



Keep It Hot: Cup Test

Mission: Customers complain their cocoa gets cold too fast. Test four cups side by side, with and without lids, and pick the cup that keeps cocoa hot the longest.

Big question: Which materials slow thermal energy transfer, and why?

★ Warm-up: Estimation station

Estimate, then explain.

Hot cocoa starts at 80 °C. What temperature will it reach if left for a whole day? ✓ **Room temperature, about 20 °C.**

Does a thermos keep things hot or cold? ✓ **Both: it slows heat transfer in either direction.**

Key vocabulary

Insulator	A material that slows heat transfer.
Convection	Heat transfer by moving liquid or gas (warm rises, cool sinks).
Rate	How fast something changes.
Room temperature	About 20 °C; things cool toward it.

1 Box 1

Predict

PREDICTION Which cup will keep cocoa hottest after 20 minutes?

☐ Foam cup ☐ Ceramic mug ☐ Glass cup ☐ Metal cup

Race the cups

In the simulator: Run the test WITHOUT lids for 30 minutes.

Record the temperatures at 20 minutes (no lids).

Cup	At 20 min (°C)
Foam	from simulator
Ceramic	from simulator
Metal	from simulator

2 Box 2

Read the graph

All four lines curve and level off. Why do they level off?

☐ They approach room temperature, so heat transfer slows ☐ The cups run out of cocoa
☐ The thermometer breaks

✓ **They approach room temperature, so heat transfer slows**

3 Box 3

Add lids

In the simulator: Reset, turn ON lids, and run 30 minutes.

What was the foam cup's temperature at 20 minutes WITH a lid?

Answer: _____ °C ✓ **varies: check the student's simulator readout**

Why lids help

Why did lids keep every cup hotter?

- ☐ They stop warm air and steam from rising away (convection/evaporation) ☐ Lids make the cocoa heavier
- ☐ Lids add heat

✓ **They stop warm air and steam from rising away (convection/evaporation)**

4 Box 4

Legend: iced drinks  **Legend only**

For an ICED drink, which cup keeps it cold longest, and why?

- ☐ Foam: insulators slow heat from the warm room getting IN ☐ Metal: it is cold to touch
- ☐ It doesn't matter for cold drinks

✓ **Foam: insulators slow heat from the warm room getting IN**

5 Box 5

Café recommendation (CER)

Which cup should the café use?

Claim

Look for: Names the best cup; at least 6 words

Evidence

Look for: Uses temperature data; Uses the lid data; a number from the simulator; at least 12 words

Reasoning

Look for: Explains insulation; at least 10 words

 **Exit ticket: answer the big question in your own words**

Which materials slow thermal energy transfer, and why?

Look for: Thermal energy always moves from hotter to colder objects. Insulators like foam slow conduction, so cocoa stays hot longer. A lid also slows convection and evaporation from the top. Metal cups lose heat fastest because metal is a good conductor.

Completion codes

Students see a code like **ABC-I3** when they finish. The first part must match below. The letter is the level (E = Explorer, I = Investigator, L = Legend), and the number at the end is how many stars they earned.

Level	Code starts with
 Explorer	UC6-E
 Investigator	TUN-I
 Legend	11Q-L

 Watch for these misconceptions

- "Cold moves into things." Heat moves; objects feel cold because heat leaves your hand.
- "Only moving things have energy." Stored (potential) energy counts too.
- "Radiation needs air to travel." Radiation crosses empty space, which is how sunlight reaches Earth.