



# Photosynthesis

## Educator Notes

### Learning Objectives

- Describe the process of photosynthesis and be able to apply the photosynthesis equation: Sunlight + Water + Carbon Dioxide --> Oxygen + Glucose (Food)
- Predict how restricting the amount sunlight, water, or carbon dioxide might affect a healthy plant

### Introduce the Challenge

#### Ask (Photosynthesis Discussion)

- Show your students the STEMonstrations: Photosynthesis video found at <https://www.nasa.gov/stemonstrations>
- Show students a live plant and ask them to think about what they already know about plants. Guide students toward the idea of plants being living organisms and ask students what keeps plants alive and growing. Have the class brainstorm ideas explaining how a plant might get its food.
- Print double-sided and handout one Photosynthesis Foldable to each student and have them fold it in half on the dotted line
- Discuss with the students the process of photosynthesis and provide the photosynthesis equation for students to write down inside their foldable where indicated
  - Ask students to predict the outcome if water is removed from the equation
  - Repeat the same process but for carbon dioxide. What would happen if carbon dioxide were removed from the photosynthesis equation?
  - Ask students what they think would happen to a plant if sunlight is removed from the photosynthesis equation
  - Have each student write their hypothesis on their foldable, stating what they think would happen to a plant if it doesn't get enough sunlight. Have some students share their hypotheses with the class.



NASA astronaut Peggy Whitson poses with cabbage plants in the Vegetable Production System (Veggie) bellows in the Harmony Node 2. **Credits: NASA**

## Grades 6 to 12

### Suggested Pacing

6 days (2 - 2.5 hours total)

Experiment Setup (50 minutes)

- Photosynthesis Discussion – 15 min
  - Experiment Setup – 35 min
- Observation Days 1-4 (40 min total)
- Record observations – 10 min per day

Day 5 (50 minutes)

- Record observations – 10 min
- Post-activity discussion – 10 min
- Summary Assignment – 30 min

### Materials

- Two small, healthy potted plants with large leaves for each group
- Photosynthesis Student Worksheet
- 1 Photosynthesis Foldable per student
- Enough construction paper squares to fully cover all the leaves of one plant per group
- Small paperclips
- 1 Permanent marker
- 1 Piece of notebook paper per student
- Colored pencils or crayons

### Next Generation Science Standards

- MS-LS1-6
- HS-LS1-5

## Facilitate the Challenge

### Plan (Experiment Setup)

- Split students up into groups of three or four and provide each group with two potted plants of the same type, and roughly the same age and size. Have students observe the plants, taking note of the overall health, leaf color, and any other specific features of each plant. Students write their observations in the Initial Observations portion of the student worksheet.
  - This is a great opportunity to discuss with your students what an experimental control is and why it is important to have one during a scientific investigation. Ask students to indicate which plant is the control in this experiment; then with a permanent marker, have each group label one pot as the “experiment” and the other as the “control.”
- Inside the foldable, have students illustrate their hypothesis. Students draw what they believe their plant might look like after five full days without sunlight.
- Have students fold their paper and write their name, group name, date, and period at the top. Collect their foldables and hold onto them until the last day of the experiment.
- Give each group pre-cut construction paper squares and paper clips to cover all the leaves of their experimental plant. Have students place the paper squares over the top of each leaf of the experimental plant and paperclip the squares to those leaves. Upon completion, the experimental plant should have all leaves covered and the control plant should have all leaves exposed.

### Test (Observation Days 1-4)

- Place all plants in an area where they will receive adequate sunlight for five full days. Throughout this period, have students check their plants daily and water their plants when the soil becomes dry. Also, have students write down or illustrate any important observations or changes they see in each plant in the Daily Observations portion of the student worksheet. Students may take off a few paper squares to observe the plant for their daily observations; however, students should replace all paper squares immediately after making observations.

### Share (Day 5)

- Give your class a quick review of photosynthesis and briefly remind them why we are doing this experiment
- Place students into their original groups. Ask them to remove all paper squares to observe the leaves of the experimental plant.
- Return each student’s foldable. Ask them to compare their hypothesis drawing to the current condition of their experimental plant. Inside the foldable, have students draw what the experimental plant looks like now, after experiencing five days of little to no sunlight.
- What happens when sunlight is removed from the photosynthesis equation? Ask each group to look for any patterns in their daily observations, describe whether their observations support or reject their hypothesis, and draw conclusions. Remind students that a rejected hypothesis does not indicate a failed experiment.
- For their individual assignment, have students write a one-paragraph summary on a clean sheet of notebook paper. Students should include the following in their summary:
  - What is the purpose of this experiment? What question are you trying to answer?
  - State your hypothesis
  - Give a summary of the procedures used to carry out this experiment
  - Explain what an experimental control is, and why it is important to have one in an experiment. Describe how you used a control in your experiment.
  - Discuss your daily observations. Can you detect an observable difference between the two plants after five days?
  - Use your observations collected over the past five days to help you determine whether your hypothesis is supported or rejected
  - Make a concluding statement answering the original question about what happens to a plant if sunlight is removed from the photosynthesis equation?

