

Year 4

States of Matter

Further background information <https://explorify.uk/teaching-support/teaching-science/states-of-matter-tackle-the-tricky-bits>

For further curriculum activities, resources and ideas see Hamilton Trust [Year 4 Science: States of Matter - States of Matter Scientists](#) and

Book Clare Fearon - The adventures of Walter the Water Droplet <https://clarefearon.files.wordpress.com/2021/03/water-cycle2-1.pdf>

Background Knowledge

In years 1 and 2, children have considered a range of different materials, their properties and how they could be changed by force. In year 3, children focused specifically on rocks and soils and their properties. In year 4, the children are moving on to consider the different states materials can take. There are strong possibilities to link this topic with other areas for example melting and solidifying chocolate could be linked with making chocolate crispy cakes. Foil cases containing different materials can be floated on bowls of warm water so the children can observe the changes. These materials could include cheese, butter, ice, pasta, wax and chocolate. You could use the research information on melting or boiling points to play a game of play your melting points right.

A solid keeps its shape and has a fixed volume. A liquid has a fixed volume but changes in shape to fit the container. A liquid can be poured and keeps a level, horizontal surface. A gas fills all the available space. It has no fixed shape or volume. Granular and powdery solids like sand can be confused with liquids because they can be poured, but when poured they form a heap and they do not keep a level surface when tipped. Each individual grain demonstrates the properties of a solid.

Melting is a change from solid to liquid. Freezing is a change in state from liquid to solid. The freezing point of water is 0 degrees centigrade. Boiling is the change of state from liquid to a gas that happens when liquid is heated to a specific temperature and bubbles of gas can be seen in the liquid. Water boils when it is heated to 100 degrees centigrade. Evaporation is the same as boiling (liquid to gas) but it happens more slowly at lower temperatures and only at the surface of a liquid. Condensation is the change back from gas to liquid caused by cooling.

Water at the surface of the seas, rivers etc. evaporates into water vapour (gas). This rises then cools and condenses back into liquid forming clouds. When too much water vapour has condensed, the water droplets in the cloud get too heavy and fall back down as rain, sleet or snow etc. and drain back into rivers etc. This is known as precipitation. This is the water cycle.

Common misconceptions

- Solid is another word for hard or opaque.
- Solids are hard and cannot break or change shape easily and are always in one piece.
- Substances made of very small particles like sand or sugar aren't 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 -ice, steam, water- are all different substances.
- All liquids boil at the same temperature as water.
- Melting 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 is condensation rather than water.
- The changing states of water are irreversible.
- Evaporating or boiling water makes it vanish.
- Evaporation is when the sun soaks up the water or when water is absorbed into a surface/ material.

What Children need to know or can do (review at beginning of topic)

Year 1

I can distinguish between an object and the material it is made from.

I can explain the materials an object is made from.

I can name wood, plastic, glass, metal, water and rock.

I can describe the properties of everyday materials. (hard, soft, stretchy, stiff, shiny, dull, rough, smooth etc.)

I can group objects based on the materials they are made from.

Year 2

- I can identify and name a range of materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard.
- I can suggest why a material might or might not be used for a specific job.
- I can explore how shapes can be changed by squashing, bending, twisting and stretching.
- I can research scientists who have found useful new materials.

Year 3

I can compare and group rocks based on their appearance and physical properties giving a reason.

I can describe how fossils are formed.

I can describe how soil is made.

National Curriculum objectives	Children's objectives
<p>Compare and group materials together, according to whether they are solids, liquids or gases</p> <p>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 ($^{\circ}\text{C}$)</p> <p>Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature</p>	<p>I can group materials based on their state of matter (solid, liquid, gas).</p> <p>I can describe in simple terms the properties of different states of matter.</p> <p>I can describe how some materials change state e.g. water.</p> <p>I can use the terms evaporation, condensation, freezing, solidify, melt to explain what happens when materials change state.</p> <p>I can measure temperature accurately.</p> <p>I can explain the part played by evaporation and condensation in the water cycle.</p>
<p><u>Scientific enquiry</u></p> <p>Asking relevant questions and using different types of scientific enquiries to answer them setting up simple practical enquiries, comparative and fair tests</p> <p>Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers .</p> <p>Identifying differences, similarities or changes related to simple scientific ideas and processes</p> <p>Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions</p> <p>Recording findings using simple scientific language, and tables</p> <p>Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions</p> <p>Using results to draw simple conclusions</p> <p>Using straightforward scientific evidence to answer questions or to support their findings.</p>	<p>I can set up a fair test investigating evaporation and explain how the test is fair.</p> <p>I can make careful and accurate observations, including the use of standard units in terms of temperature.</p> <p>I can measure accurately and precisely using a thermometer.</p> <p>I can use and spell scientific language.</p> <p>I can report my findings in different ways including oral and written explanations describing the water cycle.</p> <p>I can draw conclusions about evaporation based on my evidence and scientific knowledge.</p>

Assessment

1. Sort materials into solids, liquids and gases. What properties do they have?
2. How do these materials change when heated?
3. Look at the thermometers. What temperatures do they show?
4. How does temperature affect evaporation?
5. Describe the water cycle using the terms evaporation and condensation.
6. Is sand a liquid or a solid? How do you know?

