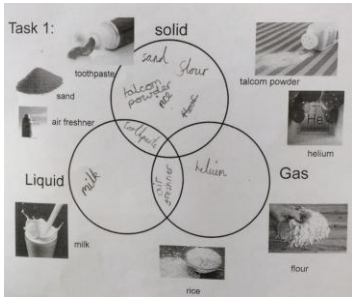




Hartford Primary School

YEAR GROUP	4	SUBJECT	Science	TERM	Autumn 2 and Spring 1 – State of Matter
National Curriculum Statements	• 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.				
Prior Learning (What should they already know)	• Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees. (Y1 - Plants) • Identify and describe the basic structure of a variety of common flowering plants, including trees. (Y1 - Plants) • Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals. (Y1 - Animals including humans) • Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). (Y1 – Animals, including humans) • Identify and name a variety of plants and animals in their habitats, including microhabitats. (Y2 - Living things and their habitats)				
Misconceptions	• ‘solid’ is another word for hard or opaque • solids are hard and cannot break or change shape easily and are often in one piece • substances made of very small particles like sugar or sand cannot be solids • particles in liquids are further apart than in solids and they take up more space • when air is pumped into balloons, they become lighter • water in different forms – steam, water, ice – are all different substances • all liquids boil at the same temperature as water (100 degrees) • melting, as a change of state, is the same as dissolving • steam is visible water vapour (only the condensing water droplets can be seen) • clouds are made of water vapour or steam • the substance on windows etc. is condensation rather than water • the changing states of water (illustrated by the water cycle) are irreversible • evaporating or boiling water makes it vanish • evaporation is when the Sun sucks up the water, or when water is absorbed into a surface/material.				

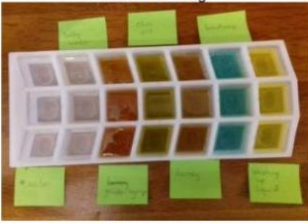
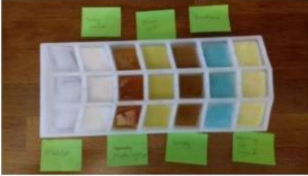
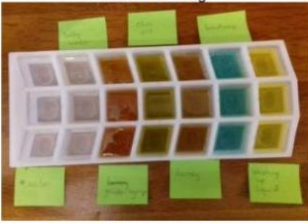
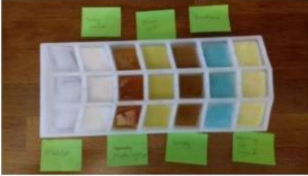
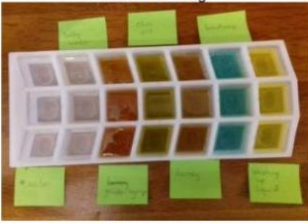
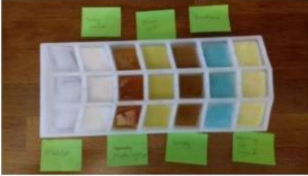
RETRIEVAL VOCABULARY	Y2: object, material, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card/cardboard, rubber, wool, clay, hard, soft, stretchy, stiff, bendy, floppy, waterproof, absorbent, breaks/tears, rough, smooth, shiny, dull, opaque, transparent and translucent, reflective, non-reflective, flexible, rigid Shape, push, pull, twist, squash, stretch	NEW VOCABULARY	solid, liquid, gas, state change, melting, freezing, melting point, boiling point, evaporation, temperature, water cycle
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	Essential Learning for this lesson	Suggested teaching tasks/approaches	New Knowledge – What I’m leaving the lesson with
LESSON 1	I can compare and group materials together, according to whether they are solids, liquids or gases (using explanations such as: solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container).	Identify properties of liquids, gases and solids. Children explore ‘what is a solid, liquid or gas?’ – by putting different things in containers, squeezing/compressing objects such as sponge, playdough, foam ball, wooden block, water, coloured squash, washing up liquid, honey, inflated balloon, sealed plastic bottle, bubble wrap, air in syringe to show compression etc. Link this activity to ‘PLAN examples of work Venn diagram’ activity:  Begin to understand why solids and liquids behave differently by looking at a simple explanation of how particles are arranged in each. Act out particles game, teacher to shout solid, liquid or gas and children spread themselves out as the particles. Extend by shouting out or holding up objects for children to decide which is which.	• All materials are made of particles • Solids keep their shape, liquids flow and take the shape of their container, gases spread out to fill the space available • Solids, liquids, and gases can be identified by observing their properties • Materials like sand, rice, or jelly may confuse children – explain how they behave overall (sand is a collection of solid grains).

