plants and animals are interdependent with their living and nonliving surroundings

Earth Resources

- 4.8 d) forests, soil, and land
- LS.4 The student will investigate and understand that there are chemical processes of energy transfer which are important for life. Key ideas include:
 - a) photosynthesis is the foundation of virtually all food webs; and
 - b) photosynthesis and cellular respiration support life processes.

Module Description

Begin. Plants and animals have several things in common: both plants and animals are composed mostly of water and protein, contain cells and tissues, consume and store energy, and reproduce. Plants and animals are also different in many ways – one major difference is that most plants can manufacture their own food. Animals cannot!

The module opens with an image of a forest in the mountains, with the sun radiating light. Narration and text introduce the concept of photosynthesis. The text reads:

“Trees and other plants are amazing because, unlike animals, they can create their own food. They do this through a remarkable process called photosynthesis,

which not only feeds the plants but also produces the oxygen we breathe.”

Photosynthesis means “putting together with light.” During photosynthesis, trees and plants use energy from the sun to change carbon dioxide and water into sugars and oxygen.

Throughout the module, the student advances to the next frame by clicking the forward arrow. Students can also return to the previous frame by clicking the back arrow.

Chloroplasts. Photosynthesis takes place in structures called “chloroplasts”. Chloroplasts are found mainly in the plant’s leaves, and contain green pigments called “chlorophyll.” Chlorophyll traps and stores energy from sunlight, and it gives leaves their green color.

“Inside the leaves are special structures where photosynthesis occurs, called chloroplasts. Imagine this: a single square millimeter of a leaf is packed with about half a million chloroplasts, each one filled with green pigments called chlorophyll. This pigment is what gives leaves their green color.”

The next frame illustrates the cross section and cell structure of a leaf.

Sunlight, Air, and Water. This frame illustrates how sunlight, water, and air enter the leaf.

"Chlorophyll absorbs energy from the sun. At the same time, air enters the leaves through openings called stomata, and water enters the leaves through veins that transport it all the way up from the roots."

"Oxygen is released back into the environment through the stomata, and we use that oxygen to breathe!"

Creating Oxygen and Sugars. Once the water and carbon dioxide reach the leaves they come into contact with the *chloroplasts*, which take energy absorbed by the *chlorophyll* and use it to change carbon dioxide and water into sugar and oxygen.

"Chloroplasts are chemical factories powered by the sun. They take carbon dioxide from the air, energy from the chlorophyll, and water from the veins, and convert them into oxygen and sugar."

Xylem and Phloem. This frame illustrates how phloem carries sugars throughout the tree. It also shows water moving up through the xylem to the leaves.

"The sugars exit the leaves through the veins and are carried down to the roots by the phloem. About half of the sugars produced during photosynthesis are used to fuel the plant's growth."

"Some scientists estimate that photosynthesis produces 176 billion TONS of

sugars each year. Water is absorbed by the roots and transported through the xylem to the leaves."

Energy Storage. This frame explains how the extra sugars produced through photosynthesis provide energy for humans and other animals.

"Fortunately for us, trees and other plants produce more food than they need. The leftover sugars are stored in the cells of stems, seeds, fruits, and roots."

"We can obtain this energy by eating the plant itself, like lettuce, or by consuming products such as bananas, apples, or nuts. The leftover sugars created by photosynthesis form the fruits and vegetables that we eat."

Fall Colors. Students and adults alike often have questions regarding why leaves change color and drop to the ground in the fall. This frame attempts to answer these questions.

"As fall approaches, the days become shorter and the temperatures drop. Trees produce less chlorophyll, allowing other pigments to emerge. The leaves change color from green to yellow, orange, red, or brown."

The image on this slide explains how features called "carotenoids" and "anthocyanins" contribute to a leaf's coloration.

"Eventually, trees stop producing chlorophyll entirely, photosynthesis ceases, and leaves fall to the ground. Conifers keep their green leaves in winter, but photosynthesis continues at a slower rate."

Decomposition. It is important to introduce the process of decomposition.

"When trees die, they fall to the ground and begin to rot. This process is called decomposition, and it's the opposite of photosynthesis. As trees decompose, they take in oxygen and give off carbon dioxide. A healthy forest produces more oxygen than one with many dead and dying trees."

Conclusion. In conclusion, although most of the Earth's atmospheric oxygen comes from plant-like organisms in the ocean and geologic processes, photosynthesis is still a very important process that helps support life on earth. Photosynthesis produces oxygen to breathe, food to eat, and materials for shelter. These are things that all animals, including people, need to live.

At this point the student can engage in an interactive learning activity by clicking to "create your own photosynthesis!"

Learning Activity - Create your own photosynthesis!

An interactive learning activity entitled “Create Photosynthesis” enables students to reinforce what they learned in the module by “creating” a photosynthetic reaction. Using the mouse, students click and drag each ingredient to the leaf. An incorrect match results in a message indicating it as such, and the ingredient returns to its position at the bottom of the screen automatically. Correct matches will result in "Correct!" appearing on the screen. The matches are sunlight, water, and carbon dioxide.

Once all three matches are made, the text “You did it! You created photosynthesis!” appears at the top of the screen. The reaction is shown in the center of the screen.

References

Campbell, N.A. 1990. *Biology*. (2nd ed). The Benjamin Cummings Publishing Company, Inc. Redwood City, CA. 1165 p.