Follow the Energy

Model matter and energy in photosynthesis

BIO.5.b "Use models of the reactants and products of photosynthesis to illustrate the conversion of light energy into stored chemical energy within cells."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two chemical reactants and circle the two chemical products. Write 1 where light energy enters the process and 2 where chemical energy is stored.

Bubbles on a Leaf

1. A small aquatic plant sits under a lamp in a clear jar. After several hours, tiny bubbles cling to its leaves. The bubbles are oxygen, one product of photosynthesis. Inside leaf cells, chloroplasts absorb light energy. Carbon dioxide enters the plant from the water around it, and water is already available inside the cells. These two substances are the chemical reactants. A useful model uses arrows pointing into a chloroplast for carbon dioxide and water. A separate arrow brings in light energy, because light provides energy but does not supply atoms for the reaction.

2. The same model needs arrows leaving the chloroplast for glucose, a sugar, and oxygen gas. One balanced summary is $6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$. Molecules of carbon dioxide supply the carbon atoms in glucose. Water supplies hydrogen atoms, and oxygen gas released during photosynthesis comes from water. The reactant and product arrows track matter: atoms are rearranged rather than created. The numbers in the summary show that six carbon dioxide molecules and six water molecules can form one glucose molecule and six oxygen molecules overall.

3. An arrow for energy tells a different story from an arrow for matter. Chloroplasts capture energy from light and use it to drive the building of glucose from smaller molecules. Some of that energy is stored as chemical energy in glucose, which can later fuel cell activities or be used to make other stored materials. The oxygen bubbles do not carry the stored sugar out of the leaf. If the lamp is switched off, the plant cannot keep using that lamp's light to make new glucose. A complete model shows both the movement of atoms and the change in energy form.

2 ANSWER WITH EVIDENCE

Use the passage

1. In a model of the plant, which two chemical substances need arrows pointing into the chloroplast? What separate input arrow is needed?

2. Draw an arrow from a reactant to the product that receives its carbon atoms. Label both ends of your arrow.

3. The bubbles are shown by an arrow leaving the chloroplast. Label the arrow with the product's formula and name the reactant that supplies its atoms.

4. A model labels the oxygen arrow “stored light energy.” What is wrong with that label? Where should the model show the stored chemical energy?

3 YOUR TURN

Your own words

Sketch a photosynthesis model for an alga growing under a lamp. Label the chemical inputs and outputs with formulas, show where light energy enters and where chemical energy is stored, and add one sentence explaining why the lamp does not supply atoms to glucose.

Follow the Energy

PART 1 · READ AND MARK

Underline the two chemical reactants and circle the two chemical products. Write 1 where light energy enters the process and 2 where chemical energy is stored. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In a model of the plant, which two chemical substances need arrows pointing into the chloroplast? What separate input arrow is needed?	**Carbon dioxide and water point into the chloroplast as reactants. A separate arrow shows light energy entering.**
2	Draw an arrow from a reactant to the product that receives its carbon atoms. Label both ends of your arrow.	**Carbon dioxide → glucose. Carbon dioxide supplies the carbon atoms in glucose.**
3	The bubbles are shown by an arrow leaving the chloroplast. Label the arrow with the product's formula and name the reactant that supplies its atoms.	**Label the arrow O_2, oxygen gas. Its atoms come from water.**
4	A model labels the oxygen arrow "stored light energy." What is wrong with that label? Where should the model show the stored chemical energy?	**The oxygen arrow shows a product of matter, not where light energy is stored. The model should show chemical energy stored in glucose.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Lamp light energy → chloroplast in alga; $6CO_2$ and $6H_2O$ → chloroplast → $C_6H_{12}O_6$ and $6O_2$. Chemical energy is stored in $C_6H_{12}O_6$. The lamp supplies energy, not atoms; carbon dioxide and water supply the atoms for glucose.

Accept models with correct input and output arrows even if the student omits molecule counts. Light must be shown as an energy input, not a chemical reactant or a source of atoms.