

Heat Loss Investigation

Introduction

My investigation is to find out the rate of which heat is lost or transferred. Heat loss happens when heat energy is exchanged between materials that are both at a two different temperature. There are different ways in which heat is lost they are: - conduction, convection, radiation and evaporation. All these processes can happen to heat.

How am I going to carry out the investigation?

I will be investigating the heat loss in animals and will be using cans to discover which can loses the most temperature. To do this experiment I will be using small, medium and large cans to perform as small, medium and large animals. Water will be positioned in these three different sized cans and the first measurement will be taken at the same temperature to keep it a fair test. I will be taking about eight readings at two minute intervals. Then I will repeat the procedure, this will then make it possible for me to take the averages.

The Equipment I will require.

- A small (150ml), medium (340ml) and a large can (520ml) - to position the hot water and then be able to put the thermometer into the cans to obtain the readings.



- Stopwatch- needed to keep track of the time and to make sure the reading is taken at the right time.



- Measuring Cylinder- to measure the amount of water placed into the cans.



- A kettle- used to produce hot water.



- Thermometer- to measure the temperature of the water.



How will I make it a safe investigation?

To make it a safe investigation I will need to put on goggles to shield my eyes from the sweltering water. Gloves will also be worn to guard my hand from the boiling water. To make it safer I will place my equipment into a tray. I will also keep my distance from other students to make my investigation safer.

How will I make my investigation a fair test?

To keep this investigation a fair test I will maintain all the starting temperatures the same. I will make sure that I measure each can at the same time. I will also place the cans in the same place so that it makes it fair. It will make it fair because the cans will be all in the same place.

The science I will use.

Conduction- conduction of heat is the process where vibrating particles pass on their extra vibration energy to neighbouring particles.

Convection- this happens whenever a liquid or gas is heated. Hot water goes to the top because heat rises. Warm air molecules spread out. Cold air molecules are closer together. Warm air rises and the cold air sinks.

Radiation- heat radiation is carried by infra-red waves emitted from the heating element. No substances are needed because the infra-red waves can travel through a vacuum.

Evaporation- this happens when some particles with more energy than the average break away from the attraction of other particles and escape into the vapour phase. The average energy of the particles that remain are lower than before this means the liquid has cooled down.

Factors which can affect my experiment.

If a lid is used- There will be a difference in the speed of heat loss if I use a lid. This is because a large amount of heat will escape from the top of the can by convection and evaporation. Therefore if I use a lid it will slow down both these processes.

Its also depends on what the lid is made out of, this will also make a difference. If a lid is made of paper or card then its insulation properties will be at bare minimum, on the other hand if the material used for a lid is bubble wrap then the heat loss through the top of the can will dramatically slow down.

Volume of water used- When the volume of water is higher, it will stay warmer for longer than if there was a low volume of water. This is because when there is a high volume of water then the outside of the water will cool down, but the inside will stay warm.

Using different sized cans- If I use different sized can I will find out which can would lose the heat quickest. For this I would use 3 cans and take down the results to see which can lose heat quickest.

If the can is insulated- If the can is insulated then it will stay warmer than if it was not. This is because the insulation slows down the process of heat loss. If the can is not insulated then heat loss will not slow down.

If different types of insulation are used then this will affect the heat loss. Materials that have high insulation such as bubble wrap will not let much heat to be transferred through it. However materials of low insulation such

as paper will let the heat pass through it much quicker.

Amount of times the insulation has been wrapped around- Depending on how many times the material has been wrapped around the can will effect how fast the heat transfer is. If it has been wrapped once it will not work as well, but if it was warped twice or even more it would work much better.

Room temperature- The bigger difference between the room temperature and the temperature of the water will mean more heat loss as the heat will want to escape. This is because if there is a bigger difference in temperature then the more heat will try to escape.

Starting temperature of the water- If the starting temperature is high then the more heat will try to escape.

