

Do Plants Run on Oxygen Too? A Claim-Evidence-Reasoning Case

Learning target: I can use gas measurements and field observations to argue whether plants carry out cellular respiration, and explain my reasoning with the idea that cells release energy from sugar by reacting it with oxygen.

Claim, evidence, reasoning

About 45 min

Individual

MS-LS1-7 · practice

MS-LS1-6 · supports

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario and study all three pieces of evidence. Answer the warm-up questions first; they will help you organize the evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response uses specific numbers from the data, uses the words reactant and product correctly, and explains why each piece of evidence matters, not just what it shows.

You will need: This worksheet, Pencil, Calculator, Scrap paper for the evidence grid

The scenario

Two students disagree. Nadia says, 'Plants make their own food with photosynthesis, so they don't need cellular respiration. They don't even take in oxygen.' Tomas says, 'Every living cell has to release energy from food, so plants must do cellular respiration too, even if they also photosynthesize.' Their teacher gives them three pieces of evidence to settle it. Study each one carefully.

Evidence 1: carbon dioxide inside a sealed box

A small basil plant was potted in sand that had been rinsed and heated so that no soil microbes were living in it. The pot was sealed inside a clear plastic box with a carbon dioxide sensor. A second, identical box held a pot of the same sterile sand with no plant. A lamp shone on both boxes for the first three hours, then was switched off for the next three hours. The sensor reports carbon dioxide in parts per million (ppm); ordinary air is about 420 ppm.

Carbon dioxide inside two sealed boxes (teaching dataset)

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

Hour	Lamp	Box with basil plant (ppm)	Box with sand only (ppm)
0	on	420	420
1	on	385	421
2	on	350	419
3	on	315	420
4	off	365	422
5	off	415	420
6	off	465	421

Simulated data for teaching. Lamp on from hour 0 to hour 3; lamp off from hour 3 to hour 6. Both boxes stayed at 23 °C.

Evidence 2: oxygen in a dark jar of sprouting seeds

Oxygen in two sealed jars kept in a dark cupboard for 24 hours (teaching dataset)

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

Jar	Oxygen at start (% of air)	Oxygen after 24 h (% of air)	What the seeds looked like after 24 h
Living sprouting seeds	20.9	17.6	white root tips about 1 cm long
Boiled seeds	20.9	20.9	swollen, no roots

Simulated data for teaching. Each jar held 50 radish seeds that had been soaked overnight. One batch was boiled first to kill the seeds.

Evidence 3: a field note

From a community garden logbook — After the creek overflowed, the low bed stayed under water for nine days. When it drained, the tomato plants in that bed were wilted even though the soil was soaking wet. We pulled one up: the roots were brown, soft and smelled sour. The tomatoes in the raised bed next to it, which drained within a day, were fine, with white, firm roots. Soil that stays flooded has almost no air left in the spaces between its grains.

Warm-up: organize the evidence

1. In Evidence 1, describe what the carbon dioxide in the plant box did while the lamp was on and what it did after the lamp went off. What did the sand-only box do the whole time?

2. Calculate the rate at which carbon dioxide rose in the plant box in the dark (hours 3 to 6), in ppm per hour. Then calculate the rate at which it fell in the light (hours 0 to 3). If the plant was releasing carbon dioxide at the dark rate the whole time, at what rate was photosynthesis removing carbon dioxide while the lamp was on? Show your work.

3. Why did the teacher include the sand-only box and the boiled seeds? What claim of Nadia's does Evidence 2 test most directly?

Your argument

CLAIM

Claim: State whether plants carry out cellular respiration, and whether they take in oxygen. Say who is right, Nadia or Tomas, and whether either is partly right.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from the three sources, with numbers where they exist (for example, the ppm values, the rates you calculated, the oxygen percentages, the root observations). For each one, say what it shows about gases going in or out of the plant.

REASONING

Reasoning: Explain how each piece of evidence connects to the claim using the model of cellular respiration: which substances are reactants, which are products, and what the reaction is for. Your reasoning must explain why the carbon dioxide went down while the lamp was on even though respiration was still happening, and why flooded roots died.

4. Suppose the lamp had been left on for a full 24 hours. Predict what the carbon dioxide reading in the plant box would have done, and explain why that result would **not** mean the plant had stopped cellular respiration.

An evidence grid before writing

On scrap paper, make three rows (Evidence 1, 2, 3) and three columns: 'What changed?', 'Which gas, in or out?', and 'What would Nadia have to say about it?'. Fill the grid before you write. For Evidence 1, use two rows: lamp on and lamp off. Each filled cell becomes one sentence of your Evidence section, and the third column gives you your Reasoning: if Nadia's idea cannot explain a cell, say so.

Design the fourth piece of evidence

Nadia now agrees that plants release carbon dioxide in the dark but says it might come from the sand after all. Design an experiment that would settle this using the sealed boxes, and say exactly what readings would support her and what readings would support Tomas. Then explain why the plant box and the sand box being at the same temperature mattered, and what you would expect to happen to the dark rate if both boxes were warmed to 33 °C.