New LESSON 2 Understanding gases	I can compare and group materials together, according to whether they are solids, liquids or gases (using explanations such as: solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container).	Ask the children what they recall about solids, liquids and gases. Can the children remember key properties of each state? If not recap together using the Video: https://www.bbc.co.uk/bitesize/clips/zpbvr82 Gases surround us, but how many can children name? Which ones make up the air around us? Which gases are important for human life or plant life? Show children list of different gases and discuss. How many of these gases have they heard of? Pass an air pump around the classroom and ask the children push the plunger so they can feel the air against their skin. Remind children that all materials are made up of particles - solids, liquids and gases! Even though many gases are not visible they are there and they are matter! Look at some empty containers with lids on, e.g. plastic bottles. Is the plastic bottle empty? Demonstrate how smell travels through air – smelly oils on tissue in one corner of the classroom or spraying perfume/air freshener, etc. Remind the children that on the Earth’s surface air fills every available space, even those tiny spaces between and within solid objects. But what evidence is there of this? Provide children with a variety of solids in containers (soil, stones, marbles). With a magnifying glass in hand, ask children to investigate what happens as they slowly pour water over them. Bubbles of air/gas escape as water fills the spaces. Where do the bubbles come from? (From the gaps between the solids.) In a bowl of water, children submerge a sponge and squeeze it. Can they explain what is happening? Where are the bubbles coming from? (From the spaces and gaps within the sponge.) Ask children to record what they have observed through annotated drawings in their book. Encourage the children to look closely using the magnifying glasses, make their sketches as detailed as they can and describe what they have seen using scientific terms. Lower ability will benefit from a word bank. Explorify: Odd One Out Gas - https://explorify.uk/en/activities/odd-one-out/gas	There are three states of matter: solid, liquid, and gas. Gases spread out to fill the space they are in (e.g. air fills a room). Gases are invisible but they are real — they have mass and take up space (e.g. air in a balloon).
New LESSON 3 – setting up tests (gas)	I can compare and group materials	Recap: Use drama to model the three states: children (particles, i.e. atoms/molecules) arranged in tidy rows holding hands, packed together (and vibrating, i.e. shaking, slightly) = solid; rows of children sliding over each other	There are three states of matter: solid, liquid, and gas.

	together, according to whether they are solids, liquids or gases (using explanations such as: solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container).	(moving back & forth in their lines), rows beginning to break as hands let go = liquid, children separate and move away from each other to fill whole space = gas. What can we find out about gases? - children can split into groups and each complete a simple test and share with the other children in class what they found out. Focus is on the children setting up their own tests – record in books however works best. This could be the simple test question and then space for the children to draw and annotate a diagram showing what they did/found. Don't spend too much time on this – they could do one per group and photocopy. Simple test - Does gas have weight? Ask the children to devise a test to find out whether gas has weight. They might choose simply to measure a balloon before inflating and then compare it to an inflated balloon. They could tie a deflated balloon on one end of a stick and an inflated balloon on the other. By holding the stick horizontally by a piece of string tied to the middle they can see which end is heaviest. Simple test - What happens to gas when it is heated? Give each group a balloon, a small plastic bottle and a bowl of warm water. Ask them to find out what happens to gas when it is heated. They should place the balloon over the neck of the bottle and then place the bottle into the warm water. They could investigate this further by changing the size of the bottle, or changing the temperature of the water. Simple test - Can gas be made from a solid and a liquid? Provide children with a small plastic bottle, water, an effervescent tablet and a balloon. The children should place the water and tablet in the bottle. The balloon can be fitted over the neck of the bottle in order to capture the gas (carbon dioxide) created. For each of these tests, the children can draw what they did and draw what happened.	Gases spread out to fill the space they are in (e.g. air fills a room). Gases are invisible but they are real – they have mass and take up space (e.g. air in a balloon).
LESSON 4	I can observe that some materials change state when they are heated.	Show the children an ice cube – discuss what state of matter it is and what will happen if it is left on the table or in hands. Introduce concept of melting and that this is the process of a material changing state when heated. Introduce skill of taking measurements with thermometer – (activity from TAPS) Ask children to put one hand in cold and one hand in warm water, then put both in tap water. What do you think the temperature of the water is for this hand, for that hand? How accurate is your hand? Need a thermometer.	• Melting is a change of state from solid to liquid caused by heating. • Thermometers are tools for measuring temperature (usually in degrees Celsius). • How to use thermometers accurately (avoid touching surfaces, read at eye level).

