Insulation investigation

Aim:

The aim of my investigation is to find the rate, at which hot water cools, in cups of different material and thickness.

Previous knowledge:

Heat can be transferred in three ways convection, radiation, or conduction. Although these three processes can occur simultaneously, it is not unusual for one process to overshadow the other two.

Conduction:

If the temperature at one end of a metal rod is increased by heating, heat is conducted to the colder end. This is believed to be p artially due to the motion of free electrons in a solid, which transport energy if a temperature difference is applied. This theory helps to explain why good electrical conductors also tend to be good heat conductors.

Materials such as gold, silver, and co pper have high thermal conductivity's and conduct heat naturally, but materials such as glass and polystyrene have low thermal conductivity and conduct heat poorly, and are known to be good insulators.

Convection:

The process of conduction between a soli d surface and a moving liquid or gas is called convection. The motion of the fluid may be natural or forced. If a liquid or gas is going through natural convection then, the hotter, lighter fluid rises while the colder, heavier fluid sinks.

E.g. if some water in a cup is heated from below, the liquid closest to the bottom expands and its density decreases, the hot water as a result rises to the top and some of the cooler fluid sinks toward the bottom from the middle, producing a cycle effect.

Because hot air rises and cool air sinks, radiators should be placed near the floor and air-conditioning appliances should be placed near the ceiling for maximum effects.

Radiation:

The process of radiation is totally different from both conduction and convection bec ause substances exchanging heat do not need to be in contact with each other.
This is because heat is transferred via waves: e.g. 1. The Sun by its radiation of electromagnetic energy gives out directly or indirectly all of the energy supporting life on earth, because all foods and fuels are dependent on plants using the energy of sunlight.

2. Light and radio waves can travel through space from the sun and stars to the earth, regardless of the frequency or wavelength. Generally, dull and rough surfaces are good absorbers of radiation. Smooth and shiny surfaces good at reflectors of radiation.

Predictions:

Qualitative predictions:

1. I predict that the wool will be a good insulator, the rate at which the water cools will be slowest when wrapped around wool because wool has air gaps within it and air is a very good insulator.
2. I predict that the cup with no insulation will cool faster. This is because the cup has no insulation and the faster it will take for heat to escape.
3. I predict that the cup with bublewrap around it will also be a good insulator as the bubbles hold the heat and then let it out when full.
4. I predict that if the room temperature is lower than the temp erature of the water inside the cup the rate of cooling will be increased.

Quantitative predictions:

1. I predict that if you double the thickness of the insulator, the rate of cooling is halved.
2. I predict that if you halve the thickness of the insulator, the rate of cooling is doubled.

Apparatus: -

- Stop clock,
- Thermometer,
- 100ml beaker,
- Wool,
- Foil,
- Bublewrap,
- Rubber bands,

Fair test: -

In order to make my experiments a fair as possible I will carry out the following:

1. I will make sure the water is the same temperature.
2. I will wrap the beaker evenly, so that the beaker has the same amount covered.
3. I will do one at a time so it will be easier,

4. and I will stop the clock as soon as hits the minute wanted.

Methodology: -

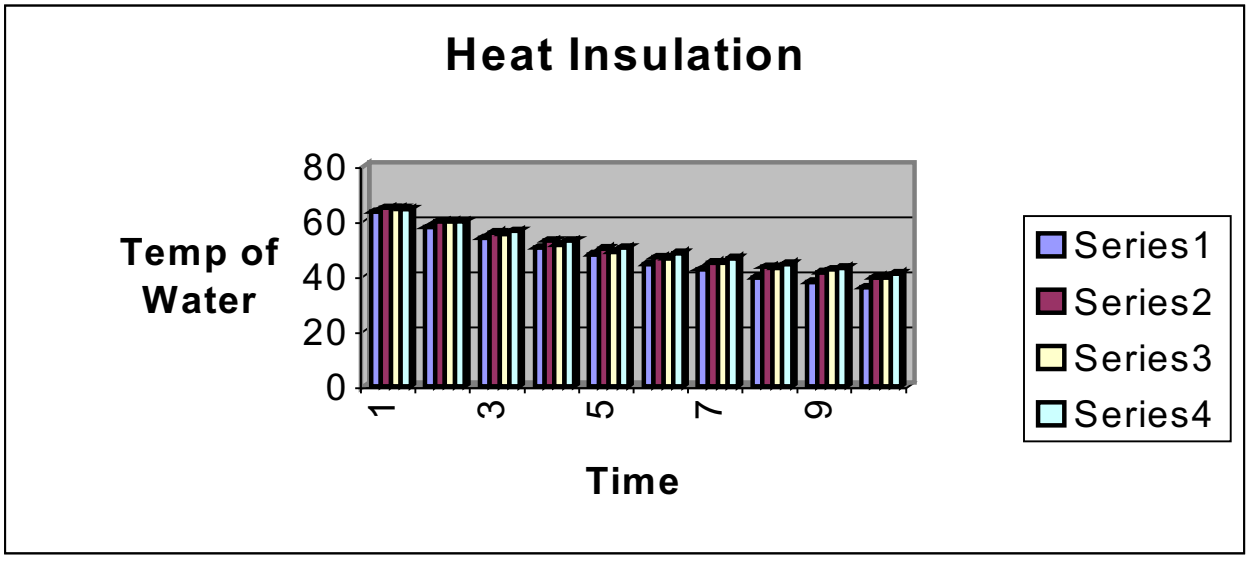
Method for heat insulation:

1. Collect appropriate apparatus.
2. Cover beaker with insulator (wool, foil…e.t.c.)
3. Pour 50ml of hot water into beaker.
4. Check temperature of water is 70 degrees.
5. Set stop clock.
6. Continue doing steps 2-5 until the entire insulator has been used.

Results:

Insulation experiment:

Time				
	No insulation	Wool	Bubblewrap	Foil
2	63.5	65	65	64.5
4	58	60	60	60
6	54	56	55.5	56.5
8	50.5	53	51.5	53
10	48	50	49	50.5
12	44.5	47	46.5	48.5
14	42.5	45	45	46.5
16	39.5	43.5	43	44.5
18	38	41.5	42.5	43
20	36	39.5	39.5	41



Conclusion: -

Through out my investigation, I concluded that I found out that wool was the best insulator, as it kept most of the heat in. I also found that foil was the best conductor of heat. I also conclude that all my predictions were correct. As the time went up the temperature of the water went down, this was because there was no lid on the beakers to keep more of the heat in.

Evaluation: -

Even though I tried my best, my result could still be more accurate. I could improve by using an electronic thermom eter to help me read the temperature instead of struggling to read the thermometer; then that way I would not have to stop the clock and my results could have been more reliable.