Materials

Year 1 – Everyday Materials

National Curriculum Objectives:

- Distinguish between and object and the material from which it is made.
- Identify and name a variety of everyday materials, including wood, metal, plastic, glass, water and rock, Describe the simple physical properties of a variety of everyday materials.
- Compare and group together a variety of everyday materials on the basis of their simple properties.

Pupils should explore, name, discuss and raise and answer questions about everyday materials so that they become familiar with the names of materials and properties such as: hard/soft; stretchy/stiff; shiny/dull; rough/smooth; bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent; opaque/transparent. Pupils should explore and experiment with a wide variety of materials, not only those listed in the programme of study, but including for example: brick, paper, fabrics, elastic, foil.

Pupils might work scientifically by: performing simple tests to explore questions, for example: 'What is the best material for an umbrella? …for lining a dog basket? …for curtains? …for a bookshelf? …for a gymnast's leotard?'

Key Ideas

a) There are different materials
b) Materials have describable properties.
c) Different materials have different properties.

Prior Learning

In Early Years:

- Children should be able to ask questions about the place they live.
- Talk about why things happen and how things work.
- Discuss the things they have observed such as natural and found objects.
- Manipulates materials to achieve a planned effect.

What are materials?

The big idea about materials.

- There are many different materials that have different describable and measureable properties.
- Materials that have similar properties are grouped into metals, rocks, fabrics, wood, plastic and ceramics (including glass). The properties of a material determine whether they are suitable for a purpose.

It is recommended that materials be taught three times through KS1. Give a theme for each topic e.g. buildings, exploration, toys, the seaside. Plan to investigate a couple of classes of materials and properties in each topic so children get a depth of experience each topic and cover all the classes of materials over the key stage. E.g.

Topic	Materials	Problems
Buildings	Rocks, wood, ceramics, metals.	• Which rocks are the least crumbly? • Which materials absorb the most water? • Which type of brick would be the easiest to drag to make a pyramid? • Which material would be the strongest to use as a floor tile?
Toys and nice things	Fabric, plastic, wood, metals	• Which fabric would make the softest blanket? • The baby has spilt her drink, which material would absorb the drink the best? • We want to make a really slippy slide, which liquid would be best to use? Which chocolate will melt the fastest on a warm plate (a model of a warm hand) Which wrapping papers are strong enough to wrap and send a present?
Clothing	Fabrics, plastics	• Which material could be used to make a waterproof hat for the teacher when she is on the playground at playtime? • Which plastic would be flexible enough to make a belt? • Which material could I wrap my ice egg / snowman in to stop it melting, or would it make it melt quicker? • What could I wrap a chicken egg in to keep it warm when it is waiting to hatch? • What could you paint on the runaway gingerbread man that would allow him to swim the river and get away from the fox and not turn to mush?

Vocabulary

Hard, soft, stretchy, stiff, shiny, dull, rough, smooth, bendy/not bendy, waterproof/not waterproof, absorbent, opaque,

In Year 2:

- Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.
- Find out how shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Year 2 – Uses for Everyday Materials

National Curriculum Objectives:

- Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.
- Find out how shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Pupils should identify and discuss the uses of different everyday materials so that they become familiar with how some materials are used for more than one thing (metal can be used for coins, cans, cars and table legs; wood can be used for matches, floors, and telegraph poles) or different materials are used for the same thing (spoons can be made from plastic, wood, metal, but not normally from glass). They should think about the properties of materials that make them suitable or unsuitable for particular purposes and they should be encouraged to think about unusual and creative uses for everyday materials. Pupils might find out about people who have developed useful new materials, for example *John Dunlop, Charles Macintosh or John McAdam*.

Pupils might work scientifically by: comparing the uses of everyday materials in and around the school with materials found in other places (at home, the journey to school, on visits, and in stories, rhymes and songs); observing closely, identifying and classifying the uses of different materials, and recording their observations.

Key Ideas:

a) Materials can be changed by physical force (twisting, bending, squashing and stretching)

Prior Learning

In Year 1:

- Distinguish between and object and the material from which it is made.
- Identify and name a variety of everyday materials, including wood, metal, plastic, glass, water and rock,
- Describe the simple physical properties of a variety of everyday materials.
- Compare and group together a variety of everyday materials on the basis of their simple properties.

