Follow the Sugar

Build and revise a model of plant biochemistry

BOT.1.6 "Demonstrate through model development and manipulation an understanding of plant biochemistry."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the inputs to photosynthesis, circle the inputs to respiration, and number three different fates of sugar. Use your marks to trace matter and energy through the plant.

Inside a Tomato Plant

1. A tomato plant on a sunny windowsill is a living chemical factory, but its parts do different jobs. In leaf chloroplasts, light energy powers photosynthesis. The plant takes in carbon dioxide (CO_2) from air and water (H_2O) from soil. It makes sugars, including glucose ($C_6H_{12}O_6$), and releases oxygen (O_2). Carbon from CO_2 becomes part of the sugar, so a model should show carbon moving from air into the plant. Some sugar travels from leaves through the stem to roots and growing fruit. Extra sugar can be converted into starch for storage.

2. Every living cell in the tomato plant needs usable energy. In mitochondria, cellular respiration uses sugar and oxygen and releases carbon dioxide, water, and energy the cell can use, often carried by ATP. Roots cannot photosynthesize in the dark soil, but their cells still respire using sugar delivered from leaves. A model can show sugar branching toward respiration, growth, and starch storage instead of ending at the leaf. Photosynthesis and respiration both occur in illuminated leaves. At night, photosynthesis stops without light, but respiration continues, using sugars made earlier or released from stored starch.

3. Models become useful when one condition changes. Suppose a screen blocks much of the light reaching the plant, while its water supply and air stay the same. Photosynthesis in the shaded leaves slows, so less new sugar is available for growth, respiration, or storage. Respiration does not stop just because the light drops. Cells can draw on stored starch, first breaking it down into sugars, to keep respiring. If the shade lasts, starch reserves may shrink and growth may slow. To test a model, compare its arrows before and after shading: which pathways shrink, and which continue?

2 ANSWER WITH EVIDENCE

Use the passage

1. In a model, trace the carbon that ends up in stored starch. Where does it enter the plant, and what does the plant make before storing it as starch?

2. Draw or describe arrows for sugar traveling from a leaf to a root and being used there. What else must enter the root cell for that process?

3. Revise a daytime plant model for nighttime. What happens to photosynthesis and respiration, and how can stored starch support root cells?

4. A screen reduces the light reaching the leaves. In a before-and-after model, which sugar-making pathway should shrink, and which energy-releasing process should continue?

3 YOUR TURN

Your own words

Draw two labeled panels showing a tomato plant before and after insects eat half its leaves. In both panels, use arrows to show leaves making sugar, sugar traveling to roots, and cells using sugar in respiration; then write one sentence predicting how leaf loss affects the sugar available to roots if the remaining leaves receive the same light.

ANSWER KEY

Follow the Sugar

PART 1 · READ AND MARK

Underline the inputs to photosynthesis, circle the inputs to respiration, and number three different fates of sugar. Use your marks to trace matter and energy through the plant. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In a model, trace the carbon that ends up in stored starch. Where does it enter the plant, and what does the plant make before storing it as starch?	**Carbon enters leaves from air as CO_2. Photosynthesis puts the carbon into sugar, which the plant can convert to starch.**
2	Draw or describe arrows for sugar traveling from a leaf to a root and being used there. What else must enter the root cell for that process?	**Sugar moves from the leaf through the stem to the root, where respiration uses it. Oxygen must also enter the root cell.**
3	Revise a daytime plant model for nighttime. What happens to photosynthesis and respiration, and how can stored starch support root cells?	**Photosynthesis stops without light, but respiration continues. Stored starch can be broken down into sugar that root cells use in respiration.**
4	A screen reduces the light reaching the leaves. In a before-and-after model, which sugar-making pathway should shrink, and which energy-releasing process should continue?	**The photosynthesis pathway makes less new sugar, while cellular respiration continues to release usable energy.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Before: Many leaves, light + CO_2 + H_2O → photosynthesis → sugar → roots; sugar + O_2 → respiration in leaves and roots. After: Half as many leaves, light + CO_2 + H_2O → less total sugar → less sugar sent to roots; sugar + O_2 → respiration in remaining leaves and roots. With half the leaves gone, less sugar is available to roots because fewer leaves make it.

Accept words or arrows that correctly trace sugar from photosynthesis to roots and respiration. For Part 3, the remaining leaves should still photosynthesize and respire, while the model predicts less total sugar available to roots.