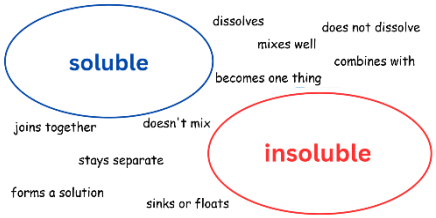
Hartford Primary School

YEAR GROUP	5	SUBJECT	Science	TERM	Autumn – Properties of Materials
National Curriculum Statements	Pupils should be taught to: • 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 metals, wood 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 that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda				
Prior Learning (What should they already know)	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. (Y2 - Uses of everyday materials) • Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching. (Y2 - Uses of everyday materials) • Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials. (Y3 - Forces and magnets) • Compare and group materials together, according to whether they are solids, liquids or gases. (Y4 - States of matter) • Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C). (Y4 - States of matter) • Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. (Y4 – States of matter)				
Misconceptions:	• thermal insulators keep cold in or out • thermal insulators warm things up • solids dissolved in liquids have vanished and so you cannot get them back • lit candles only melt, which is a reversible change.				
RETRIEVAL VOCABULARY	solid, liquid, gas, state change, melting, freezing, melting point, boiling point, evaporation, temperature, water cycle		NEW VOCABULARY	**Thermal/electrical insulator/conductor, change of state, mixture, dissolve, solution, soluble, insoluble, filter,**	

			sieve, reversible/non-reversible change, burning, rusting, new material

	Essential Learning for this lesson	Suggested teaching tasks/approaches	New Knowledge – What I'm leaving the lesson with
LESSON 1 – Separation Challenge	Compare and group together everyday materials on the basis of their properties, including their hardness, size and response to magnets.	Hook lesson and AfL focus: Recap year 3 magnets key learning and year 4 states of matter key learning. Use as AfL opportunity – can the children describe the process of some changes of state such as liquid cooling and solids heating up. Children presented with a challenge – can they separate the mixture (beads, rice, sand, paperclips) using limited equipment (paper, cups, blue-tac, etc.) Allow the children time to explore different methods and observe vocabulary they are using linked to the different properties of materials. After children have had a go, introduce further equipment of a sieve and a magnet. Children to write up in books what method they found best to separate the mixture.	The opportunity to compare and group together everyday materials on the basis of their properties, including their hardness, size and response to magnets. WS: I can evaluate my test. (Non-statutory guidance: 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.)
LESSON 2 – Dissolving	To know that some materials will dissolve in liquid to form a solution.	Starter activity: Place some materials in trays for children to sort and categorise- revising their knowledge of properties of materials. e.g. metal spoon, slinky, rock, transparent materials, opaque materials, waterproof materials, absorbent materials, flexible materials, magnetic materials, good electrical conductors. Observe how confident children are in comparing and grouping them. Show the class two transparent cups/ glasses, one containing a small amount of butter and the other containing a small amount of sugar/salt. Get the children to predict what will happen when we poor warm water into the glasses. Do so and observe together. Teaching point – highlight the difference between dissolving and melting. Provide children with clear cups containing a range of materials (soluble and insoluble) such as icing sugar, salt, flour, milkshake powder, hot chocolate powder, coffee, mini marshmallows, jelly, hundreds and thousands, popping candy, powder	Difference between melting and dissolving: Melting is when something solid turns into a liquid because it gets hot. Like when an ice cube melts into water. Dissolving is when something mixes into a liquid and seems to disappear. Like when you stir sugar into water and it looks like it's gone—but it's still there, just mixed in! Some materials will dissolve in liquid to form a solution, this means these materials are soluble.

