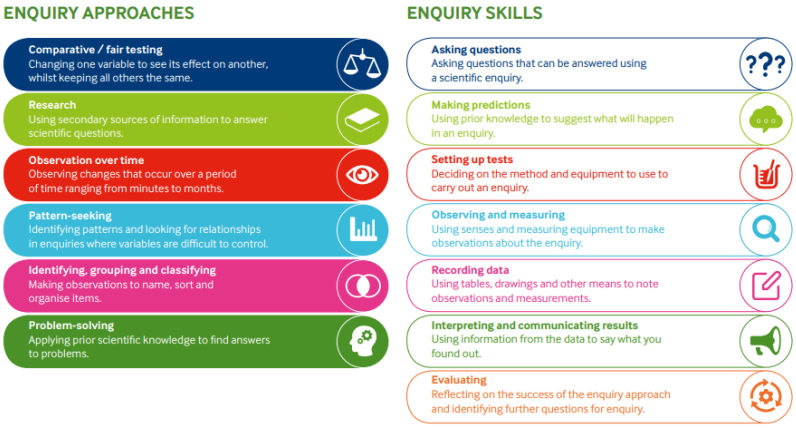
Year Group:	2	Strand: 1	Which is the best material to use?
CHEMISTRY			
Key NC Reference and Objectives	• Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses • Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.		
Enquiry Approaches and Skills in Science			
Key Investigation	- To plan and conduct an investigation into suitability of materials **Enquiry Approach: Comparative/fair testing, research, problem-solving** **Enquiry Skills: Making predictions, setting up tests, recording data, evaluating** **Guidance:** Challenge the children to design a package that keeps an egg safe – this could be in a real life context, such as supermarket packaging, or in a fictional scenario- Humpty Dumpty when he falls from his wall. Give pupils time to discuss the problem and then plan their ideas, justifying choices using some key learning and vocabulary covered in the unit. They can use a golf ball (or similar) as a substitute for an egg until the real test. The finished design should be dropped by an adult, from a desk or other surface about a metre off the ground. Pupils could take this further by comparing which device protects the egg from the greatest height, and could record this using a table. Evaluative comments about what could be done to improve the design further/in the future. An alternative to this would be to do something similar related to bridge designs, or other real-life problem solving scenarios.		
Other suggestions for investigations and activities	- Investigate the suitability of materials for a specific purpose **Enquiry Approach: Comparative/fair testing, problem solving** **Enquiry Skills: Asking questions, making predictions, setting up tests, measuring, recording data** **Guidance:** Balls are made from a variety of materials Investigate Which is the bounciest ball? Look at balls made from a variety of materials and discuss the different uses and properties, including sizes. The children can decide what they want to test eg, 'the bounciest football', 'the bounciest small ball'. What do they think 'bounciest' means? A ball that bounces the highest, or one that bounces for the longest time? The possibilities and variables are numerous, so they need to be made more specific. This is where the children learn to plan. The results will make a good bar graph. **Extension for Greater Depth:** Many properties can be explored through comparative investigations such as the one above. Pupils can test the absorbency of a material, how stretchy it is, buoyancy, etc. Pupils could choose a property or materials to test and then plan their own investigation, with consideration of which variables are being controlled to make it a fair test.		
Key scientists to learn about	**John Dunlop (1840-1921)** was a British inventor. At the time, bicycle tyres were made of solid rubber, which, coupled with rough, potholed roads, proved very uncomfortable.		

<table>
<tr><td></td><td colspan="2">Dunlop began to experiment with his son's tricycle, and in 1887 he came up with a new type of tyre. He created an inflated rubber tyre from thin sheets of rubber glued to the wheel, which he then inflated with a football pump. He called his invention a pneumatic tyre – meaning that it contained air.

He patented the idea in 1888 and founded the Dunlop Pneumatic Tyre Company. He had to fight a legal claim from another inventor, Robert Thomson, who had patented a similar idea 1847 but not developed it further. It is Dunlop who is credited as the inventor of modern rubber tyres still seen on bicycles, cars and trucks.

See also: Charles Macintosh (waterproof fabrics), John Macadam (tarmac)</td></tr>
<tr><td>Previously Taught Vocabulary</td><td colspan="2">Object, Material, Hard, Soft, Rough, Smooth, Bendy, Stretchy, Waterproof, Not waterproof, Absorbent, Not absorbent, Transparent, Opaque</td></tr>
<tr><td>New Key Vocabulary</td><td>Property: what a material is like and how it behaves
Suitability: having properties to suit a particular purpose
Natural: a material that is made directly from matter in our environment, including materials from living things (such as plants or animals) or from the ground (such as rocks and minerals).
Synthetic: a material made by humans, or made by humans mixing natural things together
Flexible: able to be bent and then return to its original shape
Translucent: allows some light to pass through
Magnetic: can be pushed or pulled by a magnet using magnetic force
Strength: the strength of a material or object is how well it can hold weight without breaking
Hardness: the hardness of a material is how easily it can be scratched</td><td>Previously taught but now have more advanced definitions:
Hard (see hardness/strength)</td></tr>
<tr><td>Core Substantive Knowledge</td><td colspan="2">A material is anything made from matter that can be shaped or manipulated in order to make something. A material is therefore anything that physically occupies space and has mass, which can be a solid, a liquid or a gas. At this stage, pupils should use the terms solid, liquid and gas when describing materials, although their understanding of the differences between these should be visual rather than linked to a particle model.

