

Evidence of Photosynthesis

Purpose

Students will describe how plants use the energy from light to make sugars from carbon dioxide and water to produce food that can be used immediately or stored for later use.

Materials

For the teacher: copy of Black Line Master (BLM) *Teacher Prep*, aluminum foil, 5 potted bean plants, 4 hot plates, 4-250 ml beakers, water, 300 ml isopropyl alcohol, 2-600 ml beakers, 1 g iodine crystals, 2 g potassium iodide, 4 small beakers, 4 medicine droppers, copy of BLM *Evidence of Photosynthesis*

For each student: science journal, pencil or pen, goggles

For each group of students: forceps, microscope slide, microscope, copy of BLM *Evidence of Photosynthesis*, petri dish, clear nail polish

Activity

A. Pre-Activity Preparation

Prepare the lab as indicated on the BLM *Teacher Prep* and put one bean plant in an area accessible to all students.

B. Pre-Activity Discussion

1. Ask students to describe what they know about *photosynthesis*.
2. Ask for volunteers to sketch the process of photosynthesis on the chalkboard. Discuss how photosynthesis takes place when plants use light energy to make sugars from carbon dioxide and water.
3. Draw a picture of a plant. Ask students if they know how plants obtain energy from sunlight, how they obtain carbon dioxide and water, and where and how the sugars are made and stored.
4. Discuss how plants obtain water through their roots.
5. Tell students that they will work on a two-part investigation to answer other critical questions about photosynthesis.

C. Activity #1

1. Ask students: "How do plants obtain carbon dioxide for photosynthesis?"
2. Divide students into groups of two or three and distribute a microscope slide, forceps, microscope, clear nail polish, and a copy of the BLM *Evidence of Photosynthesis* to each group.
3. Direct students to follow the procedure for Activity #1 on the BLM.
4. Guide students as they observe the stomata under the microscope.

(continued)



MEETING INDIVIDUAL NEEDS

Have students who need an extra challenge read *Science Fair Success With Plants*, by Phyllis J. Perry. Encourage students to carry out one of the 25 experiments with plants.



EXTENDING THE ACTIVITY

Direct students to form hypotheses and design and carry out experiments to find out what would happen if plants could not obtain carbon dioxide.

Activity (continued)


5. Explain that gases are exchanged through the stomata: carbon dioxide enters the plant through the stomata and oxygen leaves the plant through the stomata.


D. Activity #2


1. Say to students: “We know how plants obtain water and carbon dioxide for photosynthesis. How do they obtain sunlight?”
2. Explain that the leaves of green plants contain a chemical called *chlorophyll*. Explain that chlorophyll is found inside parts of plant cells called chloroplasts and that chloroplasts are primarily found in the leaves of plants.
3. Tell students that chlorophyll traps energy from sunlight and that this trapped energy is used in a chemical reaction transforming carbon dioxide and water into sugar. Explain that plants store extra sugars as starch, making an energy reserve.
4. Discuss with students how plants make sugars during photosynthesis, which are stored as starch when the plant makes more sugars than it needs. Ask students: “Knowing that light, carbon dioxide, and water are needed for photosynthesis, what do you predict will happen if a plant does not receive sunlight?”
5. Discuss student responses and direct the groups to proceed with Activity #2 on the BLM *Evidence of Photosynthesis*.
6. Monitor and guide students as they work.
7. Discuss students’ observations and ask: “What can you conclude from your results with the starch test?”
8. Discuss how chloroplasts need light in order to make glucose and that the plants that were not exposed to light were unable to make glucose because light could not reach the chloroplasts. Explain that the plant had to use its stored energy (the starch) to replace the food it was unable to make without access to sunlight.


Classroom Assessment**Basic Concepts and Processes**

At the end of the activity, ask questions, such as the following:

 Describe how plants use light, carbon dioxide, and water to produce food that can be used immediately or stored for later use.

 How does the exposure of plants to light affect their production of sugar?

 How do you know?

 How would starch production be affected if a plant could not obtain carbon dioxide? Water?

Teacher Prep

Preparation for Activity #2:

1. Place two bean plants near a lamp that can be left on during the night and ensure that the plants are exposed to light constantly for four days.
2. Place two additional bean plants in a box and cover the box to ensure that no light is present, such that the plants are in constant darkness for four days.
3. Prepare the iodine solution by dissolving 1 g iodine crystals and 2 g potassium iodide in 300 ml water.
4. Set up three stations for the class to use:

