

Contents

	Cross-curricular links	4
	Introduction	5
1	Sensing materials	7
2	The same but different	17
3	Magnetic materials	29
4	Material pick 'n' mix	41
5	Materials put to the test	53
6	Grouping materials	62
7	Material workout	71
8	Heating materials	81
9	Water world	92
10	All steamed up	100

Cross-curricular links

Chapter	Science SoW	Art SoW	Literacy framework	Numeracy framework	ICT SoW
1	Unit 1C		Y1, Term 1: T12, T14 Y1, Term 2: T22 Y1, Term 1: S4		Unit 1C
2	Unit 1C		Y1, Term 1: T12, T14 Y1, Term 2: T22		Unit 1D/2A
3	Unit 1C		Y1, Term 1: T12, T14 Y1, Term 2: T22 Y1, Term 1: S4		Unit 1F
4	Unit 1C		Y1, Term 1: S4		Unit 1B
5	Unit 1C		Y1, Term 1: T12, T14 Y1, Term 2: T22 Y1, Term 1: S4		Unit 2B
6	Unit 2D	Unit 1B	Y1, Term 1: S4 Y1, Term 1: T12, T14 Y1, Term 2: T22		Unit 2B
7	Unit 2D	Unit 1B	Y1, Term 1: S4 Y1, Term 1: T12, T14 Y1, Term 2: T22	Y1: Measures, shape and space	Unit 1C
8	Unit 2D		Y1, Term 1: T12, T14 Y1, Term 2: T22		Unit 1C
9	Unit 2D		Y1, Term 1: S4 Y1, Term 1: T12, T14 Y1, Term 2: T22		Unit 1E/2E
10	Unit 2D		Y1, Term 1: S4 Y1, Term 1: T12, T14 Y1, Term 2: T22		Unit 2B

Introduction



About this book

Curriculum Focus: Materials is about exploring the materials that make up our world. It enables teachers to lead their classes on an exciting journey of discovery. All the information, worksheets and lesson plans you need are provided, allowing you to focus on guiding the children. Although a wide variety of activities and experiments have been included, there is no requirement for the teacher to have scientific expertise or for the class to have access to scientific equipment.

This book is based on the QCA Schemes of Work. Chapters 1–5 are for Year 1 and cover Unit 1C: 'Sorting and Using Materials'. Chapters 6–10 are for Year 2 and cover unit 2D: 'Grouping and Changing Materials'. The work contained in this book ideally should come after work on Unit 1A: 'Ourselves' since the first chapter 'Sensing materials' depends on some familiarity with the five senses. Apart from that, the children are not presumed to have any other scientific background.

The chapters are designed to develop scientific skills in achievable steps. The skills include ways of recording results, concepts such as fairness and, in later chapters, the children are encouraged to sum up the key ideas in a conclusion. More able pupils can improve and extend their investigations using the guidance provided. Using the activities in *Curriculum Focus: Materials* will help to develop the skills the children will need; these skills are just as important as the concepts and knowledge they acquire. All will be used in their later scientific studies.

In the book you will find everything you need to run successful science lessons, from clear background information and full descriptions to differentiated activity sheets. Importantly, the hands-on work has been tested to ensure that it works effectively. The children will need some objects and sample materials to examine and test but care has been taken to limit these to ones readily available in the school environment or, occasionally, items such as chocolate or a cake mix, that can easily be acquired from a supermarket.

Each chapter of the book contains:

- detailed teachers' notes containing the background you need to explain the concepts you are covering;
- comprehensive lesson plans with descriptions that include how to introduce a lesson, how to resource and run the activities, how to sum up the key ideas, ways of extending the lesson and links with ICT;
- activity sheets based on the same core work, but differentiated to accommodate children attaining at three different levels (Activity sheet 1 for lower-attaining children, Activity sheet 2 for most children and Activity sheet 3 for higher-attaining children);
- a variety of generic sheets where an opportunity has been found to support the learning process.

Understanding materials

Science is about understanding what is around us; there is no better place to start than with the materials that make up our world. Babies and toddlers spend much of their time investigating materials: touching and tasting, splashing and pouring, twisting and bashing, knocking things down and building things up. The world is a treasure trove of materials and they explore it endlessly and with great enthusiasm. Children know a lot about materials as a result of these early 'tests' but most of this learning occurs before they have the language to describe it. As a result, their ability to express themselves often falls well below what they actually know.

Having this prior knowledge of materials has its benefits: children often recognise material types, such as stone, wood, glass and water, with little difficulty. It does, however, have its limitations: children have rarely considered how they know that stone is stone; they 'just know' that it is. The earliest part of this book challenges children to use different senses and descriptive words to describe materials.

