

Did a Reaction Happen? Six Changes, One Decision Table

Investigation question: For six everyday changes, which clues only look like a reaction, which property tests settle the question, and how strong is the evidence for each decision?

Data-driven decision

Groups of 4

2 sessions

Setup 10 · Activity 80 · Cleanup 10 min

MS-PS1-2 · assesses

Name _____

Group _____

Date _____

Your role today

- ☐ **Mixer:** Adds the solid or liquid for each change in the stated amount, stirs where the step says, and never adds anything that is not on the card.
- ☐ **Observer:** Reads the thermometer before and after, watches for gas, color, solid and smell (wafting only), and reports in plain words.
- ☐ **Recorder:** Fills the clue table in session 1 and the property-test and decision tables in session 2; checks that every cell has an entry.
- ☐ **Curator and safety captain:** Labels and stores every product cup and drying spot on the group tray, checks goggles before each change, and runs the cleanup list.

Safety

- Splash goggles on for both sessions. Vinegar, hydrogen peroxide and calcium chloride solutions irritate eyes; rinse 15 minutes at the eyewash if splashed.
- Nothing is tasted. Smell only by wafting with a hand; never put your nose over a cup.
- Hydrogen peroxide 3% bleaches skin white briefly and stings cuts; wash off with water. Do not mix it with anything except what the card says, and never pour vinegar and peroxide together into a bottle or store them mixed: together they slowly form peracetic acid, a stronger irritant. In change 5 the peroxide goes onto a squeezed tuft in an open cup, and that liquid is poured away at the end of session 1.
- Steel wool fibers splinter into fingers; handle with the spoon or wear gloves. Steel wool can burn: keep it away from any heat source, batteries or sparks. No flames are used anywhere in this lab.
- Calcium chloride cups get warm; use the stated amount, do not touch the solution, and report any cup that feels hot.
- Never seal a cup or bag that is fizzing or foaming. Keep all cups uncovered.
- Cleanup: liquids down the sink with running water, including peroxide and yeast; steel wool and rust in the trash wrapped in a paper towel; wash hands.

Procedure

1. Session 1. Goggles on. Label six cups C1 to C6 and six product cups P1 to P6. Write your group name on the dark lid and mark six drying spots D1 to D6 on it.

2. Change 1: 20 mL vinegar in C1; read the temperature. Add a level quarter-teaspoon of baking soda. Record gas, temperature after 60 seconds, color, smell. When the fizzing stops, pour the liquid into P1 and put three drops on spot D1.
3. Change 2: 20 mL water in C2; read the temperature. Add half a teaspoon of Epsom salt and stir 30 seconds. Record what you see and the temperature. Pour into P2; three drops on D2.
4. Change 3: 20 mL water in C3; read the temperature. Add a level quarter-teaspoon of calcium chloride and stir 30 seconds. Record what you see and the temperature. Pour into P3; three drops on D3.
5. Change 4: 10 mL baking soda solution in C4; read the temperature. Add 10 mL calcium chloride solution and swirl once. Watch for two full minutes. Record gas, cloudiness, solid, temperature. Let the cup sit undisturbed; this is P4.
6. Change 5: Soak one tuft of steel wool in 10 mL vinegar in C5 for one minute, then lift it out with a spoon, squeeze it against the cup wall and move it to P5. Add 10 mL hydrogen peroxide to the tuft. Hold the thermometer against the tuft. Record color, temperature over three minutes, gas, smell. Keep the second, untouched tuft as the 'before' sample.
7. Change 6: 20 mL hydrogen peroxide in C6; read the temperature. Add a quarter-teaspoon of yeast and swirl once. Record foam, temperature after two minutes, smell. When the foam settles, pour the liquid into P6, leaving the yeast sludge in C6. Keep both.
8. Pour the liquid off P5 down the sink with running water, keeping the tuft. Put the dark lid on the drying shelf and the product cups on the tray with the 'before' steel wool, the remaining baking soda, Epsom salt and calcium chloride, and the leftover yeast. Clean up the C cups except C6.
9. Session 2. Goggles on. Drying spots first: look at D1, D2, D3 with the hand lens and describe each residue. Scrape a little of each residue into a cup with 5 mL water: does it dissolve? Add a drop of vinegar to another part of each residue: fizz or not? Put a drop of baking soda solution on a third part: does it turn cloudy white? Do the same three tests on small pinches of fresh baking soda, Epsom salt and calcium chloride as the 'before' samples and record all six side by side. (A few dried drops are far too little to change the temperature of water, so temperature is not one of these tests.)
10. P1 leftover test: add a pinch of baking soda to half of P1 (fizz means acid remained). Add five drops of vinegar to the other half (fizz means baking soda remained). Record which reactant was used up.
11. P4: pour off the clear liquid carefully. Add 10 mL water to the white solid and stir: does it dissolve? Compare with how both starting solutions were made (both solids dissolved). Add five drops of vinegar to the solid: fizz? Record.
12. P5: hold the magnet beside the untouched steel wool, then beside the orange product. Compare the pull, the color, the shine and how each breaks apart under the spoon. Put a pinch of each in 5 mL water: does either dissolve?
13. P6: add 10 mL fresh hydrogen peroxide to the yeast left in C6 and record. Add a quarter-teaspoon of fresh yeast to the liquid in P6 and record. Decide which substance was used up and which was not.
14. Fill the decision table: for each change, the clues seen, the property test you did, what differed (or did not) before and after, your verdict, and a strength rating with a reason. Answer the analysis questions on your own.

