Unit 5D Changing state

Science Y5
Mr Jennings' class

ABOUT THE UNIT

Through this unit children consolidate their ideas about changes of state which can be reversed. They use their understanding to explain a range of familiar phenomena.

Experimental and investigative work focuses on:

- making observations and measurements and presenting these
- identifying patterns in results
- suggesting explanations for observations and conclusions in terms of scientific knowledge and understanding.

Work also offers opportunities for using IT (see IT Units 5B and 5C) to obtain, collect, retrieve and present data and using knowledge and understanding of science to explain and interpret everyday observations related to changes of state.

This unit takes approximately 12 hours.

WHERE THE UNIT FITS IN

Builds on Unit 4D 'Solids, liquids and how they can be separated' and Unit 5C 'Gases around us'

Children need:

- to know that materials can be classified as solids, liquids and gases
- to know the terms 'melting' and 'freezing'
- to be able to use a thermometer accurately.

Links with Units 3D, 4C, 6C, 6D and geography.

Elements of this work are covered in our Geography topic on water.

VOCABULARY

In this unit children will have opportunities to use:

- words and phrases related to changes of state *eg evaporation, condensation, boiling temperature, state, change of state, water cycle, conditions, solid, liquid, gas*
- names of processes and verbs related to them *eg condensation/condense, evaporation/evaporate, melting/melt, freezing/freeze, solidification/solidity*
- expressions for generalising and summarising.

RESOURCES

- kettle or saucepan for boiling water
- apparatus for measuring volume of liquids
- thermometers
- containers of similar size and shape *eg margarine tubs, yoghurt pots*
- battery-powered fan
- ice
- pictures of appliances for 'drying' *eg tumble dryers, rotary clothes line*
- can of soft drink from freezer
- IT temperature sensor
- cling film
- video or other secondary sources illustrating the water cycle

EXPECTATIONS

at the end of this unit

most children will:	name and describe examples of the main processes associated with water changing state and recognise that these processes can be reversed; explain the water cycle in terms of these processes; use patterns in data to make predictions
some children will not have made so much progress and will:	describe how to change water into ice and steam and steam into water; describe a few examples where these changes occur, and recognise patterns in data
some children will have progressed further and will also:	explain how changing conditions affects processes such as evaporation and condensation, and give reasons for predictions made using patterns in data

LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN	POINTS TO NOTE
	Introduce the idea of a concept map (with examples). Review children's understanding of solids, liquids and gases by asking them to draw a concept map using terms *eg solid, liquid, gas, melt, freeze, water, ice, change, cool, warm, flow, change shape, volume, powder, evaporate.* Discuss their maps with the children using specific examples to clarify what they know. Introduce the term 'state' to describe solid, liquid and gases.		Teachers will need to take account of what this introductory work shows about children's knowledge and understanding of solids, liquids and gases in their short-term planning of later activities. A concept map shows the connections between different ideas in a particular topic and is a useful source of information about children's understanding. Children will need to be taught how to make a concept map if they have not done so before. Children may encounter the terms 'gas' and 'vapour'. At this stage it is not necessary to make a distinction between them.
• that evaporation is when a liquid turns to a gas • to explain 'disappearance' of water in a range of situations as evaporation	♦ Remind children what happens to puddles in the playground when it stops raining and to wet washing when it is put out to dry. ♦ Make wet hand prints on a surface *eg blackboard* and watch them disappear. ♦ Show children what happens to water in a saucepan as it is heated, noting both water level and the connection between evaporation and heating and use this as a stimulus to discuss ideas about evaporation and where they encounter evaporation.	• identify the process that takes place when water changes to a gas as evaporation • identify a range of contexts *eg water left in an open dish, washing/drying, hair drying, wet hand prints disappearing* in which water evaporates	Children often use the term 'disappear' to describe evaporation. It is important that they understand that although *eg a puddle* has disappeared, the water remains in the air. **SAFETY** – Take care with boiling water. Work with boiling water should be a teacher demonstration only and children should be kept well back.
• that liquids other than water evaporate	♦ compare water evaporating from the desk with water evaporating from the desk and perfume/water evaporating from hand (warm) and desk (colder) ♦ Demonstrate using *eg nail varnish, correction fluid,* that other liquids evaporate. ♦ Ask children to explain why they can smell *eg perfume, aftershave, natural gas* from a distance. ♦ Refer to dangers of sniffing volatile materials c.f. DARE	• describe some contexts in which other liquids evaporate • explain that they smell things when they evaporate and gases reach their noses • know that sniffing solvents can be harmful c.f. DARE	At this stage, the distinction between boiling and evaporation can be drawn in terms of the large bubbles seen when the water is boiling and the 'steam' seen as hot water evaporates without boiling. **SAFETY** – Solvents such as surgical spirit and nail varnish remover are highly flammable and must NOT be allowed near naked flames. Because of the dangers of solvent abuse, their use must be closely supervised. Any LEA/school guidelines must be followed.

