

Photosynthesis

Grades 5 - 8

Teacher's Guide

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PHOTOSYNTHESIS

GRADE LEVELS: 5 - 8

INTRODUCTION

This lesson is designed for use in grades 5 - 8 as an introduction to the major ideas and concepts associated with the food making process known as photosynthesis. Only plants are capable of making their own food. In fact, as humans, all food on which we depend can be traced back to the plant world. In addition, plants release oxygen into the atmosphere as a by-product of photosynthesis. Thus, for two very important needs we owe a debt to the plant world.

INSTRUCTIONAL NOTES

Before presenting these lessons to your students, we suggest that you preview the video and review this guide and the accompanying blackline master activities in order to familiarize yourself with their content.

As you review the materials presented in this guide, you may find it necessary to make some changes, additions, or deletions to meet the specific needs of your class. We encourage you to do so, for only by tailoring this program to your class will they obtain the maximum instructional benefits afforded by the materials.

It is also suggested that the video presentation take place before the entire group under your supervision. The lesson activities grow out of the context of the video; therefore, the presentation should be a common experience for all students.

LINKS TO CURRICULUM STANDARDS

As stated in the the National Science Education Standards, "In the middle-school years, students should progress from studying life science from the point of view of individual organisms to recognizing patterns in ecosystems." The specific content standards addressed in this lesson are:

- A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- Populations of organisms can be categorized by the function they serve in an ecosystem.
- For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers (plants) into chemical energy through photosynthesis. This energy then passes from organism to organism in food webs.

STUDENT OBJECTIVES

After viewing the video and participating in the follow-up activities, students/participants should be able to...

- Identify photosynthesis as the food-making process used by green plants.
- Describe the important contributions to survival on earth green plants provide through photosynthesis and the releasing of oxygen into the atmosphere.
- Identify the necessary materials needed for photosynthesis to take place.
- Identify the fossil fuels and describe their link to energy from the sun and plants that lived millions of years ago.

ASSESSMENT TOOLS

This lesson provides you with three different assessment tools. Together they make it possible to closely follow the progress of your students and to judge their mastery of the subject matter it covers.

The **Pre-Test (Blackline Master #1)** can be used to get some idea of students' understanding of the topic before the video is presented.

The **Post-Test**, presented as **Blackline Master #7**, can be used as a final test for this Unit of Study.

The **Video Quiz** and its accompanying answer sheet (**Blackline Master #2**) can be used either as a way to introduce the topic prior to showing the video or to judge student mastery once the video has been presented.

TEACHER PREPARATION

View the video and review the accompanying activities. Duplicate any blackline masters you wish to distribute. If you plan to use the Video Quiz, which immediately follows the video presentation, you may wish to have copies of the quiz ready to distribute at the completion of the video program. Also, plan to pause the tape between questions if students require more time.

INTRODUCING THE VIDEO

This videotape is about the food-making process known as photosynthesis. Green plants use photosynthesis to manufacture their food. During the process carbon dioxide, water, and energy from the sun combine to form glucose, a form of sugar used by the plant as food. This only occurs in green plants that contain a chemical called chlorophyll. As a by-product of photosynthesis oxygen is released into the air. Green plants are responsible for releasing oxygen and as a result replenishing the earth's supply of oxygen.

VIEW THE VIDEO

Viewing Time is 10 minutes for the program and about 5 minutes for the Video Quiz.

DISCUSSION QUESTIONS

1. Discuss the relationship plants and animals share. What is it that plants need from animals and what do plants produce that is essential to animals?
2. Reinforce the importance of green plants to all life on earth. Trace different foods back to plants. Also, all forms of energy on earth such as fuels are traceable to plants and the energy of the sun.
3. Why will space missions to distant planets require the transportation and inclusion of green plants.

BLACKLINE MASTER DESCRIPTIONS

This program contains seven blackline masters that can be used to reinforce ideas and information presented in the video. Answers to Blackline Master activities appear on pages 4-6 of this guide.

