TEMPERATURE – HEAT ENERGY

SENSOR(S) - Internal temperature
- Two external temperature

INVESTIGATE
- What happens to the heat (energy) from a liquid when it cools
- That objects cool or warm to the temperature of their surroundings when left.
- To form a prediction and compare this to the result to create a conclusion

INTRODUCTION TO THE INVESTIGATION

This investigation leads on from looking at temperature, how it is measured and the thermal insulation properties of materials. It is aimed at higher level pupils and looks at what happens to the heat energy when cooling takes place. This knowledge helps better understand the techniques needed to design insulated packing.

The investigation also enables the pupils to discuss and recognise that objects cool or warm to the temperature of their surroundings when they are left.

One important aspect of the investigation is the prediction of the result. This can either be as a class discussion or in smaller groups. Most pupils can work out that the line of the graph will drop as the liquid cools and quite a few will also grasp that the cold 'outer' water will warm up. It is not uncommon, though, for some pupils to draw the graph crossing rather than the temperatures coming together then falling to room temperature.

In the investigation the outer bowl of water (see diagram) represents the air that the hot liquid would normally stand in. Some discussion may be required to explain this – get the children to carefully put their hand close to a cup of warm liquid and they will 'feel' the heat before they touch it (great care should be taken if trying this out).

RESOURCES

- Explorer datalogger , datalogging software, computer, LogIT computer link cable.
- 2 x Explorer external temperature sensors
- Electric kettle to heat water (CARE! - Water above 55° C can scold so BE CAREFUL) and a Jug of cold water
- 2 containers - 1 large, 1 small (make sure the small container safely Ţts inside the large container) - a glass bowl and glass beaker are often the best combination.
- Deep tray to place containers in to catch any spillage and plenty of paper towels or similar to deal with spillages

WHAT TO DO

- Plug the external temperature sensors into the Explorer datalogger (avoid over plugging the internal temperature sensor as this is used to monitor room temperature).
- Connect the Explorer to the computer and run the datalogging software
- Set up the logging facility of the software (if necessary set the time span of the software to at least 20 minutes, depending on the time available).
- Place the small container inside the larger one.
- Carefully pour hot water into the inner container (for safety reasons it is best that this done by the teacher unless temperatures used are below 50°C).
- Carefully pour cold water into the outer container until the level of the cold water is at the same level as the hot water.
- Place one temperature sensor into each container making sure that the sensor does not touch the sides.
- Start the software logging.
- While logging the experiment can be discussed and pupils asked to predict what will happen – get them to describe or draw the graph lines.
- At the end of the experiment stop the computer logging, save and print the graph
- Discuss and/or write up the Ţndings

If computers are limited the same investigation can be carried out using the Explorer's remote logging facility which is selected by using the blue button. Results can then be downloaded to a computer. By using remote logging the investigation can be left for a long period without tying up a computer.

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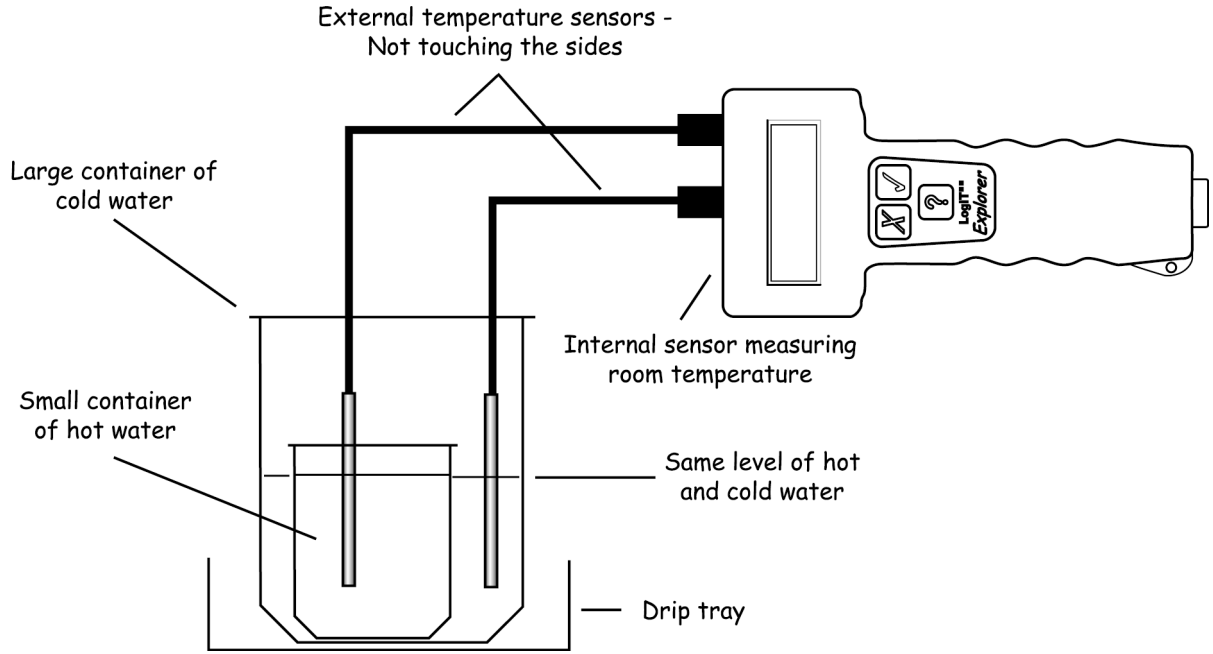
SAFETY

- Extreme care is needed when using hot water.
- Hot water can soften some types of plastic containers causing water to spill.
- Children should be kept well back if water is more than hand hot.
- Liquids and computers do not mix so ensure that a tray is used to catch spillage and that paper towels are on hand to mop up accidents.

DIAGRAM



ABOUT THE RESULTS

- Looking at the two traces where did the heat energy appear to go ?
- If the investigation could not be left for the full time discuss what would happened to the two temperatures ?
- When did the cold water gain heat energy and then lose it ?
- What happens to the heat energy lost by the cold water in the outer container ?
- Why was it important not to allow the sensors to touch the sides of the container ?
- Was it a fair test ? - should the containers have a lid ? Were they in a draught ? What about the bottom of the containers ?

EXTENSION ACTIVITIES

- Leave the cooling process over a longer period of time.
- Put a lid on the containers.
- Does the shape of the inner and outer container change the results ?
- What happens if the outer container is insulated?