States of matter

Definition: States of matter – is one of the distinct forms in which matter can exist Solid – firm and stable in shape Liquid – a substance that flows freely but is of constant volume Gas – a substance or matter in a state in which it will expand freely to fill the whole container

Chemistry definition: the branch of science that studies the properties of matter and how matter interacts with energy

POS: Y4 States of matter

- 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:

- To know what a material is
- Name objects and their properties
- Classify objects based on their properties

Links to other science topics:

- Everyday materials Y2
- Rocks – properties of rocks

Disciplinary concepts:
Changes: How might materials change state?
Process: What is the process of the water cycle?

Common misconceptions:
Many children think of solids as being strong and hard materials. Identifying soft solids like cotton wool or granular solids like sugar is more challenging. Most gases are invisible, which makes it hard to prove to children that they are there. If you show an "empty" bottle to young children, many of them will say that there is nothing inside it. Some older children will know that it contains air.
To help your class understand the nature of gases you can spray some perfume at the front of the classroom and ask the children to put their hands up when they can smell it. After being sprayed into the air, the perfume vaporises/evaporates into a gas and spreads out across the room to fill the available space. The children can't see the perfume, but they can tell it is there because they can smell it. A common misconception held by children is that solids become lighter when they melt.

Core Knowledge:

- 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 available space; it has no fixed shape or volume.
- Melting is a state change from solid to liquid.
- Freezing is a state change from liquid to solid. The freezing point of water is $0^{o}C$.
- Boiling is a change of state from liquid to gas that happens when a liquid is heated to a specific temperature and bubbles of the gas can be seen in the liquid. Water boils when it is heated to $100^{o}C$.
- Evaporation is the same state change as boiling (liquid to gas) but it happens slowly at lower temperatures and only at the surface of the liquid. Evaporation happens more quickly if the temperature is higher, the liquid is spread out or it is windy. Condensation is the change back from a gas to a liquid caused by cooling.
- Water at the surface of seas, rivers etc. evaporates into water vapour (a gas). This rises, cools and condenses back into a liquid forming clouds. When too much water has condensed the water droplets in the cloud get too heavy and fall back down as rain, snow, sleet etc. and drain back into rivers etc. This is known as precipitation. This is the water cycle.

Wider working knowledge:
Why is the water cycle so important? Website: gpm.asa.gov – why are water cycle processes important? Ancient history of Matter (links to Ancient Greece philosopher) website: chem.libretexts.org – Ancient history of matter. Everything we see, smell or touch is made of tiny particles called atoms and these can be arranged in different ways to make solids, liquids or gases. Antoine Lavoisier, Robert Boyle, John Dalton. Link to Africa and the drought that began in 2018 - 2020 and it's impact - lack of the water cycle - importance of it.

Working scientifically:

- Observe closely and classify a range of solids, liquids and gases
- Explore making gases visible e.g. squeezing sponges under water to see bubbles, and showing their effect ,using straws to blow objects, trees moving in the wind
- Observe a range of materials melting e.g. ice, chocolate, butter
- Investigating melting point of different materials e.g. ice, margarine, butter and chocolate
- Explore freezing different liquids e.g. tomato ketchup, oil, shampoo
- Use a thermometer to measure temperatures e.g. icy water (melting), tap water, hot water, boiling water (demonstration)
- Observe water evaporating and condensing e.g. on cups of icy water and hot water
- Set up investigations to explore changing the rate of evaporation e.g. washing, puddles, handprints on paper towels, liquids in containers

End points:

- To name a variety of solid, liquids and gases and explain why they know which they are
- To name the process of how to change from one state to another
- To explain the water cycle

CPD: Reach out – States of matter Science Association PLAN London Assessment Network