

Fixing Jordan's Notebook: Heat, Cold and the Missing Flat Lines

Learning target: I can find the errors in another student's statements and graph about heat, temperature and state changes, name the idea that went wrong, and rewrite each one so it is scientifically accurate.

Error analysis

About 45 min

Individual

MS-PS1-4 · practice

MS-PS3-4 · supports

writing

independent practice

Name _____

Date _____

Period _____

Directions

Jordan missed the melting lab, so he drew the graph he expected and wrote eleven statements in his notebook. Some are correct and some contain a common mistake. For each statement, decide whether it is correct and, if not, name the idea that went wrong in a few words. Then explain and rewrite the incorrect ones. Be specific: 'wrong' is not an explanation.

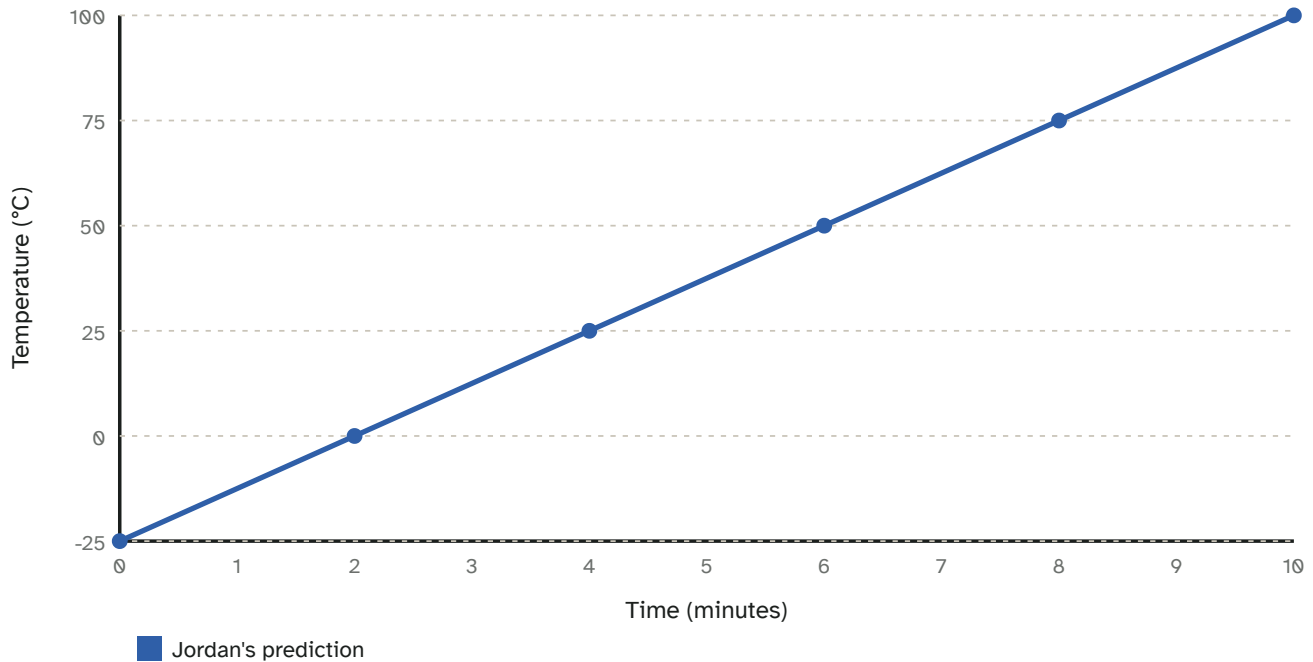
You will need: This worksheet, Pencil, Ruler

Jordan's notebook page

Jordan's notes: 'The class put crushed ice from the freezer in a beaker on a hot plate and recorded the temperature every minute until the water boiled. This is the graph I think they got.'

Jordan's sketch: temperature of ice heated on a hot plate

simulated data



Jordan's predicted heating curve for ice warmed from -25°C on a hot plate. This is a student's sketch, not real data.

1. My thermometer measures how much heat is in the water.
2. A 90°C mug of cocoa has more thermal energy than a 35°C bathtub of water, because the cocoa is hotter.
3. When I held an ice cube, cold flowed out of the ice and into my hand.
4. While the ice melted, the temperature kept rising, because the hot plate kept adding energy. (See my graph.)
5. When the water boiled, the big bubbles were air escaping from the water.
6. Water only turns into a gas at 100°C , so yesterday's puddle on the blacktop must have soaked into the ground.
7. The white cloud above the boiling beaker is water vapor.
8. When the ice melted, the water molecules melted too and became soft.
9. When the warm water and the cooler room air reached the same temperature, the overall flow of energy between them stopped.
10. Tomorrow I will wrap an ice cube in a wool sock, so the heat from the wool will melt it faster.
11. Helium boils at about -269°C because its atoms attract one another very weakly.

