



Looking at states

About this topic

Curriculum link: Year 4, States of matter

SUMMARY:

Children will learn about states of matter. They will compare and group materials together, according to whether they are solids, liquids or gases. They will observe that some materials change state when heated or cooled, and they will identify the part played by evaporation and condensation in the water cycle.

UNITS:

3.1: What's the matter?

3.2: Food changing state

3.3: The water cycle

ACTIVITY RESOURCES

- 3.1 What a state!
- 3.2 A watery end
- 3.3 Making ice-cream
- 3.4 Freezing substances
- 3.5 Cloud in a glass
- 3.6 The water cycle

ONLINE RESOURCES:

PowerPoint presentation: Looking at states

Interactive activity: Looking at states

CPD video: Looking at states

Pupil video: Looking at states

Word mat: Looking at states

Editable Planning: Looking at states

Topic Test: Looking at states

Learning objectives

This topic covers the following learning objectives:

- 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.

Working scientifically skills

This topic develops the following working scientifically skills:

- Ask relevant questions and use different types of scientific enquiries to answer them.
- Set up simple practical enquiries, comparative and fair tests.

- Make systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.
- Gather, record, classify and present data in a variety of ways to help in answering questions.
- Record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables.
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.
- Use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.
- Identify differences, similarities or changes related to simple scientific ideas and processes.
- Use straightforward scientific evidence to answer questions or to support their findings.



CROSS-CURRICULAR LINKS

This topic offers the following cross-curricular opportunities:

English

- Making lists, e.g. solids, liquids and gases.
- Drafting and re-drafting definitions, e.g. solids, liquids, gases.

- Creative writing based on ice hands.
- Use headings and sub-headings when writing up tests.
- Writing instructions, e.g. making ice hands.
- Annotating diagrams.
- Create an advert for saving water.
- Research different melting points.

Numeracy and mathematics

- Measurement, volume and time.
- Bar graphs, e.g. of melting and boiling points of different substances.
- Reading line graphs.
- Temperature, reading scales.
- Negative numbers.
- Sorting and Venn diagrams.

Computing / ICT

- Using digital thermometers.
- Making and reading computer-generated bar and line graphs.
- Using PicCollage to create water and ice montages.
- Photography and video activities.

STEAM (SCIENCE TECHNOLOGY ENGINEERING ART AND MATHS) OPPORTUNITIES

Invite into class

- Someone from local water company to explain how water gets to the home.
- University outreach – scientist to show and explain activities related to water.
- Request a STEM ambassador with knowledge and skills about water treatment, saving water, sewage treatment and careers.
- Artist to develop new approaches, e.g. watercolour wash paintings
- Photographer to teach children techniques.
- IT professional to work with children to make a video on the water cycle.
- Writer to develop creative writing linked to solids, liquids and gases.

Visit

- Site visit to a local water treatment works.
- Local canal – Canal and River Trust
- Local manufacturer that uses water in different states, solid, liquid and gas.

Drama

- Role-play the water cycle.
- Role-play solids, liquids and gases.

Design technology

- Make a water cycle model.

Art

- Painting using water colours.
- Watercolour wash paintings.
- Photography – raindrops, puddles, ripple and splashes.



TEACHER SUBJECT KNOWLEDGE

A material may exist in three states: solid, liquid, and gas. The state that a material is in depends on the temperature. Water, for example, is in its solid state (ice) at 0°C or below, liquid state (water) between 0 and 100°C and, at temperatures of 100 °C and above, water exists in the gas state, as steam. It is unique in having different names for each state of matter.

When a sample of a material is in the solid state, you can hold it in your hands. You can form it into a pile. It is not easy to change the shape of a material in the solid state. You may question this: a sponge is a solid. You can squash a sponge, but it is the air you are ‘squeezing’, not the sponge itself.

When a material is in the liquid state, you cannot hold it in your hands. It forms a pool, not a pile. Liquids take the shape of the bottom of the container they are in. Another misconception would be about sand being a solid but it runs through your fingers. You need to consider each grain as a tiny solid.

In the gas state, a material escapes from an unsealed container. It spreads out to fill all the space available, and takes the shape of the entire container.