This takes the form of games that are great fun, but are important because they home in on not just the language, but also on the understanding of 'how we know'.

Grouping materials follows and makes use of these abilities to recognise and classify materials according to 'what they are like', or their 'properties'. The book moves from observation to simple experiments where materials are tested prior to putting them into groups (for example, magnetic and non-magnetic).

The last chapters in the book look at how humans change materials by heating and cooling and, in particular, how heat is involved in the changes between solids, liquids and gases.

Each chapter has been carefully designed to build understanding, vocabulary and skills. As a result, it is best to progress through the chapters in the order they have been presented.

Science is exciting

Science is exciting, especially when it takes you into the unknown. Excitement and predictability are not usually mutual experiences. Science is exciting partly because of that unpredictability. It can be thought of as an unfolding story, a mystery, a

revelation, and it is the twists in the plot, the unexpected and the unknown that give it its zest. Science only advances when it moves into the unknown.

This book sets activities and experiments for all the class, but encourages these to be used as a platform for the children's own ideas. Children have tremendous imagination and are always keen to explore and to try out 'just to see what happens'. The book gives them a wide range of investigations but, wherever possible, you are encouraged to let them go a little further (for example, try other materials, do extra tests, allow different conditions).

When testing to see which materials were waterproof (Chapter 5 'Materials put to the test') some surprise results turned up (some fluffy materials were remarkably waterproof; some shiny ones were not). The children were intrigued and came up with suggestions for extending the test to include dripping water from a height-making the test conditions more like real rain. They were thinking creatively as well as scientifically. It was exciting, it was discovery, it was the stuff of real science.

You too can use *Curriculum Focus: Materials* as an enjoyable way of learning and as a platform to explore and to fire the imagination of your children.

Sensing materials

CHAPTER 1

TEACHERS' NOTES

What are materials?

Materials are the substances from which things are made, including solids, liquids, gases and combinations of these (such as in a car). The study of materials overlaps with many other fields – for example, living things are made from materials and therefore biologists study the complex materials of which living organisms are made. The study of materials could cover a vast range of substances, but more often concentrates on the materials that humans find useful.

At Key Stage 1 we deal mostly with solid materials, but towards the end of the Key Stage (and this book) there is some work on materials changing between the solid and liquid states.

What does the word 'material' mean?

The scientific meaning of 'material' is 'the matter from which things are made'. Unfortunately, the word 'material' has several other meanings that may cause confusion. Non-scientific meanings of the word 'material' include:

- fabric, clothing, textiles (a much narrower meaning of the word);
- information sources (as in 'reference materials');
- tools/equipment (as in 'photographic materials', 'writing materials').

The distraction of shape

If you hold up a plastic cup to the class and ask what it is, the children will quite correctly reply 'a cup', although it could also be described correctly as 'a piece of plastic'. It is natural for children to identify items by their shape and function – the material they are made from is almost always a secondary consideration. Since this topic is about the material, it would be useful to start with chunks (cubes, pieces, and so on) of the material rather than objects, so that the shape is not too much of a distraction. Children tend not only to see the object first, but when asked about the material they may well use their knowledge about the object and a process of deduction to 'identify' the material. If asked about a saucepan, they will often guess that it is made from metal because they already know

that most saucepans are made from metal. If, however, they are given a square of the same material, they have to examine the material more closely and use clues about the material itself to identify it.

Identifying materials

To identify materials we must use our senses, though not all of them are very useful/practical:

- sight – probably the most important sense, for seeing colour and texture;
- touch – important for telling the surface texture, the flexibility, the density and how well it conducts heat (see the definition of thermal conductivity on Generic sheet 2);
- taste – some materials have a distinctive taste but it would probably be unwise to use this from a health and hygiene viewpoint;
- smell – some materials have a smell (such as leather, plastic, wool) but in humans this sense isn't strong or reliably used;
- hearing – materials don't give off sound of their own accord but some have a distinctive sound when tapped (such as the ringing sound of metal).

Naming basic materials

Some material groups are fairly straightforward.

- Metals – a widely used term covering a large group with features that are fairly easy to recognise, the most obvious being the shiny 'metallic' surface (all clean metals have this). They are also dense, good conductors of heat and electricity, and tend to be tough and flexible. It is not necessary to identify the individual types of metal though some children will happily use specific names such as steel, iron, gold and silver.
- Glass – a well-known group and usually easy to identify. There are different types of glass (heat-resistant Pyrex, toughened glass, fibreglass) but most common types look the same and have similar properties of hardness, transparency and brittleness.
- Plastic – a widely used term for materials that are usually easy enough to recognise. A key issue is that they cover such a wide range of forms,

colours and types that it may be difficult to see why they all come under the same name (see 'Naming complex materials' below). Children may be familiar with some specific names such as polythene, nylon, PVC and polystyrene, but at this level it is sufficient to use the term 'plastic'.

