

Activity: We're the Producers!

Adapted with permission from Wolanyk, B. Photosynthesis is a Puzzle

Grades: 3-8

Time:

Groundwork: 30 minutes

Exploration: 40 minutes set up, 45 minutes for the activity

Making Connections: Ongoing

Materials:

- Copies of the Photosynthesis Puzzle Pieces reproduced on card stock depending on method of presentation
 - class demonstration– one set cut apart
 - 3 copies of Hydrogen puzzle piece page, one cut into separate puzzle pieces and the other two left as a whole made up of 6 atoms but cut around the outside.
 - 3 copies of water molecule page cut into two separate molecules of water
 - 2 copies of oxygen puzzle piece pages, one cut into separate pieces and the second only cut around the outside of the group puzzle pieces
 - 3 copies of water molecule page each cut into two separate molecules of water
 - 1 copy of carbon puzzle piece page left as a whole made up of 6 atoms but cut around the outside.
 - 3 copies of carbon dioxide molecule page cut into two separate molecules of carbon dioxide
 - 1 copy of plus, equals, sunlight and chlorophyll puzzle piece pages
 - small group activity) 1 set for each group using the same breakdown as above except that once cut apart, one plus sign page will serve two groups; one equals, sunlight and chlorophyll page will serve four groups so fewer of those pages are needed.
- Scissors
- Line up components to make sure that the puzzle pieces line up properly – there can be several options.

Background: The purpose of gardening within an educational setting is to utilize the garden as an educational tool. The garden and skills developed by gardening provide concrete examples of theoretical or abstract concepts or processes. This is critical for some students and will result in both greater understanding of difficult concepts and application of those concepts across diverse topics. Before one can garden well, a great deal of science needs to be understood and applied. The understanding of photosynthesis is the first of those concepts. This lesson is designed to make this relatively abstract process concrete for students and in particularly young students.

Groundwork: Producers or Consumers

Objective: To determine student understanding of food sources and delineate with examples the differences between producers and consumers.

1. Ask the students where their food comes from. Make a list of the sources they identify in a visible place under the heading “Where We Get Food?”. Encourage the students to come up with as many places as they can.

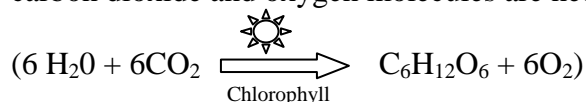
2. Next to that list place this heading “Where do they get the food?” and “How does it get there?” Ask the students those two questions. Continue the process until all ideas are exhausted.
3. Whether or not they identify a farm, plant or garden lead them to that conclusion and ask where the farmer, gardener, or plant got the food. Ask: Who made food from non-food? Plants made the food from non-food. Plants are the producers! The rest of us are consumers.
4. Have the students make a list of animals and what they eat. Then ask each to identify which ones listed are producers and consumers. (Herbivores will eat producers – plants. Carnivores will eat other consumers. Omnivores will eat both producers and consumers.)

Exploration: Photosynthesis is a Puzzle

Objective: Explain how plants make food from non-food components in the process known as photosynthesis.

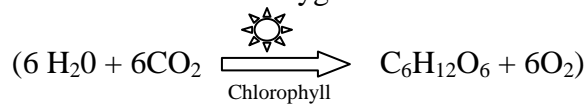
1. Ask the students how plants make food from non-food. Explain that plants capture the energy of sunlight to produce food in a process known as photosynthesis.
2. If you determined to conduct this as a small group activity, skip this step. If you determined to conduct this activity as a class demonstration, follow these steps:
 - A. Select a student to represent each step of this activity. It may also be done on a bulletin board but student involvement allows more movement and student interaction.
 - B. Have a student hold up a single puzzle piece that contains two hydrogen atoms. Explain that hydrogen can be found in the atmosphere as a hydrogen molecule that contains two hydrogen atoms. So this puzzle piece represents that molecule and the two Hs represent two atoms of hydrogen.
 - C. Have another student hold up a single puzzle piece that contains two oxygen atoms. Explain that oxygen can also be found in the atmosphere as an oxygen molecule that contains two oxygen atoms. So this puzzle piece represents that molecule and the two Os represent two atoms of oxygen.
 - D. Have another student hold up a water molecule that is a double puzzle piece (that contains one piece with two hydrogen atoms and a second with one oxygen atom). Explain that this piece is a water molecule that is made up of two hydrogen atoms and one oxygen atom.
 - i. So this combination of puzzle pieces represents that water molecule. The two Hs represent two atoms of hydrogen and the one O represents oxygen.
 - ii. Write the notations H_2 , O_2 and H_2O in a visible place and explain that this is way that this is written.
 - E. Have a fourth student hold up a carbon dioxide molecule that is a double puzzle piece (that contains one piece with one carbon atom and a second with two oxygen atoms). Explain that this piece is a carbon dioxide molecule that is made up of one carbon atom and two oxygen atoms.
 - i. So this combination of puzzle pieces represents that carbon dioxide molecule. The one C represents one atom of carbon and the two Os represents two atoms of oxygen.
 - ii. Write the notation CO_2 in a visible place and explain that this is way that this is written.

