

Spring Block 1

Properties of materials

Small steps

Step 1

Test materials – magnetism, transparency and hardness

Step 2

Test materials – electrical conductivity

Step 3

Plan – insulating heat experiment

Step 4

Investigate – insulating heat experiment

Step 5

Evaluate – insulating heat experiment

Step 6

Uses of everyday materials – plastic, wood and metal

Test materials – magnetism, transparency and hardness

Notes and guidance

In this small step, children test everyday materials and group them based on their transparency, hardness and magnetism. They also link the properties of materials to their uses. Within younger year groups, children have looked at these concepts but they will need to be revisited within this step. There are a variety of methods to test the hardness of materials. Testing for hardness can be comparative. Children should understand that a harder material will scratch a softer material.

Children should be encouraged to group the materials they have tested in different ways based on a range of categories. It is important that children are encouraged to group the materials into more than just two groups, to challenge their understanding of the properties of materials.

Things to look out for

- Children may think that all metals are magnetic.
- Children may be familiar with the terms “transparent” and “opaque”. However, they may find the term “translucent” difficult to understand.
- Children may think that all solids and metals are hard.

Key questions

- What does “magnetic” mean?
- Is _____ a magnetic material?
- Are all metals magnetic?
- What do the terms “translucent”, “transparent” and “opaque” mean?
- How could two materials be tested to see which one is the hardest?
- Which material do you think is the hardest?

National curriculum links

- Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.
- **Working scientifically** – Use and develop keys and other information records to identify, classify and describe living things and materials (non-statutory).

Test materials – magnetism, transparency and hardness

Key vocabulary

- **transparent** – an object or material that allows all light to pass through it



- **translucent** – an object or material that allows some light to pass through it



- **opaque** – an object or material that does not allow any light to pass through it



- **magnetism** – a non-contact force created by a magnet



- **hardness** – a measure of how resistant a solid is to a change of shape or indentation when a force is applied



Practical ideas

- Give children a selection of copper and silver coins.

Try to ensure that some of the 5p and 10p coins were made before 2012 and some were made after 2012. Coins made after 2012 are made from plated steel and so are magnetic.



Test the coins with a magnet to see which are magnetic.

Ask the children to group the coins based on whether or not they are attracted to a magnet.

- Hardness can be tested comparatively.
When given a selection of different materials, children should try to scratch one material with another.
A harder material will scratch a softer material.
The materials can then be put in order of their hardness.

Factual knowledge

- Materials can be transparent, translucent or opaque.
- A harder material will scratch a softer material.
- Most metals are non-magnetic. Only a few metals are magnetic, such as iron and steel.

Test materials – electrical conductivity

Notes and guidance

In this small step, children test some everyday materials and group them based on their electrical conductivity. This step builds on the electricity block studied in Year 4. The materials will be classified as conductors or insulators.

By the end of this step, children identify that conductors allow electricity to pass through them easily and can complete an electrical circuit. They should also be aware that non-conductors (insulators) do not let electricity pass through them.

Children should build circuits to test whether different materials can conduct electricity. They may need to recap how to build a working circuit before completing this step. Children should only use a battery, bulb and wires in their circuit. They should draw the circuit pictorially. Conventional circuit symbols will be introduced in Year 6

Things to look out for

- Children may think that only metals are conductors of electricity.
- Children have built circuits in Year 4. However, they may need some guidance on how to build a working series circuit before testing materials.

Key questions

- What does “electrical conductor” mean?
- What does “electrical insulator” mean?
- What components are needed in a complete circuit?
- Is _____ a conductor of electricity?
- How would you know that _____ is a conductor of electricity?
- Electrical wires are covered with a plastic casing. Why is plastic used?

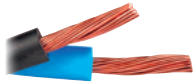
National curriculum links

- Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Test materials – electrical conductivity

Key vocabulary

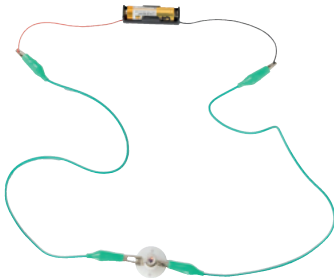
- **electrical conductor** – a material that lets electricity pass through it



- **electrical insulator** – a material that does not let electricity pass through it



- **circuit** – a complete path that allows electrical energy to flow



- **cell** – a single device which produces electricity



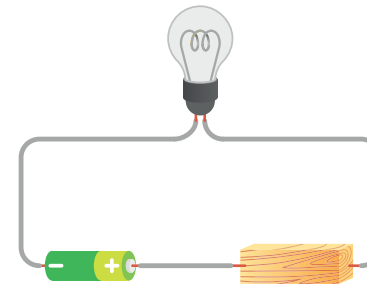
- **bulb** – a part in a circuit that produces light



Practical ideas

- Give children a selection of materials such as plastic, wood, paper and different types of metal.

