

Photosynthesis

Students discover the process of photosynthesis and see what happens if a plant's resources are limited. Students also learn why plants are green and the importance of plants to our world.

Grade Level: 3rd

Phenomena:

Plants are able to use sunlight, water, and carbon dioxide to make their own food.

Objectives:

- Students will explain how green plants use the sun's energy to produce food through photosynthesis.
- Students will identify the essential ingredients for plants to carry out Photosynthesis.

Materials:

- 5 sheets each of yellow, blue and brown construction paper, cut in to 1"x1" squares; poker chips also work well
- Poster or signs for 'ingredients'
- Half sheets of paper
- *For extension activity:* Small shrub/tree or house plant, cardboard or aluminum foil, scissors, paper clips or tape, leaves, small jars, covers for jars or aluminum foil/plastic wrap, rubbing alcohol, paper coffee filters, shallow pan, hot tap water, tape pen, plastic knife or spoon, clock or timer

Time Considerations:

Preparations: 5 minutes

Lesson Time: 50-55 minutes

Introduction: 5 minutes

Activity 1: 15 minutes

Activity 2: 15-20 minutes

Conclusion: 15 minutes

Related Lesson Plans:

Earthworms Flower's Function, Pollination Investigation, The Many Uses of Plants, Energy Chains



Next Generation Science Standards

3-LS1-1.

Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Science and Engineering Practices (SEP):

Developing and Using Models

Disciplinary Core Ideas:

Growth and Development of Organisms.

Crosscutting Concepts:

Patterns of change can be used to make predictions.

Excellence in Environmental Education Guidelines

Strand 2.2—The Living Environment

- A) Learners understand basic similarities and difference among a wide variety of living organisms. They understand the concept of habitat..
- C) Learners understand basic ways in which organisms are related to their environments and to other organisms.
- D) Learners know that living things need some source of energy to live and grow.

Background

“Of all the organisms in the natural world, green plants are the only ones that manufacture their own food. This process is called photosynthesis and begins when light strikes the plant's leaves; both sunlight and artificial light can power this process. Cells in the plant's leaves, called chloroplasts, contain a green pigment called chlorophyll which interacts with sunlight to split the water in the plant into its basic components.

“Carbon dioxide enters the leaf through holes called stomata and combines with the stored energy in the chloroplasts through a chemical reaction to produce a simple sugar,

glucose. The sugar is then transported through tubes in the leaf to the roots, stems and fruits of the plants. Some of the sugar is used immediately by the plant for energy; some is stored as starch; and some is built into a more complex substance, like plant tissue or cellulose.

“Fortunately for us, plants often produce more food than they need, which they store in stems, roots, seeds or fruit. We can obtain this energy directly by eating the plant itself or its products, like carrots, rice or potatoes. Photosynthesis is the first step in the food chain, which connects all living things. Every creature on earth depends to some degree on

green plants.

"The oxygen that is released by the process of photosynthesis is an essential exchange for all living things. Forests have been called the "lungs of the earth" because animals inhale oxygen and exhale carbon dioxide in the process of breathing, and plants take in carbon dioxide and give off oxygen in the process of photosynthesis" (*Twin Cities Public Television, Inc.*).

Preparation

Gather all appropriate materials: yellow, blue and brown color cards or poker chips for the photosynthesis game, enough sheets of paper for each student to write their photosynthesis recipe. Poster or ingredient signs.

Be sure to have a pre-made recipe for photosynthesis with blanks for the students to fill in during the lesson.

Doing the Activity

Introduction: Plant Intro

Discuss with students the importance of plants before reviewing any information with them. What do they already know about photosynthesis? How important are plants to us and our environment?

Activity 1: Photosynthesis

Introduce a concept to the students that relates to food.

You have lunch every day at school and you either bring it from home or buy it at school. Do plants eat lunch? Do they have someone cook for them? (no) Plants make their own food!

Write the formula for photosynthesis on the board and explain to students that we will be going over each of the ingredients: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Just like when cooking a meal, plants follow a recipe for their food. When using a recipe for cooking, all the ingredients are needed and the steps should be followed, the same is true for when plants make their food.

Ask students what plants need to make food? Let the students make a few suggestions.

