What Cup will keep water the hottest for the Longest?

Question

My testable question is what material cup, metal, Ceramic, or Styrofoam, will keep boiling water at the highest temperature for the longest amount of time?

Variables

There are 3 types of variables in my experiment.

The Independent variable is the material of the cup that we are using.

The dependent variable is the temperature of the liquid overtime, how long it stays hot.

Controlled variable are the amount of water that goes in every cup.

Background and Research

Have you ever been drinking a hot beverage on a cold day, and then minutes later it's already cold? The type of material a cup is made from affects how long the liquid stays hot. This is because different materials transfer heat at different rates. Heat transfer happens in three main ways: conduction, convection, and radiation. Conduction is when heat moves from one object to another through direct contact. Different materials have different abilities to hold in heat. Materials that let heat move through them quickly are called conductors, while materials that do not let heat move easily are called insulators. In this experiment, we are testing which common cup material—such as metal, plastic, paper, or ceramic—keeps a liquid hot for the longest amount of time. This is important because the material of the cup is in direct contact with the liquid, which affects how quickly heat is lost. We chose everyday cups that people use all the time to test which one will keep our liquid the hottest for the longest period of time.

Hypothesis

lif we put boiling water in a ceramic mug, stanley, and styrofoam travel mug, Then the metal stanley will keep the liquid the hottest for the after 30 mins because the metal stanley's are insulated and can hold heat in keeping the liquid the hottest.

Materials

Materials needed for this experiment:

- Ceramic Cup
- Metal Stanley
- Styrofoam travel cup
- Water Kettle
- Thermometer
- Paper to record data
- Timer
- Measuring cup

Procedures

Step 1: Heat equal amount of water to 150 degrees

Step 2:Use a measuring cup to pour exactly 1 cup into each of the cup that you are testing

Step 3: After pouring the water into each of the cups insert a digital thermometer into each cup and record the starting temperature of the water

Step 4: At the same time start you stopwatch and record the time in 5 min intervals

Step 5: Check on the temperature of the liquid and record the temperature of the water every 5 mins.

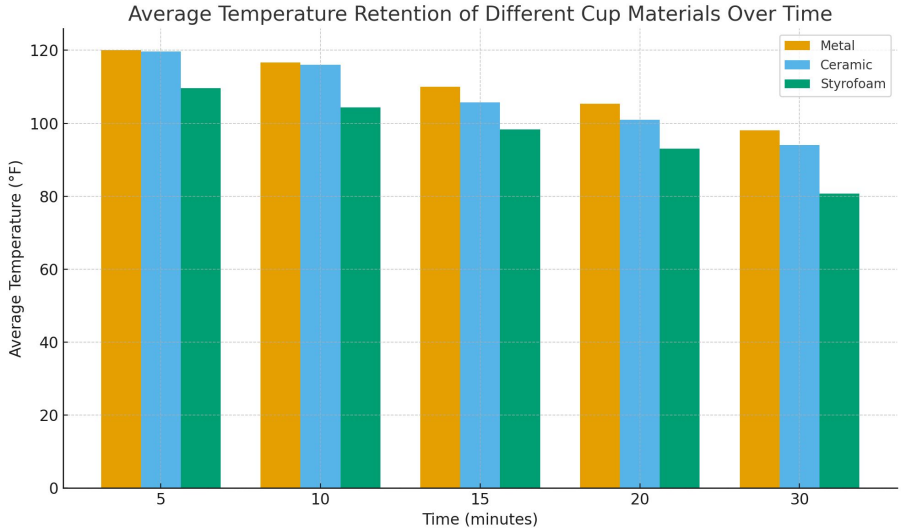
Step 6: Once you reach 30 mins stop the stop watch and record the final temperature

Step 7: Record all temps and compare between all 3 materials of the cup to see which one record at the highest temperature after 30 mins.

