Subject: Science Year 4: States of matter

NC/PoS:

- 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 pupils already know and can do)

Check the children can recall their learning about materials from the units *Science, Year 1, Materials: Everyday materials* and *Science, Year 2, Materials: Uses of everyday materials*

Recognise a material and name its properties. Know a material is used because of its properties. Know the difference between a natural and manufactured material.

End Goals (what pupils MUST know and remember)

- Know that materials can be solids, liquids, or gases (the three states of matter)
- Know the shape and volume of a solid does not change unless a bit is broken off
- Know the shape of a liquid can change, depending on the container it is in, but its volume does not change
- Know that most gases are invisible
- Know the gas in a container completely fills the container so has the same shape and volume of the container it is in
- Know liquids, change into gases when they are heated – this is evaporation
- Know liquids, change into solids when they are cooled – this is freezing
- Know gases, change into liquids when they are cooled – this is called condensation
- Know solids, change into liquids when they are heated – this is called melting e.g. heating sand at elevated temperatures produces liquid glass
- Know the rate of evaporation depends on the temperature
- Know evaporation is slow when it is cold and fast when it is hot
- Know the water on Earth is constantly recycling using evaporation and condensation
- Know the heat from the sun makes the water from the sea, lakes and rivers evaporate into water vapour
- Know that as the water vapour rises, it cools and condenses to form clouds, then falls as rain

Key Vocabulary:

water cycle, evaporation, water vapour, condensation, precipitation, property, matter, states, particles, mass, shape, volume, heat, melting point, evaporating, evaporation, boiling points, process, condensing, condensation, freezing, freezing point, temperature, rate of evaporation

Session 1: Use resources from Kapow Lesson 1: Solids

Review prior learning:

- Identify and name a variety of everyday materials.
- Describe the simple physical properties of these materials.
- Compare and group together these materials based on their simple physical properties.
- Describe how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.
- List some uses of materials.

LO: To identify solids using their properties.

To begin with lay 3 hoops on the floor and label them 'Solids', 'Liquids', 'Gases'. Allow children to place a variety of materials into the appropriate hoops and discuss to establish understanding and address misconceptions. Take a photograph for the

Floorbook.
From the ***Main Event*** section use the *Presentation: States of matter – solids* and explain that matter is anything that takes up space and can be weighed.
Discuss the challenge of defining what a solid is with the class.
By the end of the discussion the children should be able to complete the stem sentence 'A solid is…'.
Continue with the presentation to explore the properties of a solid.
Once the class have decided upon a definition of a solid they can write it in their books.
Show the *Pupil video: The properties of solids* to review the properties of solids and address any misconceptions.
Vocabulary: property, matter, states, particles, mass, shape, volume

Session 2: Use resources from Kapow Lesson 2: Liquids and gases
Recap and recall: Use the *Presentation: Flour* to recap the definition of a solid and establish that flour is a solid, but that dough and paste are not.
LO: To identify liquids and gases using their properties.
Working scientifically LO: To use results to draw simple conclusions about the properties of liquids.
Children learn that materials can be solids, liquids, or gases (the three states of matter). The shape and volume of a solid does not change unless a bit is broken off. The shape of a liquid can change, depending on the container it is in, but its volume does not change. Most gases are invisible and the gas in a container completely fills the container so has the same shape and volume of the container it is in.

Children watch steam from a kettle and 'Think, pair, share' **Is steam a gas or a liquid?**
From the ***Main Event*** section use the *Presentation: States of matter – gases.* As a class decide upon a definition of a gas and write it in their books.
Use the *Presentation: States of matter – liquids* to establish a definition of a liquid. They can complete the suggested activities and use their findings to give examples that support each definition (they **do not** need to complete the worksheet- but it can be used as a scaffold if needed)
Vocabulary: property, matter, states, particles, mass, shape, volume

Session 3: Use resources from Kapow Lesson 3: Melting and freezing.
Recap and recall: Use the *Presentation: Properties of the states of matter* to revise the 3 states of matter and their properties
LO: To describe melting and freezing.
Working scientifically LO: To use thermometers to take accurate measurements before and after melting.
Children learn solids change into liquids when they are heated – this is called melting e.g. heating sand at elevated temperatures produces liquid glass and that liquids change into solids when they are cooled – this is freezing.
Use the ***Attention Grabber*** section to discuss what will happen to ice at room temperature and the purpose of a thermometer.
Use the *Presentation: Changes of state* from the ***Main Event*** section and recap that melting is the process of changing from a solid to a liquid. This is called a **change of state**.
Either in groups, or teacher demonstration, place ice cubes in 3 different temperatures of water. Ensure all children have the opportunity to use a thermometer to measure temperature at some point in the lesson.
Lead a class discussion to reach a conclusion, for example:

- The hotter the temperature, the faster a solid, like ice, will melt.