		paint (You do not need all of these or as many- just a range). Teaching point – discuss how materials that dissolve are soluble and materials that do not dissolve are insoluble. When dissolved, soluble materials form a solution. When added to water, insoluble materials form a mixture. Children to complete a prediction table in books, "I predict these materials will be soluble (will dissolve in water)". Once prediction table is complete go over health and safety precautions around using warm water (do not give the children water any hotter than 50 degrees C). Children will then work in small groups to pour warm water into the materials and observe solubility. Discuss findings as a whole class and get children to write a summarising statement in their book stating which materials they found to be soluble and which were insoluble – add we know this because… (e.g. the sand didn't dissolve it just sat at the bottom, the sugar did dissolve because we could no longer see it).	Some materials will not dissolve in liquid and will therefore form a mixture, this means these materials are insoluble.
LESSON 3 – Dissolving (exploring different solvents)	To know that some materials will dissolve in liquid to form a solution.	Recap new learning from previous lesson. Children to use interactive activity on the board to sort vocabulary similar in meaning to soluble and insoluble.  Children then create two lists in book with soluble and insoluble as headings, choosing a few of their favourite alternatives to jot down as a reference point in books. Explain to children, last week we explored what happened when we added water to different materials and this week we will see what happens when we add different liquids! Teaching Point - different liquids = different solvents. A solvent is a liquid that can dissolve a substance. Not all substances will dissolve in all liquids. Most but not all liquids are solvents. For example, liquid metals will not dissolve things.	Children need to leave this lesson secure in the vocabulary soluble and insoluble and able to apply this independently. Sand will be insoluble in all solvents tested. Sugar will be soluble in all solvents tested except for oil.

		Give the children clear cups/glasses containing separate, small amounts of water, oil, vinegar and hand sanitizer. The children will then also have access to sand (insoluble) and sugar (soluble). Demonstrate to the whole class how sand and sugar react when mixed with water, do that one together to observe closer. Children to verbally predict what will happen when the sand and sugar are added to the other solvents. They will record findings in a results table. Sand will be insoluble in all solvents tested. Sugar will be soluble in all solvents tested except for oil. A nice way to explain this would be to show the children what happens when you mix water and oil – they stay separate, things that like to dissolve in water (like sugar) do not like to dissolve in oil as they're too different.	
LESSON 4 – Separating through evaporation.	Describe how to recover a substance from a solution. Demonstrate that dissolving and mixing are reversible changes.	Recap key vocab soluble and insoluble. Recap evaporation and condensation and the water cycle from year 4 linking to the problem of needing fresh drinking water if stranded on a desert island. Introduce to children how to set up a solar desalination device using everyday equipment:  Children to work in small groups and set their own device up ready for us to observe over the next week (store carefully out of the way and somewhere sunny so as not to get knocked over). Ensure explanation of how it will work is clear to children throughout this process and encourage them to think about the processes of evaporation and condensation and to use this vocabulary. This lesson also provides a nice opportunity to discuss solar desalination on a larger scale and to link to 'real science' and how there are jobs for scientists in this industry to tackle a huge global issue of limited access to clean water to drink. Encourage children at the same time each day over the next week to observe progress with their solar desalination devices – is fresh water gathering in the cup?	Children should leave this lesson being able to articulate the processes of condensation and evaporation and how scientists can apply this knowledge to tackle real world issues.

LESSON 5 – Separating through filtering.	Describe how to recover a substance from a solution. Demonstrate that dissolving and mixing are reversible changes.	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation and condensation. Take final observations of solar desalination devices. Talk through again with the children how this device worked using evaporation and condensation, children to have a go articulating this. Teaching Point – we have shown that dissolving is reversible, you can recover a substance (water) from a solution (brine). We used one method of separation (using evaporation and condensation) today we will try another method that is quicker (filtration). Provide the children with a sand and water mixture, a funnel, filter paper and an empty beaker. Children to have a go separating the mixture using the filter paper and funnel, they will then draw and label a diagram in their books, explaining underneath what happened and using key vocabulary such as 'filtered' and 'separated'.	Dissolving is reversible. You can recover a substance from a solution by using evaporation/condensation and filtering.
LESSON 6 – Reversible + Irreversible Changes	Demonstrate that dissolving, mixing and changes of state are reversible changes.	Model use of sieving to separate mixtures too and recap other methods we have used such as evaporation and filtering. Starter quiz on board, which method would be best in different scenarios. Explain to the children that dissolving is reversible because you can 'undo it' / revert it back to how it was before (separate). Ask the children to discuss what they think reversible and irreversible means. Can they provide any examples of changes that are either? Model to the children a couple of reversible changes such as melting ice or chocolate. Then model a couple of irreversible changes such as cracking a glow stick or frying an egg. Children to discuss whether they think each change is reversible or irreversible. In books, children to create two lists to enhance vocabulary, one with the heading 'reversible' that will contain similar phrases underneath such as 'temporary change', 'can be reversed' 'can go back to what it was like before', etc. and one with the heading 'irreversible' including phrases such as 'cannot be undone', 'permanent change', etc. Children will then split their page into two columns and draw and label some small sketches of changes, sorting them into reversible and irreversible. Provide some ideas (unsorted) on board for children to sort and draw themselves. Talk through the answers at end.	An irreversible change cannot be undone or reversed. The materials cannot be reverted back to their original state after the change has occurred. A reversible change can be reversed and the materials can be reverted to their original state after the change has occurred. Children will be able to identify some common examples of reversible changes such as melting ice or chocolate, and some common examples of irreversible changes such as baking a cake or toasting bread.

