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TEACHER NOTES:

## INVESTIGATING INSULATION

### PRIOR LEARNING EXPERIENCE:

Before students attempt this task, they must be familiar with:

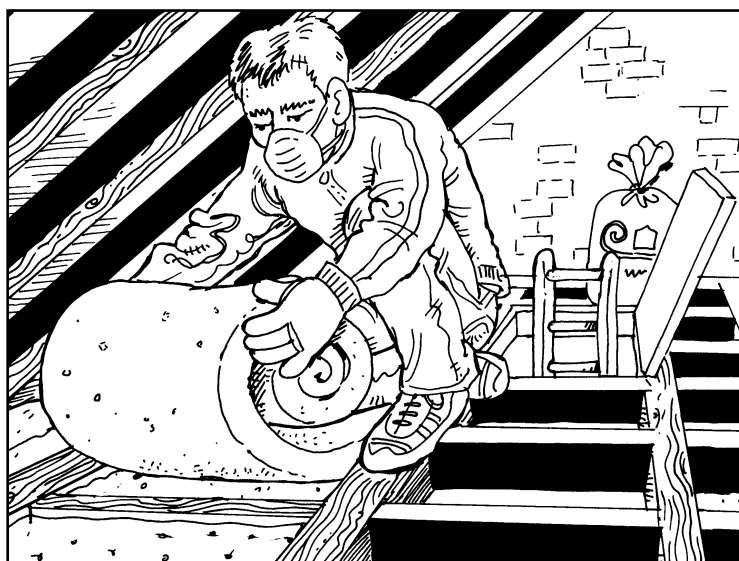
- insulating materials
- energy transfers
- planning investigations
- planning how to collect valid results.

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## TASK SHEET:

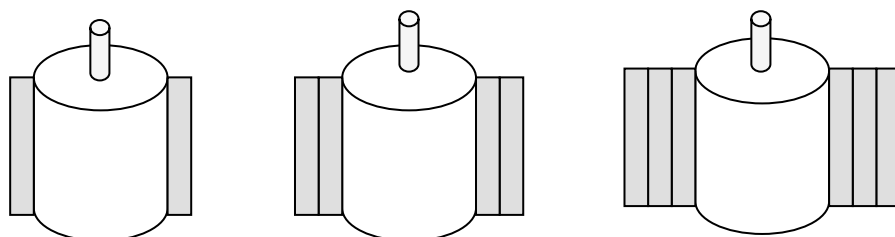
# INVESTIGATING INSULATION

According to the Energy Saving Trust, if everyone in the UK installed 270mm loft insulation, we could save around £520 million and nearly three million tonnes of carbon dioxide every year.



### TASK

Which is the best thickness of insulation to use in a loft?



### IN YOUR PLAN INCLUDE:

- equipment list
- variables - the ones you will keep the same (control) the one you will change (independent) and the one you will measure (dependent)
- a description of what you will do
- include a suitable range and intervals for your observations
- safety precautions.

### COLLECTING RESULTS:

- draw a table for your results.
- plan to collect a sufficient number of results

### KEY WORDS

conduction, control variable, convection, dependent variable, energy transfer, independent intervals, insulation, radiation, range, temperature, thermal, variable

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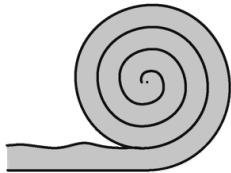


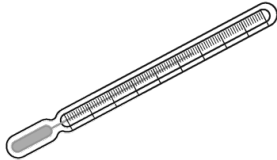
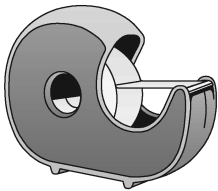

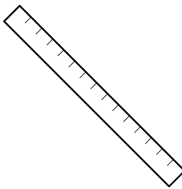


## ACE LEARNING LADDER: INVESTIGATING INSULATION

### ACE LEARNING LADDER

Assessment check	What you could include:
Advanced	<p>You will have planned an in-depth investigation into insulation, drawing on scientific knowledge and understanding. You might:</p> <ul style="list-style-type: none"> <li>• Write a detailed method that clearly shows all variables you will control, change and measure.</li> <li>• Give a detailed justification for your method and the number of repeats you plan to make, explaining how you will ensure accuracy and precision.</li> <li>• Explain, in detail, your method in terms of your scientific knowledge and understanding of insulation and energy transfers.</li> <li>• Consult secondary sources of information when writing a risk assessment for your investigation.</li> <li>• Use a range of appropriate scientific words, symbols and units accurately.</li> </ul>
Confident	<p>You will have planned an investigation into insulation, drawing on scientific knowledge and understanding. You might:</p> <ul style="list-style-type: none"> <li>• Write a method that clearly shows all variables you will control, change and measure.</li> <li>• Justify your method and the number of repeats you plan to make.</li> <li>• Explain your method in terms of your scientific knowledge and understanding of insulation and energy transfers.</li> <li>• Recognise familiar risks within your investigation and describe how you will control these.</li> <li>• Use a range of appropriate scientific words, symbols and units.</li> </ul>
Establishing	<p>You will have planned a simple investigation into insulation, drawing on scientific knowledge and understanding. You might:</p> <ul style="list-style-type: none"> <li>• With help, write a method.</li> <li>• Identify factors you will keep the same and change.</li> <li>• Select appropriate equipment for your investigation.</li> <li>• Describe how many repeats you will use.</li> <li>• Identify possible risks to yourself and others.</li> <li>• Use some appropriate scientific words, symbols and units.</li> </ul>