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LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN	POINTS TO NOTE
• to turn ideas into a form that can be investigated, to make a prediction and decide what evidence to collect • to construct a fair test	♦ Talk with children about how they could investigate a question related to evaporation *eg What makes a difference to how quickly washing dries? What affects how fast a puddle dries up and how can we turn it into a form that could be tested?* ♦ Discuss possible relevant factors *eg temperature, wind, amount (volume) of water surface area* and how these might be investigated. ♦ Help children to plan a fair test to investigate their question *eg keeping volume of water and surface area the same while temperature is changed* and to decide what evidence to collect *eg depth, volume of water in containers kept at different temperatures over a period of days.* Children to identify a wide range of factors to control. Help children to identify a means of determining the speed of evaporation.	• identify factors that could affect how fast water evaporates • make a reasonable prediction and with some help suggest a fair test to test the prediction *eg I think water will evaporate faster in containers with larger openings. I'll use the same volume of water, put them in the same place in the room and cover the containers with card with different sized holes. I'll measure the depth (or volume) left each day*	Children could test whether draughts or wind help water evaporate faster by using a battery-powered fan or putting containers near an open window during the day. This activity offers children the opportunity to carry out a whole investigation. It may be helpful to concentrate on the aspects of investigation highlighted in the learning objectives.
• to make careful measurements, recording them in tables and graphs • to identify trends in results and use these to draw conclusions, indicating whether the results support the prediction • to explain conclusions in terms of scientific knowledge and understanding	♦ Discuss results with the children and help them to present them as a graph. ♦ Compare results from different investigations and ask children what the results show about the factors affecting evaporation ♦ Help children to make generalisations and to try to explain the results (preferably using two comparatives) *eg the warmer the place, the faster it evaporates; the windier the day, the faster the clothes will dry*	• with help in choosing what to do, present results in a graph *eg showing volume of water against number of days for each container* • compare results to draw conclusions *eg this one went down faster than that one. This means the water in the container with the large opening evaporated faster than in the other ones. This is what I expected, the larger the opening the faster it evaporated*	Children should be encouraged to make generalisations of this kind from results they collect.

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LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN	POINTS TO NOTE
• to explain everyday examples of 'drying' in terms of factors affecting evaporation	♦ Show pictures of appliances *eg hairdryers, tumble dryers, rotary clothes line* and ask children to explain how these help to make things 'dry' more quickly. ♦ Record explanations in writing *eg in an advertisement for a particular sort of appliance.*	• explain how to make things 'dry' more quickly using ideas about factors affecting evaporation *eg the hairdryer warms the hair and blows the evaporated water away*	It is important that children recognise that water evaporates at all temperatures and not just when it is warm. At low temperatures evaporation is very slow. c.f. English/Literacy work on explanation writing
• that condensation is when a gas turns to a liquid • that condensation is the reverse of evaporation • to make careful observations and draw conclusions explaining these in terms of scientific knowledge and understanding	♦ Demonstrate an example of condensation *eg steam from a kettle hitting a cold surface* and discuss with children what happens to water vapour when it cools down. ♦ Discuss with children where in their homes they see water collecting on surfaces *eg in the kitchen, bathroom.* Introduce the words 'condense' and 'condensation'. ♦ Demonstrate what happens when ice cubes are placed in the centre of cling film covering a container of hot/warm water. ♦ Ask children to feel the cling film to see how warm it is in different places and to observe the size of the droplets. ♦ Ask children to illustrate in diagrams and annotate to explain what happens.	• identify the process which takes place when water vapour turns to a liquid as condensation • explain why condensation occurs in a number of situations *eg on kitchen windows on a cold day, on cold taps in the bathroom* • explain why condensation isn't so frequently seen *eg on taps and windows* on a warm day	The droplets formed on the underside of the cling film are much larger where it is coldest. These drops eventually drop back into the container. **SAFETY** – Take care with boiling water. Teachers should take care they don't scald themselves when holding the cold surface in the steam *eg by wearing oven gloves.* **SAFETY** – Try out to make sure the cling film is only warm.
• to make careful observations and draw conclusions, explaining these in terms of scientific knowledge and understanding • that air contains water vapour and when this hits a cold surface it may condense	♦ Show children examples of condensation where there is no obvious source of water vapour *eg breathing on a cold window pane, droplets of water collecting on a metal glass containing mixture of ice and water, droplets of water collecting on a can of soft drink from the freezer.* ♦ Ask children where they think the water came from and to record in a drawing with annotation.	• describe that droplets of water are formed on the cold surface • explain that air contains water vapour which cannot be seen but may condense when it hits a cold surface *eg the can was very cold so water in the air condensed on it*	