LESSON 7 - Reversible + Irreversible Changes (formation of new materials)	Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.	Ask children to look back over their work from last lesson, can they spot anything that the irreversible changes have in common? (Bread toasting, wood burning, cookie baking, potatoes boiling, etc.) Model to children creating an irreversible change such as frying an egg or toasting bread. The egg turns from runny and clear to solid and white/yellow — that's a new material being formed. You can't turn the cooked egg back into a raw egg, no matter what you do. The bread's sugars and proteins change into new chemicals that weren't there before. Once it's toasted, you can't turn it back into soft, white bread — the change is permanent. Explain that they all involve a chemical change and that is why they are irreversible. See next column for full explanation. Children to work in small groups to mix bicarbonate of soda with vinegar to create an irreversible change. Children to draw and label a diagram showing what they did and answer the question 'Why is this change irreversible?'	A chemical change happens when two or more substances mix and make something new. This new material is different from what you started with, and you can't easily change it back. (Think of it like baking a cake: You mix flour, eggs, and sugar. You bake it, and it turns into a cake. You can't turn the cake back into flour and eggs — that's a chemical change!) When vinegar (an acid) mixes with bicarbonate of soda (a base), they react and make a new gas called carbon dioxide. That's what causes the fizzing! This is a chemical change and it can't be undone — we can't get the vinegar and bicarbonate back. Why Is It Irreversible? Because a new material is made, and the old ones are used up or changed forever. You can't just "unmix" them or cool them down to get the original stuff back. Examples: Burning paper → turns into ash and smoke (new materials) Vinegar + bicarbonate of soda → makes bubbles of gas (carbon dioxide)

			Why Melting Chocolate or Ice Is Not a Chemical Change These are physical changes, not chemical ones. Melting ice just turns it into water. If you freeze it again, it becomes ice again. Melting chocolate makes it runny, but it's still chocolate. You can cool it and it goes solid again. No new material is made, so it's reversible.
LESSON 8 – Thermal Conductivity	Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation and reversible and irreversible changes. Children to discuss and respond to concept cartoon on insulation.  Introduce children to the concept of thermal insulation (see next column), get the children to physically act out the movement of heat with and without the barrier of insulation. Introduce the children to the investigative question: 'what is the best material to keep a hot drink hot and a cold drink cold?' Recap fair tests (only changing one variable). Plan together with the children an experiment to test this question (could be to insulate a cup with different materials and measure the temperature drop of water within them over a set time). Aim to get the investigation set up to reduce time spent on this next lesson.	Insulators keep heat in or out because they are really good at slowing down the movement of heat. Heat naturally wants to move from a warmer place to a cooler place, and insulators act like roadblocks for the heat, making it harder for it to escape or enter. Insulators act like protective barriers that slow down the movement of heat, helping to keep your home warm in winter and cool in summer.