- *Blackline Master #1: Pre-Test* provides a way of finding out how much students know about the material covered in this lesson before you present it. Student scores on the pre-test can be compared with their scores on the final **Post-Test (Blackline Master #7)**.
- *Blackline Master #2: Video Quiz* is to be used at the end of the video program. At the completion of the video, there is a short quiz. The narrator will read the questions which are displayed on the screen. Students can use **Blackline Master #2: Video Quiz** to record their answers.
- *Blackline Master #3: Crossword* is both a crossword puzzle and a fill-in assignment. Students will read the paragraph at the bottom of the page and place the missing words in the crossword.
- *Blackline Master #4: Tracing Back* is designed as a way for students to describe how various common items and foods can be traced back to the plant world.
- *Blackline Master #5: Carbon Dioxide and Plant Growth* is an experiment to illustrate the importance of carbon dioxide to green plants.
- *Blackline Master #6: Oxygen as a By-Product* is an experiment to show that oxygen is given off by green plants during photosynthesis.
- *Blackline Master #7: Post-Test* is the formal test for this lesson.

ENRICHMENT ACTIVITIES

1. Here is the chemical formula for photosynthesis: $6\text{CO}_2 + 6\text{H}_2\text{O}$ equals $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$. Write this on the board and have a discussion about what everything stands for in the equation. Don't forget to mention sunlight is required and that this happens in green plants that contain chlorophyll.
2. Discuss the importance of green plants to all life on earth. Why must we be careful not to disrupt the wonderful partnership shared by animals and plants?

ANSWER KEY

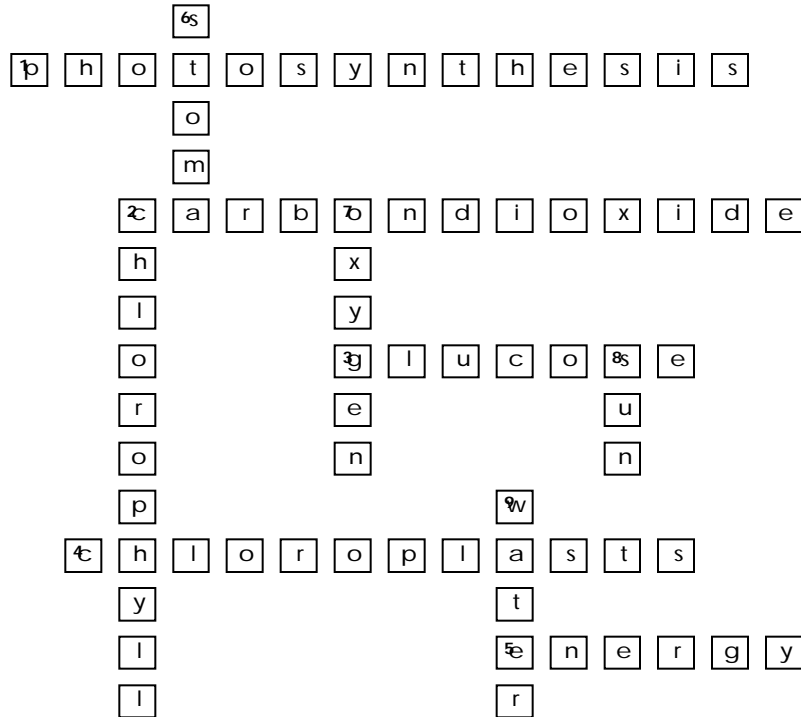
• PRE-TEST, Blackline Master #1

1. photosynthesis
2. water, carbon dioxide, energy from the sun, and chlorophyll within the plant's cells
3. chlorophyll
4. chloroplasts
5. glucose
6. stoma (plural: stomata)
7. Plants are the only living things capable of producing food. All food can be traced back to plants. Oxygen is released during photosynthesis. Also, fuels used to run our vehicles and equipment come from plants.
8. Animals exhale carbon dioxide which plants need for food making and plants release oxygen which animals need to breathe.
9. starch
10. Fossil fuels which include natural gas, oil, and coal were formed from the dead remains of animals and plants that lived millions of years ago. Their remains have changed into these various fuels which are so important to people today.

