<u>Investigating the factors affecting how quickly hot water cools.</u>

***Aim:*** **-**to sees how quickly water-cools after boiling at different volumes of water with lids on.

***Background:*** **-** heat can be lost in many ways and also gain. In human we gain heat by chemical reactions happening mostly in contracting cells of active muscle and the cells of the liver. We also gain it from the sun, which is absorbed through the skin and by eating hot food and drinks.

Heat is lost to the air by exposed surfaces of the body by conduction convection and radiation. Heat is also lost by evaporation. The cold air we breathe in and cold food and drinks products absorb heat and take heat away. We also lose or gain heat by moving into a colder or warmer place or by taking off or putting on a piece of clothing and to take exercise to keep warm.

WHAT HAPPENS TO MOLECULES WHEN THEY ARE HEATED?

When molecules are heated the molecules vibrate faster and faster and kinetic energy of the particles increases. In the end they have so much kinetic energy that the particles begin to separate and move more freely.

HOW DO BIRDS CONSERVE THEIR BODY TEMPERATURE HIGHER THAN THEIR SURROUNDINGS?

When the temperature is cold birds tend to ruffle their feather, if you have seen a bird do this they look fatter than they actually are. What they're doing is trapping air between their feathers and warming the air. This acts as an insulator and therefore keeps their body temperature higher than the surrounding.

***Hypothesis:*** **-** the breaker with the least amount of water in it will show that it will cool down faster over a period of time because there are less molecules vibrating together and bumping into each other and therefore will cool down quicker.

<u>A table of variables</u>

| Name of variable | How will it be changed? |
| --- | --- |
| Water (independent variable) | The water is changing by the volume in the beaker. |

<u>Variables that must be kept constant</u>

| Variable | How are these under control? |
|---|---|
| Beakers | Keeping them the same size |
| Thermometers | Kept at room temperature until they are being put into the water |
| Type of surface area the cup is on | Keeping them on the same surface area. |
| The air | Keeping it still with no windows open and checking the temperature regularly |
| Temperture | Checking room temperature constantly |

***Method: -***
1. I would get 9 medium size beakers, 1 big beaker, 3 thermometers and a stopwatch and I would place them on a table.
2. Then I would fill the kettle with water and bring to the boil.
3. I would then Poor a little bit of boiling water from the kettle into the big beaker.
3. I would swirl it around to make the big beaker hot and throw away the water.
4. In the remaining 9 beakers poor 100ml into the big beaker and then into beaker 1, then poor 150ml into the big beaker first then into beaker 2 and poor 200ml into the big beaker and then into beaker 3 and place lids on each beaker.
5. Then Take the temperatures from each breaker and start stopwatch.
6. Then Record the temperature every two minutes until 20 minutes have past.
7. Repeat this 3 times and average the results

***Apparatus list: -***
- 9 medium size beakers
- 1 big beaker
- A stopwatch
- A kettle
- 1350ml of water
- 9 thermometers

<u>A table to show how water cool at different volumes with lids on</u>

| | Time (minutes) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| Volume (ml) | Temperature (*C) | | | | | | | | | | |
| 100 | 78 | 71 | 66 | 64 | 61 | 58 | 56 | 54 | 52 | 50 | 49 |
| 100 | 80 | 73 | 69 | 65 | 62 | 60 | 57 | 55 | 53 | 51 | 50 |
| 100 | 76 | 70 | 66 | 63 | 61 | 58 | 56 | 54 | 52 | 51 | 49 |
| 150 | 78 | 74 | 70 | 66 | 68 | 61 | 59 | 57 | 54 | 53 | 51 |
| 150 | 79 | 76 | 72 | 69 | 66 | 64 | 62 | 60 | 58 | 57 | 50 |
| 150 | 78 | 74 | 70 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 54 |
| 200 | 78 | 75 | 72 | 70 | 67 | 65 | 63 | 62 | 60 | 58 | 57 |
| 200 | 77 | 74 | 71 | 69 | 67 | 65 | 63 | 62 | 60 | 58 | 57 |
| 200 | 76 | 78 | 70 | 67 | 65 | 63 | 61 | 59 | 58 | 56 | 55 |

| | Time (minutes) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| Volume (ml) | Temperature (*C) | | | | | | | | | | |
| 100 | 78 | 71 | 67 | 64 | 61 | 59 | 56 | 54 | 52 | 50 | 49 |
| 150 | 78 | 74 | 70 | 67 | 66 | 62 | 60 | 58 | 56 | 55 | 51 |
| 200 | 77 | 76 | 71 | 69 | 66 | 64 | 62 | 61 | 59 | 57 | 56 |

*Conclusion: -* the trend of the graph shows that on 100ml the temperature decreases over a period of 2 minutes, then it became stable for 2 minutes. Between 4-8 minutes it decreases rapidly and then decreases steadily for the last 2 minutes.

At 150ml it decreased slowly for the first 2 minutes, then rapidly between 2-6minutes then it decrease steadily between 6-10 minutes. At 200ml it increased between 0-2 minutes, then it decreased steadily for 2 minutes.

Apart from the first 2 minutes at 200ml of water the particles are vibrating faster and faster using all their kinetic energy and therefore losing heat.

*Evaluation: -* the things that were done wrong in this experiment are, as follows- didn't leave enough time for the thermometers to reach the correct temperature before starting stopwatch. The experiment cooled down quicker than one might of thought. The experiment wasn't long enough.

<u>Thing that could have been done to make it a fair test</u>

One would leave one minute at the start so that the thermometer can reach correct temperature. One might put lids on the beakers to stop the heat escaping so quickly. To make the experiment twice as long and to do more than one of each to get an average to make a fair test.

<u>Odd results</u>

The anomalous results that were found on this experiment are between 2-4 minute on 100ml and 0-4 minutes on 200ml of water. This experiment needs to be repeated 2 or 3 times to make it a fair test.

As my hypothesis says the beaker with the least amount of water would cool faster than the beaker with the most amount and as my table and graph shows it was correct.