



Summary:

Students simulate the process of photosynthesis through a whole-body demonstration

Grade Levels: (K-2) 3-4

Subject Areas: Dance, Environmental Literacy, Language Arts, Life Science, Mathematics

Setting: Classroom

Time:

Preparation: One-two hours

Activity: Three 50-minute periods

Vocabulary: Carbohydrate, Carbon dioxide, Chemical potential energy, Chlorophyll, Glucose, Greenhouse, Heat, Light, Light energy, Molecule, Oxygen, Photosynthesis, Solar energy, Sun, Synthesis, Thermal energy

Standards Addressed:

Common Core ELA: L.K.4.A, L.K.5.A&D, L.K.2.6, L.1.4, L.1.5.A-B, L.2.3, L.2.4.A-E, L.2.5.A-B, L.3.4.3, L.3.4.A-D, L.3.5.B, L.4.4.A-B, RI.2.4.3, RI.3.4, RL.4.5, SL.K.1.A, SL.K.3-4&6, SL.1.1.A-C, SL.1.4, SL.2.1.A-C, SL.2.2, SL.3.1.A-B&D, SL.3.3&6, SL.4.1.A-D, W.K.2&8, W.2.7

Common Core Math: MP5, 2.MD.1, 2.MD.2

NGSS: 2-LS2-1

SEP: Planning and Carrying Out Investigations

DCI: LS2.A: Interdependent Relationships in Ecosystems

CCC: Cause and Effect

EL&S: Connect: C1.A.i, C1.B.e

Explore: EX2.A.e, EX2.A.i, EX4.A.e, EX4.A.i

WI Env Literacy & Sustainability:

C1.A.i, C1.B.e, EX2.A.e, EX2.A.i, EX4.A.e, EX4.A.i

Materials:

- Picture or drawing of an animal such as a rabbit (optional)
- Growing plants that have turned their leaves toward the light (optional)

Continued next page

Photosynthesis Promenade

Objective

Students will be able to illustrate how plants use the sun's energy to make food.

Background

Photosynthesis is the process by which green plants use sunlight to produce carbohydrates such as glucose, other nutrients, and oxygen from simple compounds such as water and carbon dioxide. In energy terms, photosynthesis converts solar energy into chemical potential energy that is stored in carbohydrates.

Photosynthesis occurs when water is absorbed by the roots of the plant and is then carried to the leaves. Carbon dioxide then enters the plant through the leaves and goes into the plant cells that contain chlorophyll. Chlorophyll is the green pigment found in the chloroplasts of plants that are essential for producing carbohydrates by photosynthesis.

Photosynthesis gives off oxygen and takes in carbon dioxide while people take in oxygen and give off carbon dioxide. This makes photosynthesis a great example of how people and plants depend on each other.

Procedure

1. Ask the class for one volunteer to share with the class what they ate that day or the previous day. Write the name of the student on the board and then write the things the student ate around it. Pick one of the foods the student ate (fruits or vegetables are easiest) and discuss with the class where that food came from. For example, if the student lists an apple, draw an apple tree on the board. Then ask students what the apple needs to grow. As students list things draw them on the board as well. The key item students should identify is the sun.

2. Put a picture of a rabbit on the board (or write the word) and ask students to complete a food chain around the rabbit. For example, they might show the rabbit eating a carrot

that gets its energy from the sun and list a predator, such as a hawk, that eats the rabbit.

3. Have students explain what is happening between the links of the food chain, starting between the predator and the prey. They will probably be able to describe how the hawk eats the rabbit and the rabbit eats carrots, but how do they explain the connection between the sun and the carrot (or any plant)?

4. Ask students how they know plants need sunlight. Have students share their observations and thoughts about plants needing the sun. For example, students may have noticed how some plants turn their leaves toward the light. To fully address the science standards in this lesson, involve students in an investigation in which they prove plants need sunlight to survive. See *Suggested Sun Test Procedure* on the next page for ideas.

5. Students might know that plants need sunlight, but do they know how plants use the light? Have students provide explanations for how they think plants use sunlight. List their responses on the board.

6. Explain to students that sunlight helps the plant take air particles (carbon dioxide) and water and recombine them to build sugar particles (or molecules). Oxygen that we breathe is also created in the process.

7. Introduce the term photosynthesis. Students should recognize the root word "photo." Ask what they think it means. Help them understand that it means light. Students might also have heard the word synthesis or a related term, such as synthetic. Explain that to synthesize means to create or to make. See if students can use these explanations to develop a definition for photosynthesis. Make sure water, air, sun, sugar, and oxygen are included in the definition.