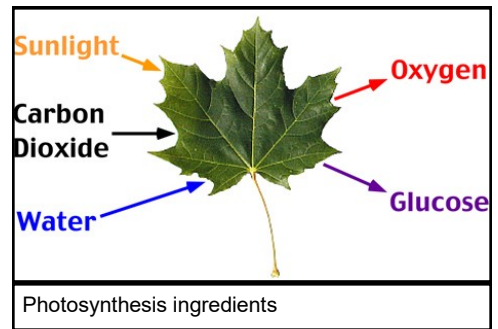
Then, list the exact ingredients on the board underneath their chemical name: carbon dioxide, water, sugar and oxygen.

Sunlight can be written above the arrow, because although it isn't in the equation, it is still necessary for photosynthesis. Chlorophyll is also necessary because it absorbs the sunlight needed for photosynthesis.

At each ingredient, stop and talk about its significance. The students probably won't be able to guess chlorophyll, so you will have to introduce this concept as the last ingredient, you can write it under the arrow.

To explain sunlight and chlorophyll tell students that

photosynthesis doesn't just happen on its own when these ingredients come together.



There needs to be sunlight for it to occur, or energy, and something to absorb the energy - chlorophyll. This can be related to making pudding. If you just put all the ingredients in a bowl will it turn into pudding? (no) You need to use your energy (sunlight) to mix them together with a spoon (chlorophyll).

After all the ingredients have been listed on the board, talk about how the plant gets each resource. Water - from the roots, sun - from the leaves, CO_2 - from the little holes on the bottom of leaves called stomata.

Give each student a recipe card to write down the equation and have them draw a picture of each ingredient to help them remember what they each stand for.

Activity 2: Photosynthesis Game

This activity is best done outside. In order to set up the photosynthesis game, have each student choose a spot to stand in the designated area. Having circles to designate

spots can be a better way to help the students stay in their spot.

Have the students select what type of plant they want to be and tell them how they will be positioned: a tall tree - student stands tall with arms out, bush with small leaves - kneels and uses both hands as leaves, flowers - kneels, uses only one hand, other behind back, and grass - lay flat on the floor, can't bend or crawl!

Ask the students if plants can get up and move around (no), and remind them that they are acting as plants, therefore they shouldn't move.

Review with the students the resources plants need: sunlight, carbon dioxide and water.

Show students the color cards or poker chips, poker chips work better especially if you are doing the activity outside where it could be windy, and tell them that you will be scattering the different game pieces around them.

Walk around and sprinkle the game pieces around them. Make sure to evenly distribute all of the colors, hopefully each student will get one of each.

Give the students a certain time limit in which to gather as many resources as they can; five to 10 seconds is good for each round.

The first round of the game is an introduction so the students will know what to do. Tell them to collect as many game pieces as possible.

Ask students what they think these game pieces represent.

For the second round, remove some of the yellow game pieces from the pile you are distributing - sunlight will be scarce during this round.

After round two, ask the students who was able to collect only a few of the sunlight game pieces; Ask students if they could survive without sunlight? Would they be able to complete photosynthesis? What types of situations do the students know that would create the problem of little to no sunlight for a plant? (a forest where the big trees shade out the younger trees)

For the third round, remove some of the blue game pieces from the pile you are distributing and replace the sunlight game pieces you took out for the previous round. Water will be scarce during this round.

After round three, ask the students who was able to collect only a few of the blue game pieces.

After round three ask the students several questions: For the students who were not able

to collect any blue game pieces, would they be able to survive without water? Would they be able to complete photosynthesis? What types of situations do the students know that would create the problem of little to no water? (in the desert)

There are only three rounds because carbon dioxide will never be limited as it is a resource that is continuously produced.

Conclusion

During the game wrap up and discuss, ask the students what factors could prevent a plant from completing photosynthesis? Ask if a resource or ingredient is taken away what can happen? Review the four ingredients with the students and why each are necessary for photosynthesis.

Ask the students to write a sentence about their importance to photosynthesis.

Ask students what might happen if there were no plants? What might happen, or does happen, if there were less and less plants but more and more people?