Station A

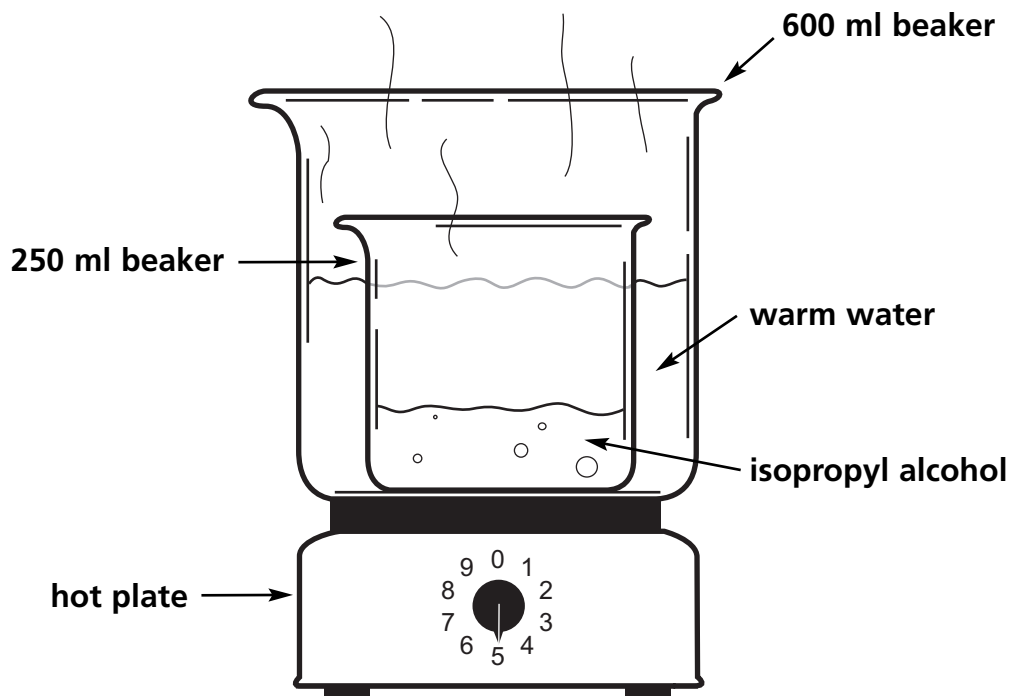
- Place the light-exposed plants and the box containing the dark-exposed plants at the station. Label each plant.

Station B

- Fill two 250 ml beakers with 150 ml isopropyl alcohol each. Place each beaker into a 600 ml beaker filled with 300 ml water. Heat the water enough to bring the alcohol to a gentle boil. [Refer to diagram below for set-up.]
- Fill two 250 ml beakers with 150 ml water each.

Station C

- Pour iodine solution into each of four small beakers with medicine droppers.
5. Safety concerns: the water does not need to boil to warm the alcohol enough to boil (alcohol has a much lower boiling point). Heat the water only enough to cause the alcohol to boil and ensure that the water does not completely evaporate. **Caution: The alcohol should NEVER be exposed directly to the heat source or it could ignite.**



Teacher Prep

Teacher Directions

Use the BLM *Teacher Prep* to prepare the lab for Activity #2 on the BLM *Evidence of Photosynthesis*.

Answer Key

Not applicable.

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Activity #1: Identification and Observation of Stomata

- ❖ Carbon dioxide enters through tiny openings on the surface of the leaf. These openings are called stomata (singular: stoma). What do stomata look like up close?

1. Obtain a leaf from the bean plant.
2. Coat an area on the underside of the leaf (about 1 cm²) with a thin layer of nail polish.
3. Allow the nail polish to dry and then carefully peel the layer off using forceps.
4. Place the layer of nail polish on the slide, ensuring that the layer is flat.
5. View the slide using the low-power objective and locate a few stomata. You may have to adjust the coarse-adjustment knob until the stomata come into focus.
6. Draw and label what you see in your science journal.
7. Switch to the high-power objective and locate one stoma.
8. Draw and label what you see in your science journal.

Activity #2: Testing for Evidence of Sugar Production During Photosynthesis

- ❖ Plants produce sugar during photosynthesis. Some of the sugars are used right away for other cell processes, but much of the sugar is converted into starch (another type of sugar) and stored for later use (as animals store excess energy as fat).
- ❖ The presence of starch can be identified fairly easily. When iodine and starch react, the combination turns a deep blue-black color.

Preparation of Leaves for Starch Test

1. At Station A, remove a leaf from one of the bean plants exposed to light and cut off the stem with scissors.
2. At Station B, take turns with other groups to place your leaf into the beaker of boiling alcohol for three minutes.
3. Use forceps to remove the leaf.
4. Place the leaf in the water for 30 seconds.
5. Remove the leaf from the water and place the leaf in a petri dish.

Testing Leaves for Starch

6. Move to Station C.
7. Cover the leaf with iodine solution.
8. Record your observations in your science journals.
9. Return to Station A and remove a leaf from one of the bean plants kept in the dark and cut off the stem with scissors.
10. Make sure to close the box to prevent the plants from being exposed to the light and repeat steps 2 through 8 with this leaf.