

YEAR 4 UNIT 3: Looking at States (States of Matter)

Enquiry Question: What happens to materials if they are heated or cooled?

Related units: Year 2 unit 2:-Why are materials suitable for different jobs? How can the shape of materials be changed? Year 5 unit 2: How can materials change?

Unit overview

National Curriculum year 4: States of Matter

Pupils will be taught to compare and group materials together, according to whether they are solids, liquids or gases. They will 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) They will identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. Children already know how to describe simple physical properties; how to compare and group together everyday materials and how to compare carefully. They also know that materials are either solid, liquid or gas; that ice melts at 0 degrees and that ice and water can be present at the same time.

Assessment (Expectations)

1. Describe how to change water into ice and steam and steam into water
2. Name a solid, a liquid and a gas
3. Explain the water cycle
4. Explain what evaporation and condensation is

Scientific vocabulary

- solid
- liquid
- gas
- temperature
- thermometer
- solidify
- identify
- boiling
- melting point
- freezing
- melting
- freezing point
- evaporation
- condensing
- water cycle
- matter

Working Scientifically

- Grouping and classifying a variety of different materials
- Exploring the effect of temperature on substances such as chocolate, butter, cream e.g. to make food such as chocolate crispy cakes and ice-cream for a party
- Research the temperature at which materials change state
- Observe and record evaporation over a period of time
- Make careful observations
- Record what has been observed

Cross-curricular links

Maths opportunities:

- To count backwards through zero, including negative numbers.

English opportunities:

- To write scientifically using headings and subheadings appropriately
- Use scientific vocabulary

Teacher 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 as 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. 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. 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.

Did you know?

- A tonne of feathers weighs the same as a tonne of lead. But why might people disagree?
- 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 they?
- Not all solids are hard. Can you find any?
- 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!

Misconceptions: Children might think:

- That materials always exist in just one state: (materials may exist in three states: solid, liquid, and gas).
- That ice is a different material from steam or liquid water, not water in different states: (the state that a material is in depends on the temperature).
- That there aren't temperatures below zero or above 100 °C: (e.g. Pure water melts at 0°C and gold melts at 1064°C).
- That only water can be found in different states: (e.g. Gold, butter, chocolate).
- That water disappears when it evaporates: (it changes state to a gas).
- That freezing and melting points are the same 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).
- That only water boils

Resources

www.vrml.k12.la.us/dcarroll/science%20quizzes.htm has some useful PowerPoints with information on – the first on matter is great to introduce different ways of sorting.

www.stem.org.uk/elibrary/collection/2888 has links to some really useful resources from the Science Year from ASE (the Association for Science Education: www.ase.org.uk)

www.metoffice.gov.uk/education/kids/things-to-do/experiments/cloud

www.kidzone.ws/water/ summarises nicely the main features of the water cycle.

The Met Office web site (www.metoffice.gov.uk/learning) has some weather related explanations, video clips and ideas for further activities.