## Extension

- Have students put their plants back in the sunlight for another five days without any paper squares and ask them to illustrate and hypothesize what will happen to the experimental plant. Continue to have students make daily observations and have them make another concluding statement after the five additional days.

## More to Explore

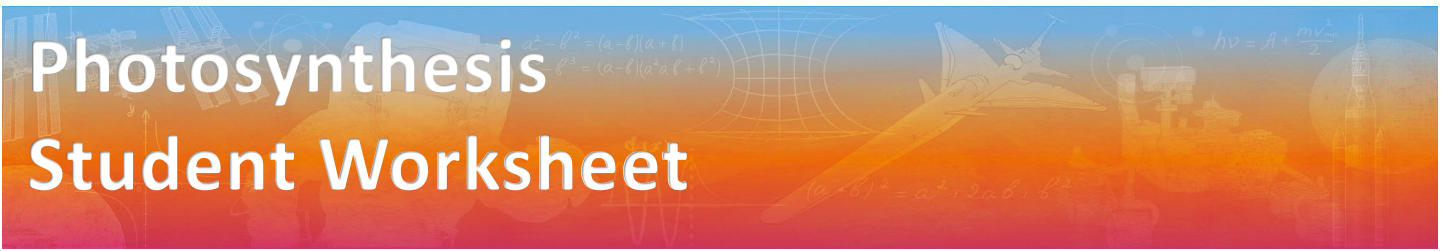
Using NASA Earth-observing satellite to Help Improve Agriculture and Water Usage

[https://qpm.nasa.gov/education/sites/default/files/lesson\\_plan\\_files/water-for-wheaties/AG\\_HS\\_Teacher%27s%20Guide.pdf](https://qpm.nasa.gov/education/sites/default/files/lesson_plan_files/water-for-wheaties/AG_HS_Teacher%27s%20Guide.pdf)

Global Phytoplankton Distribution Story Map

<https://mynasadata.larc.nasa.gov/lesson-plans/global-phytoplankton-distribution-story-map>





# Photosynthesis Student Worksheet

## Initial Observations

Date: \_\_\_\_\_

Drawings:

Control

Experiment

Notes:

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## Daily Observations

Day 1

Date: \_\_\_\_\_

Drawings:

Control

Experiment

Notes:

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**Day 2**

Date: \_\_\_\_\_

Drawings:

**Control**

**Experiment**

Notes:

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**Day 3**

Date: \_\_\_\_\_

Drawings:

**Control**

**Experiment**

Notes:

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**Day 4**

**Date:** \_\_\_\_\_

Drawings:

**Control**

**Experiment**

Notes:

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**Day 5**

**Date:** \_\_\_\_\_

Drawings:

**Control**

**Experiment**

Notes:

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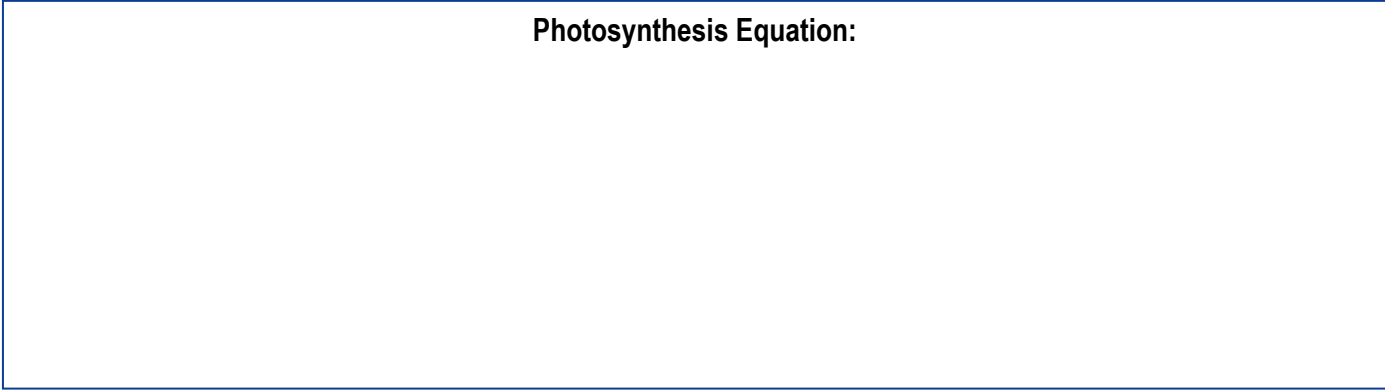
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Photosynthesis Foldable

**Photosynthesis Equation:**



My Hypothesis:

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*Fold here*

My Hypothesis Illustration

Day 5 Experimental Plant Illustration



*Inside*

Student Name: \_\_\_\_\_

Group Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_