1 TEACHER NOTES: INVESTIGATING INSULATION

NATIONAL CURRICULUM LINKS

WORKING SCIENTIFICALLY

Experimental skills and investigations

CALCULATION OF FUEL USES AND COSTS IN THE DOMESTIC CONTEXT

- domestic fuel bills, fuel use and costs
- fuels and energy resources.

ENERGY CHANGES AND TRANSFERS

- heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter one to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference; use of insulators.

CHANGES IN SYSTEMS

- energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change.

TASK:

Plan an investigation, collect evidence safely and present the data appropriately.

This task is designed to encourage students to develop their planning and data collection skills. It draws on their knowledge and understanding of energy transfers and insulation.

SUGGESTED APPROACH:

Please read the introduction to this book to get the most out of this task.

In class, use a starter activity as the stimulus to the task; introduce the task and ACE Learning Ladder, and allow 30–40 minutes to complete it. Allow students to use secondary resources such as class notes, textbooks and library books to develop their ideas. In the plenary, peer or self assess using the ACE Learning Ladder.

You may wish to show examples of different types of insulation and recap how insulation works and why it is necessary.

RESOURCES:

Lined and plain A4 paper. Possibly examples of insulation.

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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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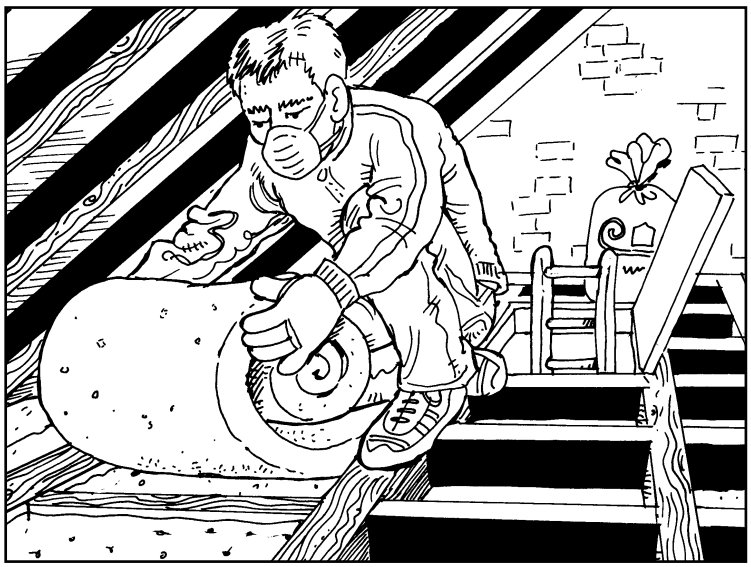
TASK SHEET:

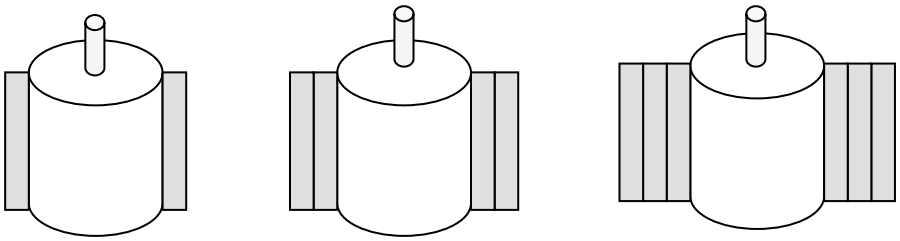
INVESTIGATING INSULATION

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

1 ACE Learning Ladder: Investigating Insulation

ACE Learning Ladder

Assessment check	What you could include:
Advanced	You will have planned an in-depth investigation into insulation, drawing on scientific knowledge and understanding. You might: • Write a detailed method that clearly shows all variables you will control, change and measure. • Give a detailed justification for your method and the number of repeats you plan to make, explaining how you will ensure accuracy and precision. • Explain, in detail, your method in terms of your scientific knowledge and understanding of insulation and energy transfers. • Consult secondary sources of information when writing a risk assessment for your investigation. • Use a range of appropriate scientific words, symbols and units accurately.
Confident	You will have planned an investigation into insulation, drawing on scientific knowledge and understanding. You might: • Write a method that clearly shows all variables you will control, change and measure. • Justify your method and the number of repeats you plan to make. • Explain your method in terms of your scientific knowledge and understanding of insulation and energy transfers. • Recognise familiar risks within your investigation and describe how you will control these. • Use a range of appropriate scientific words, symbols and units.
Establishing	You will have planned a simple investigation into insulation, drawing on scientific knowledge and understanding. You might: • With help, write a method. • Identify factors you will keep the same and change. • Select appropriate equipment for your investigation. • Describe how many repeats you will use. • Identify possible risks to yourself and others. • Use some appropriate scientific words, symbols and units.