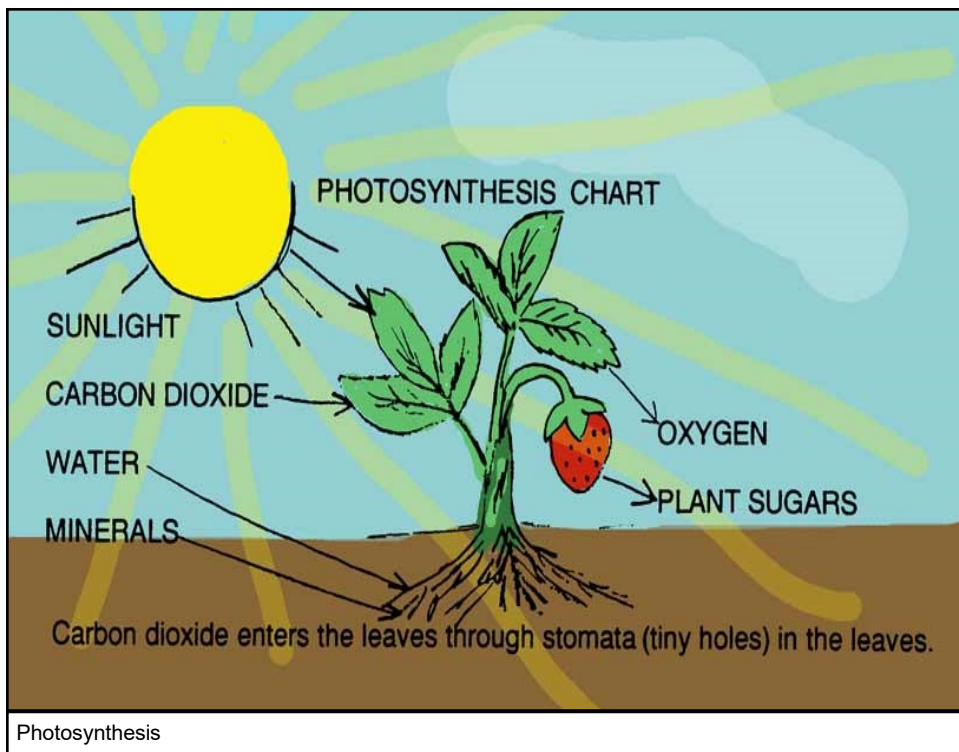
Have the students flip over their paper and draw a picture of photosynthesis with the plant they chose for the game.

Assessment

Assess student participation during the activities. How involved are they?

Break the class up into teams and assign points to those that answer review questions appropriately.

Assess students on if they are able to make a recipe card with all the appropriate ingredients needed to carry out photosynthesis.



Extensions

Chromatography

In this activity, you will be separating colors in a green leaf. Note - adult supervision is required. Please read all instructions completely before starting. Observe all safety precautions.

Collect two or three large leaves from several different trees. Tear or chop the leaves into very small pieces and put them into small jars labeled with the name or location of the tree.

Add enough rubbing alcohol to each jar to cover the leaves. Using a plastic knife or spoon, carefully chop and grind the leaves in the alcohol.

Safety Note: Isopropyl rubbing alcohol can be harmful if

mishandled or misused. Read and carefully follow all warnings on the alcohol bottle.

Cover the jars very loosely with lids or plastic wrap or aluminum foil. Place the jars carefully into a shallow tray containing one inch of hot tap water.

Safety Note: Hot water above 150°F can cause severe burns. Experts recommend setting your water heater thermostat no higher than 125°F.

Keep the jars in the water for at least a half-hour, longer if needed, until the alcohol has become colored, the darker the better. Twirl each jar gently about every five minutes. Replace the hot water if it cools off.

Cut a long thin strip of coffee filter paper for each of the jars

and label it.

Remove jars from water and uncover. Place a strip of filter paper into each jar so that one end is in the alcohol. Bend the other end over the top of the jar and secure it with tape.

The alcohol will travel up the paper, bringing the colors with it. After 30-90 minutes, or longer, the colors will travel different distances up the paper as the alcohol evaporates. You should be able to see different shades of green, and possibly some yellow, orange or red, depending on the type of leaf.