8. Have samples of fruit and vegetables handy that students can eat to taste the sweetness. Show students some plants and explain that plants use the sugar they create and other minerals from the soil to build their body structures (roots, stems, leaves, and fruit).

9. Explain that most plants are green because they contain a chemical called chlorophyll. This chemical helps the plant use the sun's light to make sugar out of water and air. If one is available, show students a picture of a magnified leaf cell with chlorophyll, or ask a biology teacher to let students look through a microscope at a leaf. You'll need to use a thin leaf such as one from a water plant or an elodea.

10. Involve students in simulating how water and air particles are recombined into sugar. Younger students can gain insight into the process of how materials are recombined to create something new through the *Chocolate Chip Demonstration*. Older students can participate in the *Photosynthesis Promenade*.

11. Have students revisit the food chain they created at the beginning of the lesson. Ask them to explain what is happening between each link, especially between the sun and the plant. Listen to see if they use the term photosynthesis.

Assessment

- Have students revisit the food chain they created at the beginning of the lesson. Ask them to explain what is happening between each link, especially between the sun and the plant. Listen to see if they use the term photosynthesis.
- Ask students to define and describe photosynthesis.
- Have students draw a picture or write a simple story about the role of the sun or the life stages of a plant. Check to see if students describe how the sun helps the plants make food out of carbon dioxide and water. out of carbon dioxide and water.

Suggested Sun Test Procedure

Ask students how they can prove that a plant will die without sunlight. If they suggest shutting a plant in a dark closet, what other things might the plant not get that could contribute to the plant's death? Help them to understand that if the plant is not watered or if it does not get air, it will also die. Students need to make sure they are testing for only one item or variable. Encourage students to develop their own test to show that plants need sunlight. Below is one procedure they might follow.



Plant seeds (bean or pea plants are recommended) and grow them to a few inches in height. Then allow one plant (the control) access to sunlight, water, and air. Have another plant get air and water, but no sunlight (put the plant in a dark closet). Let the third plant get sunlight and water, but no air (cover the plant with a plastic bag). Provide the fourth plant with sunlight and air, but no water. Make careful observations of what happens to each plant over a few days time. Then place plants in different situations/environments. Students should continue to collect daily height measurements and compare them to determine which plant is in the best environment to support growth.

- Fruits and vegetables
- Photographs of magnified leaf cells showing chlorophyll (optional)
- Props and materials for Photosynthesis Promenade (optional)
- Ingredients and equipment for making chocolate cookies (optional)

Related KEEP Activities:

Use "Photosynthesis Promenade" to enhance the KEEP activities "Food Chain Game" and "Energy from Food" (KEEP Energy Education Activity Guide) and to help students have a better understanding of how energy is stored in food and is transferred to humans when we eat. Available at keepprogram.org.

Resources:

www.sheppardsoftware.com/content/animals/kidscorner/foodchain/photosynthesis.htm

www.biology4kids.com/files/plants_photosynthesis.html

www.teachers-tools.com/photosynthesis-poster.html

<https://ed.ted.com/lessons/the-simple-but-fascinating-story-of-photosynthesis-and-food-amanda-ooten>

www.youtube.com/watch?v=zSDbts3i0Ak

Chocolate Chip Demonstration:

To help students appreciate how air and water are recombined to create sugar, show students a chocolate chip cookie and ask them how they think it is made. Describe how a cookie is prepared from scratch (or involve students in baking cookies). Explain (or show) that the different ingredients such as butter, flour, chips, sugar, water, etc. are combined, but that they do not actually become cookies until thermal energy (heat) is added. This process is much like a plant using sunlight to recombine carbon dioxide and water to make sugar.





