HOW DO PLANTS GROW AND CHANGE?

Overview

In this lesson, students will use a potted plant to investigate how plants need light in order to complete photosynthesis.

Note: This lesson needs three days to complete. The first day sets up the activity. On the second day, students observe the leaf in the bag. On the third day, students observe any changes to the taped / foiled leave.

Objectives

On successful completion of this lesson, students will be able to:

- explain why leaves are important for plant growth; and
- explain what photosynthesis is.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

[4, 5] SA3.1 The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive.

[5] SC2.2 The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by explaining how external features and internal systems (i.e., respiratory, excretory, skeletal, circulatory, and digestive) of plants and animals may help them grow, survive, and reproduce.

Alaska Cultural Standards

[E] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.2] understand the ecology and geography of the bioregion they inhabit.

Bering Strait School District Scop & Sequence

4th Grade Sequence #5: Living Things Plants

5th Grade Sequence #6: Living Things Plants

Materials

- A small potted plant with soft leaves (like a geranium)
- Colored pencils
- Masking tape
- Aluminum foil
- Resealable plastic bags
- Student Worksheet: Photosynthesis
- Growing lamp (optional)

Extension Activity

- Petroleum Jelly
- Ruler
- Hand lens
- Extension Worksheet: How Plants Grow

Multimedia

REACH Multimedia 4-6: "Photosynthesis"

Available at: www.k12reach.org

Additional Resources

HSP IV: Ch. 2, Lesson 2

HSP V: Ch. 3, Lessons 1, 2

Activity Preparation

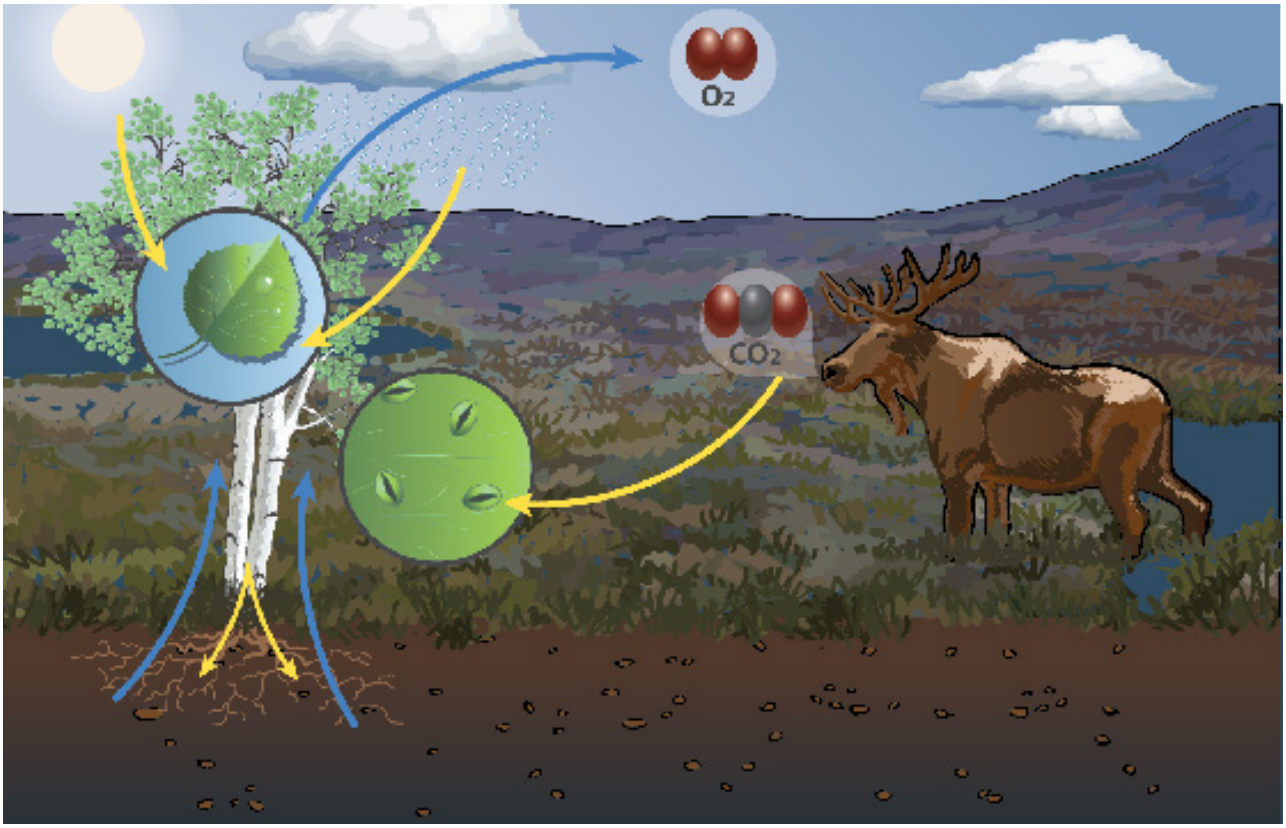
1. Gather all materials.
2. Make copies of Student Worksheet: Photosynthesis.
3. Read the Whole Picture section for teacher background information.

