

Fix the Lab Notebook: Six Conclusions That Went Wrong

Learning target: I can find the mistake in a conclusion about whether a chemical reaction happened, explain why the reasoning fails, and rewrite the conclusion so that it rests on the right kind of evidence.

Error analysis

About 35 min

Individual

MS-PS1-2 · practice

writing

independent practice

discussion

Name _____

Date _____

Period _____

Directions

Theo kept a notebook of changes he saw at home and wrote a conclusion for each one. Some conclusions are wrong. One is right but for a weak reason. Read all six entries and his rule at the end. In Part A, diagnose every entry. In Part B, rewrite the faulty ones so that each conclusion follows from the right kind of evidence. Be specific: name the change, name the evidence, and say what test would settle it.

You will need: This worksheet, Pencil

Theo's notebook

Entry 1: Ice in lemonade — I dropped four ice cubes into my lemonade. The thermometer went from 20 °C down to 4 °C and the cubes got smaller. A temperature change means a chemical reaction happened, so the ice must have reacted with the lemonade.

Entry 2: Sugar in warm water — I stirred a spoonful of sugar into warm water until I could not see it anymore. The sugar is gone, so it must have turned into a new substance. Dissolving is a chemical change.

Entry 3: Sparkling water — When I twisted the cap off a bottle of sparkling water it hissed and fizzed for a whole minute. Gas coming out is a sign of a chemical reaction, so a reaction happened when I opened the bottle.

Entry 4: Two white powders — In class we measured the melting points of two white powders from different jars. Both melted at 801 °C. Two substances with the same melting point are definitely the same substance, so the jars hold the same thing.

Entry 5: The fizz that stopped — I poured vinegar on a spoonful of baking soda in a cup. It fizzed hard for about a minute and then stopped, even though there was still plenty of liquid. The reaction ran out of energy, like a battery going flat.

Entry 6: The glow stick — I snapped a glow stick and it lit up bright green for hours. Light proves a chemical reaction, so a new substance definitely formed inside the stick.

Theo's rule — My rule for next time: if anything changes (temperature, bubbles, color, light, or a solid disappearing), it is a chemical reaction. If nothing you can see changes, it is a physical change.

Part A: Diagnose each entry

1. For each entry, say whether Theo's conclusion is right or wrong, then name the mistake in his reasoning. One entry has a right conclusion reached by weak reasoning; say so.

Conclusion right or wrong?	The mistake in the reasoning (write 'none' if the reasoning is sound)
Entry 1: ice in lemonade	
Entry 2: sugar in warm water	
Entry 3: sparkling water	
Entry 4: two white powders	
Entry 5: the fizz that stopped	
Entry 6: the glow stick	

Part B: Rewrite the faulty conclusions

2. Rewrite Entry 1. Explain why the lemonade got colder, say what the ice became, and name one measured property of the melted ice that shows it is still the same substance.

3. Rewrite Entry 2. Explain what 'the sugar is gone' really means, name the kind of change, and describe a test that would bring the evidence back. (Nothing in a lab is tasted.)

4. Rewrite Entry 3. Where was the gas before Theo opened the bottle, and why does that matter? Then explain how this fizz differs from the fizz of vinegar on baking soda.

5. Rewrite Entry 4. Explain what a matching melting point can and cannot tell you, and name two more tests that would settle whether the jars hold the same substance.

6. Rewrite Entry 5. Explain why the fizzing stopped, then describe a two-step test Theo could do with more vinegar and more baking soda to prove his new explanation.

7. Entry 6 reaches the right conclusion: a glow stick does work by a chemical reaction. Explain what is weak about Theo's reasoning, and say what kind of evidence would turn 'light' from a clue into proof.

8. Rewrite Theo's rule so that it is correct. Your rule must say what the clues are good for, what counts as proof, and what to do when a change is seen but no test has been done. Three to five sentences.

Two questions for any change

Ask these two questions about every entry. Question 1: Is the substance at the end the same substance as at the start? (Melted ice is still water. Dissolved sugar is still sugar. Rust is not iron.) Question 2: What evidence would show it? A clue is something you can see or feel during the change: bubbles, heat, cold, light, a color. Proof is a measured property of the stuff that is left, compared with the same property of the stuff you started with, at the same temperature. If Theo's conclusion rests on a clue alone, the reasoning is weak even when the conclusion happens to be right.

Write two trap entries

Write two notebook entries of your own about changes you have seen outside school. One must have a wrong conclusion built on a clue, and one must have a right conclusion built on a weak reason, like Theo's glow stick. Swap with a partner, diagnose each other's entries and rewrite them. Then agree on the single most common mistake in your four entries and write one sentence explaining why that mistake is so easy to make.