In addition to what pupils learnt about properties of materials in Y1, pupils can now start to group materials in other ways, such as those which are natural/synthetic and whether they are solids, liquids or gases. Pupils need a good understanding of the features and properties of different materials in order to then apply this to learning and exploration of suitability.

Natural materials
Natural materials are taken from our environment. Some natural materials can be used in their original forms, but most will require some processing to change their appearance and properties.

Natural materials include:
● Rocks such as granite, limestone and marble
● Fossil fuels such as coal and oil
● Clay
● Water
● Air
● Wood
● Plant fibres such as cotton and hemp
● Animal products such as wool, leather, tallow and horn
● Plant extracts such as latex</td></tr>
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Manufactured materials
Manufactured materials are ultimately derived from natural materials. However, the difference is that they have been processed or combined in such a way that their chemical composition has been altered. These chemical reactions substantially change the properties of the resultant materials.

In Y2, children might group these materials into the following broad groups:

Metals	extracted from rocks and ores
Glass	made from sand and other minerals
Paper	made from wood pulp
Rubber	made from latex or crude oil
Fabrics	made from plant and animal fibres such as wool and cotton
Plastics	polymers made from crude oil
Ceramics	made by firing clay and minerals

Synthetic materials are heavily processed, often created from chemicals found in crude oil. They include detergents, paints and many types of plastic, such as polythene and polystyrene.

Suitability

The properties of a material must be carefully considered when creating any object that has a specific function, in order to ensure it is suitable for its intended purpose. Children should be able to identify the most important properties of any material used to create a particular object.

For example, the function of an umbrella is to protect people from rain, therefore it must be made from a waterproof material that is also lightweight (so it can be carried), flexible (so it can be folded) and strong (so it can withstand heavy rain and wind). It is important to make a distinction between the object and the material from which it is made.

Some materials have multiple uses. For example, metals can be used in coins, cans, cars and table legs; wood can be used for matches, floors, shelves and telegraph poles. Different materials can be used for the same task. For example, spoons can be made from plastic, wood or metal – but they are not usually made from glass or string.

Weird materials: Ask the children to think of different objects, and then come up with silly materials that would be totally impractical to use to make them. They should explain why the materials are silly, and suggest more sensible materials to use instead. For example, they might come up with the silly idea of making a pillow out of concrete, which would be much too hard. The sensible option would be foam or feathers.

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.

Changing solid objects
Objects can be changed by the effect of forces – they bend, squash, twist and stretch. A force can be simply defined as a push, a pull or a combination of both, like a twist. We can't see the force itself, but we can see its effect on an object.

Common misconceptions:
A common misconception is that materials are all solids – children might classify liquids and gases as non-materials. This misconception can be reinforced if the materials the children investigate include only solids such as wood, glass and plastic. Avoid this by including materials such as gases (air in a balloon) and liquids when discussing materials with the children.

	Children can confuse the terms **strength** and **hardness** when describing materials. Try to encourage the use of the word strength when referring to a material's ability to support or withstand a heavy load without breaking or tearing. Hardness, in scientific terms, refers to a material's ability to withstand being scratched – hard materials cannot easily be scratched. For some of the materials there may be conflicting views on the properties. For example chocolate can have a shiny surface but has been classified as dull. Engine oil can be opaque if it is dark coloured, but has been classified as transparent. Hair is shown as being soft, and lead is often dull when we see it on buildings - but clean lead is shiny. These are important observations and show that often, there is no 'right' or 'wrong' when discussing properties of many materials. There are also many exceptions to the conclusions we come to about the properties of materials. For example, plastic has a low melting point, yet silicone is used in modern baking trays. Plastic is also typically hard, but is used to make nylon tights. Chocolate has a low melting point and paper is not waterproof, but cups made from either can hold water for some time before breaking. This is why discussion around suitability is key when talking about properties of materials; you *can* make a cup out of chocolate, but it wouldn't be suitable for the task. **Interesting Fact:** A spider's web is, weight-for-weight, 10 times as strong as steel, and far more elastic.
Prior Knowledge	1.1 Year 1 Materials – What are things made from? Pupils have conducted simple tests into a material's suitability. Pupils have recorded their findings following an investigation. Pupils have used grouped and compared different objects and materials based on their properties.
Assessment	Thorough assessment of outcomes in books and folders, quizzes and written scientific investigations, also supported by observations and questioning in lessons, assessing the following: Knowledge: - Pupils can choose a suitable material for a particular use. - Pupils know that they can change the shape of solid materials by squashing, bending, twisting and stretching - Pupils can describe properties of everyday materials using some scientific terminology Skills: - Pupils have carried out investigations to select the most suitable material. - Pupils have recorded their findings from investigations - Pupils have used fair tests to compare materials
Useful Planning Resources and Links	That's Chemistry!: A Resource for Primary School Teachers about Materials and their Properties (Edited by Jan Rees) Royal Society of Chemistry primary resources: https://edu.rsc.org/resources/grouping-and-classifying-materials/1791.article