• VIDEO QUIZ, Blackline Master #2

1. false
2. true
3. false
4. true
5. hydrogen
6. root hairs
7. fossil fuels
8. chlorophyll
9. sun
10. water

• **CROSSWORD, Blackline Master #3**



• **TRACING BACK, Blackline Master #4**

1. wool comes from sheep. Sheep feed on grass.
2. book - paper comes from trees
3. leather purse - made from animal hides. Animals eat plants.
4. cotton - from the cotton plant
5. cake - many materials that go into a cake are from plants (flour, sugar, chocolate, vanilla, fruit)
6. hamburger - comes from cattle which are fed grains and other plants
7. milk - comes from cows that feed on grass and grains
8. bread - made from flour which is ground up grain from plants
9. coal - formed millions of years ago from the remains of plants
10. honey - made by bees from the nectar of plants

• **CARBON DIOXIDE AND PLANT GROWTH, Blackline Master #5**

This experiment will show that plants need carbon dioxide from the air to carry on photosynthesis. It will also show that the carbon dioxide is taken in through the stomata located on the underside of the leaf.

• **OXYGEN AS A BY-PRODUCT, Blackline Master #6**

This is an experiment to collect oxygen from a live elodea leaf.

• **POST-TEST, Blackline Master #7**

1. photosynthesis
2. stoma (plural: stomata)
3. water, carbon dioxide, minerals from the soil, energy from the sun
4. chlorophyll
5. chloroplasts
6. glucose
7. starch
8. carbon dioxide, water, glucose, oxygen
9. Green plants are the only living things capable of making food. Plants are at the base of all food chains. Plants release oxygen, which living things need to breathe. Energy used by humans is traced back to plants.
10. All fossil fuels, such as natural gas, oil, and gasoline, have been formed over millions of years from dead animals and plants that received their energy from the sun.

INTERNET RESOURCES

The following websites may be valuable sources of additional information to reinforce the objectives of this lesson:

- (1.) **Tropical Feast** at <http://www.mobot.org/mobot/education/feast> illustrates various edible plants and fruits.
- (2.) **Tropical Rain Forests** at <http://www.mobot.org/mobot/education/tropics>.
- (3.) **Coloring Book Drawings** at <http://www.nps.gov/plants/color/20.htm>.
- (4.) **Plant Watch** at <http://www.devonianm.ualberta.ca/pwatch>.

Photosynthesis Script of Narration

Our fellow humans, the many kinds of plants and animals around us, we're all alike in one very important way: We all need nourishment. We all need food. Food, in all its forms, is the fuel that keeps the fires of life burning. We humans, and the many different critters sharing the planet with us, get the food we need by eating. Eating isn't the only way, however, that living things can get their nourishment.

Take green plants, such as the beauty I'm looking at here, for example. They can't eat. So green plants get their food another way. They make it using one of the most vital process in all nature - photosynthesis. Today we'll explore how photosynthesis works and why it's so important.

Let's start by looking at the word "photosynthesis." Photo means light, and synthesis means to put something together. And that's exactly what happens. During photosynthesis, plants use the sun's energy to put together glucose, a type of sugar, from simpler chemicals.

Here's an outline of how the process goes. First, plants collect the raw materials they need for photosynthesis. These are two common substances. Water is the first. The second is carbon dioxide. It's a common gas in the air around us. Their roots absorb the water plants need for photosynthesis. Roots are covered with tiny hair-like growths. Called "root hairs," they absorb water from the soil. This is then transported to the plant's leaves, where it's used.

Leaves are nature's food factory. They're where green plants carry on most of their photosynthesis. Here's a cross-section of a typical leaf as it looks through a microscope. Notice the tiny openings, or pores, on its underside. Called a "stoma," each of these openings is a tiny "door" through which air, and the carbon dioxide it contains, enters leaves.

Once they have water and carbon dioxide, leaves have the raw materials needed for photosynthesis. However, something else is required before the process can actually start. And that "something" is sunlight. That's because it's light from the sun that provides the energy for photosynthesis.

Look carefully at leaves and you'll see how well they're suited to capture the sun's energy. Their thin shape allows sunlight to easily reach the cells where photosynthesis takes place.

