Sc1 Investigation – Keeping things warm

Aim

In this experiment my aim is to try and distinguish what factors affect how well an object keeps warm. For practical purposes, in this experiment I shall be using water, as it is easy to get hold of.

Prediction

In this experiment I would expect to find that the heat of an object is affected by its surroundings. However, I do not think that all different factors will affect the results, which I will find. I will be using two factors for my experiment and these are; the type of material, and what heat transfer it prevents and also different colours of the same material. I think that the material that prevents conductional heat transfer will work worst in keeping the water warm. I also think that the material that prevents convectional heat transfer will work best in keeping the water warm. Colour wise I feel that the darker the colour, the more heat will be prevented from escaping.

Scientific Knowledge

I predicted that the material that prevents conductional heat transfer would work worst because when an object, like water, is cooling down its main heat transfer is convection. This is because the warm molecules in the water are less dense than the colder ones in the air. Therefore they rise and gradually cool; this causes cold molecules to come into the liquid to replace them. This process keeps on happening until the air and the water are at an equal temperature, which would be room temperature. I think that the material that prevents convectional heat transfer would work best as conduction only works properly in solids and water is a liquid. I feel that the material coloured black will prevent heat loss as black is the mixture of all the colours of the rainbow. Therefore it absorbs all colours and therefore is a very bad reflector. This means that it would take ages for it to release any of the heat wedged between the material and the liquid. However, white would not keep the drink warm as it reflects heat extremely quickly.

Safety

- Do not touch the boiling water as you will burn your arm/hand
- Do not run around the science lab as things could get knocked over
- To be extra safe wear eye protection in case some boiling water splashes in your eyes

Fair Test

In this experiment I will compare my results to those of water in a beaker on its own with no heat loss protection. I will always fill the beakers with the same amount of hot water, as volume is a factor as to how water-cools. I will also make sure that each different beaker has the same amount of cooling time and a measurement is recorded every two minutes for ten minutes. I will also make sure that the water always comes out of the same kettle as this could make a difference.

Apparatus

- 100ml beakers
- Thermometer
- Stopwatch
- Kettle
- Rubber bands
- Radiator reflector
- Polystyrene
- Aluminium foil
- Blue felt
- White felt
- Black felt

Method

1. Collect the equipment needed to carry out the experiment
2. Cover the first beaker in your first material
3. Boil the kettle and pour boiling water into the beaker
4. Record the immediate temperature and start the stopwatch
5. Allow the water to cool and record the temperature every 2 minutes
6. After 10 minutes record the final temperature and stop the stopwatch
7. Pour the used water down the sink
8. Repeat stages 1-7 until you have finished all experiments

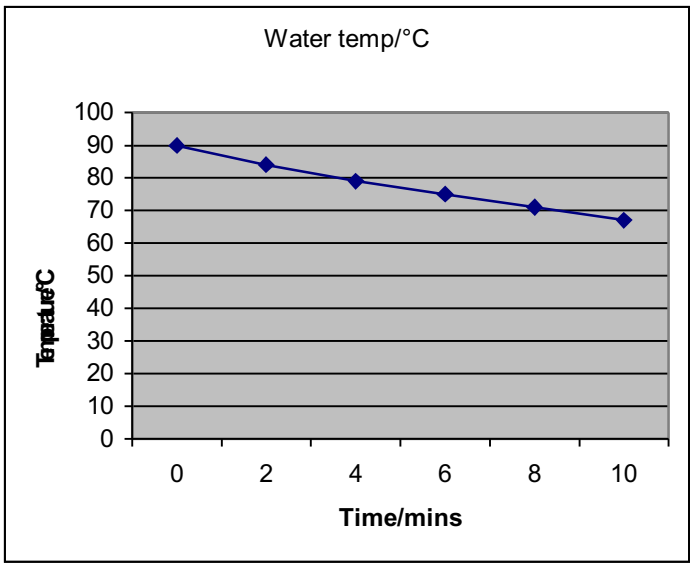
Results and Analysis

Here are the results for water on its own with no protection:

Time in minutes	**Water**
0	90°C
2	84°C
4	79°C
6	75°C
8	71°C
10	67°C

ANALYSIS - As you can see from this table water, on its own, cooled at a steady pace, about 4.5°C per two minutes. What is interesting is that if you calculate the difference between the first reading and the last reading you get an answer that is roughly the same as room temperature. This could show that an object twice the warmth of room temperature could cool to room temperature in 10 minutes without any other factors becoming involved in the process.

GRAPH



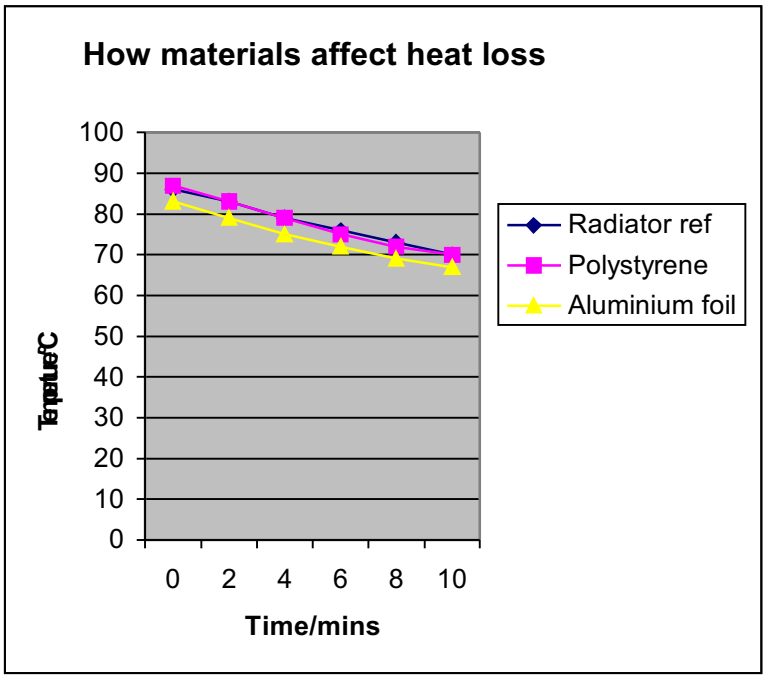
Materials

Here are the results for the different materials:

Time in minutes	**Radiator reflector (radiation)**	**Aluminium foil (conduction)**	**Polystyrene (convection)**
0	86°C	83°C	87°C
2	83°C	79°C	83°C
4	79°C	75°C	79°C
6	76°C	72°C	75°C
8	73°C	69°C	72°C
10	70°C	67°C	70°C

ANALYSIS - These results tell me that the amount of cooling is not affected much by which material the water is surrounded by and not even by whether that material is best at conduction, convection or radiation. However, I have noticed a couple of things from this set of results. These are that the amount of heat lost is not affected, but different materials affect the rate at which the heat is lost. I can see these by comparing the radiator reflector with the other two materials that I have used. Both the polystyrene and the aluminium foil begin by losing lots of heat, but then the process of heat loss slows down. However, in my results, the radiator reflector keeps losing an average of 3°C per two-minute session rather than slowing down like the other two materials. I have noticed that the rate of heat loss is lower than the rate of water with no protection, but they all have the same general affect.

GRAPH



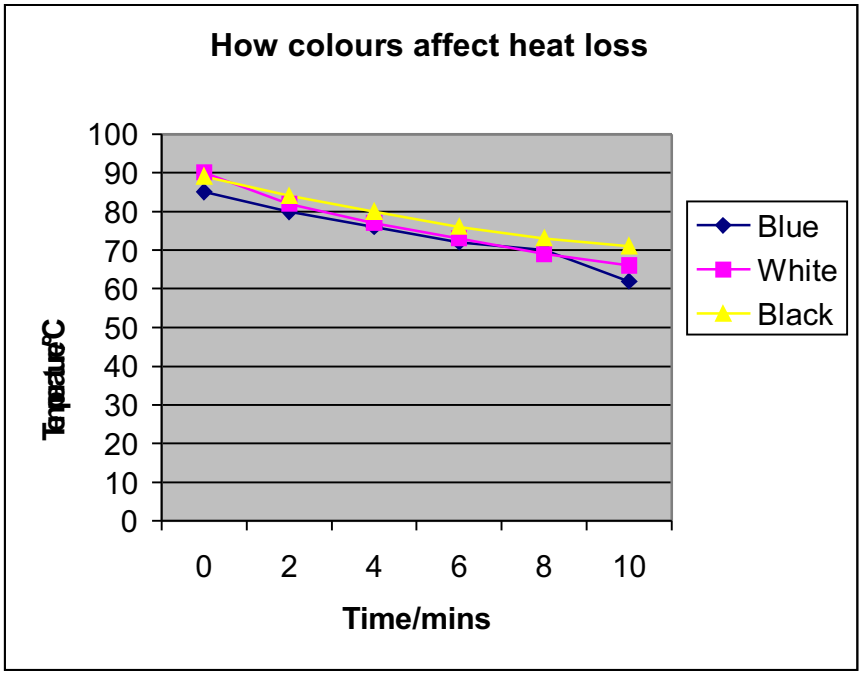
Colours

Here are the results for the different colours of felt:

Time in minutes	Blue	White	Black
0	85°C	90°C	89°C
2	80°C	82°C	84°C
4	76°C	77°C	80°C
6	72°C	73°C	76°C
8	70°C	69°C	73°C
10	62°C	66°C	71°C

ANALYSIS - These results show that colour does affect heat loss, but not every colour in the world makes a difference. Both the blue and white felt sank by room temperature in 10 minutes, which equals the effect shown by water without any protection. This shows that both white and blue have absolutely no noticeable affect on the heat loss in boiling water. However, the black material did show some positive results to match my hypothesis. The black recordings only decreased by a total of 18°C during the time period of ten minutes. This does prove that the colour black prevents heat transfer much better than any other colour.

GRAPH –



Evaluation

I am fairly pleased with the results that I found in this experiment, but if I could turn back time, I would do a few things different so that I could perfect my results. Some of these are small details, but others played a major part in the whole of the task. I am positive that I did not receive any anomalous results throughout this experiment, but some findings did surprise me and go against my predictions. For example, I predicted that the different materials that were used would make a major difference as they prevented different types of heat transfer form taking place at the same speed as normal. However this was not the case and the materials did not alter my results. Due to this, if I could redo the experiment I would chose a different factor to record instead of material as I feel that my results weren't as good as they could be for this particular factor. The sources of error in this experiment included the starting temperatures of the water, as this was hard to keep the same for each different beaker reading. Also I may have read a thermometer slightly wrong as it is sometimes hard to prevent these typical human errs. Also, to improve this investigation, I could record each different sub-factor three times and take an average; this would wipe out quite a bit of human error and would also allow me to get rid of any anomalous results. However, on this occasion, I did not have enough time to be this precise in my results. If I were to extend this investigation I would do more sub-factors to get a better idea in my mind about what all the different possibilities do. Also I could add more factors like whether a beaker is placed in a light area or a dark area. I could find out a lot more about this experiment if I were given more time, but I do feel as though, in the time I was given, I worked sufficiently and received the results that were needed for a good report.