When a sample of a material melts, it turns into a liquid, because heat has been applied. Pure water melts at 0°C and gold melts at 1064°C. You can tell a material is melting if, when taking in heat, it is

present in both its solid and liquid states, such as an ice cube with a pool of water present.

Pure water and gold melt very suddenly because they are pure substances. The melting point of a substance is the same, however big the sample. Margarine and chocolate are mixtures of substances. For this reason, they do not have sharp melting points, but melt over a range of temperatures.

The reverse of this change of state, i.e. from liquid to solid, is called freezing. When cooled, a pure substance in its liquid state freezes when it reaches a certain temperature, which is also its melting temperature. It will remain at this temperature until all the liquid has frozen. The temperature at which a particular material freezes does not change no matter how much material is present. As with melting, it is only the time taken for the change to occur that increases with an increase in the amount of material.

A mixture of salt and water freezes at a lower temperature than pure water. This means that lower temperatures can be achieved by mixtures of ice and salt than by ice alone. This principle is the reason for salting roads in winter.

Evaporation can happen at any temperature. The higher the temperature, the faster a material evaporates.

Evaporation is speeded up if moving air carries the particles away from the surface of the liquid. It is evaporation that dries wet clothes, and that dries the wet kitchen paper in the investigation in this unit.

Boiling occurs throughout a material in the liquid state. Bubbles rise to the surface, where they escape to the air.

A material can change from the gas state to the liquid state by condensing. Condensing happens at any temperature below the boiling point, but happens most readily at cold temperatures.

These processes are linked in the water cycle.

The Sun heats up a water source so that particles of water escape (evaporation takes place). The

vapour rises and cools, or the vapour condenses into droplets. These gather together to form clouds, which it drops as rain once there is too much water for them to hold. Rain fills streams and rivers and other water sources so that the process continues in a cycle.

Sometimes, water droplets in the atmosphere freeze to form tiny ice crystals. These tiny ice crystals may collide and stick together in clouds to form snowflakes. If the snowflakes get heavy enough, they fall to the ground as snow. Snow eventually melts, and moves into streams and rivers, so the water cycle continues. Hail, is a water droplet that has frozen after it has left the cloud.

Top tip: The Met Office website (www.metoffice.gov.uk/learning) has some weather-related explanations, video clips and ideas for further activities.



CHILDREN'S MISCONCEPTIONS

Children might think...

- That materials always exist in just one state.
- That ice is a different material from steam or liquid water, not water in different states.
- Soft things are not solids.
- Powders are not solids because they can be poured and take the shape of their container, e.g. sand and flour.
- That only water boils.
- That there aren't temperatures below zero or above 100°C.
- That everything freezes at 0°C.

Children already know...

- How to describe simple physical properties of everyday materials.
- How to compare and group together a variety of everyday materials.
- How to compare using observations.
- That materials are either solid, liquid or gas.
- That ice melts at 0°C.
- That ice and water can be present at the same time.



SCIENTIFIC VOCABULARY

You can download a Word mat of essential vocabulary for this topic from *My Rising Stars*.

boiling point: the temperature at which a liquid turns into a gas

boiling: when a material reaches a temperature when it bubbles and turns into a gas rapidly

condensing: the process when a gas turns into a liquid

evaporation: when a liquid turns into a gas, below its boiling point

freezing: when a liquid turns into a solid

freezing point: the same temperature as a material's melting point. This is the temperature at which a liquid turns into a solid

gas: a state of a material when it fills the entire space available

liquid: a state of a material when it can flow from one place to another, and can be poured

matter: another name for 'material'

material: what an object is made of (not just fabric)

melting: when a solid turns into a liquid


melting point: the temperature at which a solid melts

solid: a state of a material when it cannot change shape, but holds the shape of whatever container it was frozen in


temperature: a measurement of how hot or cold something is

thermometer: a device or instrument used to measure temperature

water cycle: how water moves around to create clouds, rain and the weather



Did you know?



- Water is a very special substance. The Celsius temperature scale is based on the temperatures at which it changes to ice and steam – but what are these states?
- Not all solids are hard. Can you find examples that aren't hard?
- Even the air around you can be a solid. But not with you alive in it! You would freeze to death, as air freezes at -215°C . That's over 200° below the freezing point of water.