Working towards	Age Expected	Exceeding
<p>I can group materials into solids, liquids and gases and start to describe their properties. I can observe and describe in simple terms how different materials change when heated and cooled. I can research the boiling and melting points of different materials with support. I can set up a fair test to investigate how temperature affects evaporation. I am starting to understand how I have made my test fair. I can investigate the effect temperature has on the rate of evaporation. I can measure using a thermometer. With support, I can explain the water cycle stating the role of condensation and evaporation</p>	<p>I can group materials into solids, liquids and gases and describe their properties. I can observe and describe how different materials change when heated and cooled. I can research the boiling and melting points of different materials. I can plan and set up a fair test to investigate how temperature affects evaporation. I can explain how I have made my test fair. I can explain the effect temperature has on the rate of evaporation. I can measure accurately using a thermometer. I can explain the water cycle stating the role of condensation and evaporation.</p>	<p>I can group materials into solids, liquids and gases and describe their properties. I know sand and other similar materials are solids. I can observe and describe in detail how different materials change when heated and cooled. I can independently research the boiling and melting points of different materials. I can confidently plan and set up a fair test to investigate how temperature affects evaporation. I can explain clearly how I have made my test fair. I can explain the effect temperature has on the rate of evaporation explaining why. I can measure accurately and precisely using a thermometer. I can explain the water cycle in detail stating the role of condensation and evaporation</p>

Key Vocabulary	
<p><u>Topic vocabulary</u></p> <p>Boiling- changing from liquid into gas.</p> <p>Condensation- the process of a gas cooling and changing into a liquid.</p> <p>Evaporation - the process of liquid heating and changing into gas.</p> <p>Freezing - changing from a liquid into a solid.</p> <p>Gas- substance that has no fixed shape like oxygen.</p> <p>Liquid- substance that can flow and take on the shape of a container.</p> <p>Melting- changing from a solid into a liquid.</p> <p>Solid- material that stays the same shape whether it is in a container or not.</p> <p>Temperature- a measure of how cold or hot something is.</p> <p>Water cycle- the process of water being recycled again and again.</p> <p>Water vapour- the gas state of water.</p>	<p><u>Scientific Enquiry Vocabulary</u></p> <p>Conclusion: To look at our results and explain what we have found out.</p> <p>Fair test- an investigation changing only one variable and keeping the others the same.</p> <p>Investigation - to find something out</p> <p>Measure- to find out the quantity of something.</p> <p>Observe - to look at something closely</p> <p>Record- to write down what we found out.</p> <p>Table- a way of organising your findings.</p> <p>Variable- A quantity or condition that can be changed.</p>

Character Opportunities	Possible STEM careers linked to unit
<p>Curiosity</p> <p>Resilience</p>	<p>Biochemist (investigates chemical processes that take place inside living things)</p> <p>Chemical engineer (solves problems involving chemicals)</p> <p>Materials scientist (researches structures and properties of materials)</p> <p>Nanoscientist (studies incredibly small things such as atoms)</p>

Activities in italics are in addition to the core activities

Key vocabulary is given in red

Further activities here <https://explorify.uk/teaching-support/teaching-science/states-of-matter-explore-with-your-class>

**See <https://www.hamilton-trust.org.uk/science/year-4-science/states-matter-states-matter-scientists/>

NC Objectives	Working Scientifically	Lesson Outcome	Activity
<p>Compare and group materials together, according to whether they are solids, liquids or gases.</p>	<p>Ask relevant questions, using different types of scientific enquiries to answer them</p>	<p>To begin to understand the properties of solids, liquids and gases</p>	<p>Introduce solids, liquids and gases by sorting objects according to their state .Identify the properties of solids, liquids and gases. Include solids such as sand, stone, gravel, salt,sugar, sugar cubes, sawdust, milk, honey, shaving foam Children sort into groups and explain reasoning. See Powerpoint https://www.hamilton-trust.org.uk/science/year-4-science/states-matter-states-matter-scientists/</p>
<p>Compare and group materials together, according to whether they are solids, liquids or gases.</p>	<p>Set up simple practical enquiries and comparative and fair tests. Record findings using simple scientific language, drawings and labelled diagrams.</p>	<p>To understand further properties of gases To understand that gas is all around, even if we can't see it</p>	<p>See session 2 https://www.hamilton-trust.org.uk/science/year-4-science/states-matter-states-matter-scientists/ Explore gas escaping from between rocks, soil, stones marbles etc Use annotated drawings to show findings</p>
<p>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).</p>	<p>Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers Make observations over time Record results in a table</p>	<p>To know that materials have different melting and freezing points</p>	<p>See session 3 resources https://www.hamilton-trust.org.uk/science/year-4-science/states-matter-states-matter-scientists/ Teach children how to measure temperature incl minus temperatures. Explore the melting points of various materials eg chocolate, ice cream etc Place juice etc in freezer and measure temperature Measure the boiling point of water (adult led)</p>

<p>Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.</p> <p>ii) 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</p>	<p>Ask relevant questions and use different types of scientific enquiries.</p> <p>Set up simple practical enquiries and comparative and fair tests.</p> <p>Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers</p>	<p>Children begin to understand the concept of evaporation</p>	<p>See session 4 resources https://www.hamilton-trust.org.uk/science/year-4-science/states-matter-states-matter-scientists/</p> <p>Evaporation</p> <p>Explore how puddles evaporate. Record using photographs</p> <p>Experiment using different conditions (eg use a hairdryer, colder/hotter water etc)</p> <p>Record comparisons using a table</p> <p>Discuss that this is the process of evaporation</p>
<p>Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.</p>	<p>Make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.</p> <p>Use straightforward scientific evidence to answer questions or to support findings.</p>	<p>Children understand the concept of the water cycle</p>	<p>Water cycle</p> <p>The adventures of Walter the Water Droplet: https://clarefearon.files.wordpress.com/2021/03/water-cycle2-1.pdf</p> <p>water cycle song: https://www.youtube.com/watch?v=qrLEHV580Mg</p> <p>Met office explanation : https://www.metoffice.gov.uk/weather/learn-about/met-office-for-schools/other-content/other-resources/water-cycle</p> <p>Learn about the water cycle incl terms: Precipitation, condensation, evaporation, water vapour</p>