

Clue, Proof or Not Yet: The Evidence Sort

Learning target: I can work with a group to sort described changes into reactions confirmed by a property comparison, physical changes shown by a property comparison, and changes where only a clue has been seen, and I can defend each placement with the evidence on the card.

Collaborative investigation

About 50 min

Small group

MS-PS1-2 · practice

collaboration

discussion

data analysis

Name _____

Date _____

Period _____

Directions

Work in groups of three or four. Step 1 (5 minutes): deal the eleven cards around the group and read yours aloud, one at a time, so everyone hears every card. Step 2 (15 minutes): sort the cards into the three piles described in the task, agree on each placement, and fill in the group record. Step 3 (10 minutes): rate the evidence and plan tests for the 'not yet' pile. Step 4 (8 minutes): trade one card with a neighboring group and challenge each other's placement. Step 5 (12 minutes): answer Part C alone, without talking.

You will need: One set of eleven cards per group, cut from the card sheet, Sticky notes, Group record table, Pencils

Eleven evidence cards

1 Card 1: Ice in lemonade

What was seen: the drink cooled from 20 °C to 5 °C; the cubes shrank and disappeared. Test result: liquid that dripped from a melting cube froze at 0 °C and boiled at 100 °C, the same as the water the cubes were made from.

2 Card 2: Steel wool pad in vinegar and hydrogen peroxide

What was seen: the pad warmed by 8 °C, turned orange-brown and crumbled. Test result: a magnet lifted a fresh pad but not the orange crumbs; the fibers of a fresh pad bend, while the crumbs snap. Reference values: iron has a density of 7.87 g/cm³; rust has a density of about 5.2 g/cm³.

3 Card 3: Sparkling water opened

What was seen: a hiss and streams of bubbles for a minute. Test result: the gas turned limewater cloudy, so it is carbon dioxide; the label says carbon dioxide was dissolved into the water at the factory; the flat water left behind froze at 0 °C.

4 Card 4: Calcium chloride pellets in water

What was seen: the water warmed from 21 °C to 38 °C and the pellets vanished. Test result: when the water was evaporated and the teacher dried the solid in a hot oven, a white solid was left whose solubility at 20 °C matched the original pellets within 1 g per 100 mL, and it warmed fresh water in the same way when added again.

5 Card 5: Sugar heated in a pan

What was seen: white crystals turned into a clear liquid, then golden brown, with a new smell. Test result: the brown material dissolved in water to give a brown liquid; evaporating that liquid left a brown, sticky solid, not white crystals. Fresh sugar dissolves to give a colorless liquid and comes back as white crystals.

6 Card 6: Glow stick snapped

What was seen: a bright green glow for hours; the stick felt slightly warm. Test result: no test was done on the liquid inside.

7 Card 7: Two clear solutions mixed

What was seen: a solution of Epsom salt and a solution of washing soda were poured together; the mixture turned cloudy white at once and a white solid settled; the temperature did not change. Test result: the dried white solid dissolved less than 0.1 g per 100 mL at 20 °C; both starting solids dissolve more than 20 g per 100 mL at 20 °C.

8 Card 8: Salt water in a sunny dish

What was seen: over two days the water vanished and white crystals appeared on the dish. Test result: the crystals dissolved 36 g per 100 mL at 20 °C, the same as the table salt used to make the salt water, and they were small cubes like the original grains.

9 Card 9: Hydrogen peroxide with a pinch of yeast

What was seen: foam rose up the cup and the cup warmed by 6 °C. Test result: the gas made a glowing splint burst into flame; no gas came out of the peroxide bottle before the yeast was added; the liquid left in the cup did nothing when fresh yeast was added.

10 Card 10: Kettle boiling

What was seen: bubbles roared up from the bottom and steam poured from the spout. Test result: steam caught on a cold lid turned into drops that froze at 0 °C; the water left in the kettle still boiled at 100 °C.

11 Card 11: Banana on the counter

What was seen: over four days the peel turned brown and spotted and the fruit went soft. Test result: no test was done.

Part A: The group sort

1. Make three spaces on the desk labeled REACTION CONFIRMED (a property of what is left differs from the starting substance), PHYSICAL CHANGE SHOWN (a property of what is left matches the starting substance) and NOT YET (a change was seen but no property test was done).
2. Place each card by its **test result**, not by what was seen. If the card says no test was done, it goes in NOT YET no matter how dramatic the change looked.
3. For every card in REACTION CONFIRMED, write on a sticky note the property that differed. For every card in PHYSICAL CHANGE SHOWN, write the property that matched.
4. Rate each REACTION CONFIRMED card's evidence as strong (a measured property such as solubility, density or melting or boiling point, or a chemical property shown to be lost) or fair (a difference in appearance or behavior only). Write the rating on the sticky note.
5. For each NOT YET card, agree on one property test that would move it to another pile, and what result would send it where.

6. Fill in the group record. Every member must be able to explain every placement.

Group record (fill in)

Pile	Card numbers	Property that differed or matched (one per card)
Reaction confirmed		
Physical change shown		
Not yet		

1. Group answer: Which card did your group argue about longest, which piles were the two choices, and what sentence on the card finally settled it?

2. Group answer: For each NOT YET card, write the test your group chose and the result that would move it to REACTION CONFIRMED.

3. Group answer: Which REACTION CONFIRMED card has the weakest evidence? Give its rating from step 4 and name one measurement that would make it strong.

4. Group answer: Write the challenge the neighboring group made to one of your placements and how you answered it using the card.

Part C: Individual accountability (complete alone)

5. Cards 3 and 9 both produced a gas. Explain why they belong in different piles, using the sentence on each card that tells you where the gas came from.

6. Cards 2 and 4 both got warm. Explain why they belong in different piles, naming the property that differed on one card and the property that matched on the other.

7. Cards 1, 8 and 10 each show something appearing or disappearing (cubes vanishing, crystals appearing, steam leaving). What single kind of test result put all three in the same pile?

8. Write a rule, in your own words, for when a clue becomes proof that a new substance formed. Your rule must mention same conditions, a characteristic property, and what to do when no test has been done. Then apply your rule to Card 11 in one sentence.

Cover the top half

If a card is hard to place, cover the 'What was seen' sentence with your hand and read only the 'Test result'. Ask: does the test compare a property of what is left with the same property of what we started with? If the properties match, it is the physical change pile. If they differ, it is the reaction pile. If no test was done, it is the NOT YET pile. Only after placing the card uncover the top half and notice how dramatic the clue was; that is the trap the sort is teaching you to avoid.

Make the twelfth card

Write a Card 12 for a change that looks like nothing happened (no bubbles, no heat, no color) but is a chemical reaction, and whose test result proves it with a measured property. The silver tarnish that forms on a spoon, or the slow change of a cut apple, are starting points, but you must invent the test and the numbers (label them as made up) so that a group could place the card without seeing anything dramatic. Then write one sentence on why this card is the hardest kind for Theo's 'if nothing changes it is physical' rule.