Materials, their properties and why we choose materials to do jobs.

Exploring materials and their properties.

These ideas are explored through testing materials to see if they are appropriate for particular jobs.

Topics need to be arranged so that all the main groups of materials are explored and important properties are investigated (strength, flexibility, waterproofness, absorbency, softness, slippiness, stretchiness, brittleness)

It is recommended that materials be taught three times through KS1. Give a theme for each topic e.g. buildings, exploration, toys, the seaside. Plan to investigate a couple of classes of materials and properties in each topic so children get a depth of experience each topic and cover all the classes of materials over the key stage. E.g.

Topic	Materials	Problems
Buildings	Rocks, wood, ceramics, metals.	• Which rocks are the least crumbly? • Which materials absorb the most water? • Which type of brick would be the easiest to drag to make a pyramid? • Which material would be the strongest to use as a floor tile?
Toys and nice things	Fabric, plastic, wood, metals	• Which fabric would make the softest blanket? • The baby has spilt her drink, which material would absorb the drink the best? • We want to make a really slippy slide, which liquid would be best to use? Which chocolate will melt the fastest on a warm plate (a model of a warm hand) Which wrapping papers are strong enough to wrap and send a present?
Clothing	Fabrics, plastics	• Which material could be used to make a waterproof hat for the teacher when she is on the playground at playtime? • Which plastic would be flexible enough to make a belt? • Which material could I wrap my ice egg / snowman in to stop it melting, or would it make it melt quicker? • What could I wrap a chicken egg in to keep it warm when it is waiting to hatch? • What could you paint on the runaway gingerbread man that would allow him to swim the river and get away from the fox and not turn to mush?

Vocabulary

Waterproof, fabric, rubber, cars, macadamisation, rock, paper, cardboard, wood, metal, plastic, glass, brick, twisting, squashing, bending, matches, cans, spoons,

In Year 3:

 Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties Describe in simple terms how fossils are formed when things that have lived are trapped within rock Recognise that soils are made from rocks and organic matter.

Year 3 – Materials and their uses.

National Curriculum Objectives:

 Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties Describe in simple terms how fossils are formed when things that have lived are trapped within rock Recognise that soils are made from rocks and organic matter.

Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.

Pupils might work scientifically by: observing rocks, including those used in buildings and gravestones, and exploring how and why they might have changed over time; using a hand lens or microscope to help them to identify and classify rocks according to whether they have grains or crystals, and whether they have fossils in them. Pupils might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed. Pupils could explore different soils and identify similarities and differences between them and investigate what happens when rocks are rubbed together or what changes occur when they are in water. They can raise and answer questions about the way soils are formed.

Key Ideas:

a) Fossils provide evidence that living things have changed over time.

Prior Learning				**Vocabulary**
In Year 2: • Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. • Find out how shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching. • May have some understanding of a variety of different rocks in the natural world. • Some understanding of what soil is. (how to identify soil etc) • May have some knowledge of what a fossil is.	**Chapter 1:** There are different types of rock. There are different types of soil. • Locate Soil and Rock types in school grounds. *(Rock Scavenger Hunt)* • Soil Detectives *(How are the soils different? What characteristics are the same? Which do you think has best drainage? Which is more likely to lead to flooding? How many soil types have we found? Where might you find more? How might the soil be different in different countries?)* • What rock is best for a kitchen chopping board? *(What might be the issues with various materials and what they have to withstand? Lots of rock samples, foods such as ketchup, 'vinegar')* • Make chocolate rocks: Chocolate can be ground into small particles (weathered), heated, cooled, and compressed — just like rocks. Unlike rocks, chocolate can undergo these processes safely and at reasonable temperatures. • Use your chocolate to create "sedimentary," "metamorphic," and "igneous" chocolate. And at the end of it all, make a tasty treat!	**Chapter 2:** Soils change over time. Different plants grow in different soils. • The Soil Factory (*Why is your recipe the best for effective soil? What would grow best in your soil? Why do you think worms are important to the creation of soil? How can we use composting to make our own soil? Does it currently look like real soil? How long do you think this process will take and why?* • Use rocks in school grounds to build a structure. • *This could be a structure that becomes a permanent fixture within the school grounds and links to a topic* • *Multiple classes could work on one design over the course of the topic and add to it as they discover new information and facts.*	**Chapter 3:** Fossils tell us what has happened before. Fossils provide evidence. Paleontologists use Fossils to find out about the past. • Investigate different fossils. • Make your own fossils (*How are fossils created? Why do fossils help us find out about historical events? If you could fossilise an object what would it be?)* • Link to skeletons topic – how do scientists know what dinosaurs looked like.	Rocks, igneous, metamorphic, sedimentary, anthropic, permeable, impermeable, chemical fossil, body fossil, trace fossil, Mary Anning, cast fossil, mould fossil, replacement fossil, extinct, organic matter, top soil, sub soil, base rock.