- F. Explain that these are the basic components that plants use to make food during a process of photosynthesis. Have the hydrogen holding student sit down.
- Line up the student with the carbon dioxide molecule first and share that the plant takes in carbon dioxide from the atmosphere through its leaves and/or stem.
 - Have a student holding a plus sign stand next to the carbon dioxide and connect their puzzle piece if possible. (You may wish to tape the pieces together.) Then line up the student with the water molecule and explain that the plant takes water in mainly from its roots. Line up that puzzle piece.
 - Follow with another student holding the equal sign puzzle piece and say, "Now let's watch photosynthesis happen."
 - Wait a few seconds and say, "I don't see anything happening. Do you? We must have forgotten something. What can it be?" Students will probably volunteer sunlight, if not ask what plants need. SUNLIGHT!
 - Add a student with the sunlight puzzle piece and connect it to the equals sign above or below the piece as it fits best and say again, "Now let's watch photosynthesis happen."
 - Wait a few seconds and say, "I don't see anything happening again. Do you? We must have forgotten something else. What can it be now?" Students will probably not volunteer an answer. Ask the class if they know what makes plants green. Share that a pigment named chlorophyll makes plants green and is needed for photosynthesis.
 - Have a student with the chlorophyll puzzle piece attach the piece to the equal sign opposite the sunlight and then say, "Now photosynthesis can take place in the plant."
 - Bring up a student holding the combined group of puzzle pieces containing six carbon atoms another two students each holding the combined group of puzzle pieces containing six hydrogen atoms each for a total of 12 hydrogen atoms. Explain that the process of photosynthesis uses the energy of the sun to split apart the water molecule, the carbon dioxide molecule combining the carbon dioxide with hydrogen from the water. Add a fourth student holding up a combined page containing six oxygen atoms. Connect them together as the puzzle pieces allow.
 - Explain that this combined molecule is a sugar molecule and is written $C_6H_{12}O_6$.
 - Continue with, "But the oxygen is left over and released into the air. That is where we get the oxygen that we breathe." Have a student with an plus sign attach their piece and the last student hold up a puzzle piece or pieces made up of two oxygen atoms. Attach the oxygen after the plus
- G. For older students ask them to balance the equation. How many water molecules, carbon dioxide and oxygen molecules are needed to create one sugar molecule?



- To conduct this as a small group activity, provide students with a set of the materials and walk the students through a modified version of step number 2 using the words and having students determine what components those will be.
 - Identify the molecule components of water, carbon dioxide, atmospheric oxygen.
 - Have the students assemble what these components are.

- C. Describe the inputs that plants need to undergo photosynthesis.
- D. Have students create the equation piecing the puzzle pieces together.
- D. Describe the components of the outputs.
- E. Have students assemble the rest of the equation together by piecing the correct puzzle pieces together.
- F. For older students ask them to balance the equation. How many water molecules, carbon dioxide and oxygen molecules are needed to create one sugar molecule?



- 4. Post the equation as written above.

Making Connections

Ask the students these questions:

- Is photosynthesis the only function of plants?
- Do plants only make sugar?
- What else do plants make?
- What is the source of those components?
- How do the plants acquire those components?

Extensions for middle and high school:

1. Balance the photosynthesis equation and identify how many molecules of water, and carbon dioxide are needed to balance the equation and how many molecules of sugar and oxygen are produced.
2. Have the students research and identify what other atoms are needed to produce starches, proteins, fats, and oils. Expand the protein building to include the human proteins that are used to build muscle, organ tissue, hair, finger and toe nails and/or plant proteins.
3. Have the students research the impact of input deficiencies on the photosynthesis process (lack of light, improper light spectrum, nutritional and water deficiencies).
4. Have students research input excesses (carbon dioxide, water, nutrients, etc.)