Whole Picture

Other than lichens and mosses, most of the plants we encounter in the BSSD region are vascular plants. Vascular plants are composed of a system of tissues, xylem and phloem, designed for transporting water, nutrients, and food to particular parts of the plant. Xylem is the vascular tissue that carries water and nutrients from the roots to other parts of the plant. Phloem is the vascular tissue designed for carrying food from the leaves to the plant cells.

Photosynthesis takes place primarily in the leaves of plants (though some vascular plants, like

cacti, depend greatly on the photosynthesis that happens in the stems). In photosynthesis, the plant makes sugar by using sun energy, carbon dioxide, and water. Chloroplasts inside the leaf cells absorb sunlight. The stomata (tiny holes on the leaf surface, usually on the bottom) let in carbon dioxide. These sugars are then transported by the phloem back to the rest of the plant, and oxygen, a waste product, is emitted back into the air.



Other types of plants in the BSSD region include mosses and lichens — neither of which are vascular. Mosses are nonvascular plants, meaning they do not have a system of vascular tissues (xylem and phloem) through which nutrients, water, and food are carried. Instead, water and nutrients are absorbed directly by the plant cells. Because of this, mosses can dry out, and appear to be dead, but actually spring back to life when water returns. Lichens, a primary food for caribou, are an entirely different type of organism. In fact, lichens are composite organisms — part fungus and part photosynthetic partner (like green algae), living in a symbiotic relationship. Both the fungus and the photosynthetic partner gain water and nutrients primarily from the air. Unlike other plants, lichens do not have roots, and so can grow where other plants would not be able to (like on stones and branches).

Scientists, elders, and culture bearers alike have noticed changes in plant structure and timing as the result of climate change. Scientists with the USGS (the U.S. Geological Survey) are currently

studying the effects of climate change on plants in the Arctic and subarctic. They've found that warming temperatures and melting sea ice impact plants in a myriad of ways. In some areas, plants have been completely lost due to salt water inundation. In others, warmer temperatures make plants produce "more biomass that is of relatively lower nutrient content" (USGS). These changes make it difficult to continue depending on particular areas and species for subsistence.

In Savoonga for example, Paul Rookook and Jeanette L. Aya have noticed a change in the timing and quality of plants. Where once plants were tender, and could be harvested at leisure, they are now tough and easily burned by the sun. Too, they seem to be growing more quickly and during unexpected times. In the past, Jeanette L. Aya says, it was "as though time stood still" — people had time to gather. Now, the plants are nearly useless by the time they are first noticed (Aya, 2011). Plants need to be harvested before they flower, otherwise they become tough and woody; but timing is off — plants are flowering before the snow even melts (Asicksik, 2010). Shaktoolik resident, Teresa (no last name provided) added that an additional challenge is the time it takes to harvest. Unlike the past, people have to spend more time searching for plants that haven't been stunted or burned by the sun, and the resulting harvest yield is much lower than in times past.

There are no certainties in the types of plant changes that will come as the result of climate change. But it is clear that these changes are happening and people feel impacted by them.

Vocabulary

photosynthesis the process plants use to make sugar

Activity Procedure

DAY 1

1. With students, brainstorm things they need to survive. (Guide students to narrow the list to air, water, food, and shelter.)
2. Broaden the brainstorm to include plants — What do plants need to survive? (Answers: light, air, water, nutrients, space).
3. Instruct students to think about where their own food comes from (they may say from hunting, whaling, fishing, gathering, or the village store).
4. Explain that plants are special because they can make their own food through a process called *photosynthesis*.
    a. Explain that photosynthesis happens mostly in the leaves, and is a process where plants take the energy from the sun, carbon dioxide from the air, water from the plant's root system and the air, and nutrients from the soil to create sugars that it uses for food.
5. Explain that students will investigate the leaves of a plant to learn how photosynthesis works.
6. Pass out the Student Worksheet: Photosynthesis.

7. Show students the plant, and allow them to touch the leaves.
8. Instruct students to draw a picture of the leaves (including coloring) in Section 1 of their worksheet (in the "Before" column).
9. Instruct a student volunteer to put a piece of masking tape over a section of one of the leaves.
10. Instruct another student volunteer to wrap a small piece of aluminum foil around a section of a different leaf.
11. Instruct a third student volunteer to carefully pluck a leaf (or two if the plant has many) from the plant and place it in a resealable plastic bag (ensure that the student has successfully closed the bag).
12. Place the plant and the plastic bag with the leaf in a sunny spot in the classroom, or under a growing lamp.

DAY 2

1. Instruct students to examine the leaf in the bag. What do they notice? (There should be moisture inside the bag.)
2. Explain that this moisture comes from the leaf. During photosynthesis, water is released from the leaves of the plant.
3. Invite students to draw a diagram of the leaf in the bag in Section 2 of their Student Worksheet: Photosynthesis. They should also write their observations in 2A on their worksheet.