In Year 4:

Compare and group materials together, according to whether they are solids, liquids or gases.

Observe that some materials change state when heated or cooled, and measure and research the temperature at which this happens in degrees Celsius. Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

In Year 6:

- Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.

Year 4 – Solids, Liquids and Gases

National Curriculum Objectives:

- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when heated or cooled, and measure and research the temperature at which this happens in degrees Celsius.
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter (solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container). Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled. Note: Teachers should avoid using materials where heating is associated with chemical change, for example, through baking or burning.

Key Ideas:

a) Solids, liquids and gases are described by observable properties.
b) Materials can be divided into solids, liquids and gases.
c) Heating causes solids to melt into liquids and liquids evaporate into gases.
d) Cooling causes gases to condense into liquids and liquids to freeze into solids.
e) The temperature at which given substances change state are always the same.

Prior Learning

In KS1:

- Distinguish between an object and **the material from which it is made.**
- Identify and name a variety of **everyday materials, including wood, plastic, glass, metal, water, and rock.**
- Describe the simple physical **properties of a variety of everyday materials.**
- Compare and group together a variety **of everyday materials on the basis of their simple physical properties.**
- Identify and compare the suitability of **a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.**
- Find out how the shapes of solid **objects made from some materials can be changed by squashing, bending, twisting and stretching.**

Solids, Liquids and Gases

Chapter 1: Properties of solids, liquids and gases.

Materials can be divided into solids liquids and gases.

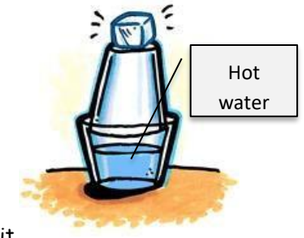
- **Solids** hold their shape unless forced to change.
- **Liquids** flow easily but stay in their container because of gravity. The more viscous a liquid the less runny it is.
- **Gases** move everywhere and are not held in containers by gravity.

- Give children a variety of materials (including powders, gels, foams and things like blu tac) ask them to classify them as solids, liquids or gases.
- How does the amount of water added to flour affect its state?
- We need to make the best water slide possible. How does the amount of detergent added to water affect how slippy it is?
- How does the temperature affect how viscous a liquid is (use cooking oil)?
- Put a series of liquids into order of viscosity (choose ones that are similar so they have to perform an accurate test).
- Spray perfume or water (children don't know which) at one end of the room and they raise their hands when they can smell it. They then draw diagrams of their choice to show what happened to the smell (gas) and explain the pattern of its movement.
- Dancing raisins. Place a handful of raisins in a small bottle of lemonade. Children explore why they behave the way they do.
- Place a peach in a glass of lemonade and watch it spin. Why does it behave that way and can you prove it?

Chapter 2: Changing state.

- Heating causes solids to melt into liquids and liquids to evaporate to gases.
- Cooling causes gases to condense to liquids and liquids to freeze to solids.

- Demonstrate the water cycle by melting ice, heating water to let it evaporate, showing the steam condense on a cold surface and letting it run off and drip like rain back into the original container.
- Children are shown the following equipment and asked to predict what will happen and why, and then



  they do it.
- The council put salt on ice and snow to melt it. How does the material sprinkled on ice and snow affect how quickly it melts?

Chapter 3: Melting, freezing, boiling and condensation temperatures.

Different substance change state at different temperatures but the temperatures at which given substances change state are always the same.

