EASY | AGE: 14+ | 2 – 3 HRS

1. Find out about different types of materials used for building insulation
2. Investigate which materials are good thermal insulators

# INSULATION INVESTIGATION

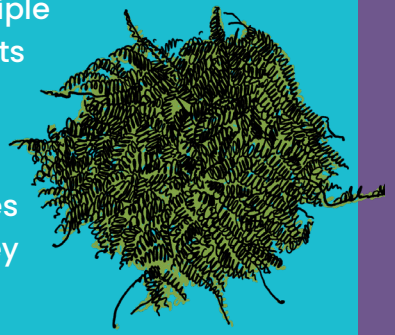
# INTRODUCTION

**Insulating materials can be used to stop heat from leaving, or entering a building.**

In colder countries, such as the UK, we have historically focussed on preventing heat loss from buildings.

Insulating materials can be used in the building process to prevent heat loss from buildings. Materials such as wool, cotton, rubber, cork and fibre glass all share one thing in common: they are poor conductors of heat. This is largely due to the fact that they are usually low density material and contain pockets of air, air being a poor conductor of heat. Cavity wall insulation, loft insulation, underfloor insulation and double glazing are all based on the principle that lining a building with a poor heat conductor prevents heat transfer to its surroundings.

Natural materials containing living microbes often generate heat. Think of a compost heap. As the microbes in the compost heat break down the organic matter, they release heat energy and the compost heap heats up. The same is true in landfill sites and hay storage areas. The temperature must be managed carefully to prevent fires.



# SAFETY

- **Adult supervision is required for activity 1**
- **Do not go out alone at night. Stay on footpaths and pavements, and do not enter building sites**
- **Avoid any known allergens such as sheep's wool or hay**
- **Take care with natural materials that might harbour unknown microbes. Always wash hands after handling.**

## YOU WILL NEED

- 2 empty cardboard boxes, one slightly larger than the other so when one is placed inside the other, there is a 5 – 10cm gap between the boxes
- A roll of catering wrap / cling film
- A plate or saucer
- Timer / watch
- Access to a freezer
- 6 ice cubes, all the same size and shape
- 6 different types of materials a mixture of man-made & natural materials is good. Such as moss, dried leaves, hay, wool, polystyrene packaging pellets, tin foil, washing up sponges, polyester / nylon clothing or blankets.

# ACTIVITY 1

## LOOKING AT THE TYPES OF MATERIALS USED IN BUILDINGS.

### INSTRUCTIONS

1. Go for a walk in your local area. Look carefully at the buildings on the route and observe the materials they are made from. Are they all similar? Try to compare older and newer buildings.
2. Compare the variety of construction materials used, which type of buildings incorporate the greatest variety of materials, older or newer buildings?
3. Which type of buildings incorporate more 'natural' building materials, older ones or newer ones?

# ACTIVITY 2

## TESTING DIFFERENT MATERIALS AS THERMAL INSULATORS IN A MODEL HOUSE.

### INSTRUCTIONS

1. Place the smaller cardboard box inside the larger cardboard box. This should leave a small gap around all 4 sides.
2. Measure a piece of catering wrap / cling film to fit over the top of the boxes to form the 'roof'.
3. Pack one of the materials into the gap between the boxes along all 4 sides.
4. Place the plate / saucer on the centre of the bottom of the boxes. Remove an ice cube from the freezer and place it on the plate / saucer.
5. Fit the roof over the boxes to ensure there are no draughts.
6. Measure the length of time taken for the ice cube to fully melt inside the box. Record your result in the table below.
7. Remove the plate, wash and dry ready for re-use. Remove the material from the gap between the boxes and dispose of the material appropriately. Some of the 'natural materials' may be disposed of in a compost bin / local authority garden waste bin. Please check with an adult first.
8. Repeat steps 3 – 7 with a different material each time, until you have tested all 6 insulating materials. Remember to wash your hands after the experiment.

## WHAT'S HAPPENING?

Traditional building methods often followed the rule that the shape, form and construction materials used reflected the function of the building. For instance, important buildings such as courts, museums or libraries typically incorporated lots of large open spaces with impressive facades and large windows, and were commonly constructed out of stone or brick. These older buildings tended to be poorly insulated, especially the roofs and windows. In towns and cities, older buildings generally have little use of 'natural' materials such as roof thatching and wool / hay insulation but instead rely heavily on locally available materials such as brick, stone, clay tiles and slate.

Modern architectural designs and building standards have transformed the construction of newer buildings so they are more energy efficient. For instance, newer buildings may have more internal compartmentalisation (smaller rooms), triple glazed windows, insulation on all external surfaces including under the floor, in spaces between walls and in loft spaces. Newer buildings might incorporate more natural materials such as turf roofing or being partially built into the landscape. These are all good methods of insulating a house and preventing heat loss.

## NOTES

## DID YOU KNOW?

Garden composting is an environmentally friendly way of disposing of food waste and garden waste. The temperature of a compost heap depends on many factors such as humidity, oxygen availability and the particle size of the waste in the heap.
A compost heap can reach temperatures of between 49°C – 79°C in a matter of days.
This heat can be used to heat homes, greenhouses or water. During the Georgian period (in the late 1700s), piles of composting manure were created around frost-susceptible crops such as melons and cucumbers, and even pineapples. Examples of manure heated hothouses include those at the Lost Gardens of Heligan in Cornwall, Holkham Hall in Norfolk and Dunmore Park House grounds near Falkirk (hence the famous Dunmore Pineapple building). To prevent heat accumulating to very high temperatures and killing the beneficial microbes, it is a good idea to regularly fork through or 'turn' the compost heap over to maintain a temperature of approximately 65°C.

# RESULTS TABLE

| MATERIAL | 'NATURAL' (N) or 'MAN-MADE' (MM) | TIME TAKEN FOR ICE CUBE TO MELT (SECONDS) |
|---|---|---|
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## QUESTIONS

1. Which is the best insulating material you tested? Can you explain why that material is a good thermal insulator?

2. Is there a difference in the time taken for the ice cube to melt when using 'natural' materials likely to harbour microbes compared with more sterile 'man-made' materials?

3. Would these be useful materials with which to insulate modern homes, and why?

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