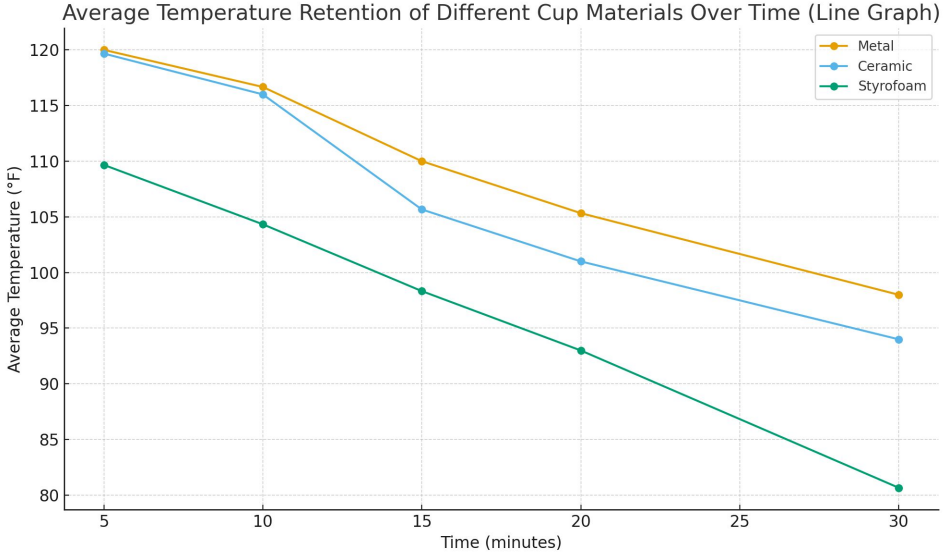
Data Table

Time Trial:	Trial 1:	Trial 2:	Trial 3:
5 Mins	- Metal: 119 F - Ceramic: 119 F - Styrofoam: 110 F	- Metal: 121 F - Ceramic: 120 F - Styrofoam: 107 F	- Metal: 120 F - Ceramic: 120 F - Styrofoam: 112 F
10 Mins	- Metal: 112 F - Ceramic: 109 F - Styrofoam: 103 F	- Metal: 120 F - Ceramic: 120 F - Styrofoam: 102 F	- Metal: 118 F - Ceramic: 119 F - Styrofoam: 108 F
15 Mins	- Metal: 105 F - Ceramic: 101 F - Styrofoam: 99 F	- Metal: 118 F - Ceramic: 110 F - Styrofoam: 101 F	- Metal: 107 F - Ceramic: 106 F - Styrofoam: 95 F
20 Mins	- Metal: 99 F - Ceramic: 100 F - Styrofoam: 98 F	- Metal: 117 F - Ceramic: 105 F - Styrofoam: 90 F	- Metal: 100 F - Ceramic: 98 F - Styrofoam: 91 F
30 Mins	- Metal: 96 F - Ceramic: 92 F - Styrofoam: 82 F	- Metal: 101 F - Ceramic: 99 F - Styrofoam: 81 F	- Metal: 97 F - Ceramic: 91 F - Styrofoam: 79 F

Bar Graph



Line Graph



Observations

Observation 1: The water started to bubbles as the temperature rose and the bubble started to rise to the top

Observation 2: Bigger Bubbles started to form and eventually the bubble started to turn in to steam and fog and the water started rumbling and the water began to boil.

Observation 3: During the experiment the bubbling immediately stopped once we pour the water into the cup.

Observation 4: The temperature of the water starts to change and go down. We noticed that the styrofoam cup lost heat the quickest and the metal cup kept its heat the longest.

Data Analysis

Information from the bar graph:

You can see that:

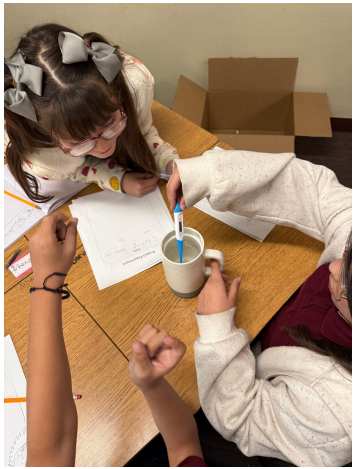
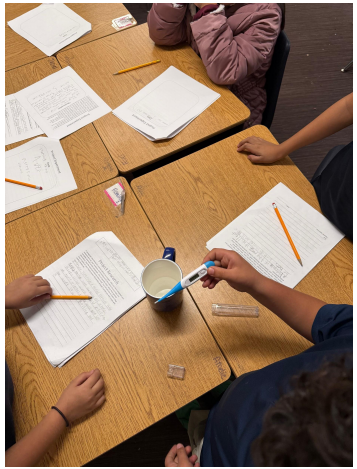
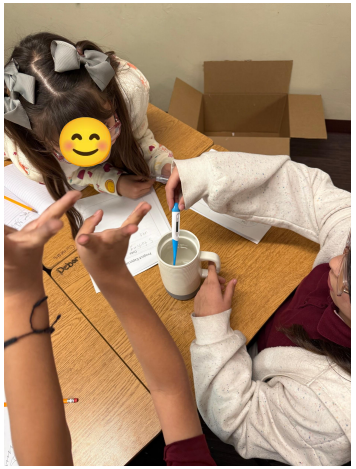
- Metal cups maintained the highest average temperature throughout the 30 minutes.
- Ceramic cups cooled a bit faster.
- Styrofoam cups lost heat the quickest on average.

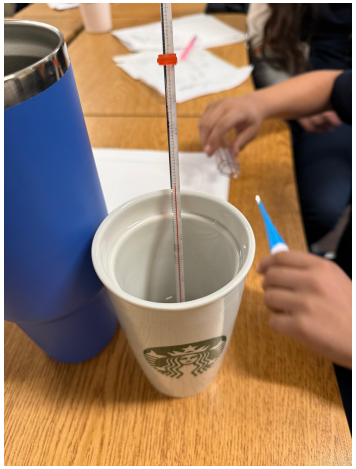
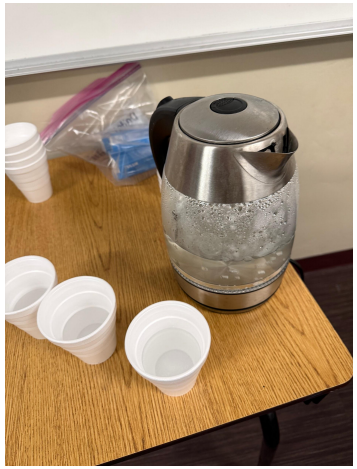
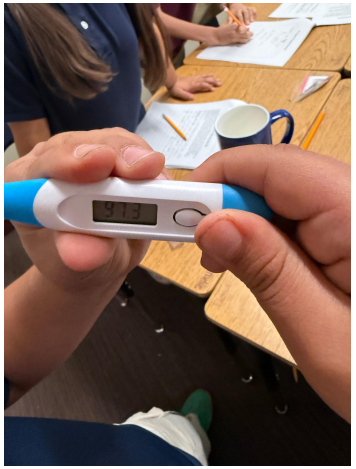
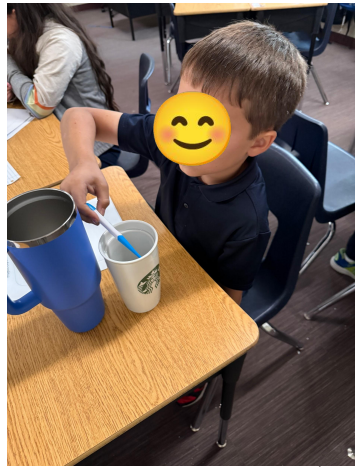
Information from the line graph:

It clearly shows that:

- Metal cups retain heat the longest.
- Ceramic cups lose heat steadily.
- Styrofoam cups cool the fastest overall.

Pictures

Conclusion

Based on the data we gathered during our experiment, we found that our data supported our hypothesis, the metal Stanley cup kept the water at the highest temperature after 30 minutes, followed by the ceramic cup, and lastly the styrofoam cup. This conclusion suggests that if you want your morning coffee to stay hot while you are teaching and busy throughout the day, you should invest in a metal insulated travel mug.

Further Research

In future investigations, we could test additional types of cups or brands to see if insulation quality varies. We could also extend the experiment by measuring temperatures over a longer period of time, such as one or two hours, to see if the results remain consistent. Another idea would be to test how well each cup keeps cold drinks chilled. Finally, exploring how factors such as lid type, cup size, or starting temperature affect heat retention would deepen our understanding of how different materials and designs influence temperature over time.

References

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