Part A: Diagnose

1. Complete the table for all eleven statements. If a statement is partly right, mark it incorrect and name only the part that is wrong.

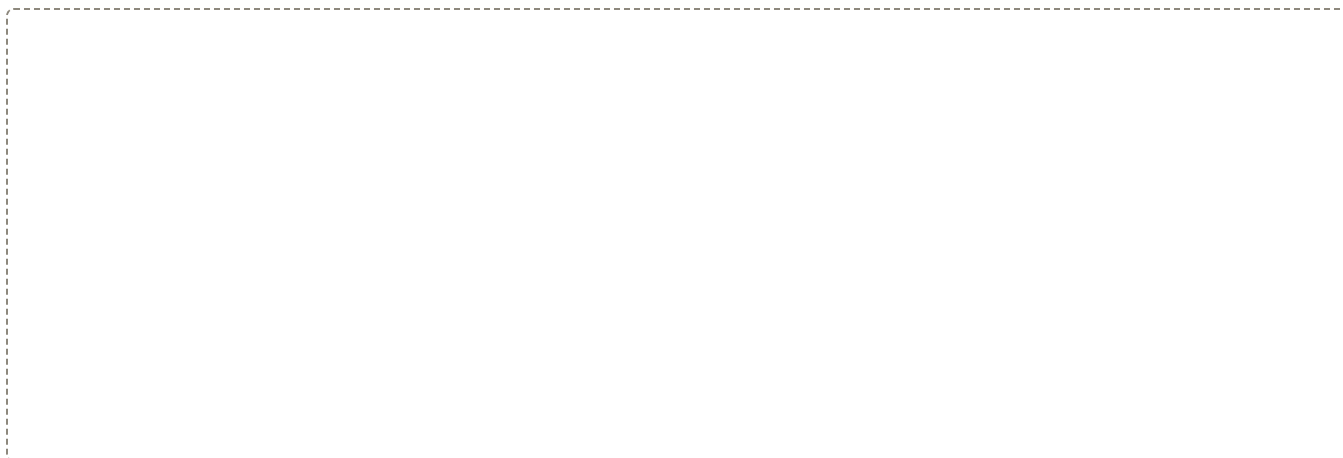
Correct or incorrect?	If incorrect, the idea that went wrong (a few words)
Statement 1	
Statement 2	
Statement 3	
Statement 4	
Statement 5	
Statement 6	
Statement 7	
Statement 8	
Statement 9	
Statement 10	
Statement 11	

Part B: Explain and rewrite

2. Statements 1 and 2: What does a thermometer actually measure? Explain why the bathtub has more thermal energy than the cocoa even though it has a lower temperature. Rewrite both statements.

3. Statement 3: Use particle collisions to explain which way energy really moved between Jordan's hand and the ice cube, and why his hand felt cold. Rewrite the statement.

4. Statement 4 and Jordan's graph: Sketch a corrected heating curve for ice warmed from -25°C until the water boils. Label the melting and boiling stretches with their temperatures and the state or states present in each part.



5. Statement 4: Jordan is right that the hot plate kept adding energy. Explain where that energy went while the ice was melting, and rewrite the statement.

6. Statements 5 and 7: What are the big bubbles in boiling water really made of, and what is the white cloud above the beaker made of? Rewrite both statements.

7. Statement 6: Explain how the puddle could disappear without the water ever reaching 100°C . Name the change of state and rewrite the statement.

8. Statement 8: What actually changes when ice melts, and what stays the same about the water molecules? Rewrite the statement.

9. Statement 10: Predict what the wool sock will really do to the ice cube compared with a bare ice cube, and explain why. Rewrite the statement.

Part C: The rule behind the mistakes

10. Statements 3 and 10 come from the same confusion, and so do statements 4 and 6. Choose one of these pairs. Name the confusion and write a two-sentence rule Jordan could tape inside his notebook that would prevent both mistakes.

Three checks for every statement

For each statement ask: (1) Does it treat heat or cold as a substance that objects contain? Only thermal energy is stored, and only energy moves, from warmer to cooler. (2) Does it say temperature must change whenever energy is added? During melting and boiling the temperature holds steady. (3) Does it say the particles themselves change? Particles keep their size and identity; only their arrangement and motion change.

Write three new mistakes

Write three new statements about heat, temperature or state changes that each contain a different mistake not on Jordan's page (for example, about frost, about dry ice, about why sweating cools you, or about boiling on a mountain). Trade with a partner, diagnose each other's statements, and rewrite them. Then decide together which of your six mistakes would be hardest for a seventh grader to notice, and explain why.