Name: _____ Date: _____ Group: _____

Photosynthesis

The word photosynthesis can be broken down to its Greek roots: *synthesis* is to "put together to form something new" and *photo* means "light." So the Greek origin of the word photosynthesis means "put together to form something new from light." This amazing process of forming something new from light, photosynthesis, is what sustains life on Earth. The most important aspect of photosynthesis is that radiant energy (from the Sun) transforms to chemical energy. The chemical energy is stored in the plant as sugar (glucose) and is available as food. The leaves of plants contain everything needed to absorb the rays of the Sun and start photosynthesis. This interaction between radiant energy from the Sun and matter (carbon dioxide and water) causes a chemical reaction with the result of the formation of different matter (glucose and oxygen). The radiant energy absorbed by the plant is transformed during the process of photosynthesis and is stored within the newly formed sugar as chemical energy in the plant. Fortunately for us, oxygen is also released into the atmosphere during this process.

Scientists are not currently able to recreate the natural process of photosynthesis using artificially made materials. However, what happens to the beginning substances (the reactants) and resulting substances (the products) during photosynthesis is understood, can be measured, and can be easily represented using models.

In this activity, you will model the process of photosynthesis to see what happens to elements and compounds of the reactants and products as radiant energy is transformed to chemical energy. Answer the questions below in your lab journal.

1. What interaction between matter and energy occurs during the process of photosynthesis?

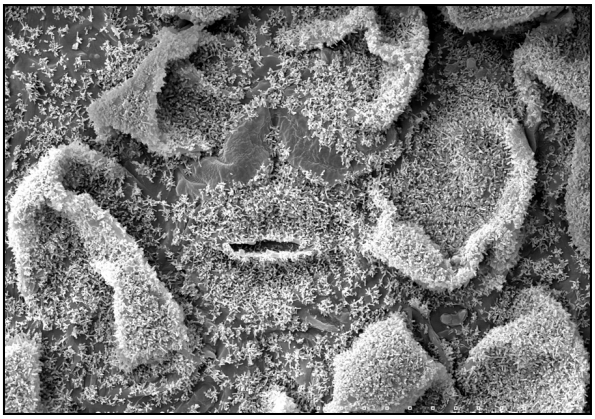
2. How does radiant energy become food for a plant?

3. Put the meaning of the Greek origin words "synthesis" and "photo" together to explain the meaning of the word "photosynthesis."

Photosynthesis

Part I: The Reactants

The reactants must be present and available to the plant for photosynthesis to occur. Carbon dioxide is in the atmosphere and enters the plant through structures in the leaf called stomata. Water is absorbed by the plant's roots.



In the center of the picture is the breathing structure of the leaf (stoma), magnified 800 times in an electron microscope.

Procedure

1. Obtain 12 plastic chips labeled "H," six plastic chips labeled "C," 18 plastic chips labeled "O," and the *Reactants of Photosynthesis* page.
2. The plastic chips represent atoms of hydrogen, carbon, and oxygen.
3. Use these atom models to build and represent water and carbon dioxide on the *Reactants of Photosynthesis* page. Place a stack of atom chips on each circle to represent the substance.
4. Answer the questions below in your lab journal:
    1. How many hydrogen atoms in total appear as any part of the reactants?
    2. How many carbon atoms in total appear as any part of the reactants?
    3. How many oxygen atoms in total appear as any part of the reactants?
    4. What is the source of the carbon dioxide as a reactant in photosynthesis?
    5. How does carbon dioxide enter the plant?
    6. What is the source of water as a reactant in photosynthesis?
    7. How does the water enter the plant?

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Part II: Energy Transformations

Leaves absorb radiant energy from the Sun and can be thought of as solar-energy collectors. A leaf contains a pigment called chlorophyll. Chlorophyll gives a plant its green color and takes part in the action of transforming radiant energy to chemical energy. During photosynthesis, chlorophyll absorbs radiant energy and transforms it to chemical energy when water and carbon dioxide react. The reaction produces combinations of atoms with usable chemical energy stored within these newly formed substances of glucose and oxygen.

1. Place your *Energy Transformation through Photosynthesis* page directly to the right of the *Reactants* page.
2. Sweep all of the atoms of the reactants into one big, messy pile on the energy transformation arrow.
3. Answer questions below in your lab journal:
    1. What acts as the radiant-energy collector in a plant?
    2. What part does chlorophyll play in the photosynthesis process?
    3. After the transformation from radiant energy, where is the chemical energy stored?

Photosynthesis

Part III: The Products

The sugar that forms as a result of photosynthesis is called glucose. The product glucose is a larger molecule than either of the reactants, water and carbon dioxide. Glucose is used by the plant as its own generated food source. Glucose can also remain in the plant and may serve as an energy source for a consumer. A by-product of the photosynthesis reaction is oxygen gas, which is released from the plant through the stomata.

1. Place your *Products of Photosynthesis* page directly to the right of the *Energy Transformation through Photosynthesis* page.

2. Obtain a paper model of glucose from your teacher.

3. Count the number of carbon atoms in the paper model of glucose. Take that number of carbon atoms from the pile of atoms on the energy transformation arrow, and set them aside in a stack.

4. Count the number of hydrogen atoms in the paper model of glucose. Take that number of hydrogen atoms from the pile of atoms on the energy transformation arrow, and add them to the stack of carbon atoms.

5. Count the number of oxygen atoms in the paper model of glucose. Take that number of oxygen atoms from the pile of atoms on the energy transformation arrow, and add them to the stack of carbon and hydrogen atoms.

6. Set your stack of carbon, hydrogen, and oxygen atoms on the *Products of Photosynthesis* page in the space labeled “glucose.”

7. Take the remaining atoms from the pile of atoms on the energy transformation arrow, and distribute them equally on the spaces provided on the *Products of Photosynthesis* page.

8. Answer the questions below in your lab journal:
    1. How many hydrogen atoms in total appear as any part of the products? Were any hydrogen atoms gained or lost as a result of photosynthesis?
    2. How many carbon atoms in total appear as any part of the products? Were any carbon atoms gained or lost as a result of photosynthesis?
    3. How many oxygen atoms in total appear as any part of the products? Were any oxygen atoms gained or lost as a result of photosynthesis?
    4. Are all of the atoms used to create the glucose?
    5. Why does it make sense to call oxygen a byproduct of photosynthesis?

Photosynthesis

Part III: The Products, continued

6. Explain how the model shows storage of chemical energy.
7. Add arrows and additional labels to the picture your teacher gives you to demonstrate the information you learned in this activity about photosynthesis, including the energy involved in the process.

Unlike plants, animals are unable to make their own food through the process of photosynthesis. Write a scientific explanation describing how a mouse gets energy to live and grow. Include your claim, evidence, and reasoning.

Photosynthesis

Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Not applicable.	Answers the question and is accurate based on data.	No claim or does not answer the question.
Evidence	Cites data and patterns within the data. Uses labels accurately.	Cites data from the data source, but not within the context of the prompt.	No evidence or cites changes but does not use data from data source.
Reasoning	Cites the scientifically accurate reason using correct vocabulary and connects this to the claim. Shows accurate understanding of the concept.	Cites a reason, but it is inaccurate or does not support the claim. Reasoning does not use scientific terminology or uses it inaccurately.	No reasoning or restates the claim but offers no reasoning.
Rebuttal	Rebuttal provides reasons for different data or outliers in the data. Can also provide relevance to the real world or other uses for the findings.	Rebuttal is not connected to the data or is not accurate.	Does not offer a rebuttal.