

Task:

Approach:	Team	Year:	8
Focus:	Heat transfer and experiment design		
Resources:	3 cups marked A (paper), B (plastic), C (ceramic); paper towels, measuring jug, 3 thermometers, team answer sheet, stop watch, jug with very hot water		

Questions / instructions:

Boil the jug of water immediately before starting the task. It will cool off a little as students work through the initial part of the task.

Some cups keep liquids warmer for a longer time than other cups. You are going to design an experiment to find out which cup keeps the water hot for the longest amount of time. After you have designed your experiment, you are going to do the experiment.

Show students the equipment, but do not give it to them until after they have designed their experiment.

You will have three cups made from different materials, three thermometers, a stop watch, a measuring jug and a jug of hot water. In your group, design how you will do an experiment to find out which cup keeps the water warm for the longest amount of time. On the answer sheet, write down the steps you will follow in your experiment, and write down how you will keep a record of the results for each cup.

Hand out team answer sheet. Allow time.

1. Before you start to do your experiment, describe to me how you are going to do it.

Give students the equipment (three cups, stop watch, three thermometers, measuring jug and jug of hot water) and caution them on the safe use of the hot water.



You are going to do your experiment now, taking special care with the hot water, and following your plan. Remember, you will need to have a way of writing down the results for each cup.

Students conduct experiment. Teacher keeps an eye on students' handling of the hot water to ensure safety.

- Now tell me the results of your experiment. What is your conclusion from these results?
- If there were any changes that you made to your plan for the experiment, explain to me what the changes were, and why you made those changes.

Criteria	% responses	Criteria	% responses
Used water at same temperature <i>(e.g. pour into cups quickly one after another):</i>	y8	Took temperatures in three cups nearly simultaneously each time temperature was taken: <i>(or at same interval after filling)</i>	y8
in plan and implemented	36	in plan and implemented	42
in plan, but not followed through	6	in plan, but not followed through	1
not in plan, but implemented in experiment	45	not in plan, but implemented in experiment	31
not mentioned or done	13	not mentioned or done	26
Put the same amount of hot water into each cup:		Made table/chart/graph of change in temperature across time:	
in plan and implemented	54	in plan and implemented	39
in plan, but not followed through	3	in plan, but not followed through	5
not in plan, but implemented in experiment	15	not in plan, but implemented in experiment	30
not mentioned or done	28	not mentioned or done	26
Time from when water was added:		Results and conclusion:	
in plan and implemented	52	Report matches observations:	fully 34
in plan, but not followed through	7	moderately 38	
not in plan, but implemented in experiment	18	poorly 28	
not mentioned or done	23	initial drop in temperature when cups are filled was reported <i>(first temperature recording)</i>	24
Took initial temperature in three cups soon after cups were filled:		report explicitly deals with <u>different rates of cooling</u>	37
in plan and implemented	21	report appropriately identifies cup that keeps water warmest for longest amount of time	53
in plan, but not followed through	8	Ideas for improvement if done again:	
not in plan, but implemented in experiment	24	two or more useful suggestions	18
not mentioned or done	47	one useful suggestion	41
Took temperatures in three cups at later times after cups were filled: <i>(recorded time and temperature)</i>		no useful suggestions	41
in plan and implemented	58	Total score:	17-21 13
in plan, but not followed through	4	13-16 27	
not in plan, but implemented in experiment	10	9-12 29	
not mentioned or done	28	5-8 22	
Took at least three temperature measurements in each cup after cups were filled:		0-4 9	
in plan and implemented	27		
in plan, but not followed through	1		
not in plan, but implemented in experiment	7		
not mentioned or done	65		

Commentary:

Because this is a team task, no graph of subgroup performance is possible. This was quite a challenging experimental task, complicated by the high thermal mass of the ceramic cup (which caused an immediate drop in temperature when filled). The performances of the teams of year 8 students were very diverse.