Lesson Topic: Chemical Reactions in Photosynthesis

Objective:
Students will be able to:

1. Trace the movement of matter and energy during the photosynthesis reaction.
2. Explain how missing or insufficient amounts of reactants and energy will affect the overall photosynthesis reaction.

Time Required: 80 minutes

Materials Needed:

- Legos, Mega Bloks or similar snap together building blocks (representing matter)
- Flashlight (representing sunlight/energy)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional - Middle School - Chemical Reactions in Photosynthesis
- Assign a Legends of Learning Content Review Quick Play playlist for the day after the lesson.
    - Content Review - Middle School - Chemical Reactions in Photosynthesis
- Label snap together blocks with chemical symbols from the photosynthesis reaction (see illustration).
- Ensure batteries work in flashlight.

Engage (10 minutes):

1. Write the following list of materials on the board and ask students which they think are food for plants. The list should include sunlight, plant food from a garden center, sugar, carbon dioxide, minerals, fertilizer, soil, water, and oxygen.
    a. Students will likely assume most of these materials are plant food since they assist plant growth. However, sugar is the only food on this list.
2. Elicit students to explain their thinking about their responses.
    a. Students will respond that these are things plants need to live.
3. Discuss that you will be using the term “food” in a new way. Describe how our cells and the cells of plants need specific molecules for fuel. This is the scientific concept of food. A plant’s food is a carbohydrate/sugar called glucose ($C_6H_{12}O_6$). It is created through a chemical reaction that requires both energy and matter. The energy comes from sunlight. Carbon dioxide and water are the building blocks needed for the production of glucose.

Explore (15 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
    a. This will allow students to interact with the concept of photosynthesis and build a framework.

Explain (30 minutes):

1. Identify the required input elements (reactants) for photosynthesis: energy (sunlight), carbon dioxide, and water.
2. Identify the output elements (products) for photosynthesis: oxygen, sugar (carbon-based organic molecules/carbohydrate/glucose)
3. Write the photosynthesis chemical equation and identify reactants and products.
    a. Water (H_2O) + carbon dioxide (CO_2) yields oxygen (CO_2) + sugar/glucose ($C_6H_{12}O_6$) when sunlight is present.
    b. Explain that to create one molecule of glucose, 6 molecules of carbon dioxide and 6 molecules of water are needed.
4. Create models of water and CO_2, using the building blocks. Demonstrate that when sunlight hits the molecules, the bonds are broken and can rearrange into new products, oxygen and glucose.
5. Enlist students to hold the 12 models created by the teacher (6 carbon dioxides and 6 waters).
6. The teacher should shine the flashlight on each molecule and have students disassemble the model, placing all the blocks on a table or desk.
7. Students should then work cooperatively to build the new molecule of glucose, referring to the chemical equation as needed.
    a. They will discover the 12 additional oxygen blocks and put them together to form six separate oxygen molecules.

Elaborate (5 minutes):

1. Ask students to consider what could happen if any of the necessary reactants and/or energy from sunlight were reduced or eliminated. Allow the students to turn and talk.

Evaluate (20 minutes):

1. Based on the explanation and exploration, ask students to consider why a plant without enough water may not survive.
    a. Students should respond that water is needed for photosynthesis and if enough isn't available, the reaction will stop.
2. What would happen if a plant is deprived of carbon dioxide?
    a. Students should respond that carbon dioxide is needed for photosynthesis and if enough isn't available, the reaction will stop.
3. Why do plants need sunlight?
    a. Students should respond that energy from sunlight is necessary to break the bonds between water and carbon dioxide, allowing the rearrangement into glucose and oxygen molecules.
4. Why are plants important for organisms that require oxygen?
    a. Students should respond that plants produce oxygen as a waste product, but other organisms, like ourselves, must have it.
5. Have your students sign in to Legends of Learning. Instruct students to complete the Content Review playlist.
6. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Illustration for Teacher Preparation of Blocks

H_2O (Create 6)

H
H
O

CO_2 (Create 6)

C
O
O

Students will build the following:

O_2 (Create 6)

O
O

$C_6H_{12}O_6$ (Create 1)

C
C
C
C
C
C
H
H
H
H
H
H
H
H
H
H
H
H

O
O
O
O
O
O

O_2 (Create 6)

O
O