- What is the freezing temperature of water? (Mixing ice and salt produces mixtures that can be as cold as -15°C and make good baths for freezing water in).
- Does the volume of water affect the temperature at which it freezes?
- Chocolate smugglers. Children have been trying to smuggle chocolate into class by putting it in their pockets, but it always ends up as a squidgy, liquid mess. What chocolate would be best to smuggle? ***How does the type of chocolate affect its melting temperature?***
- Give children a range of substances and ask them to put them in order of what they think their melting temperatures may be. Include metals, rocks, and oils. Can they estimate the melting temperatures?

Chapter 4 What happens at the melting temperature?

- The temperature at which a substance melts from a solid to a liquid is the same at which it freezes from a liquid to a solid.
- The temperature at which a substance boils from a liquid to a gas is the same at which it condenses from a gas to a liquid.
- Liquids evaporate slowly, even below their boiling temperatures.

- What is the melting temperature of ice and how does it compare with the freezing temperature of water?
- Is the melting temperature of wax the same as its freezing temperature? Investigate.
- What do we think will happen to an ice cube if it is left out for a few days? What do we think would happen to a lump of wax and why is there a difference?

Vocabulary

Solid, liquid, gas, particles, state, materials, properties, matter, melt, freeze, water, ice, temperature, process, condensation, evaporation, water vapour, energy, precipitation, collection,

In Year 5: 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. Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.

- Use knowledge of solids, liquids, and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.
- Give reasons based on evidence from comparative and fair tests, for the particular uses of everyday materials, including wood, metals and plastic.
- Demonstrate that dissolving, mixing and changes of state are reversible changes.
- Explain that some changes result in the formation of new materials, and this kind of change is usually not reversible, including changes associated with burning and the action of acid on bicarbonate of soda.

Year 4 – Mixtures

National Curriculum Objectives:

- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when heated or cooled, and measure and research the temperature at which this happens in degrees Celsius.
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Pupils might work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream (for example, to make food such as chocolate crispy cakes and ice-cream for a party). They could research the temperature at which materials change state, for example, when iron melts or when oxygen condenses into a liquid. They might observe and record evaporation over a period of time, for example, a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting.

Key Ideas:

a) When two or more substances are mixed and remain present the mixture can be separated.
b) Some changes can be reversed and some can't.
c) Materials change state by heating and cooling.

Prior Learning	Mixtures and Separating them			Vocabulary
In KS1: • Distinguish between an object and the material from which it is made. • Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock. • Describe the simple physical properties of a variety of everyday materials. • Compare and group together a variety of everyday materials on the basis of their simple physical properties. • Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. • Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.	**Chapter 1: What are mixtures?** When more than one substance are present in the same container it is called a mixture Give a range of mixtures and ask children to say what they think is in each. If they can't tell allow them to say that. (Sensible mixtures: flour and currants, sand and stones, sand and salt, hole punch paper bits and sand, water and salt, water and oil)	**Chapter 2: What does dissolving mean?** When a substance is added to a liquid it has dissolved if no bits of the substance can be seen and the liquid is transparent. This mixture is called a solution. Not all substances dissolve in water. *(Always be aware that if too much substance is added it may appear as if it hasn't dissolved but some may have, so add small quantities)* • Which of the following dissolve in water: sugar, bicarbonate of soda, oil, chocolate, coffees, dark vinegar and wax? • How does the amount of water used affect how much sugar will dissolve in it? • Which sweets dissolve in water? • Place skittles in a shallow flat saucer (agar plates work well) so that water comes half way up them. Children predict what will happen. Set and leave without touching (one of the real wonders of the universe!)	**Chapter 3: Deciding how to separate mixtures.** All mixtures can be separated if they have a difference in property. This is because both (or all) of the materials are still present. | Separating technique | Difference in property required | | --- | --- | | Filtration and sieving | A solid that does not dissolve in a liquid. Different sized solid bits | | Magnets | Some materials magnetic others not | | Evaporation | A solid dissolved in water and the solid has a high boiling temperature | | Floating | Some materials float and other sink | • Each of these techniques will need to be taught and then give children the freedom to decide which method would be appropriate to separate other mixtures: ➢ Plastic covered steel wire from strands of string and plastic. ➢ Separate out the bits of wood from stones and sand in soil. ➢ Get pure salt **and** sand from a salty sandy mixture. • Give children some card and a sharp pencil; challenge them to make their own sieve to separate sharp sand from fine sand. • When water evaporates slowly from a solution, large crystals can form. Who can make the largest crystal (sugar works well).	Solid, liquid, gas, particles, state, materials, properties, matter, melt, freeze, water, ice, temperature, process, condensation, evaporation, water vapour, energy, precipitation, collection,

In Year 5: 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. Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.

