Investigation Report (Year 9): Coffee Cup Evaluation

Which coffee cup is best?

Clear title and section headings to identify the stages of the report

Aim

To determine which coffee cup is the best choice for a coffee shop to use based on its cost, insulation ability and whether it is biodegradable.

Third person used

Introduction

Insulators are materials that prevent heat from moving between objects. Conductors are materials that allow heat energy to flow through them to other objects that have less energy. A range of materials are tested that have insulative properties. The best insulator will pass on less energy to the surrounds and keep the cup of coffee the hottest.

Present and future tenses used in Aim and Hypothesis sections

No contractions

Hypothesis

The Styrofoam cup will be the best insulator and may also be the cheapest cup. It may not be biodegradable though and so might not be the best choice for the environment.

Bulleted list of required items

Materials

- 6 different coffee cups with lids
- 6 analogue thermometers
- Electric kettle
- Stopwatch
- Measuring cylinder
- Beaker

Verbs to begin each step of the procedure

Method

1. Collect six different types of coffee cups and their lids.
2. Label the cups 1 to 6.
3. Collect six thermometers.
4. Put some tap water into a beaker and place all six thermometers in there.
5. Check to see that all of the thermometers show the same temperature after about 5 minutes.
6. Use a pen to place a hole in the top of each coffee cup. Try to make the hole so that the thermometer fits into it tightly and so that there are no cracks in the plastic of the lid.
7. Fill an electric kettle with water and boil.
8. Measure 200 ml of water using a measuring cylinder and place it into the first cup.
9. Repeat for the other five cups and put their lids on with the thermometers through the holes, making sure that the thermometers are submerged in the water to the same depth.
10. Record the temperature of the thermometers after every minute according to the stopwatch for 20 minutes.
11. Repeat the experiment twice.

Use of scientific terms (eg. *measuring cylinder, thermometers, depth*)

Results

Table 1 – Cost and material

Cost and material

Cup	Cup Cost ($)	Lid Cost	Total Cost	Material
1	0.15	0.04	0.19	Styrofoam cup and plastic lid
2	0.49	0.14	0.64	Biodegradable cardboard cup and plastic lid
3	0.31	0.04	0.35	Cardboard cup and plastic lid
4	0.46	0.05	0.51	Cardboard cup and plastic lid
5	0.42	0.21	0.63	Cardboard cup and plastic lid
6	0.12	0.21	0.33	Cardboard cup and plastic lid

Recording of research results in appropriate format with observations (quantitative and qualitative data)

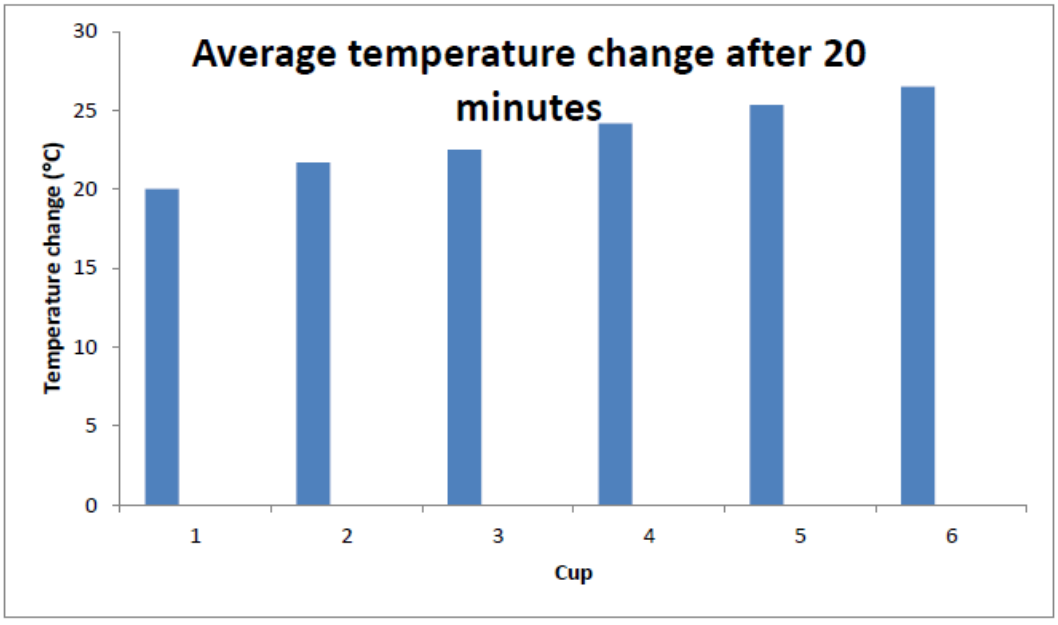
Table 2 – Temperature change after 20 minutes