Children can use their findings to support their conclusion. 'We discovered that…'
Watch the *Pupil video: Freezing*; children can answer questions on whiteboards. Children should record in books the temperature at which water freezes/ice melts and should note

in the fact that melting point/freezing point can be changed by adding other substances eg. salt.
If time allows you can watch the following to further their understanding:
https://www.youtube.com/watch?v=pVTZySPJh5w melting points
https://www.youtube.com/watch?v=gZBt4_Ds3lI boiling points up to 2.03

Vocabulary: heat, melting, melting point, boiling points, freezing, freezing point, process

Session 4:
Recap and recall: Use the *Presentation: Changes of state* to recall the processes melting and freezing, and the melting point/freezing point of water.
LO: To describe condensing and evaporating.
Working scientifically LO: To make predictions for new values about evaporation rates.
Children learn liquids, change into gases when they are heated – this is evaporation and gases, change into liquids when they are cooled – this is called condensation.
Use the ***Attention Grabber*** section to explore evaporation and condensation. Using the *Presentation: Evaporating and condensing*, explain that when a liquid is heated above its boiling point, it evaporates and changes into a gas. At its boiling point of 100 °C, water bubbling and steam from the kettle can be observed.
Allow the children to follow the method suggested in the ***Main Event*** section to experience that temperature and wind both affect evaporation (results do not need to be recorded).
Get children to draw a simple diagram (similar to the one on slide 2 of the *Presentation: Evaporating and condensing)*. Those who are able can write an explanation to go with their diagram.
Vocabulary: condensing, condensation, evaporating, evaporation

Session 5: Use resources from Kapow lesson 5: The water cycle
Recap and recall: Display the *Presentation: Agree or disagree?* and read through the three statements as a class and discuss each to recall knowledge of changes of state.
LO: To describe the different stages of the water cycle.
Play the video on the link: BBC Teach - The water cycle. In pairs, children note down keywords from the water cycle and then invent actions to represent each and present to the class.
Children learn the water on Earth is constantly recycling using evaporation and condensation. The heat from the sun makes the water from the sea, lakes and rivers evaporate into water vapour. As the water vapour rises, it cools and condenses to form clouds, then falls as rain.
If the iPads are available allow children to work in pairs to create a diagram:
Direct children to the link: Sketchpad. Display Sketchpad on the board and show the following steps to create the diagram.

1. Select the paint can from the left sidebar and change the colour to pale blue.
2. Use the paint can to colour the background of their page pale blue.
3. Select the pen from the left sidebar and change the width to around 50 px.
4. Change the colour to a darker blue.
5. Draw in the sea (it helps to start from the bottom of the diagram and work up).
6. Select the next appropriate colour and draw each section step by step.
7. When they have drawn all parts, they can select the 'T' for text from the left sidebar.
8. Use text to add the keywords evaporating, condensing, precipitation and run-off.

These can be screenshot, printed and stuck into books. Children use their diagrams/or a printed version of The Water Cycle (if no iPads) to explain the water cycle to another pair.
Vocabulary: water cycle, evaporation, water vapour, condensation, precipitation

Session 6: Use resources from Kapow lesson 6: Climate change and the water cycle

Recap and recall: Play the link: BBC Teach - The water cycle and ask the children to act out the actions they practised in *Lesson 5: The water cycle*.

LO: To describe how temperature affects evaporation rates and the water cycle.

Working scientifically LO: To research climate change and the water cycle.

Play the *Pupil video: Climate change and the water cycle*, which covers the melting of polar ice and the increase in rainfall and flooding. Ask pupils to write down three interesting facts from the video.

Children use this and the *Resource: Climate change and the water cycle* to create their own climate change report in their books using appropriate scientific vocabulary.

Complete the unit quiz.

Vocabulary: climate change, drought, flood

Link to career scientist:
https://pstt.org.uk/application/files/1116/2851/6355/Materials_scientist_-_Pearl_Agyakwa.pdf
https://pstt.org.uk/application/files/4616/2851/6691/Water_Scientist_-_Zoe_Ayres.pdf

Scientists who have helped develop understanding in this field: the ancient Greeks