Ask children to build a series circuit to test whether the different materials can conduct electricity or not. This can be done by leaving a gap in the circuit for the materials to be added in to complete the circuit.



Encourage children to predict whether the material will be an insulator or a conductor of electricity before each test.

Factual knowledge

- An electrical conductor is a material that allows electricity to flow through it.
- An electrical insulator is a material that does not allow electricity to flow through it.
- Metals are good electrical conductors.
- Plastic, wood and paper are electrical insulators.

Plan – insulating heat experiment

Notes and guidance

In this small step, children plan a comparative test to investigate which material is the best thermal insulator. Over the next three steps, children explore which material is the best at keeping hot water warm. Children learn that a thermal insulator is a material that prevents heat passing through it. They should choose three different materials, such as bubble wrap, aluminium foil and felt, to wrap around the beakers filled with hot water. Alongside this, children should have a beaker that is not wrapped in any material. This beaker provides a control that they can use to measure temperature differences against.

Children have learnt how to use a thermometer in Year 4 (States of matter block) to accurately measure the temperature of water over time. However, this skill may need practising prior to the investigation. Within this step, children should create their experiment plan and identify the independent, dependent and controlled variables.

Things to look out for

- Children may think that insulators are only used to keep things warm. They can also keep things cold. Ice melts when the heat in a room is transferred to the ice. An insulator slows down this transfer of heat.

Key questions

- What is a thermal insulator?
- When would you need to keep something hot?
- When would you need to keep something cold?
- What are the independent, dependent and controlled variables in this experiment?
- What equipment will you use and why?
- How will you record your results?

Enquiry question

- Which material is the best insulator of heat?

National curriculum links

- Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.
- **Working scientifically** – Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Plan – insulating heat experiment

Experiment variables

- **independent variable** (what will change) – the material that the beaker is wrapped in



- **dependent variable** (what will be measured) – the temperature of the water over time



- **controlled variable** (what is kept the same) – the temperature of the water in each beaker at the start of the experiment, the number of layers of insulation wrapped around the beakers, the volume of water in the beakers and the shape and size of the beakers



Equipment needed

- four same-sized beakers
- aluminium foil
- cloth
- bubble wrap
- four thermometers
- hot water
- stopwatch or timer



Practical activity

- Put children in small groups.
Give each group the equipment needed for the experiment.
Children should identify what the equipment is and why it is used within the experiment.

Planning sentence stems

- I predict that ...
I think this will happen because ...
- We are changing the ...
- We are measuring the ...
- We are keeping the _____ the same.

Investigate – insulating heat experiment

Notes and guidance

In this small step, children carry out a comparative test to explore which materials are the best insulators of heat. Before they begin the investigation, children should be encouraged to recap their experiment plan and identify the independent, dependent and controlled variables.

Within the spring term, children should set up their own investigations more independently, including the control beaker. They should identify that the control beaker is one without any layers of material insulation. They should be able to identify that having a control beaker allows them to compare the temperature change of water in an uninsulated beaker with the temperature changes of water in beakers with different types of insulating layers.

Things to look out for

- When setting up the experiment, the temperature of the water should not exceed 50°C to align with health and safety regulations.
- Children may think that their results are inaccurate once all four beakers have reached room temperature and the temperature in each beaker is the same.

Key questions

- What is a thermal insulator?
- What is your experiment plan?
- What is your prediction for the experiment?
- Why was one of the beakers not covered in insulation?
- What did you notice about the temperature of all four beakers at the end of the experiment?

Enquiry question

- Which material is the best insulator of heat?

National curriculum links

- Compare and group together everyday materials based on their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.
- **Working scientifically** – Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Investigate – insulating heat experiment

Key vocabulary

- **thermal insulator** – material that does not let heat pass through it quickly/efficiently/easily



- **thermometer** – a piece of equipment used to measure temperature



- **control beaker** – a beaker that is not wrapped in material so it can be used for comparison with other beakers



- **temperature** – the measure of how hot or cold something is

Equipment needed

- four same-sized beakers
- aluminium foil
- felt
- bubble wrap
- four thermometers
- hot water
- stopwatch



Method

1. Get four beakers of the same size.
2. Wrap three beakers in one layer of material – aluminium foil, felt and bubble wrap.
3. Leave one beaker without insulating material to use as a control.
4. Add hot water (no hotter than 50°C) to each beaker.
5. Record the starting temperature of each beaker. Leave the thermometer in each beaker to avoid delays in recording the data at each interval.
6. Record the temperature of each beaker at five-minute intervals.
7. Repeat this process for 30 minutes.
8. Ask children to identify which material is the best insulator of heat.