Remove the strips of paper, let them dry and then tape them to a piece of plain paper.

This activity shows the students the colors that were in the green leaf the whole time! Since

chlorophyll is necessary for photosynthesis to take place, when the leaves change colors, it shows the absence of chlorophyll - the green, and why photosynthesis doesn't take place during the winter.

Lights Out!

Here is a great activity, but you need a few days to see the results. Pick a shrub, tree or houseplant that you can use for the experiment.

Take your cardboard/aluminum foil shapes and paperclip or tape each shape on a different leaf.

If you use a house plant, place it near a south, west or east window where it will get plenty of sunlight.

Have the students guess what the covered spots will look like.

Make notes about the weather each day and add them to your observations.

After four days, remove the shapes from the leaves that had a shape covering it.

Compare the areas on the leaf that were covered with the

shape the other parts of the leaf.

Ask the students: What has happened to the leaves? Describe the effects that lack of sunshine has on leaves. What has or has not happened in the different parts of the leaf?

If you only have one class period to present your material, you can prepare the leaves ahead of time and simply ask the students questions about the leaves.

What has happened to the leaves? What do you think could have affected the leaves?

Where have you seen similar effects in nature? What resource was taken away from the plant (*Twin Cities Public Television, Inc.*)?

Vocabulary

Chlorophyll: a green substance which gives leaves their color; chlorophyll absorbs energy from sunlight which a plant uses to make food

Chloroplast: a plastid that contains chlorophyll and is the site where photosynthesis and starch formation occur

Glucose: a type of sugar that is found in plants and fruits

Photosynthesis: the process by which a green plant turns water and carbon dioxide into food when the plant is exposed to light

Stomata: a very small hole in the surface of a leaf; oxygen and carbon dioxide from the air enter through the stomata; oxygen, carbon dioxide and water vapor leave through the stomata

Sources

- Twin Cities Public Television, Inc. *Photosynthesis*. Retrieved Dec. 12, 2011, from Newton's Apple: <http://www.newtonsapple.tv/TeacherGuide.php?id=915>

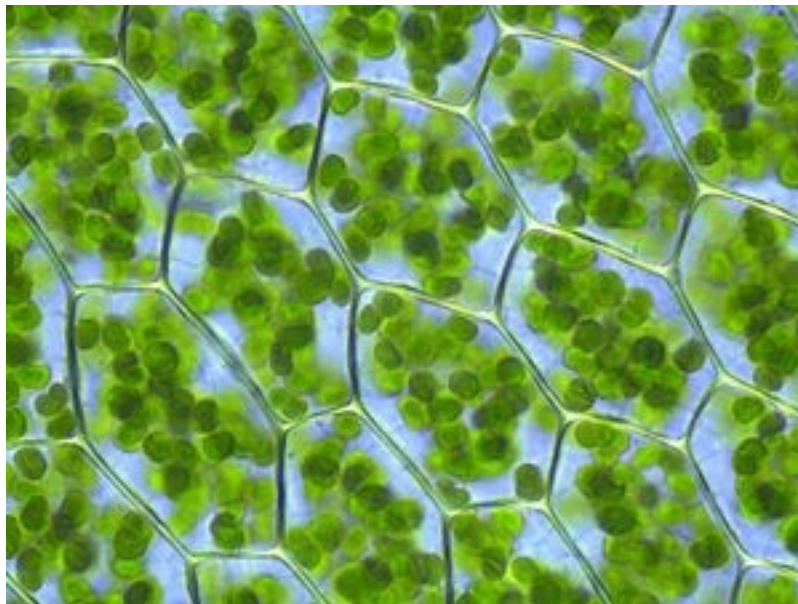
Images:

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Picture of leaf up close

http://www.photo-dictionary.com/photofiles/list/2090/2735leaf_structure.jpg



Chlorophyll structure

http://wpcontent.answcdn.com/wikipedia/commons/thumb/4/49/Plagiomnium_affine_laminazellen.jpeg/300px-Plagiomnium_affine_laminazellen.jpeg

Name: _____

Photosynthesis

Formula		+	→		+
Simplify		+	→		+
Draw it!		+	→		+

How does photosynthesis happen?

