How do Colours and Radiation Affect the Rate of Cooling of Tap Water?

Aim: To investigate radiation and the rate at which it cools ordinary tap water according to the colour of insulation.

Apparatus needed:

- Several Standard 250ml glass beakers (to be replaced after each test)
- A kettle (to heat the water)
- A square of bubble-wrap (to sit under the beaker to insulate it from the floor)
- A Thermometer
- A stopwatch
- Safety Goggles (due to handling very hot water)
- The materials I will use to encourage radiation are:

  Silver Foil
  Black Paper
  White Paper

Method:

1/ After setting the equipment up, as shown. Apply safety goggles and use the kettle to boil water
2/ Pour 250ml of boiled water carefully into the beaker.
3/ Once the temperature of the solution has reduced to 80◦c, begin timing.
4/ At each minute record the new temperature of the water in ◦c.
5/ Record each minute for 10 minutes. Repeat steps 2-5, three times and take the average temperature found.
6/ Repeat 1-5 using a new covering.

- Before I carry out a test with a covering I must first carry out a control test using no covering. I will then be able to compare just how much colour and radiation makes a difference based upon a normal template.

- I will record my results on this results table:

Time	Temperature Readings											
	Control			Black			White			Foil		
	1	2	3	1	2	3	1	2	3	1	2	3
Start Temp	80	80	80	80	80	80	80	80	80	80	80	80
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

Fair Test: There are obviously some limits as to how fair I can make this test. There are obviously some factors which are out of my control, for example, room temperature. I endeavour to make the test as fair as possible, some of the procedures I will use to keep the results congruent are, using the same; thermometer, same beaker (same type of beaker). I will take every result 3 times and take the average, this narrows down the chance of human error. It is vital I use the same method for every stage of my test.

Prediction:
It is excepted scientific fact that in radiation. Black absorbs heat and silver/white reflects it. This theory can be supported by looking at nature. The zebra for example is now thought to have its black and white stripes to cool itself down.

Wind is caused by changes in air pressure. It is when air is forced into a place of low pressure from an area of higher pressure. The black stripes on the zebra absorb heat and therefore create an area of low density, low pressure air. The white stripes however

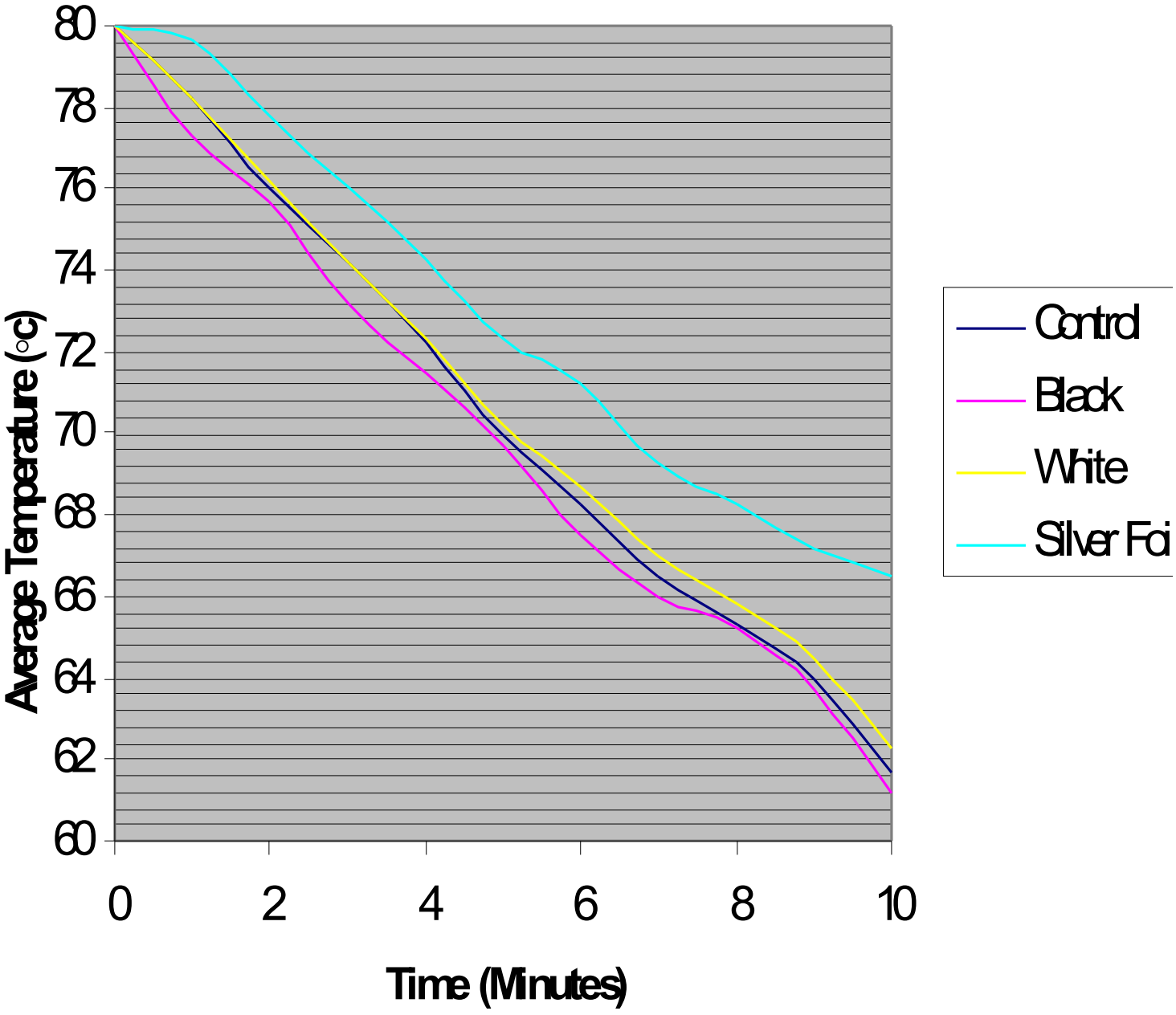
have the opposite affect. It is this minute change in pressure, which is thought to cause a micro-wind running across the surface of the zebra, hence cooling the animal down in the high temperatures of the African savannah.
Regarding my test, my prediction is as follows: black paper will increase the rate of cooling, the heat will be drawn out of the water quicker with black paper. Silver Foil will prove to be the best insulator, as heat will be reflected back in by the metallic silver of the foil.