- Sand – a well-known term and easily identified.
- Wood – a common term, and types are relatively easy to identify by their colour, feel and pattern (see 'Naming complex materials' below).
- Paper – a common term and easily identified.
- Rubber – its highly elastic properties are familiar, used to make the soles of shoes and tyres.
- Fabric – woven fibres to make clothing and upholstery; can be made from many materials so not strictly speaking one group but at this level it is probably best to keep it as one.

Some material groups are more problematic.

- Rock or stone – many different colours and textures exist. A common building material in the past. The words may be more familiar to children as objects ('a rock' and 'a stone' for pebbles and boulders) than as a material. There can also be confusion with similar manufactured materials, such as concrete and brick.
- Concrete – grey, uniform and easily confused with rock, stone or brick. Can be mixed and poured into a mould to set, providing pre-cast beams for large constructions such as bridges, or building blocks (about twice the size of a house brick, with a grey, lumpy finish).
- Brick – its shape, size and colour are special features. Made from baked clay. Can be confused with rock, stone and concrete, especially if only a fragment is provided.
- Clay – a natural soft material which can be shaped and then set hard by baking at high temperatures. Commonly used to make crockery and kitchenware, but although easy to recognise there is no ideal term that encompasses the whole group. 'Clay' is perhaps the best term, though the word is more correctly used for the material in its soft, pre-fired form. 'Ceramics' is a more accurate term as it covers fired clay but is not so commonly used and is perhaps a bit technical at this level. Specific types of clay have fairly popular names but are difficult for the

non-expert to differentiate – earthenware, china, stoneware and porcelain. The term 'pottery' further complicates things as the term comes from the word 'pots' and is typically applied to handcrafted ceramics.

Naming complex materials

Our ability to develop a huge range of new materials has made the task of identifying material types more complex. Composites have become increasingly common (materials that are a mix of different materials). It is probably best to avoid providing these as samples in class exercises, except possibly for the more able. Children may ask about them as they are becoming increasingly common. It is usually possible to put these composite materials into one of the main groups according to the main material used in their production. For example:

- Composite wood products (chipboard, blockboard, fibreboard, MDF). These usually look and feel enough like wood to be identified easily. Most are made by chopping or pulping wood and then gluing it in sheets. Often used as sheeting for building. Should be classed as wood.
- Laminated wood products. These are usually composite wood products (see above) coated with plastic such as Formica. Very commonly used for kitchen worksurfaces, doors, tables, shelving, flat-pack furniture. Should be classed as wood or wood/plastic.
- Coated materials. Many materials that children encounter will have coatings, making them less easy to identify. Metals are very commonly painted or given other coatings for the sake of appearance or to protect them from rusting (radiators, white goods in the kitchen, cars, bikes). Wood is often painted or varnished. Packaging may be cardboard but with plastic or metal foil coatings (fruit juice cartons). Glass bottles are sometimes shrink-wrapped with plastic.
- Materials that mimic. Manufacturers often produce less expensive materials that are designed to look like the real thing. Plastic-coated wood often has a grain pattern and colour to mimic solid wood. Bathroom fittings (taps), toys and watches are sometimes made from plastic with a metallic coating and can look very like solid metal.

Sensing materials



Science objectives (Unit 1C)

- To know that every material has many properties, which can be recognised using our senses and described using appropriate vocabulary.
- To record observations of materials.
- To ask questions and to explore materials and objects using appropriate senses, making observations and communicating these.
- To know that there are many materials and that these can be named and described.

Resources

- Sample materials (pieces of materials rather than identifiable objects) – about six per group
- A selection of about ten objects made from different materials
- Generic sheets 1–3 (pages 11–13)
- Activity sheets 1–3 (pages 14–16)
- Cardboard boxes to make window boxes, one per group, with an opening in the top and a hole about 3cm x 3cm cut in one side
- Labels written on card (metal, plastic, wood, paper, glass, clay, rock, fabric, sand)
- Ideally, the objects illustrated on the activity sheets.

Starting points: *whole class*

Use a selection of five to ten objects to introduce the idea of what we mean by ‘materials’. Have some simple examples, such as wooden, plastic and metal spoons, and some slightly more challenging examples, such as a painted metal toy car or a metal spoon with a plastic/wooden handle. Show the objects to the class and discuss what they are and what they are made from, drawing their attention to the words we use to describe them.