LESSON 9 – Thermal Conductivity	Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation and reversible and irreversible changes. Introduce concept of thermal conductivity (see next column). Go over definitions of thermal insulation once more, again getting the children to physically act out the movement of heat. Make clear links that the insulator is the material we will test in our investigation and also to thermal conductivity, a better insulator will slow the movement of heat quicker (use more children to model the insulation barrier) – this will have low thermal conductivity - and a worse insulator will allow the heat to move quickly through (this time get children to actively move out of the way to allow the heat through) – this will have high thermal conductivity. Children to draw results table and set up the experiment that was planned last week. Work in small groups to carry out experiment and ensure measurements are recorded as they work.	Thermal conductivity is how easily heat can move through a material. A thermal conductor is a material that lets heat move through it quickly, like metal. A thermal insulator is a material that keeps heat from moving easily, like wood or plastic.
LESSON 10 - Conductivity	Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation and reversible and irreversible changes. Go over definitions of thermal insulation once more, again getting the children to physically act out the movement of heat. Make clear links that the insulator is the material we tested in our investigation and also to thermal conductivity, a better insulator will slow the movement of heat quicker (use more children to model the insulation barrier) – this will have low thermal conductivity - and a worse insulator will allow the heat to move quickly through (this time get children to actively move out of the way to allow the heat through) – this will have high thermal conductivity. Look at results tables together – which material had the lowest thermal conductivity (was the worst insulator) and why? Which material had the highest thermal conductivity (was the best insulator and why? Which material would be best then at keeping a hot drink hot and a cold drink cold? Children to write conclusions to the drinks company using the key vocab “high/low thermal conductivity/ thermal conductor/ thermal insulator”.	Electrical conductivity is how easily electricity can flow through a material. Which materials (out of ones tested) are good electrical conductors and which ones are not.

		Look back at concept cartoon from lesson 8 together – would the children like to now change their responses? Explain how conductivity can also be electrical and not just thermal. (If time, it would be nice to act out the movement of electricity instead of heat to further embed the idea). Present the children with pictures of different materials (including metals, wood and plastic. Ask the children to think about how we tested thermal conductivity, how could we test electrical conductivity? Explain/agree that next lesson you will test this with a simple circuit and different materials (test if a bulb lights up or not).	
LESSON 11 Electrical Conductivity	Compare and group together everyday materials on the basis of their properties, including their conductivity (electrical and thermal).	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation and reversible and irreversible changes. Go over definitions of conductivity once more, again getting the children to physically act out the movement of heat and/or electricity. Make clear that a better insulator will slow the movement of heat and/or electricity quicker (use more children to model the insulation barrier) – this will have low thermal/electrical conductivity - and a worse insulator will allow the heat/electricity to move quickly through (this time get children to actively move out of the way to allow the heat/electricity through) – this will have high thermal/electrical conductivity. Children to draw results table to test different materials connected to a simple circuit (including metals, wood and plastic) to see if a bulb lights up or not. Children to work in small groups to carry out the experiment.	
LESSON 12 – Grouping and Comparing	Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation, reversible and irreversible changes and conductivity. Children to match different materials (such as copper, sugar, plastic, salt, sand, iron, glass, wood) to different properties (e.g. soluble, magnetic, conductor, transparent, hard) in groups to develop articulation and oracy. Play a game with children describing different mystery mixtures to see if they can work out what the materials might be and how best to separate the mixtures, e.g.	Practical application focus of all new knowledge covered this unit: which method of separation would work best in different real life scenarios and why. Why the different properties of everyday materials makes certain objectives fit for use.

	thermal), and response to magnets. Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.	salt and water described as "Beachy Blend - This mixture looks like tiny white crystals mixed with rough, grainy particles. One part disappears when stirred into water, but the other part sinks to the bottom and stays there." Or "Salty Solution - This clear liquid looks like plain water, but it tastes very salty. There are no bits floating in it, and nothing sinks to the bottom. Hints: It's a solution, not a mixture of solids." Etc. Children create a poster on everyday materials and their uses – explain why their properties (provide a wordbank) make them suitable for their use. Play a game with children giving them a list of 6 changes (e.g. melting chocolate, burning wood, dissolving sugar, mixing vinegar and bicarbonate of soda, freezing water, rusting iron). For each, decide: Is it reversible or irreversible? What evidence supports your answer?	
LESSON 13 – How scientists create new materials	Non-statutory guidance: pupils 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.) and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.	Recap key concepts from previous learning including, soluble, insoluble, dissolving, melting, and forming a solution, forming a mixture, evaporation, condensation, reversible and irreversible changes and conductivity. Plymouth Science – Year 5 Properties of Materials, Lesson 6.	Children will be able to name a real life scientist who invented a new material and will be able to discuss how they achieved this and creative uses of the material.

Helpful resources to reference	