- To test my prediction, I decided to run a few preliminary tests. These would test whether my prediction was accurate, noticeable or worth doing. I also decided on volumes of water to use, and an appropriate starting temperature. After making my initial method better I set out my final method.

These are the results from my actual experiment. I have written down each result from every test and then used a computer program to find the averages. These are written in the "Ave." column.

Time	Temperature Readings (◦c)															
	Control (No Insulation)				Black Insulation				White Insulation				Silver Foil			
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.
0	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
1	78	78.5	78	78.2	78	77	77	77.3	78	78	78.5	78.2	80	79	80	79.7
2	76	76	76	76	76	75.5	75.5	75.7	75.5	76.5	76.5	76.2	78.5	78	77	77.8
3	74	74.5	74	74.2	73.5	73	73	73.2	74	74.5	74	74.2	77	75.5	75.5	76
4	72	72.5	72	72.2	72	71	71.5	71.5	72	72.5	72.5	72.3	75	74	74	74.3
5	70	70	70	70	70	69	70	69.7	70	70.5	70	70.2	73	72	72	72.3
6	68.5	68.5	68	68.3	68.5	67	67	67.5	68.5	69	68.5	68.7	72	70.5	71	71.2
7	66.5	67	66	66.5	66.5	65.5	66	66	67	67.5	66.5	67	70	69	69	69.3
8	65	65.5	65.5	65.3	66	64.5	65	65.2	65.5	66	66	65.8	69	67.5	68.5	68.3
9	63.5	64	64.5	64	64.5	63	63.5	63.7	64	64.5	65	64.5	68	66	67.5	67.2
10	62	62	61	61.7	62	60.5	61	61.2	63	62.5	61.5	62.3	66.5	66	67	66.5

A Graph to Show the Rate of Cooling of Tap Water Due to Radiation According to the Effects of Colour of Insulation



Conclusion: All my results are clear and follow a general pattern. This can be seen by looking at my graph, all of the trend lines run on a steady gradient. This fact suggests that there are no anomalous results.

Both the graph and results clearly back up my prediction, the black insulation drew heat out of the water, whilst the silver foil reflected heat back in, hence the water losing less heat. My results also clearly support the theory used in my prediction. 'Black absorbs heat and silver/white reflects it.'

- I feel the outcome and the experiment in its entirety was a successful one. My results provide clear conclusions without any anomalies. This I feel was due to the simplicity in which I laid out my methods, which was made easier my successful preliminary tests.
  My results were very accurate, but, these could be made even more accurate by the use of technology, for example, using a temperature controlled room, electronic thermometers backed up with computer timing would make the results infallible.
  The next step to take to prove the reliability of my findings would be to set up some fieldwork regarding radiation affects in the wild. As mentioned on Zebras in my prediction.
  If I were to attempt this experiment again I would draw up a different method. In this new method, instead of measuring temperature difference over a 10 minute period, I will measure timings in a 20◦c range.