



## ACTIVITY

# Photosynthesis Phun

### Summary:

*Participants explore plant needs with live plants.*

### Grade Level:

1-8

### Time:

3 or more 30-minute sessions over four weeks

### Learning Objectives:

*Participants will be able to:*

- ◆ Identify the four basic plant needs, and describe how each is important.
- ◆ Predict what would happen to plants lacking these needs.
- ◆ Formulate a hypothesis.
- ◆ Test hypotheses with live plants.

### Materials Needed:

- ◆ Poster board, butcher paper, or dry-erase/chalkboard
- ◆ Markers, pencils and/or chalk
- ◆ 50 bean, pea, alfalfa, or sunflower seeds
- ◆ Paper towels
- ◆ Copies of both worksheets
- ◆ Approx. 20 containers for planting seedlings (2 egg cartons will do)
- ◆ A small bag of potting soil
- ◆ A gallon glass jar
- ◆ Colorful construction paper and glue, OR notebook paper, graph paper, and pencils
- ◆ Optional: several room plants for demonstration

### Background:

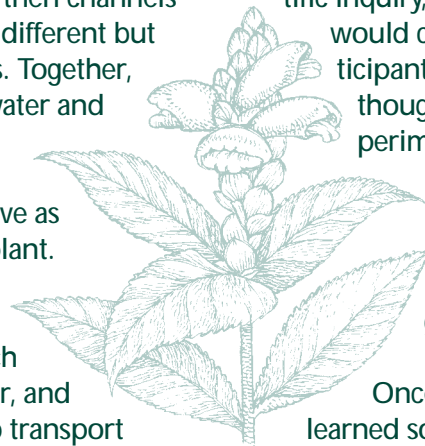
In order to survive and grow, green plants need sunlight, water, soil, and carbon dioxide from the air. They need sunlight for the energy to convert water and carbon dioxide into the simple sugars they use for food. Water transports food and other nutrients, and with carbon dioxide, serves as important building material. Plants need soil to hold their roots in place and provide nutrients, such as nitrogen, to help with growth.

Green plants are called **primary producers** because they, unlike most other organisms, manufacture their own food. Plants do this in a process called **photosynthesis**. In photosynthesis, plant leaves act like solar panels to collect sunlight. A pigment called **chlorophyll** absorbs the energy collected, then channels this energy to power different but interrelated reactions. Together, these reactions use water and carbon dioxide to generate simple sugars, which in turn serve as food energy for the plant. Other by-products of photosynthesis include oxygen, which is released into the air, and water, which helps to transport nutrients to the rest of the plant.

There are certainly many other plant needs, including the right amount of space, special nutrient requirements, and certain conditions for plant reproduction and seed germination, but since these can all be highly variable from plant to plant, this activity focuses on the four basic needs above. Participants may be able to devise different experiments to explore these other plant needs.

This activity allows participants to explore the different needs of plants. It is also an inquiry-based activity, so in essence, it follows the scientific method. According to the scientific method, participants will begin this activity by making general observations (in this case, observations about plants). These observations are followed by questions raised by participants. In true scientific inquiry, these questions would come from the participants themselves, though to facilitate the experiment the instructor may suggest questions (e.g., “*What do plants need to survive?*”) to the group.

Once participants have learned some background information regarding their ques-



Here is a simplified chemical equation for photosynthesis:





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tions, they may formulate a plan as to how they might test out these ideas. Again, this activity deviates from the scientific method in that the basic plan for how to run the experiment has already been laid out. However, if you have the time, we encourage you to have participants come up with their own experiments from their questions.

Before they execute a plan, participants will form **hypotheses**; they will guess the outcome of their experiment based on background information available to them (e.g., “When we stop watering the plant it will stop growing, dry up, and die in two days.”). After formulating and recording their hypotheses, they will perform the **experiment** (e.g., to test for sunlight, they might hide the plant away in a dark closet) and **collect data**. Finally, they will **analyze** the data, propose different answers based on their results and background, and write a **conclusion** about the results of the experiment. A conclusion compares the results of the experiment to the participant’s hypotheses and suggests reasons why the two did or did not match. Often in science, a conclusion will wind up stimulating more questions than it answered.

### What to Do:

**Preparation:** About three weeks before beginning the experiment portion of this activity, it is necessary to prepare about 50 bean, pea, or alfalfa seeds for planting. Have participants place the seeds in a clear container (a glass jar will do fine), on a bed of damp paper towels. It is important that the seeds stay moist and get enough sunlight, so keep them near a window and monitor the towels’ moisture over the weeks. When roots and leaves begin to develop, the plants, called “seedlings” at this point, will be ready for planting. Have participants watch over the weeks as the seeds develop into seedlings.

