

Kinetic Energy and Temperature Change

Joe was pouring glasses of water for himself and his friend Hannah. He put two ice cubes in each glass, then filled the glasses with water. Hannah asked Joe to add an additional ice cube to her glass, since she likes her water extra cold.

"One more ice cube won't make any difference in the temperature of your water!" Joe cried as he added the additional ice cube to Hannah's glass.

Hannah disagreed with Joe. She thought that adding more ice to her glass would cool down her water more quickly and to a lower temperature. To settle their disagreement, Hannah and Joe decided to conduct an experiment.

They started their experiment by pouring 200 milliliters of room temperature water into a cup. Next, they added three ice cubes to the cup. Then, they took the temperature of the water every two minutes for 14 minutes. Hannah and Joe repeated this procedure three more times in identical cups: first with two ice cubes, then with one ice cube, and finally with no ice cubes at all. They organized their data into a table, shown below.



	Cup A (3 ice cubes)	Cup B (2 ice cubes)	Cup C (1 ice cube)	Cup D (no ice cubes)
Initial temperature	72.6°F	71.6°F	71.2°F	71.4°F
Temperature at 2 min.	51.6°F	55.5°F	57.3°F	71.4°F
Temperature at 4 min.	46.4°F	50.7°F	55.7°F	71.4°F
Temperature at 6 min.	44.1°F	48.7°F	56.1°F	71.4°F
Temperature at 8 min.	43.1°F	48.9°F	56.6°F	71.4°F
Temperature at 10 min.	42.8°F	48.7°F	57.3°F	71.4°F
Temperature at 12 min.	42.8°F	49.2°F	58.1°F	71.4°F
Temperature at 14 min.	42.9°F	50.0°F	59.0°F	71.4°F

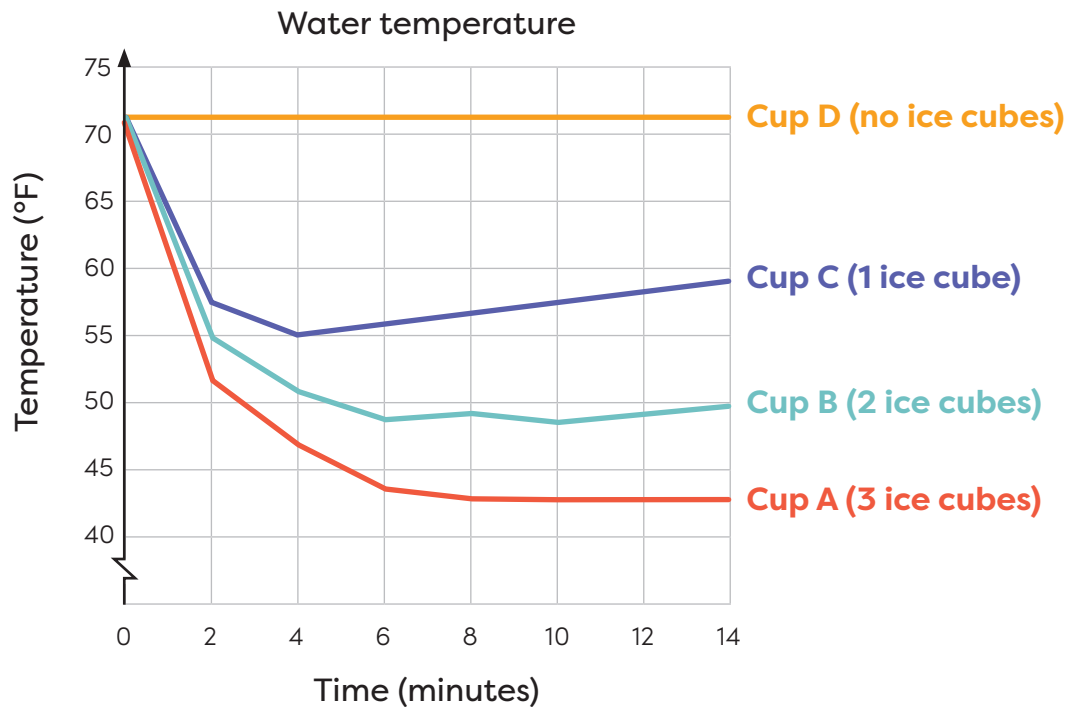
Help Hannah and Joe analyze their results by answering the questions below.

- What states of matter are involved in this experiment?
Solids and liquids
- What is the independent variable? Hint: The independent variable is the variable that Hannah and Joe changed.
The amount of ice in each cup
- What is the dependent variable? Hint: The dependent variable is the variable that Hannah and Joe measured.
The temperature of the water
- What are the constants? Hint: Constants are variables that remain the same in each experimental trial.
(Sample answer) The amount of water in each cup, the type of cup, and the amount of time between temperature readings

Kinetic Energy and Temperature Change

Keep going! Answer the questions below.

5. Hanah and Joe graphed their data for Cup B, Cup C, and Cup D. Using the table on page 1, add Cup A to the graph. Roughly plot each data point on the graph, and then connect the points.



6. a. Using the table on page 1, calculate how much the water temperature dropped in each cup in the first two minutes.

	Cup A	Cup B	Cup C	Cup D
Temperature drop in the first 2 min.	21.0°F	16.1°F	13.9°F	0°F

- b. Which cup had the largest drop in temperature in the first two minutes? Cup A

7. Hannah thought that adding more ice to her glass would cool down her water more quickly *and* to a lower temperature. Was she right? Explain your answer.

(Sample answer) Hannah was right. Cup A had the most ice, and it both cooled down the quickest and reached the lowest temperature.

8. Recall that temperature is a measure of the kinetic energy in particles of matter. Do you think that energy was transferred from the ice to the water, or from the water to the ice? Explain your reasoning.

(Sample answer) Energy was transferred from the water to the ice. The temperature of the water dropped, meaning the water lost energy. At the same time, the ice melted, meaning the ice gained energy.

9. Did the amount of energy transferred increase or decrease as more ice cubes were added to the cup?

The amount of energy transferred increased as more ice cubes were added.