

Where Did the Oxygen Go? A Sealed-Jar Claim-Evidence-Reasoning Case

Learning target: I can use data from a sealed model biosphere to argue what caused its oxygen to fall, explain the reasoning with energy and matter, and say how the model should be changed for the next test.

Claim, evidence, reasoning

About 45 min

Individual

MS-ETS1-4 · practice

MS-LS2-3 · supports

writing

data analysis

Name

Date

Period

Directions

Read the scenario, then study the dataset and the observation notes. Answer the warm-up questions first; they organize your evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response uses specific numbers from the table, names the living things involved, and explains how energy and matter moved inside a jar that nothing could enter or leave. Finish with the two design questions.

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

The scenario

A seventh-grade class built three sealed 4-liter glass jars as small models of a biosphere. Each jar held the same three small, healthy plants, the same 200 mL of water, and the same air to start. The only planned difference was the soil: **Jar A** had washed, baked sand; **Jar B** had ordinary garden soil; **Jar C** had garden soil mixed with a cup of fresh compost (partly rotted leaves and vegetable scraps). Each jar was sealed with a lid and wax so that no air, water or soil could get in or out, placed on the same sunny windowsill, and fitted with small sensors that read the percentage of oxygen and of carbon dioxide in the jar's air every five days for thirty days.

Oxygen and carbon dioxide in the three sealed jars (teaching dataset)

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

Day	Jar A oxygen (%)	Jar B oxygen (%)	Jar C oxygen (%)	Jar A carbon dioxide (%)	Jar B carbon dioxide (%)	Jar C carbon dioxide (%)
0	20.9	20.9	20.9	0.04	0.04	0.04
5	21.0	20.5	19.6	0.03	0.1	0.25
10	21.1	20.1	18.4	0.03	0.15	0.45
15	21.1	19.8	17.3	0.03	0.2	0.65
20	21.2	19.5	16.4	0.03	0.24	0.85
25	21.2	19.3	15.7	0.03	0.27	1.0
30	21.3	19.1	15.1	0.03	0.3	1.1

Simulated data written for teaching. The pattern is realistic for sealed jars with and without decomposing material, but these numbers were not measured in a real classroom.

Observation notes from the class log — Day 5: Jar C's glass is fogged every morning and the soil surface has turned darker; a thermometer taped to Jar C's glass reads 1 °C warmer than the other two jars overnight. Day 15: all plants in all three jars are green and upright; Jar C's soil has a few white threads of fungus. Day 30: all plants still alive; Jar A's plants have grown the least, Jar B's the most. No jar leaked (the wax seals were checked with a soap-film test each week).

Warm-up: organize the evidence

1. Calculate the change in oxygen from day 0 to day 30 for each jar (final minus starting). Which jar changed the most, and in which direction?

2. Describe what the carbon dioxide readings did in each jar over the thirty days, and how the carbon dioxide pattern compares with the oxygen pattern.

3. Each jar was sealed so that no matter could enter or leave. Name one form of energy that **could** still cross the glass, and explain why the plants needed it.

Your argument

CLAIM

Claim: State what caused the oxygen in Jar C to fall so much more than in the other jars.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from the dataset and the log, with numbers. For each, say which possible explanation it supports or rules out (for example: a leak, the plants, something living in the soil).

REASONING

Reasoning: Explain how your evidence connects to your claim using what you know about living things, matter and energy in a sealed system. Your reasoning must say where the oxygen went, what the living things got out of using it, and why the sealed lid matters.

Design the next test

4. The class wants Jar C's design to keep oxygen above 19% for thirty days while still having rich soil. Propose one specific change for the next version of the jar, and name the data you would collect to find out whether the change worked.

5. A classmate suggests a fourth jar to test your claim directly: garden soil plus compost that has first been baked in an oven to kill everything living in it. Predict the oxygen reading on day 30 for that jar if your claim is right, and explain what result would make you change your claim.

Three suspects, one table

On scrap paper make three columns headed 'A leak,' 'The plants,' and 'Living things in the soil.' Under each heading list every number or note from the sheet that fits or does not fit that suspect. For example: the soap-film test goes under 'A leak' as evidence against; the fact that all three jars had the same plants goes under 'The plants' as evidence against. The suspect with evidence for it and nothing against it is your claim, and the columns are your evidence section.

The missing carbon dioxide

When living things use oxygen to break down food, they release carbon dioxide in roughly equal amounts. Jar C lost about 5.8 percentage points of oxygen but gained only about 1.1 percentage points of carbon dioxide. Propose two places the missing carbon dioxide could have gone inside a sealed jar (think about the water, the plants and the glass), and design a measurement for each. Then find out what happened to carbon dioxide in the real Biosphere 2 project and compare it with your ideas.