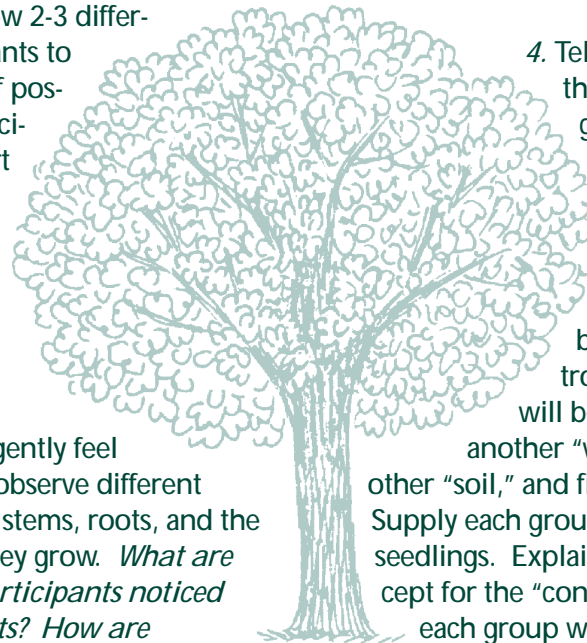
1. When the seedlings are ready for planting, you are ready to start the activity. Show 2-3 different kinds of plants to the group, or, if possible, take participants on a short tour of a garden with many different kinds of plants. Ask participants to observe the plants closely. Allow them to gently feel and otherwise observe different types of leaves, stems, roots, and the soil in which they grow. *What are some things participants noticed about the plants? How are*

*the plants alike? How are they different?*

2. Ask participants, *What elements do plants need to survive?* Make a list of answers on a chalkboard or a piece of butcher paper. Talk about each one briefly. Participants should understand that all plants need sunlight, water, soil, and air to survive. *How do they know these things are true? How could they test whether these are truly basic needs or not?* Brainstorm and discuss some of their ideas.

3. Tell them that for the experiment, they will test the importance of each basic plant need by depriving some of the plants of those needs. Ask participants, *What would happen to a plant that was given no sunlight? What about air? Water? Soil?*

4. Tell participants that each group will take care of a specific part of the experiment. One group will be the “control,” another will be “light,” another “water,” another “soil,” and finally, “air.” Supply each group with four seedlings. Explain that, except for the “control” group, each group will test the





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importance of a different plant need by depriving the plant of one such need (e.g., sunlight) and noting the effects. The group called “control” will give their plants all basic plant needs, so that the others can compare their plants with a healthy one. If possible, have volunteers oversee small groups.

5. Hand out the data collection sheet and ask each group to come up with a hypothesis as to what will happen to their particular plants over the next four weeks. Have them write down their ideas on the worksheet, and to be as specific as they can. For example, the soil group might write, “We think that since the seedlings survived without soil, and since plants only need soil to hold their roots, the plants will grow normally but might not be able to stand as tall.” It is important to note that a hypothesis does not have to be correct; the point of the experiment is to test out participants’ ideas. A hypothesis should, however, have some basis in what participants may already know or have learned in group discussion or research.

6. Give the following instructions to the five different groups. If participants come up with different plant needs, (e.g., a certain amount of space, a certain type of soil, unpolluted water, just the right amount of water), or if testing all four different plant needs is not workable, tailor the activity accordingly.

- Have the control group plant their four seedlings in four small cups filled with potting soil (they can use four parts of an egg carton for this). Have them label the cups “Control,” and place them in a well-lit area (in sunlight or under a grow lamp). Participants should water the plants just enough so that the soil remains moist.
- The group testing for sunlight should plant their seedlings in four similar cups, label them with the word “Light,” and circle the word and put a slash mark through it. Have the group cover the plants loosely with a dark cloth or place them in a dark closet. Have participants water the plants as the control group above.
- The water group should do everything the control group did (plant seedlings in soil, keep in a well-lit area), except water the plant. They should label their plants “Water,” then circle the word and put a slash mark through it.
- To test for the effects of a lack of soil, participants in the soil group should place seedlings in small containers, but instead of soil they should use damp paper towels. Participants should label these plants “Soil” with a slash mark through it. They should keep the plants in a well-lit area and keep the paper towels moist.
- Finally, have the air group plant their seedlings in four small cups with a good amount of potting

soil. Have them place the cups in a large-mouthed, clear jar that has a good seal on it. This group should water the plants as needed, and label the plants “Air” with a slash through it.