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LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN	POINTS TO NOTE
• that the boiling temperature of water is 100°C • to identify patterns in data and use these to make predictions • to decide whether the evidence collected supports the prediction and explain what happened in terms of scientific knowledge and understanding	♦ Show children a chart or graph of the temperature of a container of water as it is being heated *eg temperature rising 5 degrees every minute from 20°C to 45°C* ♦ ask them to predict what the next five readings will be. ♦ show them similar results from 90°C and ask them to make similar predictions. (Link with ICT unit 5e) ♦ Using an IT sensor (or a suitable thermometer), carry out the experiment and compare results with predictions or use results already obtained. ♦ Talk with the children about what the results show about boiling.	• identify the pattern in data and use this to make predictions • recognise that simply heating water at its boiling point will not result in it getting hotter • state that the boiling temperature of water is 100°C	In these activities the mixture may need to be stirred around the temperature sensor or thermometer. Pure water boils at 100°C. Many of the thermometers used in primary schools are not very accurate, especially if they are not immersed to the correct depth. **SAFETY** – Take care with boiling water. Work with boiling water should be a teacher demonstration only and children should be kept well back. **SAFETY** – Mercury thermometers are more accurate than spirit thermometers but less suitable for primary schools because of the problem of clearing up toxic mercury if they are broken.
• to obtain evidence by making careful observations • to make predictions using scientific knowledge and understanding	♦ Use an IT sensor to take the temperature of a mixture of ice and water at five minute intervals over a period of two or three hours. (Link with ICT unit 5e) ♦ Discuss what the data shows about the melting temperatures of ice and the temperature of the room. ♦ Ask children to predict what the data would show if the room was ten degrees hotter.	• state that the freezing temperature of water is 0°C • recognise that the temperature in the classroom is usually around 18°C – 22°C • with help/discussion, suggest data, showing the ice warms up more quickly and finishes at the new temperature of the room	

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LEARNING OBJECTIVES CHILDREN SHOULD LEARN	POSSIBLE TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN	POINTS TO NOTE
• that melting, freezing, condensing and evaporating are all changes of state which can be reversed	♦ Review work on changing state by presenting children with pictures or descriptions of simple situations *eg breathing on a mirror, a picture of a kettle boiling, clouds forming, wax running down the side of a lighted candle, a wet hand print on a suitable surface eg blackboard, molten lava from a volcano solidifying, leaving an ice cube in a warm room* ♦ ask them to link the situation to the process involved. ♦ Re-introduce the terms 'state' and 'changes of state'.	• recognise that melting, freezing, evaporation and condensing are all changes which can be reversed and all changes which involve a change of state • identify correctly examples of the above changes	
• that water evaporates from oceans, seas and lakes, condenses as clouds and eventually falls as rain • that water collects in streams and rivers and eventually finds its way to the sea • that evaporation and condensation are processes that can be reversed • to interpret the water cycle in terms of the processes involved	♦ Ask children a question about our water *eg Where does our bath water come from?* ♦ Use secondary sources *eg video, CD-ROM, reference books* to show where our water supply comes from. ♦ Help children to see the relationship to earlier work on evaporation and condensation, and to work on rocks and soils, and to use what they know to build up the water cycle from first principles. (c.f. Geography topic on Water and Rivers)	• describe the water cycle, naming processes correctly *eg by telling the story of a drop of water from when it left the sea until it returned to the sea* • recognise that evaporation and condensation are processes that can be reversed	Children do not need, at this stage, to use the term, 'precipitation' to describe rainfall, hail or snow.

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