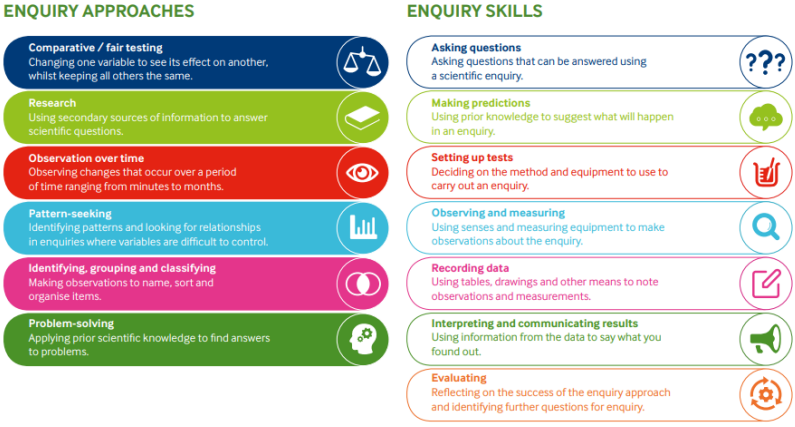


Year Group:	4	Strand: 1	Is water always wet?
CHEMISTRY			
Key NC Reference and Objectives	<ul style="list-style-type: none"> compare and group materials together, according to whether they are solids, liquids or gases observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. 		
Enquiry Approaches and Skills in Science			
Key Investigation	<ul style="list-style-type: none"> Investigating evaporation Enquiry Approach: Observation over time Enquiry Skills: Making predictions, setting up tests, observing and measuring, interpreting and communicating results Guidance: Investigate how the water level in a petri dish changes over time. A comparative test can be set up by placing dishes in different parts of the room, or with different amounts of water. One dish could have a lid on and observations can be made on how this affects the rate of evaporation. 		
Other suggestions for investigations and activities	<ul style="list-style-type: none"> Investigate how the size of an ice lolly affects the speed it melts Enquiry Approach: Pattern seeking testing, problem solving Enquiry Skills: Asking questions, making predictions, setting up tests, interpreting and communicating results, evaluating Guidance: Set up an investigation to explore how quickly ice lollies/ice cubes of different sizes melt in the same location. This could be further explored through investigating ice lollies/ice cubes of the same size, which are different shapes. Alternatively, the question can be posed in a different way, where pupils need to find out whether it is better to cool a drink with a few large ice cubes, or many small ones. The type of drink and the starting temperature of the drink are other variables which can be changed. Investigating freezing with ice cream Enquiry Approach: Observing over time Enquiry Skills: Observing, setting up tests, gathering and recording data to help in answering questions, interpreting and communicating results Guidance: On its own, placing a bag of ice around an ice cream mixture would not be enough to freeze it. This is because the ice cubes would melt before the milk reached its freezing point. Adding salt to ice, however, lowers the temperature at which it freezes. So when the ice and salt are mixed, the water draws heat from its surroundings to dissolve the salt, resulting in a drop in temperature. This drop in temperature means the milk can be cooled more quickly, and the temperature drops low enough for the ice cream mixture to freeze. This can be related to salt spreading on roads before it is due to snow/be icy. 		