		Demonstrate accurate reading: keeping thermometer in the water, head down to the level, explain how to use the scale, how to estimate numbers between lines and what accuracy to aim for (e.g to nearest 1 or 5 degrees C.) Investigation - melting chocolate in pie dishes in a tray of warm water. Measure temperature of water with thermometers to record in table (teacher made) when they melt. Compare milk, dark, and white chocolate. http://www.stpetersbrayblog.com/2019/04/29/melting-chocolate-experiment-stem-fourth-class/	
LESSON 5	I can observe that some materials change state when they are heated and measure (for water/ice below 50°C)	Give each group of children a balloon that has had water frozen inside it. They can peel off the balloon and explore the ice balloon. Ask them to work out how the ice balloon was made. They can try placing a few drops of food colouring on the ice and observe what happens over time. Drama/modelling – Being a solid and liquid Act out being a solid: children line up in line to form a large square. Each of the children can represent a particle of solid. Ask the children to wriggle a little on the spot. Apply more energy to this model by calling out ‘heat energy’. The children can now begin to form a long line and move around the room. To initiate solidification/freezing, call out ‘remove heat energy’. The children should now begin to move more slowly until they are back wriggling in their square. Recap temperatures recorded last lesson, was it different for the different chocolate types? Introduce idea of melting points and that different materials will melt at different temperatures, link to water and that it freezes to become ice at 0 degrees Celsius and so it will melt back to water at anything above this. Big Question – Do all liquids freeze? Children carry out investigation to find out whether all liquids will freeze (see below). Recording They can draw their liquids at different stages; before going in the freezer, immediately when removed, and one hour later. Discuss which liquids turned to solids – what do they notice after an hour?	• Different materials melt at different temperatures. • Melting point of ice is 0°C • Not all solids melt at 0°C – chocolate, butter, etc. melt at different (and lower) temperatures than water-based ice.

		<table><tr><td>Year</td><td>4</td><td>Topic</td><td>States of matter</td></tr><tr><td colspan="4">Focus of assessment (National Curriculum statements)</td></tr><tr><td colspan="4"> 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). </td></tr><tr><td colspan="4">Description of activity</td></tr><tr><td colspan="4">The children were given small amounts of seven liquids to explore. The teacher had previously put these liquids in an ice cube tray and placed in them in the freezer. The children were then given the frozen cubes to explore.</td></tr></table><table><tr><th colspan="2">EVIDENCE OF LEARNING</th><th>ASSESSMENT</th></tr><tr><th>Oral evidence</th><th>Examples of work</th><th>Knowledge</th></tr><tr><td> "They are all liquids because they fill the bottom on the pot and the surface is flat. Some of them are thicker and are not as easy to pour." "You can push your finger in the honey cube. It hasn't really changed. It is still a thick liquid. The salt water cube is white and doesn't feel as smooth. The oil melted back into a liquid quickly." Teacher observations </td><td> Before freezing  After freezing </td><td> Chaya describes how things change as they are heated and cooled. Working scientifically Chaya makes careful observations of the similarities and differences between the liquids and the frozen cubes. </td></tr></table> Comparative test from PLAN examples of work: Overnight prior to the lesson freeze different liquids in ice cube trays (enough for children to have one per group) – observe states at 0 degrees Celsius (some may still be liquid). Children predict either temperatures of the melting points for the different materials or the order that they will melt in. Observe how they melt. Take temperatures with thermometers when liquid and record measurements in table to show what temperature they have melted at.	Year	4	Topic	States of matter	Focus of assessment (National Curriculum statements)				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).				Description of activity				The children were given small amounts of seven liquids to explore. The teacher had previously put these liquids in an ice cube tray and placed in them in the freezer. The children were then given the frozen cubes to explore.				EVIDENCE OF LEARNING		ASSESSMENT	Oral evidence	Examples of work	Knowledge	"They are all liquids because they fill the bottom on the pot and the surface is flat. Some of them are thicker and are not as easy to pour." "You can push your finger in the honey cube. It hasn't really changed. It is still a thick liquid. The salt water cube is white and doesn't feel as smooth. The oil melted back into a liquid quickly." Teacher observations	Before freezing  After freezing 	Chaya describes how things change as they are heated and cooled. Working scientifically Chaya makes careful observations of the similarities and differences between the liquids and the frozen cubes.	
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LESSON 6	I can observe that some materials change state when they are cooled.	Recap findings from last week. Children to create a bar chart showing the temperature that (some of) the different liquids melted at. Teacher to demonstrate the process of melting chocolate using induction hob highlighting the change of state as it goes from a solid to a liquid again to recap. Children to make crispy cakes and observe as the liquid chocolate hardens into a solid when cooled. Ensure that children are clear that this process is freezing as a common misconception is that only water freezes because it feels much colder than solid chocolate does. This activity could be recorded in books but does not	- Freezing is the reverse of melting – liquid to solid. - Cooling removes energy, causing particles to slow and settle into a fixed structure. - Freezing is the change of state of a liquid to a solid – it does not mean 'cold'!																													

