

The Shrinking Candle: Was Any Matter Destroyed?

Learning target: I can use mass data, product tests and the atom model to argue, in a Claim-Evidence-Reasoning paragraph, that a burning candle loses mass without any matter being destroyed.

Claim, evidence, reasoning

About 40 min

Individual

MS-PS1-5 · assesses

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario, the two sets of readings and the observation notes. The readings are a teaching dataset written to be realistic; your teacher may show the real demonstration instead. Answer the warm-up questions first; they organize your evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong argument quotes specific numbers, names the substances the atoms ended up in, and explains the difference between the open and the sealed run. Do not burn anything yourself; the candle is lit by the teacher only.

You will need: This worksheet, Pencil

The scenario

Ms. Okafor set a short candle in a small metal dish on a balance that reads to 0.01 g, lit it, and read the balance every two minutes for ten minutes while it burned in the open air. Then she took a second, identical candle, lit it, and lowered a 1-liter glass jar over it onto a plate with a rubber gasket so that no air could get in or out. The jar, plate, candle and dish all sat on the balance together. The flame went out after about 15 seconds. She kept reading the balance for five minutes. A student asked, 'The first candle lost mass. Where did it go? Was it destroyed?' Your job is to answer with evidence.

Run 1: candle burning in open air (teaching dataset)

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

Time (min)	Balance reading (g)
0	48.20
2	47.88
4	47.56
6	47.24
8	46.92
10	46.60

Simulated data for teaching, realistic for a small candle. The dish and candle were weighed together.

Run 2: candle sealed under a jar (teaching dataset)

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

Time (min)	Balance reading (g)	Flame
0	612.40	lit
1	612.40	out (went out at about 15 s)
3	612.40	out
5	612.40	out

Simulated data for teaching. The jar is rigid glass, so its size did not change. The whole sealed setup was on the balance.

Observation notes from the demonstration — 1. A cold, dry drinking glass held upside down above the open flame fogged up within seconds; the fog was tiny droplets of water. 2. Gas collected from just above the flame and bubbled through limewater turned the limewater cloudy, which is the standard test for carbon dioxide. 3. Candle wax is a mixture of molecules made of carbon and hydrogen atoms. 4. Inside the sealed jar, the glass fogged, and when the jar was lifted after the run the air inside smelled smoky. 5. After Run 2 the wick was blackened and a little wax at the top had melted and hardened again; so little wax had burned that the candle did not look any shorter.

Warm-up: organize the evidence

1. Calculate the total mass lost in Run 1 and the average loss per minute. Then describe the pattern in the readings: did the candle lose mass in equal steps or not?

2. Notes 1 and 2 are tests on the gases above the flame. What two substances do they show were being produced? Which atoms in each of those substances came from the wax, and which came from somewhere else?

3. In Run 2 the flame went out after about 15 seconds and the reading never changed. Explain both facts: why the flame died, and why the reading stayed at 612.40 g even though some wax burned.

Your argument

CLAIM

Claim: Was any matter destroyed when the open candle lost 1.60 g? State your answer in one sentence that also says where the lost mass is now.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from the readings and the notes, with numbers where they exist (the open-air loss, the sealed reading, the product tests, the jar notes). For each piece, say what it shows.

REASONING

Reasoning: Explain how the atom model connects your evidence to your claim. Your reasoning must say what happened to the carbon and hydrogen atoms in the wax, what joined them from the air, why the open reading fell while the sealed reading did not, and why that difference proves the mass was moved rather than destroyed.

4. After Run 2, Ms. Okafor lifted the jar and weighed the candle and dish by themselves. Predict whether that reading was higher than, lower than, or the same as at the start, and say exactly where the difference is at that moment. Then explain what the air inside the jar gained or lost.

Evidence sentence frames

For each piece of evidence, write one sentence in this shape: 'The _____ (reading, test or note) shows _____ because _____.' Example: 'The sealed reading of 612.40 g at every time shows that nothing left the jar because a sealed system keeps all its atoms.' For reasoning, use this chain in order: the wax's carbon and hydrogen atoms bonded to oxygen atoms from the air; the new substances were gases; in the open the gases drifted away with their mass; under the jar they stayed and were weighed. Remember that an atom's mass does not change when it changes partners.

The argument in reverse

A steel wool pad burned in open air gains mass (2.00 g becomes 2.14 g). Write a second, shorter Claim-Evidence-Reasoning argument, five to seven sentences, that uses the same atom model to explain the gain. Then explain why the candle and the steel wool, one losing and one gaining, are actually evidence for the same law. Finish by describing one sealed experiment that would test both at once, and the reading you would expect.