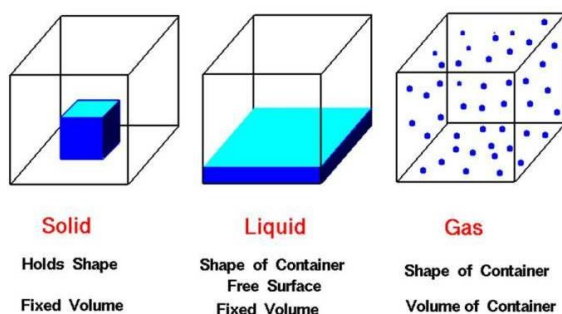
	<p>Variable that can be changed: amount of ice/salt, time it is agitated</p> <p>Other ways to demonstrate substantive ideas:</p> <ul style="list-style-type: none"> ● Oobleck is a substance which doesn't follow the typical rules of how a liquid should behave. You can make oobleck by mixing 500 g cornflour with approximately 250 ml water. ● Magic Snow - Cut open the absorbable area of a disposable nappy to reveal the white powder inside. Shake this powder onto a sheet of newspaper and then pour it carefully into a polystyrene cup. This powder is sodium polyacrylate and it can absorb many times its own weight in water. Gradually add water to the cup of sodium polyacrylate and watch the powder expand. See how much water it can absorb. After doing this, add 2 or 3 teaspoons of table salt, stir well, and then observe what happens. The salt interferes with the powder's ability to hold onto the water, and so the gel turns back to a liquid. ● Water cycle in a jar- Take a large glass jar and add hot water, so it's a third full. Place a small plate over the top of the jar and put several ice cubes on top of the plate. You should notice that some of the water evaporates and rises as water vapour. It will then hit the cold plate, condense into a liquid again, and fall back into the jar. Children can add sticky labels to the bag to show what is going on. 	
Key scientists to learn about	N/A	
Previously Taught Vocabulary	property, suitability, natural, synthetic, flexible, translucent, magnetic, strength, hardness, object, material, hard, soft, rough, smooth, bendy, stretchy, waterproof, not waterproof, absorbent, not absorbent, transparent, opaque	
New Key Vocabulary	<p>Matter: any solid, liquid or gas that exists in the universe</p> <p>Mass: A mass of a solid substance, a liquid, or a gas is an amount of it</p> <p>Particle: an extremely small unit of matter</p> <p>Solid: A material made of tightly bound vibrating atoms or molecules that is rigid and has a definite volume and shape.</p> <p>Liquid: A material made of vibrating atoms or molecules with a definite volume but no fixed shape. Liquids are able to flow and take the shape of their container, but they cannot be compressed.</p> <p>Gas: A fluid substance that is neither solid nor liquid. The particles are widely separated and are in constant random motion. Particles in a gas have more energy than in a liquid or solid, and move about to fill the container they are in.</p> <p>Water cycle: the process of water being recycled over and over again</p> <p>Melting: the process of solid cooling and changing into liquid</p> <p>Freezing: the process of liquid cooling and changing into solid</p> <p>Evaporation: the process of liquid heating and changing into gas</p> <p>Condensation: the process of gas cooling and changing into liquid</p> <p>Precipitation: liquid or solid particles that fall from the clouds as rain, sleet or snow</p> <p>Temperature: how hot or cold something is</p>	Previously taught but now have more advanced definitions:
Core Substantive Knowledge	<p>States of Matter</p> <p>Everything is made of matter- something that has a mass and occupies a volume. Matter is made of atoms, which are arranged in different ways to make different states of matter: solids, liquids,</p>	

gases and plasma. Pupils should only be introduced to solids, liquids and gases at primary school level.

The fourth state of matter, plasma, is the most abundant state of matter in the universe. It was identified by British physicist, Sir William Crookes in 1897. Natural forms of plasma include lightning and the spectacular light displays of the Northern and Southern Lights. There are also many man-made plasmas, including fluorescent light bulbs, neon signs and some television and computer screens.

At primary level, pupils should be taught the particle model to explain how matter is comprised. Careful references to atoms and molecules can be made if appropriate and if the teacher feels confident enough, but particle models should be the main way of supporting pupils to understand and classify states of matter at this point.

The arrangement of particles gives the different states of matter their different properties.



Nearly all substances can exist as a solid, liquid or a gas and the state they are in depends on the temperature.

Ice, water and steam are all made of the same water particles; they are just physically arranged differently. Solid iron can be turned into a liquid in a furnace. If oxygen is cooled enough, it can be turned from a gas to a liquid.

Changing state

Children often only associate terms such as freezing, melting and evaporating to how water changes state. It is important throughout teaching this, to emphasise that changes to the state of matter can happen to nearly all substances e.g. all liquids can freeze to become solid (molten chocolate freezes at 35 degrees celcius, molten iron freezes at 1535 degrees celcius).

“When heat energy is supplied to a solid, the particles vibrate more violently. Eventually, if supplied with enough energy, the particles can separate from each other and move freely, becoming a liquid. This change is called melting. Because melting occurs at a fixed temperature, a melting substance will remain at that temperature until it has entirely changed to liquid. So, the temperature of melting ice will remain at 0°C, until all the ice has become water.



Heating a liquid makes its particles move more quickly. With enough energy, some particles near the surface escape to become a gas. This is called evaporation.

If the temperature rises high enough, particles start to escape from throughout the liquid (and not just at the surface), forming bubbles. This is called boiling. At boiling point, the temperature of a substance remains the same, however strongly it's heated, until all the liquid has become a gas. This takes place at a specific temperature for each pure liquid. In pure water, the boiling point is 100oC.

Cooling a gas down to below its boiling point will cause the particles to move more slowly. The gas changes back to a liquid; a change called condensing. If a liquid is cooled enough, its particles come together to form a solid. We call this freezing.”