*Note: It is very likely that the “air” experiment will produce healthy plants. This is largely because of a process called respiration, in which energy stored by photosynthesis is released. In this process, simple sugars react with oxygen to create carbon dioxide and water. This is the reverse of photosynthesis, so it is conceivable that a plant in an “air-tight” jar will recycle its byproducts from one process to the next and essentially reuse its own air. It is also unlikely participants will be able to create a truly airless environment, though they may have some ideas after the experiment. Encourage participants to suggest reasons their plants did or did not do well in this environment.*

7. Have each group measure their plants on the first day and record this initial measurement. They should measure height, color, number of leaves present, and thickness of the stalk.

8. As time passes, have each group make observations of their plants. Each week, ask groups to measure the height of the plants with a ruler or with a strip of colorful construction paper. Younger participants

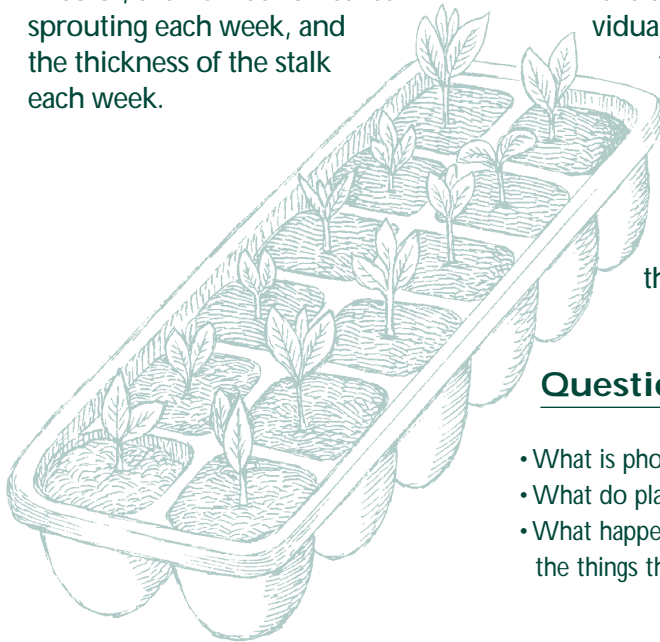




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(i.e., 3rd grade and below) may need to use the construction paper, and should use different colors each time they measure. To show their results, younger participants should create bar graphs with the different colored strips of paper, each color representing a different day. On the other hand, participants measuring plants with rulers should record their data on the data collection sheet provided below. By recording data, they can later create graphs on graph paper, with inches on the left-hand (vertical) axis and time in weeks on the lower (horizontal) axis. Other observations include plant growth rate, which participants can figure by dividing how much the plant has grown by the number of weeks passed. Also, have them observe any change in color, the number of leaves sprouting each week, and the thickness of the stalk each week.



9. At the end of the set growing period (four weeks or so), discuss with all the participants what they discovered. Ask each group to show how their plants grew over time. Discuss which plants grew the most, which did not grow as much, and any other differences between the plants. Have participants revisit their hypotheses and check and see how they match with what happened. Have them write up a conclusion on their worksheets. Wrap up with a review of the different things plants need to survive.

### For Older Participants (Grades 7 and Up):

Have participants work in pairs to test one of the conditions AND have their own control, individually comparing results between the two plants. After the initial experiment, ask them to come up with additional questions and design an experiment to test these questions.

### Questions:

- What is photosynthesis?
- What do plants need to grow?
- What happens if they do not have one of the things they need?

### Adaptations:

*Refer to general adaptations on pages 11-16.*

### Hearing Disabilities:

- Make a poster depicting photosynthesis to illustrate the process.
- Use hands-on examples to illustrate plant needs. Suggestions: a squirt bottle of water for water, a fan for air, a grow lamp for sunlight, and a soil sample for soil. Encourage participants to experience each of the plant needs. You may also go outside and view/discuss representations of each need.
- If desired, use different colored blocks to help illustrate the chemical breakdown of photosynthesis (e.g., red = carbon dioxide, etc.). Have participants create the chemical chain with blocks to help illustrate the concept.

### Learning/Cognitive Disabilities:

- Make a poster depicting photosynthesis to illustrate the process. Use minimal text on the poster as appropriate.
- Use hands-on examples to illustrate plant needs. Suggestions: a squirt bottle of water, a fan for air, a grow lamp for sunlight, and a soil sample for soil. Encourage participants to experience each of the plant need samples. You may also go outside and view/discuss natural representations of each plant need.
- As appropriate, use different col-





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ored blocks to help illustrate the chemical breakdown of photosynthesis (e.g., red = carbon dioxide, etc.). Simplify as needed. Assist participants in creating the chemical chain with blocks to help illustrate the concept.