DAY 3

1. After three days, invite student volunteers to carefully remove the tape and foil and observe these areas of the leaves. (The leaves should be brown and crisp in the areas where the tape and foil were. If they are not dead, they should be nearing dead).
2. Students should also observe the leaf that was placed in the plastic bag. On their Student Worksheet: Photosynthesis they should note any changes from the previous day in Section 2.
3. Discuss what happened. Instruct students to complete Section 1 on their Student Worksheet: Photosynthesis. Assist as necessary.

Extension Activities

1. To further explore transpiration (the process by which a leaf gives off water vapor), ask students how they think the leaf produces water — e.g., where does it come from? Students may think there are tiny holes in the leaves. To investigate this, instruct students to rub petroleum jelly over the leaf and place it back in the bag for a day. Does it produce more moisture? (No.) This is because the stoma (the holes through which the leaf gives off water and oxygen and takes in carbon dioxide) are blocked by the petroleum jelly.

2. To further investigate plants and how they grow and live, allow students to inspect the potted plant from roots to leaves. Use the Extension Worksheet: How Plants Grow.
    a. Instruct students to closely observe and record information about the leaves of the plant. Students can measure the length and width of a few leaves, then calculate the average length and width of all leaves. Invite students to observe the leaves by using a hand lens. Students should record all findings on their worksheet.
    b. Instruct students to carefully observe the stems on the plant. They can use the hand lens to observe it in more detail. Students should determine whether the stem bends (without breaking it) and whether it has branches. Students record their findings and observations on the worksheet.
    c. Hold the potted plant upside down, and gently tap the pot until the plant comes out. Shake the soil from the roots so that they can be easily seen (be sure to reserve the soil so that the plant can be repotted after the activity).
    d. Instruct students to carefully observe the roots. They should use a hand lens to observe in more detail. Students can use a ruler to measure the length of some of the roots. Students should record their observations on their student worksheet.
    e. Discuss with students what they can infer about the function of each part of the plant (answers might include: roots hold the plant in place in the ground and draw up water and nutrients; stems hold up the leaves and bring them water and nutrients; leaves absorb energy from the sun; veins (that can be seen in the leaves, but exist throughout) act as tubes carrying water and nutrients to the plant.

Answers

1A. The leaf turned brown / yellow in this area; it is no longer soft, but is now crisp and papery. This happened because the leaf did not have access to sunlight to complete photosynthesis.

1B. The leaf turned brown / yellow in this area; it is no longer soft, but is now crisp and papery. This happened because the leaf did not have access to sunlight to complete photosynthesis.

2A. There is moisture inside the bag. The moisture comes from the leaf as it transpires.

References

Asicksik, Eugene. (2010). *Stories About Adaptation and Subsistence: Native Voices from the Frontlines of Climate Change.* Aksik. Accessed from: http://aksik.org/village/shaktoolik.

Aya, Jeanette L. (2011). *Stories About Adaptation and Subsistence: Native Voices from the Frontlines of Climate Change.* Aksik. Accessed from: http://aksik.org/village/savoonga.

Rookook, Paul. (2011). *Stories About Adaptation and Subsistence: Native Voices from the Frontlines of Climate Change.* Aksik. Accessed from: http://aksik.org/village/savoonga.

Teresa (no last name) (2011). *Stories About Adaptation and Subsistence: Native Voices from the Frontlines of Climate Change.* Aksik. Accessed from: http://aksik.org/village/shaktoolik.

USGS. (n.d.). "Changes in Plant Forage and Phenology and the Response of Wildlife Populations." *Changing Arctic Ecosystems.* Accessed from: http://alaska.usgs.gov/science/interdisciplinary_science/cae/arctic_coastal_plain.php.

Student Worksheet: Photosynthesis

Name: _____

Section 1

In the boxes below, draw a picture of the leaves on the plant before you covered them with tape / foil and after.

Before	*After*

1A. What happened to the place on the leaf that was covered with tape? Explain why this happened.

_____

_____

_____

Student Worksheet: Photosynthesis

Name: _____

1B. What happened to the place on the leaf that was covered with foil? Explain why this happened.

_____

_____

_____

Section 2

In the space below, draw a picture of the leaf in the bag. Be sure to label any moisture.

2A. What do you notice about the leaf that was placed in the plastic bag? Why do you think this happened?

_____

_____

_____

Extension Worksheet: How Plants Grow

Name: _____

Part 1: In the chart below, record your measurements and observations for each part of the plant.

Plant Part	Details	Observations
Leaf	Length: Width:	
Stem	Bend (circle one): Yes No Branches (circle one): Yes No	
Roots	Shape: Length:	

Part 2: In the space below, draw a diagram of the plant. Be sure to label all the parts, including the roots, stem, and leaves.