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## GCSE Physics required practical activity 2: Thermal insulation (physics only)

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### Student sheet

Required practical activity	Apparatus and techniques
Investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.	AT 1, AT 5

#### 1. Investigating the effectiveness of different materials as thermal insulators.

In this part of the experiment you will measure the rate of cooling of a beaker of hot water when insulated with different materials.

You will plot cooling curves to determine which is the best thermal insulator.

Learning outcomes
1
2
<b>Teachers to add these with particular reference to working scientifically</b>

### Method

You are provided with the following:

- large beaker (eg 800 ml)
- small beaker (e.g. 250 ml)
- thermometer
- kettle to heat water
- piece of cardboard
- scissors
- stopwatch
- selection of insulating materials, eg polystyrene granules, sawdust, bubble wrap, newspaper.

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## Risk assessment

Take great care when pouring the near-boiling water from the kettle. If you splash any on yourself, immediately wash the affected area with cold water.

**You should read these instructions carefully before you start work.**

1. Use the kettle to boil water and then put 80 ml of this hot water into a 100 ml beaker.
2. Place the small 100 ml beaker inside the large beaker.
3. Use a piece of cardboard, with a hole for the thermometer, as a lid for the large beaker.
4. Insert the thermometer through the hole in the cardboard lid so that its bulb is in the hot water.
5. Record the temperature of the water and start the stopwatch.
6. Record the temperature of the water every 5 minutes for 20 minutes.
7. Repeat steps 1 to 6, but this time fill the space between the small and the large beaker with an insulating material. Make sure that you use the same volume of water each time.
8. Draw cooling curve graphs by plotting temperature against time for each insulator.
9. From your graphs, determine which material is the best insulator.
10. Record your results in a table such as the one below.
11. Plot a cooling curve for each type of material used.

Material used for insulation	Temperature in °C				
	At the start	after 5 minutes	after 10 minutes	after 15 minutes	after 20 minutes

**Note:** If you are working on your own in this investigation, you should be provided with at least 5 beakers of each size, and 5 thermometers. This will enable you to set up the equipment for all of the different insulators at the same time.

Alternatively, your teacher may decide to pool the class results so that you only need to set up the equipment for one of the insulators.

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## 2. Investigating factors that may affect the thermal insulation properties of a material.

In this part of the experiment you will measure the rate of cooling of a beaker of hot water when insulated with different thicknesses of the same materials.

You will plot cooling curves to determine which is the best thermal insulator.

### Method

**You are provided with the following:**

- beaker (eg 250 ml)
- thermometer
- kettle to heat water
- piece of cardboard
- scissors
- stopwatch
- insulating material, eg newspaper, corrugated cardboard, bubble wrap
- rubber bands.

### Risk assessment

Take great care when pouring the near-boiling water from the kettle. If you splash any on yourself, immediately wash the affected area with cold water.

**You should read these instructions carefully before you start work.**

1. Use the kettle to boil water and then put 200 ml of this hot water into a 250 ml beaker.
2. Use a piece of cardboard, with a hole for the thermometer, as a lid for the beaker.
3. Insert the thermometer through the hole in the cardboard lid so that its bulb is in the hot water.
4. Record the temperature of the water and start the stopwatch.
5. Record the temperature of the water every 5 minutes for 20 minutes.
6. Repeat steps 1 to 5, but this time insulate the beaker by wrapping one or more layers of insulating material around the beaker. The insulating material may be held in place by using rubber bands. Make sure that you use the same volume of water each time.
7. Draw cooling curve graphs by plotting temperature against time for each number of different layers of insulation.
8. From your graphs, write a conclusion about the effect of changing the number of layers of insulation.
9. Record your results in a table such as the one below.
10. Plot a cooling curve for each type of material used.

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Number of layers of material used for insulation	Temperature in °C				
	At the start	after 5 minutes	after 10 minutes	after 15 minutes	after 20 minutes

**Note:** If you are working on your own in this investigation, you should be provided with at least 5 beakers and 5 thermometers. This will enable you to set up the equipment for all of the different numbers of layers of insulation at the same time.

Alternatively, your teacher may decide to pool the class results so that you only need to set up the equipment for one particular number of layers.