And here's the leaf's inside again. The small granules you see in its cells are called "chloroplasts." They contain a complex, green-colored chemical called "chlorophyll." However, in this slide, the chloroplasts look blue because of the way in which it was prepared.

It's chlorophyll that gives leaves, such as these giant water lilies, their characteristic green color. Chlorophyll also gives the green color to plants such as these cacti and this paloverde bush.

Both live in sun-baked desert areas, and to reduce water loss they grow few, or no, leaves. Instead, as their green color shows, they have chlorophyll in their trunks, stems, and branches, letting them carry on photosynthesis there.

But regardless of where it is, when sunlight falls on chlorophyll, light energy is absorbed and a series of complex chemical reactions begins. These reactions split some of the carbon dioxide molecules plants take in into carbon and oxygen atoms. The same thing happens to some of the water molecules plants absorb. They're broken apart into hydrogen and oxygen atoms.

Some of the resulting carbon, hydrogen, and oxygen atoms then join together to make glucose, a kind of sugar. This glucose contains stored energy which came from the sun. Plants do different things with the glucose their photosynthesis produces. They use some of it right away as food to provide the energy they need to carry on their life processes. Plants can also change some of the sugar they make into starch and store it for later use. And here we see some of that stored energy. Whenever we dine on potatoes, yams, and similar foods, we're eating food which plants stored in their roots as starch to meet their future energy needs.

Plants also store energy in their seeds, or, as we sometimes call them, "grains." Later, this stored food energy is used by the young plants that sprout from these seeds. We humans also benefit greatly from these energy-rich foods, both by eating them ourselves and by feeding them to our animals.

But, as important as it is, photosynthesis provides far more than just food alone. Take, for example, breathing. It may be hard to believe, but without photosynthesis, we couldn't. And that's because the world's oxygen supply is a by-product of photosynthesis.

Here's how. Remember how earlier we learned that during photosynthesis plants use light energy to split water molecules into hydrogen and oxygen atoms?

Plants use some of these oxygen atoms for their own life processes. Some of them, however, are released into the air around them. We humans breathe this oxygen - the oxygen photosynthesis produces - as do all the many other critters, both big and small, that share the planet with us.

In addition, some of the oxygen photosynthesis produces becomes dissolved in the world's waters. This is the oxygen that fish and other aquatic critters, such as this crab use, use.

And then there are our fuels! Believe it or not, nearly all the fuels that do such things as power our vehicles, cook our food, and keep us warm come to us thanks to photosynthesis.

Called "fossil fuels," much of the energy we use comes from fuels formed from the remains of green plants and other organisms that lived, and carried on photosynthesis, millions of years ago. Since then, their remains have changed, into natural gas, oil, and coal. Today, when we burn these fuels, we are actually reaching back into time and benefiting from energy that photosynthesis captured from the sun hundreds of millions of years ago.

As we've seen today, photosynthesis is one of nature's most important processes. Powered by the sun's energy and fueled by water and carbon dioxide, photosynthesis not only gives us, and countless other living things, food, it also provides the oxygen we, and other organisms, breathe, as well as fuels to warm us and power our vehicles.

Now let's take a few minutes to answer some questions. They'll help you remember the key points we covered today. The directions are simple. When you hear this tone, check either "true" or "false" or fill in the blank with the correct word. Good luck, and let's get started.

True or False. One of the raw materials used by green plants during photosynthesis is the gas carbon monoxide.

True or False. Plants can store some of the food they manufacture as starch.

True or False. The tiny holes through which gases enter and exit leaves are called chloroplasts.

True or False. During photosynthesis green plants manufacture a sugar called glucose.

Now let's change the way we're doing things. Instead of checking "true" or "false," just fill in the blanks with the correct words after you hear the beep tone.

During photosynthesis water molecules are split into atoms of oxygen and _____.

Roots absorb the water they need for photosynthesis through tiny outgrowths called _____.

Because they are produced from long-dead plants and other organisms, coal, gasoline, and oil are often called _____ fuels.

Green plants get their color from a chemical called _____ .

The energy plants use during photosynthesis comes from the _____ .

During photosynthesis sunlight provides the energy to split molecules of carbon dioxide and _____ .



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