

Fixing Tomas's Lab Summary: Seven Energy Errors

Learning target: I can find the errors in a student's explanation of hot and cold packs, explain what idea went wrong in each, and rewrite the explanation correctly.

Error analysis

About 35 min

Individual

MS-PS1-6 · supports

writing

independent practice

Name _____

Date _____

Period _____

Directions

Tomas tested three packets in science class and wrote the summary below. His measurements are fine; the numbers are a teaching scenario and he recorded them carefully. His explanations are not fine. Seven of his eight numbered sentences contain a science error, and one is correct. Your job is to be the editor: find each error, explain what idea went wrong, and rewrite the sentence so it is right. Use the data table as evidence. Do not just say 'wrong'; say why.

You will need: This worksheet, Pencil

Tomas's measurements (teaching scenario, room at 21 °C)

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

Packet	What was mixed	Start (°C)	After 3 min (°C)	Other observations
P1	Baking soda and vinegar in a cup	21	16	Fizzed hard for a minute, then stopped
P2	Calcium chloride granules and water in a cup	21	47	No bubbles; granules disappeared
P3	Iron powder pouch, opened to the air	21	36	Still warming at 3 min; 44 °C at 10 min; 24 °C the next day

Tomas's summary (numbered sentences) — (1) P1 fizzed really hard, so it was giving off a lot of energy and must be exothermic. (2) P2 got hot because the calcium chloride dissolved and the net energy transfer was out of the system into the water, the cup and my hand. (3) P1 got cold because the reaction released cold into the water. (4) P3 warmed up because breaking the bonds in the iron released the energy that was stored in them. (5) Since P3 needs air to keep going, it must be endothermic, because endothermic reactions need a continuous supply from outside. (6) Energy was created inside P2 and P3 and destroyed inside P1. (7) The equation for P3 is $4\text{Fe} + 3\text{O}_2 + \text{energy} \rightarrow 2\text{Fe}_2\text{O}_3$. (8) P2 reached 47 °C and P3 only reached 44 °C, so P2 will stay warm longer than P3.

Part A: Diagnose

1. Mark each sentence as correct or error. For each error, name the idea that went wrong in a few words (for example, 'confuses fizzing with energy direction').

Correct or error?	What idea went wrong (a few words)
Sentence 1	
Sentence 2	
Sentence 3	
Sentence 4	
Sentence 5	
Sentence 6	
Sentence 7	
Sentence 8	

2. Sentence 1 uses the fizzing as evidence. What measurement in the table is the real evidence for P1's energy direction, and what direction does it show?

3. Sentence 3 says the reaction 'released cold.' Explain what actually moved, and in which direction, when P1's water went from 21 °C to 16 °C.

4. Sentence 4 has the bond idea backwards in one important way. What does breaking a bond always do to energy, and where did P3's released energy actually come from?

5. Sentence 5 uses the rule 'needs a continuous supply, so endothermic.' P3 does need a continuous supply of something. What is it, and why does needing it not make P3 endothermic?

6. Sentence 8 predicts P2 will stay warm longer because it got hotter. Use the table's other observations for P3 to show why peak temperature does not decide how long a pack lasts, and name what does.

Part B: Rewrite

7. Rewrite sentence 7 as a correct equation for P3, with energy on the correct side:

8. Rewrite Tomas's whole summary as five correct sentences. Your version must classify each packet (exothermic, endothermic) with its evidence, state the direction of energy flow for each, explain P3's energy using bonds correctly, and replace sentence 6 with a true statement about what happens to energy.

Three test questions for every sentence

Read each of Tomas's sentences and ask: (1) Is the direction of energy decided by a thermometer reading or by light and sound leaving, or by something else like fizzing or needing a start? Only the first kind counts. (2) Does the sentence say energy was created, destroyed, or let out of a broken bond? Those are always errors. (3) Does it say 'cold' moved? Only energy moves. If a sentence passes all three tests, it is probably correct; sentences 2 and 7 are the ones to check most carefully against the table.

Write the next bad summary

Write a four-sentence summary of a different pair of changes (hydrogen peroxide with yeast, which foams and warms, and citric acid with baking soda in water, which fizzes and cools) that contains exactly two errors of kinds Tomas did not make. Swap with a partner, find each other's errors, and write the corrections. Then explain in two sentences why the foaming and fizzing in these two changes tell you nothing about the direction of energy flow.