

The Sealed Greenhouse Ledger: Where Did the Basil's Mass Come From?

Learning target: I can use measurements of gases, water, minerals and dry mass from a sealed growth chamber to argue where a plant's new matter came from and what its energy source was.

Claim, evidence, reasoning About 40 min Individual MS-LS1-6 · assesses writing data analysis

Name

Date

Period

Directions

Read the scenario and study the ledger. Answer the warm-up questions first; they organize the evidence you will need. Then write your Claim, Evidence and Reasoning in the boxes. A strong response names specific numbers from the ledger and explains how the rule that matter is never created or destroyed connects those numbers to your claim.

You will need: This worksheet, Pencil, Scrap paper for the ledger, Calculator (optional)

The scenario

A plant research lab grows basil in two identical sealed, clear chambers. The plants sit in trays of water mixed with minerals; there is no soil. Every gram that goes into or out of each chamber is recorded on a ledger, the way a bank records money. Chamber A gets bright lamps for 14 hours a day. Chamber B is kept dark. Both run for 30 days at the same temperature. Because weighing a living plant includes the water inside it, the lab measures **dry mass**: a matched set of plants was dried in an oven and weighed on day 0, and the chamber plants were dried and weighed on day 30. The numbers below are a teaching dataset, invented to be realistic and to add up cleanly.

Thirty-day ledger for two sealed basil chambers (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Item	Chamber A: lit 14 h per day	Chamber B: dark
Dry mass of plants, day 0 (g)	40	40
Dry mass of plants, day 30 (g)	166	36
Carbon dioxide added to keep the level steady (g)	176	0
Carbon dioxide removed because the level kept rising (g)	0	6
Oxygen removed because the level kept rising (g)	128	0
Oxygen added because the level kept falling (g)	0	4
Water taken from the tray by the plants (g)	9400	310
Water collected as condensation from the air (g)	9328	312

Item	Chamber A: lit 14 h per day	Chamber B: dark
Minerals taken up from the tray solution (g)	6	0.3
Hours of light over 30 days	420	0

Simulated data for teaching. 'Added' means pumped into the chamber to keep the level steady; 'removed' means drawn out of the chamber and weighed.

How to read the water rows — Plants pull far more water from the tray than they keep; most of it evaporates from the leaves and the chamber collects it again as condensation. The water the plants actually **kept** is the difference between the two water rows.

Warm-up: organize the evidence

1. Calculate the change in dry mass for each chamber (day 30 minus day 0). Then calculate how much water each chamber's plants kept (taken minus condensed). Show your work.

2. For Chamber A, add up all the matter that went **into** the plants (carbon dioxide added, water kept, minerals) and all the matter that came **out** or stayed as new plant (oxygen removed plus the dry-mass gain). Compare the two totals. What does the comparison show?

3. What percent of Chamber A's dry-mass gain could the minerals account for at most? Show the division. What does the rest of the gain have to be made of?

Your argument

CLAIM

Claim: State where the new matter in Chamber A's basil came from (name the substances and their rough shares) and what the source of the energy was.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from the ledger, with numbers. Include at least one comparison between Chamber A and Chamber B. Say what each piece of evidence rules in or rules out.

REASONING

Reasoning: Explain how the rule that matter is neither created nor destroyed connects your evidence to your claim. Your reasoning must explain why the ledger has to balance, why light cannot be the matter source even though Chamber A needed it, and what Chamber B's losses tell you about what plants do with sugar.

4. A classmate says: 'Plants are mostly water, so the water is obviously where the basil's mass came from.' Use the dry-mass rows and the water rows to respond.

5. The lab plans a Chamber C: lit 14 hours a day like Chamber A, but with a device that strips carbon dioxide out of the air. Predict the day-30 dry mass and explain what result would **confirm** your claim and what result would **force you to change** it.

A two-column ledger before writing

On scrap paper draw two columns for Chamber A: 'In' and 'Out or kept.' Copy the carbon dioxide added, water kept and minerals into 'In' and the oxygen removed and the dry-mass gain into 'Out or kept.' Total each column. Then write one sentence beside each number saying what it proves (for example, '176 g of gas went in, so the air supplied matter'). Those sentences are your Evidence; the matching totals are the start of your Reasoning.

Balance Chamber B

Chamber B's plants lost 4 g of dry mass while 4 g of oxygen was added and 6 g of carbon dioxide was removed, and the water rows show about 2 g of water appeared that the plants did not take from the tray. Set up the 'In' and 'Out' ledger for Chamber B, show that it balances, and then write the word equation for what the plants in the dark were doing with their stored sugar. Explain why this reaction is, in terms of matter, the reverse of photosynthesis.