		need to be, the children need to leave the lesson being able to articulate that liquid chocolate hardens to solid chocolate when cooled and that this is freezing.	
LESSON 7	I can identify the role of evaporation and condensation in the water cycle.	Teacher demonstrate how water changes state using a pan and induction hob with creating steam and showing water on pan lid. Ask what will happen when the water on the lid drips down into the pan and heats up again? Introduce the water cycle and the terms evaporation and condensation. Puddle experiment - Children go out onto playground and find a puddle, draw around with it chalk and take the temperature of water and outdoor temperature, observing changes throughout the day and recording temperatures in a table as a class. (Wet handprint on paper towels and observe it dry if wrong weather conditions).	• Melting point of ice is 0°C; boiling point of water is 100°C. • Evaporation is when liquid water turns into water vapour (gas). • Condensation is when water vapour cools and turns back into liquid. • Water constantly changes state in nature. • Evaporation can happen below boiling point. • Condensation often happens on cool surfaces (e.g. windows, drink bottles). • Water vapour is invisible – steam is tiny droplets of water.
New LESSON 8	I can identify the role of evaporation and condensation in the water cycle.	Ask the children what they already know about the water cycle. Show the children the Water Cycle diagram with no captions or labels – allow the children time to discuss what they think is happening. https://www.bbc.co.uk/bitesize/topics/zkgg87h/articles/z3wpp39 The Water Cycle explained: Begin with the rain and discuss with children what happens to the water: falls onto ground (precipitation) and runs off mountains and lower land into streams, which become rivers, which in turn empty into the sea. Some water ends up in lakes and ponds and some infiltrates the ground. Sun and wind cause evaporation and the warm air containing water vapour rises. As the air cools the water vapour condenses into water droplets which form clouds. These clouds get blown by the wind and they precipitate the water again as rain, particularly over higher ground. The cycle begins again. Children to create their own 'water cycle in a bag' in groups to tape onto windows. Observe changes overtime throughout the lesson and the week (ideally same time	The Sun provides heat, which causes water to evaporate from oceans, lakes, rivers, and puddles. Evaporation: Liquid water → water vapour (gas). Water vapour rises, then cools and condenses into tiny droplets, forming clouds. Condensation: Water vapour (gas) → liquid droplets.