Record your observations

Lab 2 recording sheet: Did a reaction happen?

Session 1: fill the clue table as each change runs. Write 'none' where you saw nothing; a blank is not data.

Session 2: fill the property-test table, then the decision table.

Session 1: clues seen during each change

Change	Temperature before (°C)	Temperature after (°C)	Gas? (none/bubbles/foam)	Color or solid change?	Smell? (waft only)	First guess: reaction or physical?
1 Baking soda + vinegar						
2 Epsom salt + water						
3 Calcium chloride + water						
4 Baking soda solution + calcium chloride solution						
5 Steel wool + vinegar, then peroxide						
6 Hydrogen peroxide + yeast						

Session 2: properties before and after

Change	Property tested	Starting substance(s): result	Product: result	Same or different?
1	Residue dissolves in water? Fizzes with vinegar?			
1	Leftover liquid: fizz with baking soda? with vinegar?			
2	Residue: looks like? dissolves? fizz? clouds soda solution?			
3	Residue: looks like? dissolves? fizz? clouds soda solution?			
4	White solid dissolves in water? Fizzes with vinegar?			
5	Magnet pull? Color and shine? Crumbles? Dissolves?			
6	Fresh peroxide on used yeast? Fresh yeast in used liquid?			

Decision table

Change	Clues (session 1)	Property evidence (session 2)	Verdict: reaction or physical change	Evidence strength (strong/medium/weak) and why
1				
2				
3				
4				
5				
6				

1. Which change fooled your first guess in session 1, and which session-2 result changed your mind?

Analysis questions

2. Changes 1 and 3 both changed temperature. Explain why you reached different verdicts for them, naming the property evidence for each.

3. In change 4 nothing dramatic happened: no big fizz, no heat, just a cloudy cup. Explain why it still earned a 'reaction' verdict and why the solubility of the white solid is the key piece of evidence.

4. The magnet pulled hard on the untouched steel wool and barely on the orange product. Why does that count as evidence of a new substance, and why would 'it turned orange' alone have been weaker evidence?

5. In change 6, fresh peroxide foamed on the used yeast but fresh yeast did nothing in the used liquid. Which substance was the reactant that got used up, and what role did the yeast play? What does this tell you about the liquid left in the cup?

- 6.** Neither the steel wool nor the rust dissolved in water. Does that result argue against a reaction? Explain what a 'same' result in a property test does and does not tell you.

- 7.** Rank your six verdicts from strongest evidence to weakest. For the weakest, describe one more test (any property) that would strengthen it.

- 8.** A friend who missed the lab says: 'Just tell me the rule: bubbles or heat means reaction.' Write the better rule in two sentences, using one example from this lab for each sentence.