Additional Materials:

1. Use the lesson “Gifts from the Sun” from Project Food, Land & People’s *Resources for Learning*.
2. The ***Keeping Florida Green*** Curriculum developed by Florida Ag in the Classroom, Inc. has many lessons about food and Florida agriculture that can be used in concert with the garden. It can be obtained by attending a workshop.

Next Generation Sunshine Standards Met:	
SC.1.L.17.1	Through observation recognize that all plants and animals, including humans, need the basic necessities of air, water, food, and space.
SC.2.L.17.1	Compare and contrast the basic needs that all living things, including humans, have for survival.
SC.3.L.14.1	Describe structures in plants and their roles in food production, support, water and nutrient transport, and reproduction.
SC.3.L.17.2	Recognize that plants use energy from the Sun, air and water to make their own food.

SC.4.L.17.2	Explain that animals, including humans, cannot make their own food and that when animals eat plants or other animals, the energy stored in the food source is passed to them.
SC.4.L.17.3	Trace the flow of energy from the sun as it is transferred along the food chain through the producers to the consumers.
SC.7.L.17.1	Explain and illustrate the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
SC.8.L.18.1	Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll; production of food; release of oxygen.

Sample Pre-Post Assessment

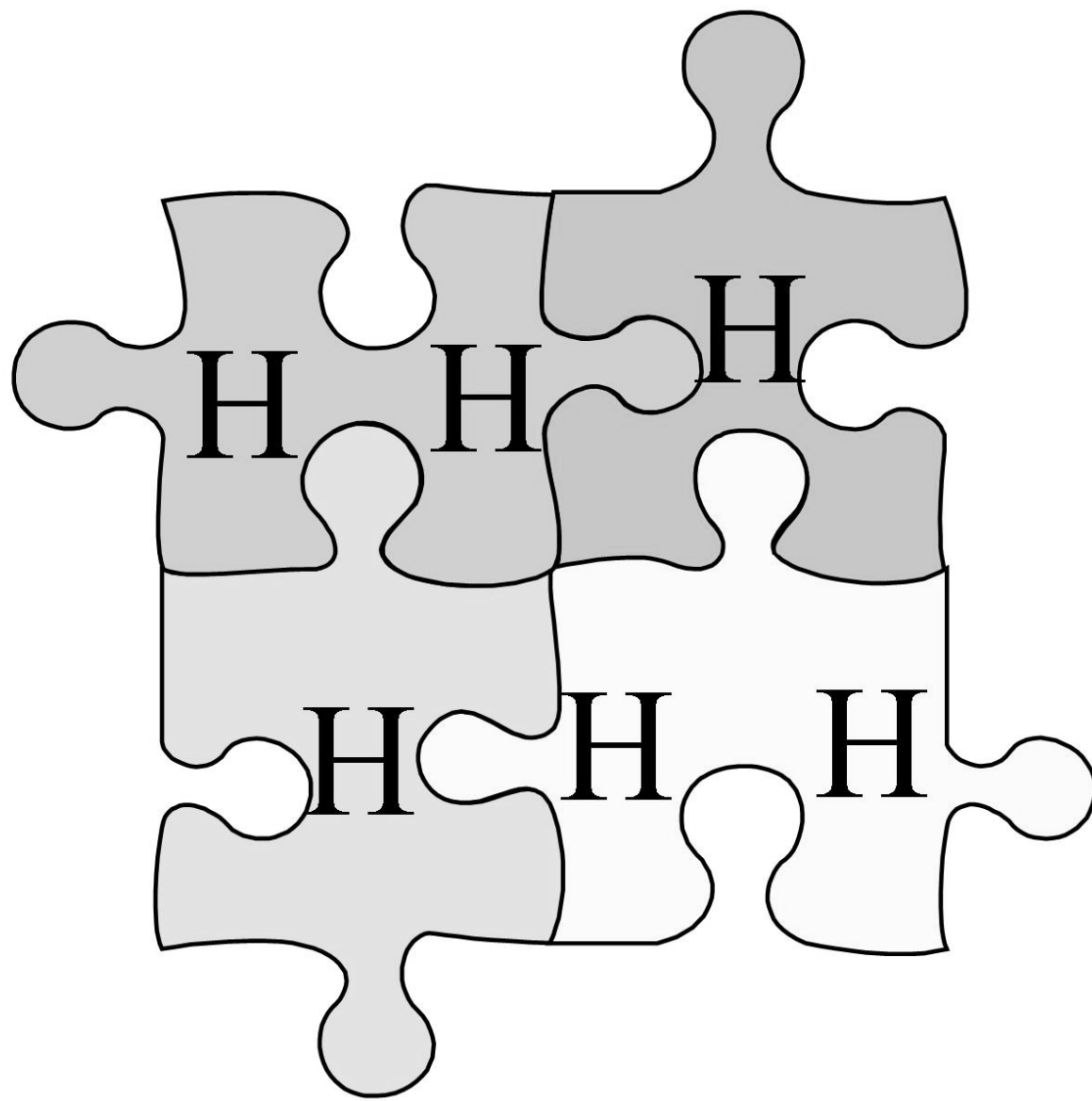
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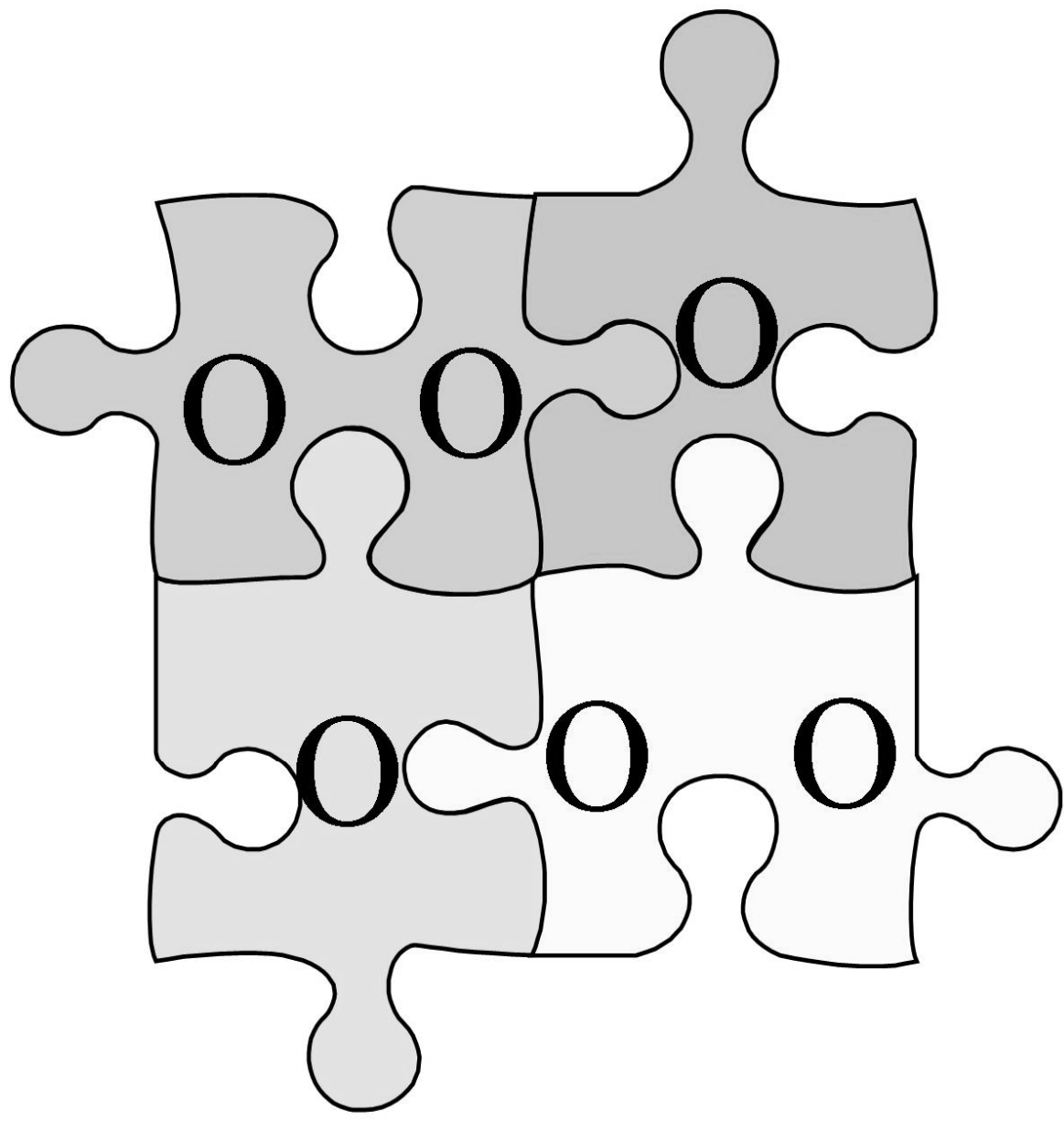
1. Plants are producers and animals are consumers. True False