- Have pre-printed plant group labels available for participants who have difficulty writing.
- Provide a small tape recorder for participants who have difficulty writing to track their plants' progress or have a partner assist with completing the worksheet.
- Consider taking instant photographs and having them create a photo journal of the experiment.
- Have participants make a bar graph using strips of colored paper to chart plant growth. Have partners assist as needed.

### ***Motor Disabilities:***

#### *Overall:*

- Make sure plants are kept in an accessible spot for participants who use wheelchairs.

#### *For participants with limited muscle strength, coordination, or dexterity of the hands:*

- Use an ice cream scoop or build up the handle on a spoon with tape or foam for planting.
- Use beans or larger seeds that are easier to handle. Have partners assist as needed.
- Put a piece of no-slip material down under the plant containers when working for participants

with spasticity. You may also use clay to attach plant containers to the work surface.

- Have pre-printed plant group labels available for participants who have difficulty writing.
- Have participants use a turkey baster or spray bottle to water their plants as needed.
- Have participants make a bar graph using strips of colored paper to chart plant growth. Have adaptive scissors available to cut the strips. Have partners assist as needed.
- Consider taking instant photographs and having them create a photo journal of the experiment.

### ***Visual Disabilities:***

#### *Overall:*

- Use beans or larger seeds that are easier to handle.
- Have partners verbally guide participants through planting, measuring, and collecting data as needed.
- Use hands-on examples to illustrate plant needs. Suggestions: a squirt bottle of water, a fan for air, a grow lamp for sunlight, and a soil sample for soil.
- Encourage participants to experience each of the plant

need samples. You may also go outside and view/discuss natural representations of each plant need.

- Make a tactile poster of photosynthesis using different fabrics. Label poster in large print and Braille. Encourage participants to explore the poster.
- Have participants make a bar graph using strips of heavy paper or fabric to chart plant growth. Have partners assist as needed.

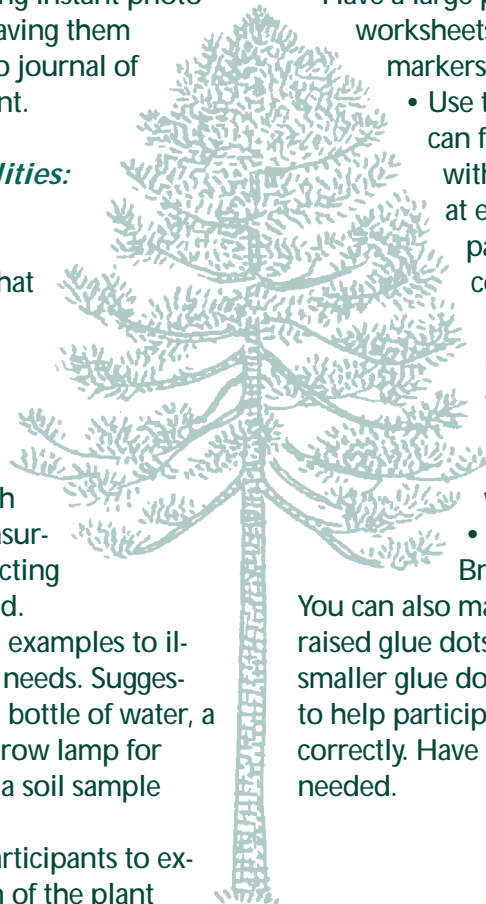
#### *For participants with low vision:*

- Have a large print version of the worksheets. Provide thick black markers to use.
  - Use the largest ruler you can find. Mark the ruler with raised glue dots at every inch to help participants measure correctly.

#### *For participants who are blind:*

- Have a Braille version of the worksheets available.
  - If possible, have Braille rulers available.

You can also mark a ruler with large raised glue dots at every inch and smaller glue dots at every half-inch to help participants measure correctly. Have partners assist as needed.





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WORKSHEET

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**Plant group title** (e.g., "control," "air," "soil," "water"): \_\_\_\_\_

**Method** (How did you run your experiment?):

**Group hypothesis** (i.e., an educated guess as to what is going to happen to the plants for the next 4 weeks):

**Conclusion** (What happened in the end? How well did the results match up with your hypothesis?):



## DATA COLLECTION SHEET

Data for:	Week 1	Week 2	Week 3	Week 4
Plant Height (in cm)				
Plant Growth Rate (in cm)				
Plant Color (describe as closely as possible, and especially note changes in color from week to week)				
Number of Leaf Sprouts				
Thickness of Plant (in cm, use decimal if less than 1 cm)				