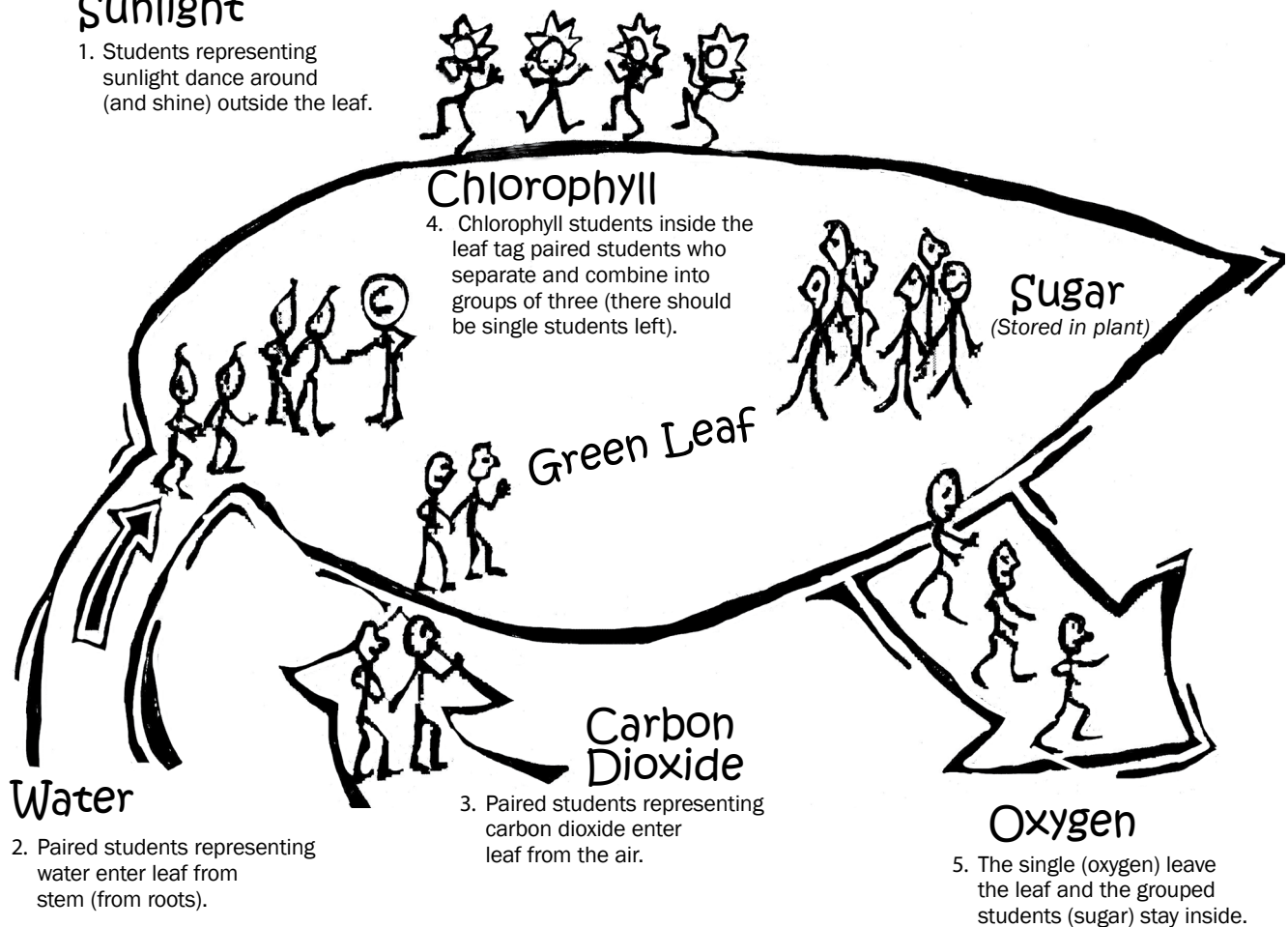
How to do the Photosynthesis Promenade

For the promenade, students might be interested in adapting the simulation into a dance or play with costumes and props. For example, students representing chlorophyll can be dressed in green (or use colored name-tags) and those representing the sun can be dressed in yellow and carry flashlights. A simple stage can be created to represent the leaf. Make sure students understand that this is a simple demonstration and does not represent the actual chemical process, which is very complex. If you do the simulation as a dance, consider playing music.

- Designate one section of the room as the leaf of the plant.
- Divide the class in half and have each half stand on either side of the leaf. Instruct students to stand in pairs. Pull out a few extra students to play the sunlight and chlorophyll. Direct the chlorophyll student(s) to stand inside the leaf area.
- Tell half the students they are air particles and the other half they are water that is coming to the leaves from the roots (drawn up from the plant's stem). It might be helpful to give them signs labeling them as water or air molecules (particles).
- Instruct students to file as pairs into the leaf area.
- Provide the students representing sunlight with a flashlight and tell them to stand outside the leaf and shine the light on the students who are chlorophyll. Students should shine the light during the whole next step; they might want to dance about to music while shining the light. (Be sure students so not shine the light in other students' eyes.)
- The chlorophyll students gently tag the air and water pairs once they enter the leaf. When paired students are tagged, they separate. If signs are being used, the chlorophyll students should take these away. When all the students are milling about into singles, instruct the chlorophyll students to recombine students into groups of three; there should be some single students left over.
- Direct the single students to leave the leaf.
- Ask students to suggest what the recombined group and single students are. The groups are sugar molecules and the single students represent the oxygen molecule (which is actually composed as two oxygen atoms). New signs can be distributed to these two groups."