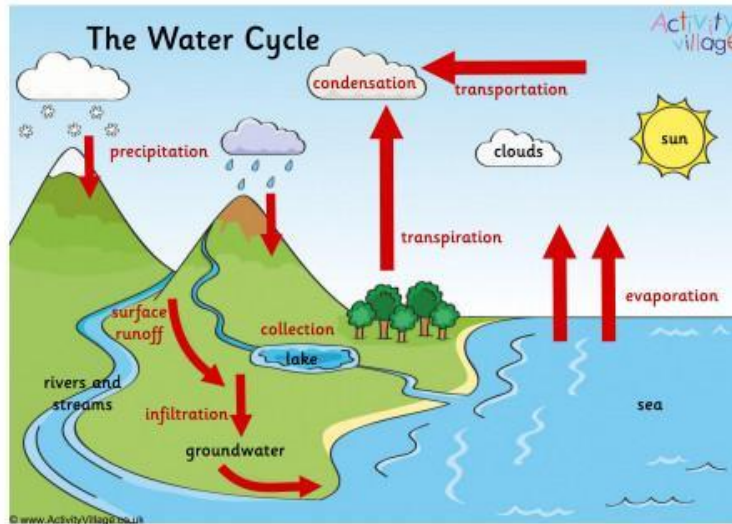
(This explanation has been taken directly from ReachOut CPD – Upper Primary – States of Matter)

Children need to understand that when a puddle evaporates, it is not because the water has reached boiling temperature, but because some of the water particles on the surface of the puddle have gained enough energy to break away. This is a much slower process than boiling.

This knowledge of changing state needs to be clear for pupils in order to understand the different parts of the water cycle. The teaching of the water cycle also helps to clarify that the water from wet washing or a puddle does not 'disappear' once it is no longer visible as a liquid.

Transpiration: water on the Earth's surface moves to the air in a process called transpiration, where water turns into water vapour (gas) on the surface of leaves on plants

The Water Cycle



The water cycle shows the continuous transportation and recycling of water. It can move in different forms, including vapour, rain, snow or hail.

“When water within the oceans, lakes and seas is warmed by the Sun's energy, it turns into a vapour and rises into the atmosphere. This process is called evaporation. Water within plants is also lost to the

atmosphere in a process called transpiration. As this vapour rises, the air cools and the water vapour condenses into tiny water droplets, forming clouds.

Many children think that clouds are made of gas, but this is not the case. They are made from tiny water droplets suspended in the air. Because the droplets are so small they do not weigh very much, and so can be held up by air currents.

The water droplets in clouds eventually become so large that they fall as precipitation. The water then moves through or over the land before reaching rivers, seas and oceans and starting the cycle again. Sometimes water can spend thousands of years stored underground or locked up as ice before eventually getting back to the sea.” (*Reach Out CPD, Upper Primary - Changes of State*)

Common misconceptions:

Some substances are more challenging for pupils to identify as solids, liquids and gases. Exposure to them and discussion will clarify this for pupils. Balloons, cotton wool and sponges are all solids, even though they contain pockets of air. Powders, such as flour and sand, also present a challenge for children, as they can be poured, spilled and take the shape of their container like a liquid. Looking at individual grains under a microscope can help with their understanding of these as solids.

When discussing or demonstrating changes of state, teacher should avoid using materials where heating is associated with chemical change, for example, through baking or burning.

Prior Knowledge

2.1 Year 2 Materials – What is the best material to use? Children have chosen materials for a specific purpose. Pupils have used some scientific terminology to describe materials and their properties. Children have carried out fair tests into the properties and suitability of materials, and recorded their findings.

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:

	<ul style="list-style-type: none"> - Pupils can describe whether materials are solids, liquids or gases. - Pupils know that states of matter are made up of particles - Pupils understand that the state of matter affects the properties of a material - Pupils know that materials can change state through freezing, melting and evaporation. - Pupils know that water changes its state multiple times during the water cycle, and can explain this <p>Skills:</p> <ul style="list-style-type: none"> - Pupils have carried out investigations or observations to investigate the properties of different states of matter - Pupils have drawn conclusions from their results from investigations - Pupils have observed materials changing state through heating or cooling - Pupils have conducted investigations into the temperature that some materials change state
<p>Useful Planning Resources and Links</p>	<p>Reach Out CPD: www.reachoutcpd.com BBC Bitesize: https://www.bbc.co.uk/bitesize/topics/zkkg87h/articles/zsgwwxs BP Water cycle online experiment: https://bpes.bp.com/the-water-cycle-online-experiment STEM resources on states of matter, including a lot of practical ideas and video clips: https://www.stem.org.uk/resources/community/collection/12345/year-4-states-matter</p>