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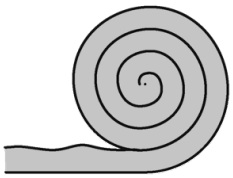
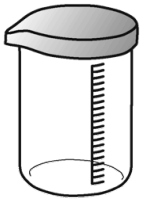
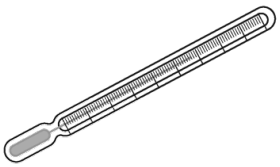
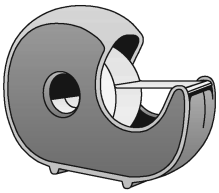
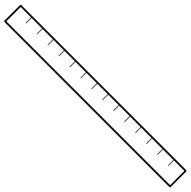
SUPPORT SHEET 1: ESTABLISHING TO CONFIDENT

INVESTIGATING INSULATION

Equipment options			
			
Insulating material	Large beaker with cover	Stopwatch	Thermometer
			?
String, sticky tape, or elastic bands	Kettle	Ruler	Other?

Variables

Control, dependent, independent

- ☐ thickness of insulation
- ☐ type of insulation
- ☐ starting temperature of water
- ☐ time intervals
- ☐ temperature decrease
- ☐ others?

Safety for yourself and others

Risks

- ☐ insulating material
- ☐ glass
- ☐ thermometer
- ☐ hot water

How will you control them?

Range and intervals

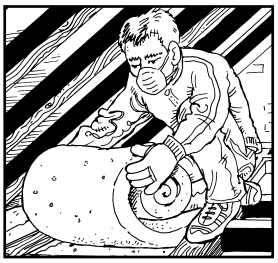
How many thicknesses of insulation will you compare?

How many times will you repeat each measurement?

About insulation

Insulating material traps warm air.

This slows down convection (warm air rising) and heat loss from the house.



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SUPPORT SHEET 2: CONFIDENT TO ADVANCED

INVESTIGATING INSULATION

Equipment

Possible equipment.

- ☐ insulating material
- ☐ large beaker with a cover
- ☐ thermometer or data logger
- ☐ stopwatch
- ☐ string, rubber bands or sticky tape
- ☐ kettle
- ☐ other?

Techniques

Measuring temperature
What is the advantage of using a data logger over a thermometer?

Starting temperature
How will you decide the starting temperature? Does it matter?

Variables

Consider the variables that you can control, measure and change.

What will you do to control the variables?

Safety

What risks are there when using:

- ☐ insulating material?
- ☐ a kettle?
- ☐ glass?

How will you control them for yourself and for others?

Range, intervals and reliability

Range:
How many thicknesses of insulation will you investigate?

Intervals:
What intervals of measurements are you using?

Reliability:
How many times will you do each test?

How will you ensure that your investigation is reliable?

About insulation

Insulating materials usually trap air and slow down thermal energy transfers.

Heat energy is usually lost from the roof by convection. Roof insulation does reduce this.

The thicker the insulation, the more expensive it is to install. Is it worth putting very thick insulation in the roof?

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SUPPORT SHEET 3: ADVANCED EXTEND AND STRETCH

INVESTIGATING INSULATION

Techniques

What makes insulation effective?

What's the best way to measure the effectiveness of insulation?

When would you start the measurement and finish it? What effect may this have?

How will you ensure the water starts at the same temperature? Does it matter?

What is it exactly that you want to investigate?

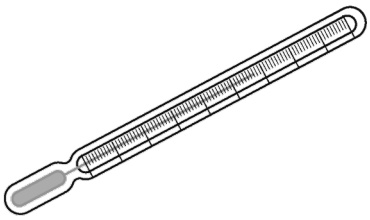
Controlling risk

Safety – research guidance from:

- CLEAPSS
- Using hot water
- Other?

Variables

Identify the variables that are not easy to control and consider how to reduce errors from them.



Controlling errors

What possible errors could happen in your measurements?

Consider each stage of the investigation.
How can you ensure that you measure accurately?

Consider the errors that may occur when you carry out the investigation.

How will you control them?

Precision and reliability

Which measurements will need to be precise?

How will you ensure precision?

How are reliability and error control linked?

How will you ensure the results are reliable?

About insulation

Thick insulation is more expensive. Is it worth having very thick insulation?

What else could you do to reduce thermal energy loss from your home?