Temperature change after 20 minutes

Cup	Test 1 (°C)	Test 2 (°C)	Test 3 (°C)	Average (°C)
1	23	18	19	20
2	23	21	21	21.67
3	23	22.5	22	22.5
4	26	23.5	23	24.167
5	27	25	24	25.33
6	27	28.5	24	26.5

Clear labels for tables and figures

Figure 1 – Average temperature change after 20 minutes



Discussion

Cup 1 was the best insulator. In order to explain this we need to understand how heat travels. The temperature loss took place in all of the cups due to something called conduction. Conduction is the transfer of heat energy from one substance to

Mixture of past, present and future

another. These substances need to be in contact with each other. In this experiment, heat was conducted from the water to the cups by conduction. This took heat energy away from the water which caused the temperature to drop. Styrofoam material does not conduct heat well and so is called an insulator. Cup 1 was a Styrofoam cup which allowed it to maintain the temperature of the water the best by losing the least amount of heat energy. The Styrofoam in cup 1 was also several times thicker than the materials the other cups were made of, adding to its insulating properties.

Although Styrofoam cups make the best insulators, many companies do not use them as they are not biodegradable, making them bad for the environment. There are also some concerns about chemicals from the Styrofoam leaching into the coffee.

Cup 1 maintained the temperature of hot water for the longest and so is the best insulator out of the six cups. It is also the cheapest so would be a good decision for the coffee shop based on money. The problem with this cup though is that it is the least biodegradable so a coffee shop might not want to use it. Cup 2 is totally biodegradable and was a good insulator but was quite expensive. So cup 3 might be the best choice. The cardboard cup would be biodegradable, even though the lid would not be, it is a medium insulator and is not too expensive.

The method for the experiment worked pretty well and produced good results. Some of the results in test 1 were different from tests 2 and 3. This may have been because the lids were not placed on the coffee cups fast enough which caused some heat to be lost by evaporation. As control improved in tests 2 and 3 lids were placed on with increasing speed. The results of test 1 could be left out and a fourth test completed to get more reliable results.

Another thing that might have affected the results is the overall volume of the cup. Each cup contained 200 ml of water and that made some of the cups full, while others were less full. The cups that were not full may have lost heat faster. If the experiment was done again, all cups could be filled to the top and the temperature change could be measured and the rate of temperature change per ml could be worked out.

Conclusion

Taking into account all of the variables, cup 3 is the best choice for the coffee shop because it has a good balance of the three properties of cost, insulation and biodegradability.

Bibliography

Milton, Chris, 2013, *Global Science in Action*, Oxford, South Melbourne, Victoria.

tenses

Discussion features paragraphs

Relevant scientific language adds authenticity analysis and conclusions presented

Cause and effect language and phrases used when discussing results

Adapted from: ACARA, Work Sample 7, Work Sample Portfolio Year 8 Above Satisfactory. Retrieved 27 October, 2014.
http://www.acara.edu.au/curriculum/worksamples/Year_8_Science_Portfolio_Above.pdf