Materials

Year 1 – Everyday Materials

National Curriculum Objectives/Knowledge Statements (Substantive):

- Distinguish between an 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
a) properties.

Prior Learning	Breakdown of Lessons		Vocabulary
	Lesson and Big Question	Knowledge **(Progression of substantive knowledge – what?)**. Or Science Enquiry/Skill Based Lesson **(Disciplinary/National Curriculum Working Scientifically Statements – why/how?)**. These inc: Fair Testing (Asking Scientific Questions, Planning and Enquiry, Observing closely, Drawing Conclusions, Making Predictions, Evaluating an Enquiry), Identifying & Classifying, Observation Over Time (Observing closely), Pattern Seeking/Research.	
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.	Lesson 1 - Albert Einstein was very interested in materials and what they were made of, calling things solids, liquids or gases. Can you help him by observing and investigating different materials and name what they are made of and what properties they have. Prove it? BIG QUESTION – Name different materials and prove what they are and the properties they have	Knowledge – know the names of different materials	Hard, soft, stretchy, stiff, shiny, dull, rough, smooth, bendy/not bendy, waterproof/not waterproof, absorbent, opaque,
	Lesson 2 - Peidong Yang is a Chinese-American chemist and material scientist. A materials scientist is someone who studies the properties and structure of different man-made and natural material. Professor Yang needs help describing the properties of different materials. BIG QUESTION – what properties do different materials have?	Knowledge – know the properties of different materials.	
	Lesson 3 - Charles Goodyear was an American self-taught chemist who developed rubber which was waterproof and you can mould it. BIG QUESTION - Charles needs to know if this material is good for wellington boots, he thinks it is. Prove it.	Science Enquiry – Research – find the best material for wellington boots.	
	Lesson 4 - We know that Charles Goodyear was an American self-taught chemist who developed rubber which was waterproof and you can mould it. Charles needs to test lots of materials to find their properties before he can use them. Can you help him? BIG QUESTION - Charles thinks different objects have some different and some of the same properties. Prove it.	Science Enquiry – Research – find the different/same properties of different materials.	
	Lesson 5 - Carl Linnaeus was a Swedish botanist, zoologist, taxonomist know for scientific classification. He sorted plants and animals by their characteristics and wants to know if you can sort manmade and natural materials by their properties. BIG QUESTION – Can materials be sorted by their properties? Prove it.	Science Enquiry – Identifying & Classifying/Pattern Seeking – sorting materials into groups by properties.	
	Lesson 6 – Re-cap/Assessment		

- 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/Knowledge Statements (Substantive):

- 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.

Key Ideas:

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

Prior Learning	Breakdown of Lessons		Vocabulary
	Lesson and Big Question	Knowledge **(Progression of substantive knowledge – what?)**. Or Science Enquiry/Skill Based Lesson **(Disciplinary/National Curriculum Working Scientifically Statements – why/how?).** These inc: Fair Testing (Asking Scientific Questions, Planning and Enquiry, Observing closely, Drawing Conclusions, Making Predictions, Evaluating an Enquiry), Identifying & Classifying, Observation Over Time (Observing closely), Pattern Seeking/Research.	
• 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.	Lesson 1- Can you compare and identify the suitability of everyday materials? (Albert Einstein)	Knowledge- know and compare different materials.	Waterproof, fabric, rubber, rock, paper, cardboard, wood, metal, plastic, glass, brick, twisting, squashing, bending, matches, cans, spoons
	Lesson 2 – Is rubber the best material for a tyre? (John Dunlop)	Science enquiry- testing rubber for friction etc.	
	Lesson 3 – Could another material have been used for a waterproof jacket? (Charles Mackintosh)	Science enquiry- testing different materials for waterproofing.	
	Lesson 4- Can you bend, twist, and squash and stretch all materials? (Antony Gormley)	Science enquiry- testing different materials for bending, twisting, squashing and stretching.	
	Lesson 5- Why is leather a suitable material for school shoes? (Charles Goodyear)	Knowledge- recognising the properties and suitability of leather,	
	Lesson 6- What do we know about recycling of materials? (Peidong Yang)	Knowledge- discussion about what can be recycled and why.	

- 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 – Rocks

National Curriculum Objectives/Knowledge Statements (Substantive):

- 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.

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.

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	Lesson and Big Question	Knowledge **(Progression of substantive knowledge – what?)**. Or Science Enquiry/Skill Based Lesson **(Disciplinary/National Curriculum Working Scientifically Statements – why/how?)**. These inc: Fair Testing (Asking Scientific Questions, Planning and Enquiry, Observing closely, Drawing Conclusions, Making Predictions, Evaluating an Enquiry), Identifying & Classifying, Observation Over Time (Observing closely), Pattern Seeking/Research.	
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)	Lesson 1 - Joanne Johnson is a British geologist from Birmingham. She studied at Durham university and thinks that rocks have a variety of purposes. **BIG QUESTION** – Rocks have a variety of purposes (uses). Do you agree?	Science Enquiry – Identifying & Classifying/Pattern Seeking – sorting rocks into groups by their uses.	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.
	Lesson 2 - Friedrich Mohs was a scientist who studied rocks and liked to identify minerals. He looked at crystal closely and checked its hardness to say what kind of rock it was. He knew that some minerals could scratch others and used this to identify which rocks were harder than others. He believed that all rocks had different properties and could be sorted into groups. **BIG QUESTION** – Can rocks be grouped by their properties?	Science Enquiry – Identifying & Classifying/Pattern Seeking – sorting rocks into groups by their properties.	
	Lesson 3 - Nicolas Steno was one of the founders of modern geology, establishing some of its fundamental principles, including the fact that there are three different types of rock that are made in different ways. **BIG QUESTION** – How are rocks formed?	Knowledge – know the different types of rocks (metamorphic, sedimentary and igneous)	
	Lesson 4 - Mary Anning became an expert at spotting fossils in rocks and her father taught her how to extract the fossils from the rock by gently chipping the rock away from the fossil using a hammer and chisel. Mary Anning is a very famous palaeontologist (someone who studies rocks) and she thinks that people are wrong when they say fossils are very old animal bones. **BIG QUESTION** – Fossils are not just the bones of very old animals. Prove it.	Science Enquiry – Research – research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed	