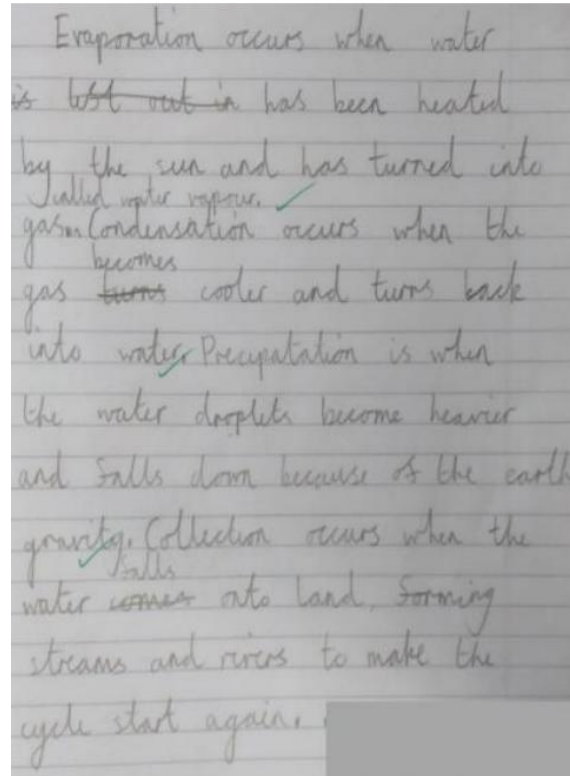
		every day) and revisit next lesson. Throughout the week draw attention to the weather to prompt children to begin to build links that they might observe differences on a warmer/sunnier day as opposed to a cooler/cloudier day - a room thermometer on window would be a great enhancement. Look at the concept cartoon and discuss if they agree with the comments the characters are making. If possible, have a jug of iced water on the table and allow the children to pour some into a clean, dry glass. What can they see? What other examples of condensation can children think of? Breath that can be seen on a cold day, dew, person wearing spectacles going from cold outside to warm room, etc. Where does the liquid water come from? Water vapour (gas) in the air. 	When droplets in clouds get heavy, they fall as precipitation (rain, snow, hail). Water then collects in rivers, lakes, and seas, and the cycle starts again. The water cycle is continuous — water keeps changing state and moving around Earth.
LESSON 9	I can identify the role of evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	Check status of water cycle in a bag on windows and discuss the changes you have observed across the week. Children to draw and label diagram of water cycle in books and write their own explanation of how it works using key vocabulary: heats/heated, evaporates/evaporation, cools/cooled and condenses/condensation. Show the children a shallow dish of water – we want this water to evaporate, where should we put it? Does it matter? Will it evaporate better/quicker in some places rather than others? Set up investigation to again observe changes throughout the week, place several shallow containers (same) with a small, equal amount of water and place in different places around the room, identifying warm places and cool places. Place with a thermometer next to each water dish. Observe changes overtime throughout the week (ideally same time every day) are some evaporating quicker	• Heat speeds up evaporation. • Rate of evaporation depends on temperature, surface area, air movement. • Evaporation happens at the surface of the liquid. • Evaporation is a surface phenomenon, not like boiling.

		than others? Have any completely evaporated yet? Is it the ones in warmer places, etc. Check thermometer temperatures and record as a class.	• More energy (heat) means faster-moving particles, leading to quicker escape as vapour.
LESSON 10	I know that some materials change state when they are heated or cooled and can research (for water above 50°C) the temperature at which this happens in °C. I know that you can speed up the rate of evaporation by increasing the heat.	Recap the different states of matter, the water cycle and condensation and evaporation. Investigate if the rate of evaporation can be sped up. In groups, children are given small pieces of wet fabric (or paper towels) and must design an experiment to test how to dry them the fastest. Possible variables they could explore: Location (sunny window, near a heater, in a cupboard) Air movement (fan vs. still air) Surface area (spread out vs. folded) Material (cotton vs. synthetic, if available) Equipment: thermometers, timers, fans, pegs, string, trays, etc. Children set up their drying stations and record how long it takes for the fabric to dry. They observe and measure temperature where possible. Each group presents their method and results. Discuss: What helped the water evaporate faster? Why? Link back to key vocabulary including evaporation.	• Evaporation is the process where liquid water turns into water vapour (gas). • The rate of evaporation increases with: ○ Higher temperature ○ Greater air movement (e.g. wind or fans) ○ Larger surface area (e.g. spreading out fabric) • Evaporation happens at the surface of a liquid and does not require boiling. • Understanding evaporation helps solve real-world problems like drying clothes quickly.
LESSON 11	I know that some	Show a cold drink bottle or glass from the fridge. Ask: Why is there water on the outside? Discuss misconceptions (e.g., “the water is leaking”).	• Condensation is the process where water

