

Why some changes heat up and others cool

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

Do dissolving solids make a mixture hot or cold? In this lab you add four solids to water in an insulated cup, measure the temperature change and classify each change. You then use your data to estimate the energy involved.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-6

Aim

To measure the temperature change when four solids dissolve in water and decide whether each change is exothermic or endothermic.

Equipment

- Polystyrene cup with a lid, and a beaker to hold it steady
- Thermometer reading to 0.5 °C or a digital probe
- 50 mL measuring cylinder and a balance
- Calcium chloride, ammonium chloride, sodium chloride and potassium nitrate
- Stirring rod, spatula, stopwatch and paper towel

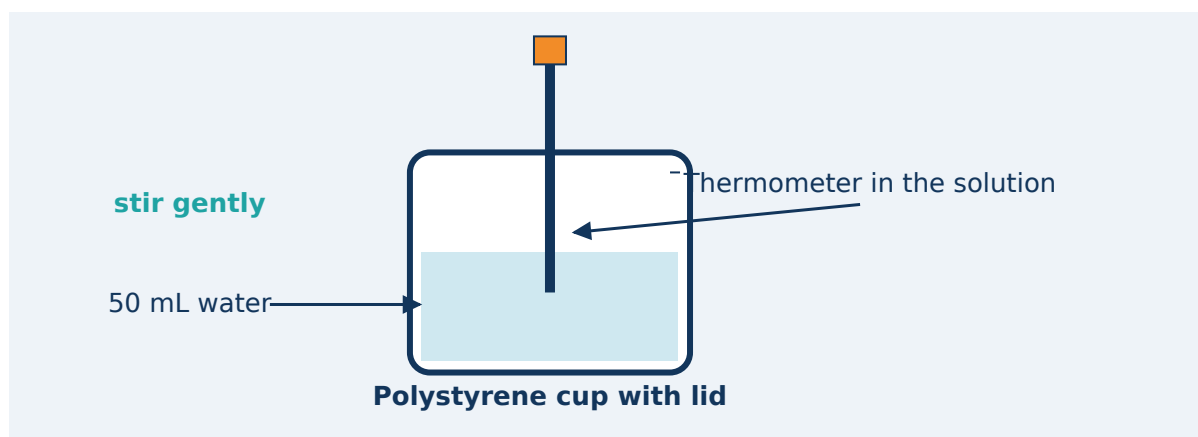
Safety

Safety

Wear goggles. Calcium chloride irritates the eyes and ammonium chloride is harmful if swallowed, so never taste anything and wash hands afterwards. Do not heat the solids. Rinse solutions down the sink with plenty of water.

Method

1. Measure 50 mL of water into the cup and record the start temperature after one minute.
2. Weigh the mass of solid listed in the table.
3. Add the solid, put on the lid and stir gently.
4. Watch the thermometer and record the highest or lowest temperature reached.
5. Rinse the cup and repeat for each solid, using fresh water at about the same start temperature.



Set-up for the dissolving lab.

Results

Sample data for one group. Use the density of water 1.0 g/cm^3 so that 50 mL has a mass of 50 g.

Solid	Mass of solid (g)	Start temperature ($^{\circ}\text{C}$)	Final temperature ($^{\circ}\text{C}$)
Calcium chloride	3.0	20.5	30.0
Ammonium chloride	5.0	21.0	15.5
Sodium chloride	5.0	20.5	20.0
Potassium nitrate	5.0	20.5	13.5

Analysis questions

Question 1 Temperature changes

Calculate ΔT for each solid.

Question 2 Classify

Classify the dissolving of each solid as exothermic or endothermic.

Question 3 Energy transfers

Use $Q = m \times c \times \Delta T$ with $c = 4.2 \text{ J/(g } ^{\circ}\text{C)}$ to calculate the energy transferred to or from the water for calcium chloride and ammonium chloride.

Question 4 Sodium chloride

Explain why the result for sodium chloride is not strong evidence of an energy change.

Question 5 Heat loss

Explain why a lidded polystyrene cup is used and how heat loss would change the results.

Question 6 Choosing solids for packs

Suggest which solid would suit a hot pack and which a cold pack, and give one concern.

Question 7 Improving reliability

Suggest two improvements to make the comparison fairer.