2. What does a plant need for photosynthesis?
 - a. Oxygen, water, soil, sugar
 - b. Nitrogen, water, soil, air
 - c. Carbon dioxide, water, chlorophyll, sunlight
 - d. Carbon dioxide, chlorophyll, sunlight, oxygen

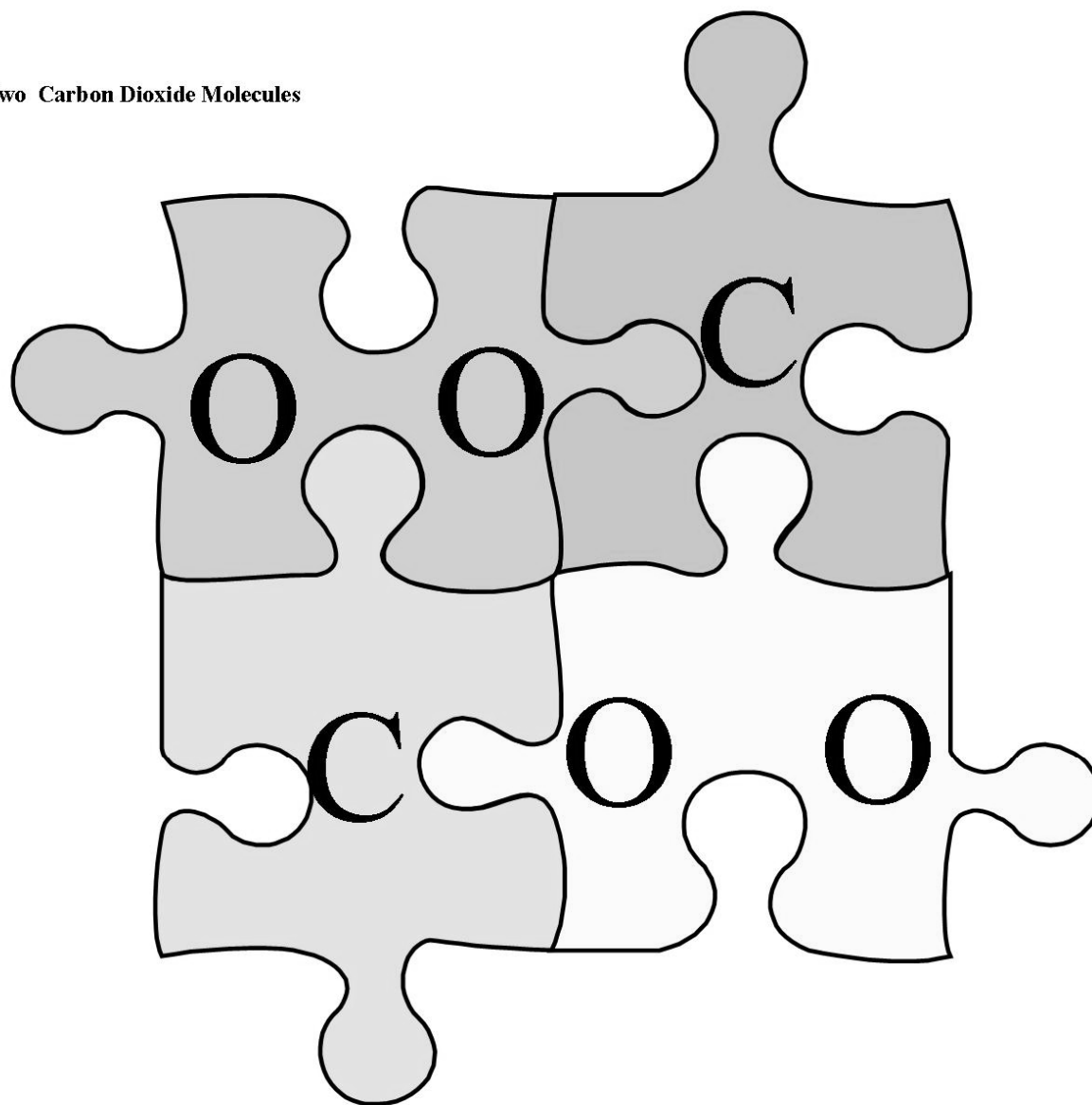
3. A plant gives off _____ that animals need to breathe.

4. Plants take in _____ through their leaves and
 _____ through their roots.





Two Carbon Dioxide Molecules



Two Water Molecules