- Use knowledge of solids, liquids, and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.
- Give reasons based on evidence from comparative and fair tests, for the particular uses of everyday materials, including wood, metals and plastic. Demonstrate that dissolving, mixing and changes of state are reversible changes.
- Explain that some changes result in the formation of new materials, and this kind of change is usually not reversible, including changes associated with burning and the action of acid on bicarbonate of soda

Year 5 Changing Materials

National Curriculum Objectives:

- 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.
- Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.
- Use knowledge of solids, liquids, and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.
- Give reasons based on evidence from comparative and fair tests, for the particular uses of everyday materials, including wood, metals and plastic.
- Demonstrate that dissolving, mixing and changes of state are reversible changes.
- Explain that some changes result in the formation of new materials, and this kind of change is usually not reversible, including changes associated with burning and the action of acid on bicarbonate of soda.

Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, *Spencer Silver*, who invented the glue for sticky notes or *Ruth Benerito*, who invented wrinkle free cotton.

Note: Pupils are not required to make quantitative measurements about conductivity and insulation at this stage. It is sufficient for them to observe that some conductors will produce a brighter bulb in a circuit than others and that some materials will feel hotter than others when a heat source is placed against them. Safety guidelines should be followed when burning materials.

Pupils might work scientifically by: carrying out tests to answer questions, for example, 'Which materials would be the most effective for making a warm jacket, for wrapping ice cream to stop it melting, or for making blackout curtains?' They might compare materials in order to make a switch in a circuit. They could observe and compare the changes that take place, for example, when burning different materials or baking bread or cakes. They might research and discuss how chemical changes have an impact on our lives, for example, cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.

Key Ideas:

a) All matter (including gas) has mass.

b) Sometimes mixed substances react to make a new substance. These changes are usually irreversible.

c) Heating can sometimes cause materials to change permanently. When this happens, a new substance is made. These changes are not reversible.

Prior Learning

In Year 4:

- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when heated or cooled, and measure and research the temperature at which this happens in degrees Celsius.
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Making New Substances.

The big idea

It is possible to change materials into completely different ones. This is very important because new substances might have different properties to materials we currently have. For example plastics can be moulded into intricate shapes, are waterproof, strong and electrical insulators.

When materials are heated or mixed with other materials they sometimes can be made to turn into new materials. The question is how would we know if it was a new material or the same material mixed differently?

Indicators that something new has been made are:

1. The properties of the material are different (colour, state, texture, hardness, smell, temperature)

If it is not possible to get the material back easily it is likely that it is not there any more and something new has been made (irreversible change)

The key question we want children to interrogate is "have we made a new substance?" Wet clay, air-dried clay fired clay.

- Flour and water , dough , bread
- Add sugar to fizzy water; it fizzes up. Has a new substance been made? (No, the gas was dissolved in the water and adding sugar made it become un dissolved)
- Add baking powder to vinegar, it fizzes up. Has a new substance been made? (Yes the gas was not in the vinegar as it wasn't fizzy, so it must have been made)
- Add water to instant snow.
- Use lemon juice as an invisible ink, heating gently makes the ink visible. Is this a new substance?
- When water is added to jelly and it is set, is it a new substance.

Vocabulary

Hardness, Solubility, Transparency, Conductivity, Magnetic, Filter, Evaporation, Dissolving, Mixing

Material, conductor, dissolve, insoluble, suspension, chemical, physical, irreversible, solution, reversable, separate, mixture, insulator, transparent, flexible, permeable, soluble, property, magnetic, hard.

In KS3: the concept of a pure substance

- mixtures, including dissolving
- diffusion in terms of the particle model
- simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography
- the identification of pure substances