

Energy in Leaves

Track matter and energy in a photosynthesis model.

HS-LS1-5 "Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in..."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each matter input and output, circle every energy phrase, and number the sentences that explain what a useful photosynthesis model must show.

A Model for Photosynthesis

- ① On a clear afternoon, leaves in a school courtyard act as energy-changing systems. Chlorophyll and other pigments absorb some wavelengths of sunlight. This light energy does not become matter. Instead, it provides the energy needed to rearrange atoms from carbon dioxide and water. Carbon dioxide enters a leaf mainly through tiny openings called stomata. Water moves upward from roots through the plant's transport tissues. These substances supply the carbon, hydrogen, and oxygen atoms that can become sugar. A model of photosynthesis should show these matter inputs entering the photosynthesizing cells and should show light arriving as energy, not as an ingredient with atoms.
- ② Inside the cells, the atoms are reorganized into glucose, a sugar with chemical energy stored in its bonds. Oxygen gas is also produced and can leave the leaf through stomata. A simplified model can represent the overall change with an equation: $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$. The coefficients show that matter is conserved: six carbon dioxide molecules and six water molecules provide the same kinds and numbers of atoms found in glucose and oxygen. The equation is not a list of events in order. It is a model of the starting materials, products, and energy transformation.
- ③ A useful diagram separates matter arrows from energy arrows. For example, arrows labeled carbon dioxide and water can point into a box labeled photosynthesis in a leaf cell. Arrows labeled glucose and oxygen can point out. A separate arrow labeled light energy can point into the box, while a note inside the box states that light energy is transformed into chemical energy stored in glucose. The model should not show energy leaving as oxygen or carbon dioxide turning directly into energy. Photosynthesis transfers matter by moving atoms into new molecules, and it transforms energy by changing light energy into chemical energy.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 Use the equation in the passage to identify the two matter inputs, the two matter outputs, and the energy input.

2 Why should a photosynthesis model show light as an energy arrow instead of a matter ingredient?

3 How do the coefficients in the equation support the idea that matter is conserved?

4 A diagram shows carbon dioxide and water leaving a leaf cell, while oxygen and glucose enter it. Its note says, "Light energy is made from glucose." Identify two errors and correct them.

3 YOUR TURN _____ Your own words

Create a labeled conceptual model for photosynthesis in a kelp cell. Use arrows to show carbon dioxide, water, and light energy entering and glucose and oxygen leaving, distinguish matter from energy, and add a note about chemical energy storage and matter conservation.

PART 1 • READ AND MARK

Underline each matter input and output, circle every energy phrase, and number the sentences that explain what a useful photosynthesis model must show. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	Use the equation in the passage to identify the two matter inputs, the two matter outputs, and the energy input.	Matter inputs: carbon dioxide and water. Matter outputs: glucose and oxygen. Energy input: light energy.
2	Why should a photosynthesis model show light as an energy arrow instead of a matter ingredient?	Light energy does not contain atoms that become part of the products. It provides energy for rearranging atoms from carbon dioxide and water.
3	How do the coefficients in the equation support the idea that matter is conserved?	Six carbon dioxide molecules and six water molecules supply the same kinds and numbers of carbon, hydrogen, and oxygen atoms found in glucose and oxygen.
4	A diagram shows carbon dioxide and water leaving a leaf cell, while oxygen and glucose enter it. Its note says, "Light energy is made from glucose." Identify two errors and correct them.	Carbon dioxide and water should enter, while glucose and oxygen should leave. Light energy is transformed into chemical energy stored in glucose, not made from glucose.

PART 3 • YOUR TURN (SAMPLE ANSWER)

CO₂ (matter) and H₂O (matter) → [photosynthesis in a kelp cell] → glucose (matter with stored chemical energy) and O₂ (matter); sunlight (energy) → [photosynthesis]. The carbon, hydrogen, and oxygen atoms are conserved as they are rearranged into the products.

Accept diagrams, equations, or clearly labeled conceptual models that show carbon dioxide and water as matter inputs, glucose and oxygen as matter outputs, and light energy transformed into chemical energy stored in glucose. Require a clear distinction between matter movement and energy transformation, without requiring biochemical steps.