• May have some knowledge of what a fossil is.	Lesson 5/6 - Justus Von Liebig was a German scientist who studied agriculture and soils. He understood that compounds such as nitrogen were found in soils and were important for plant nutrients. He was the first person to develop a nitrogen based fertiliser. **BIG QUESTION** – Are all soils the same?	Science Enquiry – Identifying & Classifying/Pattern Seeking – 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.	

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 – States of Matter

National Curriculum Objectives/Knowledge Statements (Substantive):

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

Prior Learning	Breakdown of Lessons		Vocabulary
	Lesson and Big Question	Knowledge **(Progression of substantive knowledge – what?)**. Or Science Enquiry/Skill Based Lesson **(Disciplinary/National Curriculum Working Scientifically Statements – why/how?)**. These inc: Fair Testing (Asking Scientific Questions, Planning and Enquiry, Observing closely, Drawing Conclusions, Making Predictions, Evaluating an Enquiry), Identifying & Classifying, Observation Over Time (Observing closely), Pattern Seeking/Research.	
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.	Lesson 1 How are the particles in different materials arranged? Practical Session	Knowledge based. Children to learn about how particles are arranged and their movement. Children then to draw the particle structure and properties in the their Science Books. Children to act out the movement of particles for solids, liquids and gases on the playground. Children will sort objects into those which are solids, liquids and gases.	Solid, liquid, gas, particles, state, materials, properties, matter, melt, freeze, water, ice, temperature, process, condensation, evaporation, water vapour, energy, precipitation, collection.
	Lesson 2 Albert Einstein asks; do gases weigh anything?	Scientific enquiry (asking scientific questions, making predictions, evaluating an enquiry) Use fizzy drink bottle to see how gases react. Use knowledge of particle structure to help explain your answers. Children weigh the fizzy drink, then stir until flat and weigh again. What do they notice?	
	Lesson 3 and 4 Brain Cox Why do materials melt? Why do some melt easier than others?	Scientific knowledge - Chn to get into 6 groups. 2 Groups represent solid particles, 2 liquid and 2 gas. Chn to show what happens when heating and cooling is applied to them. They will show this by using their bodies and show how the particles react to different temperatures. Scientific Enquiry (Making predictions/comparison investigation) - Melting chocolate at different temperatures. Create a graph to show how long it took each to melt.	
	Lesson 5 Roger Bacon- Explain how water can change states and the processes it goes through when it changes state.	Scientific knowledge- What are the different states of water? E.g. ice, water, water vapour – Relate this to what happens to the particles and why. What are these processes called? Vocab- evaporation, condensation, melting, freezing. Find out the melting/freezing points of different liquids.	
	Lesson 6 The Water Cycle Fadj Zaouna – Maina- Explain the water cycle and the importance of each process in it.	Scientific Knowledge- Know what happens in the water cycle and the role played by evaporation and condensing. Scientific Enquiry- (Observation over time) Children make their own mini water worlds and observe the process of the water cycle happening and the water condenses onto the cling film.	

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 Properties and Changes of Materials

National Curriculum Objectives/Knowledge Statements (Substantive):

- 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.

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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	Pierre Curie was a French chemist (a scientist who studies materials). He wants to know can all materials be grouped by their properties; solubility, conductivity, magnetism or transparency?	Scientific Enquiry – Identifying and Classifying Children will be aware of properties of a range of materials and know how to group them accordingly. Record data using scientific diagrams and labels, classification keys, tables.	Hardness, solubility, transparency, conductivity, magnetic, filter, evaporation, dissolving, mixing, material, conductor, dissolve, insoluble,

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.	Joseph Piriestly was an English Chemist (a scientist who studies materials). He made great advances in the understanding of solids liquids and gasses. He wants to know do all materials dissolve in liquid- if so can they be recovered?	Scientific Enquiry – fair testing hildren will understand what a solution is and that some materials sink or float as they don't dissolve – insoluble. Begin to plan different types of scientific enquiry including recognising and controlling variables.	suspension, chemical, physical, irreversible, solution, reversible, separate, mixture, insulator, transparent, flexible, permeable, soluble, property, magnetic, hard.
	Marie Curie thinks that all materials can be separated- Prove it	Scientific Enquiry – fair testing Children understand how to separate a range of materials according to their properties and size. Record data using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.	
	Leo Baekeland was an industrial chemist who helped found modern plastics through his inventions. He wants to know why some everyday materials are used for specific purposes such as glass for windows.	Scientific Enquiry – Identifying and Classifying Children can explain why certain materials are used in certain scenarios according to their properties/characteristics. Begin to identify scientific evidence that has been used to support or disagree with arguments.	
	Joseph Piriestly was an English Chemist (a scientist who studies materials). He made great advances in the understanding of solids liquids and gasses. He asks, 'When changing the state of a material, is the change always reversible?'	Scientific enquiry – Pattern seeking/ research Children can explain that some kinds of change are not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda. Report and present findings, including conclusions, in oral and written forms.	

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.

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