The emphasis here is on information from the senses. It would be a good idea to go over the five senses and discuss which are most appropriate here.

Ask questions such as:

- What is the object called?
- What is it made from?
- How can you tell what it is made from?
- What senses are you using?
- What colour is it?

Now move on to identify materials without having clues from the shape of the object. Use material samples if available (squares or shapes that are not specific objects). Samples are preferable since children can handle and examine the materials. However, if a suitable range is not available, use the window box method. This can be used to show the class samples of a material without them seeing the object. Put items inside the box, taking care not to let the children see the object until the material has been identified. Let them put their fingers through the hole in the side to touch the item. They may want to guess what the object is but emphasise that this is not the aim.

Sum up by discussing which senses are most useful for identifying a material and the words that describe what each sense detects – for example, the sense of touch can tell us if it is rough or smooth, warm or cold.

Group activities

Activity sheet 1

This activity is aimed at children who can recognise the simpler material types (wood, plastic, stone, metal, glass) and can use descriptive words from a list to guess basic material types. Ideally, have examples of each object on the sheet for the children to examine.

Activity sheet 2

This activity is aimed at children who can recognise most of the common material types (wood, plastic, stone, metal, glass) and can, with support, correctly record their properties using a good range of vocabulary. Ideally, have examples of each object on the sheet for the children to examine.

Activity sheet 3

This activity is aimed at children who can recognise most of the common material types and a number of less obvious materials and can correctly describe a wide range of these materials' properties using appropriate vocabulary. Ideally, have examples of each object on the sheet for the children to examine.

Plenary session

Mystery material game

At this stage of the whole-class work, the emphasis is on the words we use to describe materials.

Using a box with just an opening in the top, ask a volunteer to be the 'sensor' for the class. Explain that the sensor's job is to use their senses to answer questions from the class about the material, but the sensor must not tell the class directly what the material is. The sensor can look down into the box and is allowed to see, feel and handle the object but should take care not to allow the class to see it. Acceptable questions are 'Is it soft?' and 'Is it clear?' Unacceptable questions include 'What is it like?' and 'What do you use it for?'

Give the rest of the class copies of Generic sheet 3. Invite them to ask sensor-specific questions using descriptive words (see Generic sheet 1, and Generic sheet 2 for more able children). The sensor should try to answer the questions with brief, factual answers, preferably using yes, no or one-word answers. As each question is answered, the descriptive words should be written up (for example, on a whiteboard) thus building up a descriptive profile of the material. When enough descriptive words have been obtained, the children should be able to guess the material's identity and then the name of the material should be added above the list of descriptive words on the display.

Some children may be tempted to guess the material before they have sufficient information to do so reliably. Don't allow guesses until at least three questions have been answered.

Gather a few of the materials used in the game and go over some of the descriptive words. Point out that everything around us is made from materials and ask the children to point out a material in use in the classroom. Then ask for words to describe the material's properties.

Ideas for support

If the children have difficulty recognising the name of the material then this could be written on the bottom of the object so that they can look if they are stuck. Copies of Generic sheet 1 should help them to devise questions and record descriptive words. A display could be made up of a few sample objects and labels added to give the name of the material and terms describing the properties of the material.

Ideas for extension

Challenge these children to do a class survey on what materials are in their pencil cases (or choose another source/area), recording and displaying the number of occurrences of each.

They could take a complex object, such as a metal toy car, draw a diagram of it and label all the materials used to make it.

They could investigate historical, unusual or specially developed materials using an encyclopedia, CD-Rom encyclopedia or the internet. Terms to look up are: gold, silver, lead, tungsten, alloy, Teflon, tungsten carbide, diamond, graphite, fibreglass and carbon fibre.

Linked ICT activities

Provide the children with about ten objects made from different materials. Organise them into five or six groups and give each group a different object, taking care not to let each see what the others have been given. Using a tape recorder ask the children to describe their object using some of the descriptive words they have been introduced to during this chapter. Encourage them to describe the material, explaining how the object feels and so on. When all the recordings have been completed, put the objects onto a table and play them back. Can the class guess which of the objects on the table the children in the different groups are describing?

Sensing materials

Here are some basic words for describing materials.

WORD BANK

hard

soft

rough

smooth

shiny

dull

bendy

stiff

stretchy

not stretchy

strong

weak

thin

thick

coloured

colourless

clear

not clear

cold to the touch

warm to the touch

heavy

light

metallic

non-metallic