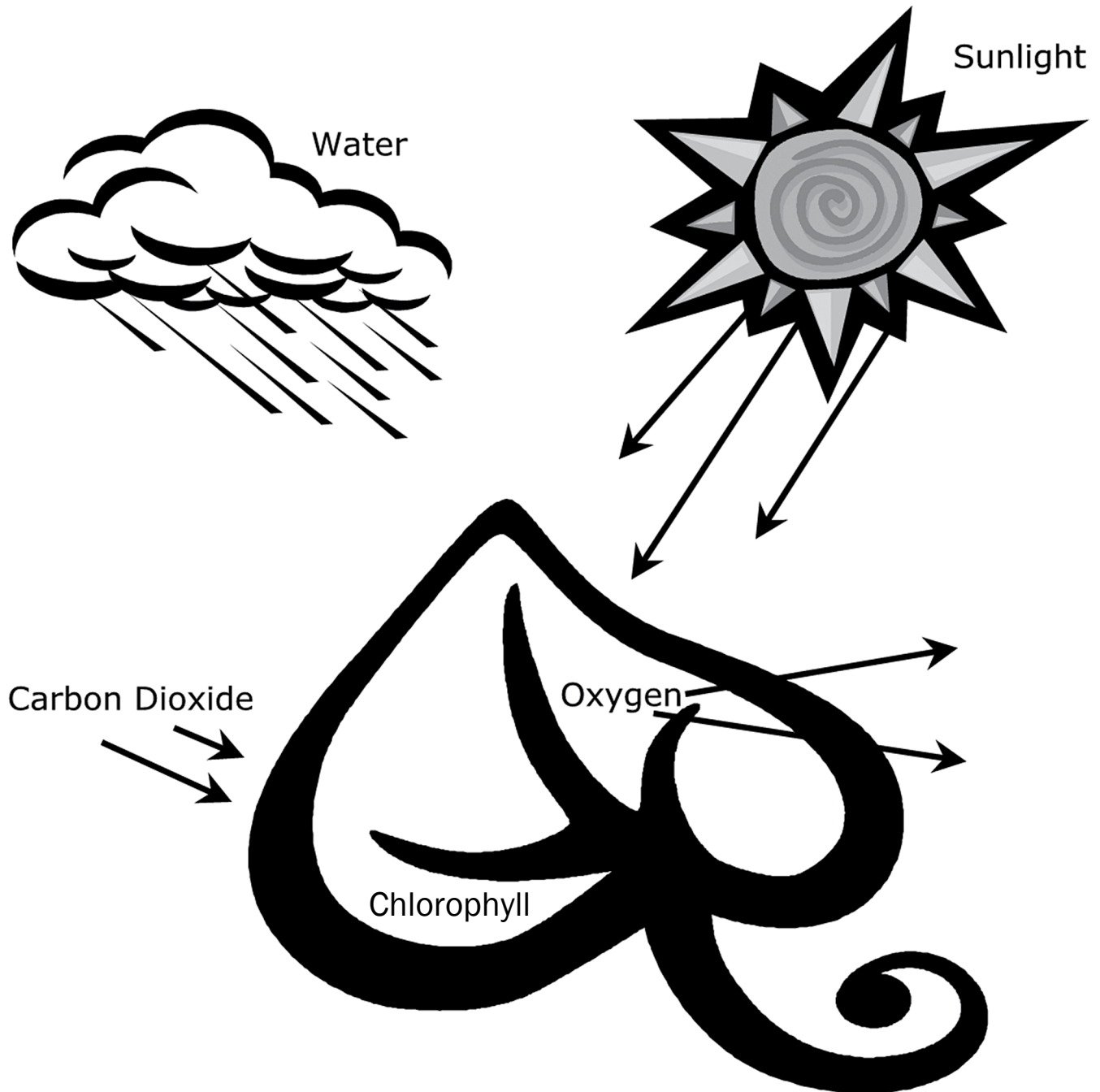
Sunlight

1. Students representing sunlight dance around (and shine) outside the leaf.





Photosynthesis





Rabbit Image for Activity