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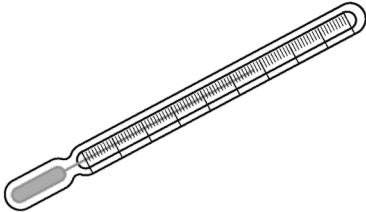
## SUPPORT SHEET 1: ESTABLISHING TO CONFIDENT INVESTIGATING INSULATION

Equipment options			
			
Insulating material	Large beaker with cover	Stopwatch	Thermometer
			
String, sticky tape, or elastic bands	Kettle	Ruler	Other?
<p><b>Variables</b></p> <p><b>Control, dependent, independent</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> thickness of insulation</li> <li><input type="checkbox"/> type of insulation</li> <li><input type="checkbox"/> starting temperature of water</li> <li><input type="checkbox"/> time intervals</li> <li><input type="checkbox"/> temperature decrease</li> <li><input type="checkbox"/> others?</li> </ul>		<p><b>Safety for yourself and others</b></p> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> insulating material</li> <li><input type="checkbox"/> glass</li> <li><input type="checkbox"/> thermometer</li> <li><input type="checkbox"/> hot water</li> </ul> <p>How will you control them?</p>	
<p><b>Range and intervals</b></p> <p>How many thicknesses of insulation will you compare?</p> <p>How many times will you repeat each measurement?</p>		<p><b>About insulation</b></p> <p>Insulating material traps warm air. This slows down convection (warm air rising) and heat loss from the house.</p> 	

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## SUPPORT SHEET 2: CONFIDENT TO ADVANCED INVESTIGATING INSULATION

<p style="text-align: center;"><b>Equipment</b></p> <p>Possible equipment.</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> insulating material</li> <li><input type="checkbox"/> large beaker with a cover</li> <li><input type="checkbox"/> thermometer or data logger</li> <li><input type="checkbox"/> stopwatch</li> <li><input type="checkbox"/> string, rubber bands or sticky tape</li> <li><input type="checkbox"/> kettle</li> <li><input type="checkbox"/> other?</li> </ul>	<p style="text-align: center;"><b>Techniques</b></p> <p><b>Measuring temperature</b> What is the advantage of using a data logger over a thermometer?</p> <p><b>Starting temperature</b> How will you decide the starting temperature? Does it matter?</p>
<p style="text-align: center;"><b>Variables</b></p> <p>Consider the variables that you can control, measure and change.</p> <p>What will you do to control the variables?</p>	<p style="text-align: center;"><b>Safety</b></p> <p>What risks are there when using:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> insulating material?</li> <li><input type="checkbox"/> a kettle?</li> <li><input type="checkbox"/> glass?</li> </ul> <p>How will you control them for yourself and for others?</p>
<p style="text-align: center;"><b>Range, intervals and reliability</b></p> <p><b>Range:</b> How many thicknesses of insulation will you investigate?</p> <p><b>Intervals:</b> What intervals of measurements are you using?</p> <p><b>Reliability:</b> How many times will you do each test? How will you ensure that your investigation is reliable?</p>	<p style="text-align: center;"><b>About insulation</b></p> <p>Insulating materials usually trap air and slow down thermal energy transfers.</p> <p>Heat energy is usually lost from the roof by convection. Roof insulation does reduce this.</p> <p>The thicker the insulation, the more expensive it is to install. Is it worth putting very thick insulation in the roof?</p>

<p style="text-align: center;"><b>Techniques</b></p> <p>What makes insulation effective?</p> <p>What's the best way to measure the effectiveness of insulation?</p> <p>When would you start the measurement and finish it? What effect may this have?</p> <p>How will you ensure the water starts at the same temperature? Does it matter?</p> <p>What is it exactly that you want to investigate?</p>	<p style="text-align: center;"><b>Controlling risk</b></p> <p>Safety - research guidance from:</p> <ul style="list-style-type: none"> <li>• CLEAPSS</li> <li>• Using hot water</li> <li>• Other?</li> </ul> <div style="text-align: right;">  </div>
<p style="text-align: center;"><b>Variables</b></p> <p>Identify the variables that are not easy to control and consider how to reduce errors from them.</p> <div style="text-align: center;">  </div>	<p style="text-align: center;"><b>Controlling errors</b></p> <p>What possible errors could happen in your measurements?</p> <p>Consider each stage of the investigation. How can you ensure that you measure accurately?</p> <p>Consider the errors that may occur when you carry out the investigation. How will you control them?</p>
<p style="text-align: center;"><b>Precision and reliability</b></p> <p>Which measurements will need to be precise?</p> <p>How will you ensure precision?</p> <p>How are reliability and error control linked?</p> <p>How will you ensure the results are reliable?</p>	<p style="text-align: center;"><b>About insulation</b></p> <p>Thick insulation is more expensive. Is it worth having very thick insulation?</p> <p>What else could you do to reduce thermal energy loss from your home?</p>