

Which Element Is Sample X? A Claim-Evidence-Reasoning Case

Learning target: I can use measured atomic mass and observed behavior, together with the patterns of the periodic table, to argue which element an unknown sample is and where it belongs.

Claim, evidence, reasoning

About 40 min

Individual

MS-PS1-1 · practice

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario and the technician's notes. Study the candidate table. Answer the warm-up questions first; they will help you organize your evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response names specific numbers and observations and explains how the periodic table's patterns connect the evidence to the claim.

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

The scenario

A school stockroom has a small sealed jar whose label has worn off. All that remains is 'Sample X' and the words 'keep under oil.' The science technician, Mr. Reyes, cannot throw it out until he knows what it is, because some metals need special disposal. He runs four safe tests and sends a tiny piece to a university lab that can measure the typical mass of the atoms in a sample. His notes are below. The stockroom inventory lists only six metals that were ever ordered, so the sample must be one of those six.

Technician's notes on Sample X — 1. The jar holds a lump of metal stored under oil; the lump floats on the oil. 2. The lump is soft: a steel knife slices it easily. The fresh cut is shiny silver but turns dull gray within a few minutes in air. 3. A rice-grain-sized piece placed in a dish of water fizzes steadily, moves around on the surface and slowly disappears. There is no flame, no spark and no popping. 4. The university lab reports the typical atomic mass as **between 6 and 9 daltons**; their instrument could not be more precise with such a tiny piece.

The six candidate metals (real rounded data)

Element	Symbol	Atomic mass (Da)	Column of the table	Hardness	Behavior in water	Normally stored under oil?
Lithium	Li	7	1	soft, cuts with a knife	fizzes steadily, no flame	yes
Beryllium	Be	9	2	hard, scratches glass	no reaction	no
Sodium	Na	23	1	soft, cuts with a knife	reacts fast; can catch fire	yes
Magnesium	Mg	24	2	fairly hard	almost no reaction in cold water	no
Potassium	K	39	1	very soft	bursts into flame immediately	yes
Calcium	Ca	40	2	fairly hard	fizzes steadily	no

Warm-up: organize the evidence

1. Using only note 4 (the atomic mass range), which candidates are still possible? Which are ruled out?

2. Of the candidates left after q1, which notes rule out all but one? Name the note numbers and explain what each one eliminates.

3. Note 3 says the sample fizzed with no flame. Explain why this single observation is enough to rule out sodium and potassium even without the mass measurement.

Your argument

CLAIM

Claim: State which element Sample X is and which column of the periodic table it belongs in.

EVIDENCE

Evidence: List at least three specific pieces of evidence from the notes and the table, with numbers where they exist (for example, the mass range, the hardness, the water behavior, the oil storage). Say which candidates each piece rules out.

REASONING

Reasoning: Explain how the periodic table's patterns connect your evidence to your claim. Your reasoning must use the idea that elements in the same column behave alike, and must explain why the mass evidence and the behavior evidence were both needed.

4. Mr. Reyes could ask the university lab to repeat the mass measurement with a larger piece. Would a more precise mass change your claim? Explain what result would **confirm** your claim and what result would **force you to change** it.

Evidence table before writing

On scrap paper, make a grid with the six candidates across the top and the four notes down the side. For each note, cross out every candidate it rules out and write the reason in two or three words (for example, 'too heavy', 'not soft', 'would catch fire'). The one column with no crosses is your claim, and each cross you wrote is a piece of evidence you can copy into your CER.

A seventh candidate

Suppose the inventory also listed rubidium (Rb, 85.5 Da, column 1, very soft, stored under oil, explodes on contact with water). Rewrite your Evidence section so that it rules rubidium out, and then explain, using the column-1 pattern from lithium to potassium, why rubidium's reaction with water is expected to be even more violent than potassium's, even though no note describes it.