Chosen factor- The factor that I will be investigating the heat loss between the sizes of the 3 different sized cans, which can losses the heat the quickest. I have chosen this because I want to find the difference in heat loss between the 3 cans. I want to see which can loose heat the quickest.

What do I expect to happen and why?

I would expect the small can to lose heat quicker than the other sized cans. I expect this to happen because the smaller can has a smaller surface area to a larger volume which means it will have the biggest ratio.

The measurements I will make. How often? Over what range?

I will take the first measurement and start measuring using the same starting temperature to keep it fair. I will also be taking the readings after every two minute intervals. I will take between eight to ten readings.

Will I repeat any measurements? How many times? Averages?

Yes, I will repeat the measurements so that I have two sets of results to work from. By doing this it will enable me to work out the averages.

Table of results:-

		0 mins	2 mins	4 mins	6 mins	8 mins	10 mins	12 mins	14 mins	16 mins
Small Can	1 st reading	75°C	70°C	66°C	63°C	61°C	58°C	56°C	55°C	53°C
	2 nd reading	75°C	70°C	65°C	61°C	59°C	57°C	54°C	52°C	51°C
Medium Can	1 st reading	75°C	72°C	69°C	66°C	64°C	62°C	60°C	59°C	57°C
	2 nd reading	75°C	71°C	70°C	67°C	66°C	64°C	62°C	61°C	60°C
Large Can	1 st reading	75°C	72°C	69°C	68°C	66°C	64°C	62°C	61°C	60°C
	2 nd reading	75°C	72°C	70°C	69°C	67°C	65°C	64°C	63°C	61°C

Table of averages:-

	0 mins	2 mins	4 mins	6 mins	8 mins	10 mins	12 mins	14 mins	16 mins
Small Can	75°C	70°C	65.5°C	62°C	60°C	57.5°C	55°C	53.5°C	52°C
Medium Can	75°C	71.5°C	69.5°C	66.5°C	65°C	63°C	61°C	60°C	58.5°C
Large Can	75°C	72°C	69.5°C	68.5°C	66.5°C	64.5°C	63°C	62°C	60.5°C

Graph is on the next page

What patterns can you see in your results?

I can observe that the small can loses the most temperature according to my graph. The large can lost the smallest amount of temperature according to my graph.

Using Science explain how I got these results.

I got these results because the smaller can has a smaller surface area to a larger volume which means it has the biggest ratio which meant it lost the most heat. (Surface area is worked out using the formula: $2\pi rh + 2\pi r^2$ where h is the height of the can. Volume is worked using the formula: $\pi r^2 \times h$ where h is the height of the can).

Also conduction, convection, radiation and evaporation were involved to produce these results. Conduction meant that heat was lost. It was lost because there was extra vibrational energy (heat) that was passed onto the

surface of the can causing the can to heat up. But as the surroundings were colder than the can, the can cooled down.

Convection also occurred. It occurred because of the heat. As heat raises the bottom water would be much cooler than the top. This happened because the warmer air molecules rise, this is because they take the heat energy with them and become less dense. They rise, but when the energy is used up the particles drop. This means all the heat will escape.

Radiation occurred too.

Evaporation happened when some particles with more energy than the average broke away from the attraction of other particles and escaped into the vapour phase. The average energy of the particles that remained are lower than before this meant that the liquid has cooled down.

Evaluation

Describe any problems that I had when carrying out my investigation.

Whilst carrying out this investigation I had no problems that I can recall of. My investigation was problem free.

Describe how accurate my results are. If there are some odd results which are they?

My results are very accurate. I know they are very accurate because I have got similar results when I repeated the investigation. But if I did carry out another set of results these current results would become more accurate. I also know that they are very accurate because I did not get any odd results. The results I have are very close to each other and form a curve to show the fall in temperature. My results are reasonably easy to understand.

What could I have done differently to make my results more accurate or reliable?

To make my results more accurate and reliable I would repeat this investigation another once or twice more. By repeating the investigation it would make my results more and more accurate the further times I do this investigation.