The Cooling Test

Plan fair comparisons with four kinds of measurement

PHS.1.4 "Design and conduct investigations to explore techniques in measurements of mass, volume, length, and temperature."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each measuring tool and the detail that makes its measurement reliable, then circle what Maya keeps the same in both cups.

Will a Paper Sleeve Keep Water Warm?

1. At a school science fair, Maya wants to test whether a paper sleeve slows the cooling of warm water. She prepares two identical cups, one bare and one wrapped with a paper strip. She cuts the strip 30 centimeters long and 6 centimeters tall, measuring from the ruler's zero mark rather than its edge. Both cups stand on the same table, away from vents and sunlight. The sleeve is the only planned difference between them. To make the comparison fair, Maya will use the same starting volume and temperature of water in each cup.

2. Maya measures 100 milliliters of water for each cup in a graduated cylinder. She reads the bottom of the curved water surface at eye level, then pours carefully to avoid spills. She uses a balance to find each empty cup's mass, with the sleeve on one cup, before filling them. After filling, she measures each cup again and subtracts its empty mass to find the mass of the water. She records those masses to check whether the cups started with similar amounts of water. A balance measures mass, while the cylinder measures the space the water occupies.

3. Next, Maya checks that the water in each cup begins at 40 °C. She places a thermometer in the center of the water without touching the cup's sides or bottom. She records both temperatures immediately and repeats the readings after five and ten minutes. At each time, she uses the same thermometer position in each cup. She also measures the filled cups' masses again at the end to check for water lost during the test. She repeats the whole test twice with fresh water and a dry sleeve. She compares the temperature drops, not just the final temperatures.

2 ANSWER WITH EVIDENCE

Use the passage

1. How should Maya read the graduated cylinder, and what volume should she pour into each cup?

2. How should Maya use the ruler to measure the sleeve, and what dimensions should the strip have?

3. How can Maya use her balance readings to find the mass of water in each cup? Why must the sleeve be on the cup for both readings?

4. How should Maya measure temperature so she can fairly compare the two cups' temperature drops?

3 YOUR TURN

Your own words

Design a test of whether adding salt to water changes how fast an ice cube melts. Explain how you will measure mass, volume, length, and temperature, what you will keep the same, and how you will decide which cube melts faster.

ANSWER KEY

The Cooling Test

PART 1 · READ AND MARK

Underline each measuring tool and the detail that makes its measurement reliable, then circle what Maya keeps the same in both cups. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How should Maya read the graduated cylinder, and what volume should she pour into each cup?	**Read the bottom of the curved water surface at eye level and pour 100 mL into each cup.**
2	How should Maya use the ruler to measure the sleeve, and what dimensions should the strip have?	**Measure from the ruler's zero mark. Cut the strip 30 cm long and 6 cm tall.**
3	How can Maya use her balance readings to find the mass of water in each cup? Why must the sleeve be on the cup for both readings?	**Subtract each empty cup's mass from its filled mass. Keeping the sleeve on for both readings prevents its mass from being counted as water.**
4	How should Maya measure temperature so she can fairly compare the two cups' temperature drops?	**Start both cups at 40 °C. Hold the thermometer in the center without touching the cup, take readings immediately and after five and ten minutes, then compare each cup's drop from its starting temperature.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I will use a graduated cylinder to put 100 mL of water into each identical cup. I will weigh 5 g of salt with a balance and dissolve it in one cup. Before adding ice, I will use a thermometer to make sure both cups are at 20 °C. I will select ice cubes with the same mass and use a ruler to check that their side lengths match. I will add the cubes at the same time, record when each disappears, and repeat the test.

Accept plans with a measured salt amount in one cup, comparable ice cubes and water volumes, equal starting temperatures, and a clear timing method. Students may choose different amounts or temperatures if they keep the conditions consistent between cups.