	materials change state when they are heated or cooled and can research (for water above 50°C) the temperature at which this happens in °C.	Set up a condensation station: Place metal tins or glasses filled with ice water around the room. Have students observe and record what happens on the outside of the containers. Use magnifying glasses to look at water droplets forming. Try placing cling film (or a clear plastic plate) over a bowl of hot water and placing ice cubes on top. Watch condensation form on the underside of the film and drip back down—like rain! Link to the water cycle and real-life examples (bathroom mirrors, windows, glasses). Children draw and label a diagram showing condensation and explain it using key vocabulary.	vapour (gas) cools and turns back into liquid water. • Condensation happens when warm, moist air touches a cooler surface (e.g. windows, cold drink bottles). • Water droplets that form on surfaces are not from inside the object—they come from the air. • Condensation is a key part of the water cycle and happens naturally in many everyday situations.
LESSON 12	I know that some materials change state when they are heated or cooled. I can identify the role of evaporation and condensation in the water cycle.	Explorify: What if? – What if water didn't evaporate? - https://explorify.uk/en/activities/what-if/water-didn-t-evaporate In pairs, discuss what might be a Plus, Minus and Interesting way to think about the question. Stuck for ideas? They could think about: • Would hot countries have the same amount of water as cold countries? • Would the playground always be covered in puddles? • Would it ever rain again? Watch; https://www.bbc.co.uk/bitesize/clips/z8qtfg8 to review learning from previous lesson. Recording example: Extended writing opportunity: Ask the children to use everything they now know about states of matter and evaporation and condensation to write an	The Sun provides heat, which causes water to evaporate from oceans, lakes, rivers, and puddles. Evaporation: Liquid water → water vapour (gas).

explanation of what happens during the water cycle. The children could write this as a diary from the perspective of a raindrop.

See example writing:



Evaporation occurs when water is ~~lost out in~~ has been heated by the sun and has turned into ~~called water vapour~~ gas. Condensation occurs when the gas ~~turns~~ ^{becomes} cooler and turns back into water. Precipitation is when the water droplets become heavier and falls down because of the earth's gravity. Collection occurs when the water ~~comes~~ ^{falls} onto land, forming streams and rivers to make the cycle start again.

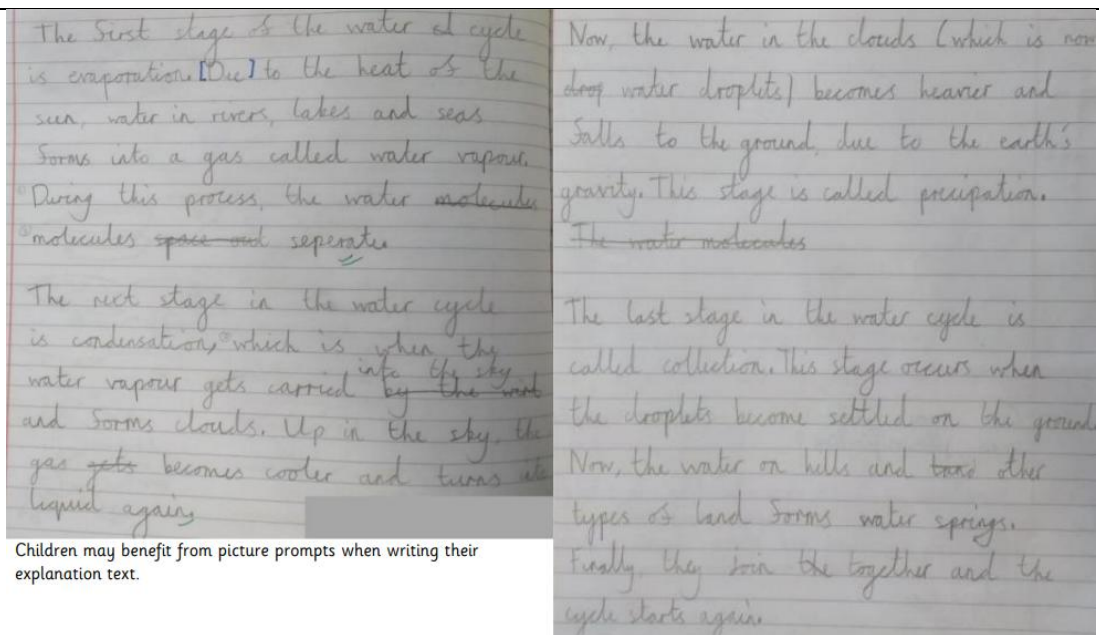
Water vapour rises, then cools and condenses into tiny droplets, forming clouds.

Condensation: Water vapour (gas) → liquid droplets.

When droplets in clouds get heavy, they fall as precipitation (rain, snow, hail).

Water then collects in rivers, lakes, and seas, and the cycle starts again.

The water cycle is continuous — water keeps changing state and moving around Earth.



Children may benefit from picture prompts when writing their explanation text.

Assessment Questions:

What are the three states of matter?

What happens when some materials are heated or cooled?

What is evaporation? What speeds it up?

What is condensation?

What is the water cycle?

Helpful resources to reference