Evaluate – insulating heat experiment

Notes and guidance

In this small step, children work scientifically to analyse data, make conclusions and evaluate the insulation experiment from Step 4. Children can use the evaluation sentence stems to structure their written analysis and evaluation.

Within this step, children should use their data to explain which material was the best insulator of heat. Children should be encouraged to refer to the control beaker within their evaluation. This will allow them to make a comparison between the insulated beakers and the non-insulated beaker.

Children should be given the opportunity to answer the enquiry question and discuss which material is the best insulator of heat. They should determine that the best insulating materials will slow down the warm air passing through the insulation.

Things to look out for

- Children may think that the experiment is inaccurate as heat has been lost due to the beakers having open tops. Use this as a point within the evaluation step to discuss how to make the experiment more reliable if they were to undertake it again.

Key questions

- What do the results tell you about which material is the best insulating material?
- If you were to repeat this experiment, how could you improve your results?
- How could you make your results more reliable?
- What questions do you have for further investigation?

Enquiry question

- Which material is the best insulator of heat?

National curriculum links

- Compare and group together everyday materials based on their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.
- **Working scientifically** – Using test results to make predictions to set up further comparative and fair tests.

Evaluate – insulating heat experiment

Key vocabulary

- **thermal insulator** – material that does not let heat pass through it quickly/efficiently/easily



- **data** – facts and numerical information collected

Insulating material	Temperature (°C)			
	0 min	5 min	10 min	15 min
aluminium foil	45	41	38	36
felt	45	43	40	37

- **temperature** – a measure of how hot or cold something is



- **conclusion** – what has been found out during an investigation
- **anomalous result** – a result that does not fit in with the pattern of the other results

Practical ideas

- Children could extend the experiment to test whether the material that keeps the water hottest for longest is also the material that keeps ice coldest for longest.

Children could wrap ice cubes in different materials and record the loss in mass after 10 minutes.

The material that leads to the least loss in mass will be the best insulator.

One of the ice cubes should be uncovered for comparison.



Evaluation sentence stems

- I predicted that ...
My prediction was correct/incorrect because ...
- From looking at our results, I can see that ...
This happened because ...
- Our results are/are not reliable because ...
- To make our investigation more accurate, we could ...
- For future investigation, I would like to find out ...

Uses of everyday materials – plastic, wood and metal

Notes and guidance

In this small step, children look at three common materials, plastic, wood and metal, and link the uses of these materials to their properties. In this block, children have completed a variety of tests to explore electrical and thermal conductivity as well as hardness, transparency and magnetism.

When thinking about the uses and suitability of materials for different purposes, children should be encouraged to use evidence from their own testing to explain why a material would be suitable or unsuitable for use.

Children should identify that some materials have the same uses and all the different properties must be considered to make a justified decision on which material is best for the particular use. Sometimes, two or more of the materials can be correct.

Things to look out for

- Children may think that an object can only be made from one material. Show examples of objects that are made from a mixture of multiple materials and discuss their suitability for purpose.

Key questions

- What is an electrical conductor?
- What is an electrical insulator?
- What is a thermal insulator?
- What object is this?

What material is it made from?

What other materials could this object be made from?

- Why is _____ a suitable material for a _____?
- Why would _____ be unsuitable for a _____?

National curriculum links

- Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.
- **Working scientifically** – Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas (non-statutory).

Uses of everyday materials – plastic, wood and metal

Key vocabulary

- **properties** – the qualities and characteristics of a material



- **wood** – a natural material that is generally hard and comes from the stem or branches of trees and shrubs



- **metal** – a material that can typically conduct electricity and heat



- **plastic** – a man-made material that is often strong, lightweight and can be formed into many shapes



- **lifespan** – the length of time that a material or object is useful for before it must be replaced

Practical ideas

- Give children a selection of metals, plastics and wood. Ask them to test the properties of different materials. Example questions are listed below. Children could record results in a table.

- Are they magnetic?
- Are they hard or soft?
- Are they flexible or rigid?
- Are they waterproof?
- Can they be recycled?
- Are they expensive or cheap?
- Can they conduct heat or electricity?



Children should use their own testing and findings from previous steps when defining materials. They should be encouraged to think about when these materials would be suitable or unsuitable for a particular purpose.

Factual knowledge

- Materials have specific uses.
- Metals are good conductors of electricity and heat.
- Plastics are good insulators of electricity.