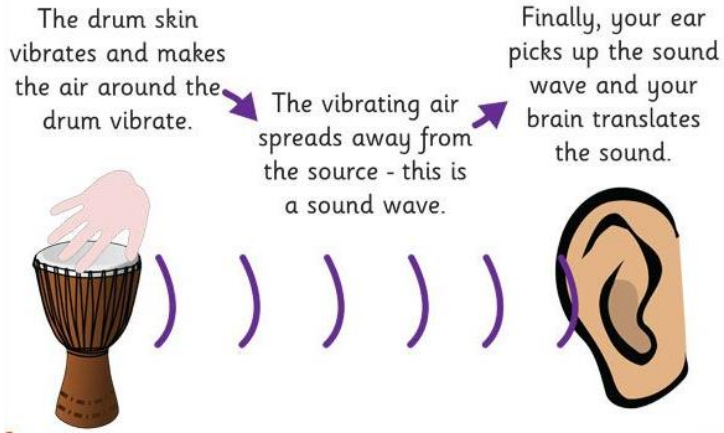
Y4 SCIENCE KNOWLEDGE - ORGANISER AUTUMN 1: WHAT ARE SOUNDS AND HOW DO WE HEAR THEM?
THRESHOLD CONCEPT: PHYSICS – INVESTIGATE SOUND AND HEARING

Key Vocabulary			
vibration	A movement back and forth to create a sound.	vacuum	A space with nothing in it— not even air.
wave	A form that sound takes as it moves through air, water etc. Recorded on a graph.	sound proof	Something such a material that prevents the passage of sound through it.
volume	The loudness of a sound.	decibel	A unit measurement given to the loudness or intensity of a sound.
pitch	The quality related who whether sounds are 'high' or 'low'.	eardrum	The part of the ear that vibrates when receiving sounds.
tone	A musical or vocal sound with reference to its pitch, quality, and strength.	insulation	Material used to trap air and sound.

Sound is a type of **energy**. Sound is produced by vibrations, even when it is hard to see them. The vibrations travel through the air and are detected by our ears. Within the ear is an ear drum which vibrates and turns the vibrations into signals to the brain, which then 'hears' thecsounds.

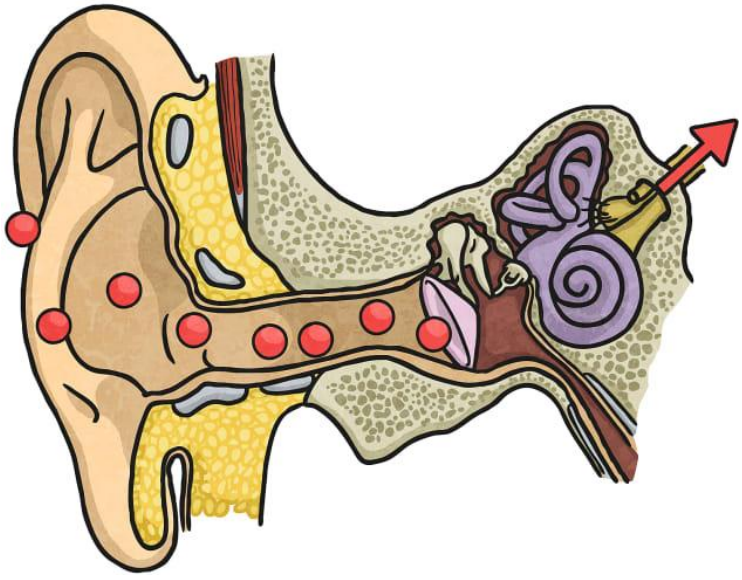
The **loudness of a sound** depends on the size of the vibration: the bigger the vibration, the louder the sound. The greater the volume of air vibrating, the louder the sound will be. A large drum struck with the same force as a small drum will sound louder because the bigger drum can make more of the air move, simply by have a bigger 'skin' to vibrate. A vibrating tuning fork cannot be heard until the stem is placed on a table. This causes the table to vibrate very slightly, but there is a large volume of air in contact with it compared to the small volume of air in contact with the prongs of the tuning fork.

Sound waves spread out in all directions from the source of the sound. The front of the wave is in the shape of a sphere, which gets larger as the wave moves through the air. The energy from the source is spread out over the surface of the sphere.



Super Scientist
As a scientist, da Vinci was interested in how sound moves through different materials. He is often credited with discovering that sound travels in waves, allowing Galileo to later on discover more properties of sound waves.

Sound (or vibrations) enters the ear through the ear canal. When sound waves reach our ear, it travels through the ear canal and hits the eardrum, causing vibrations. The eardrum sends these vibrations to three tiny bones in the middle of the ear (the hammer, the anvil and the stirrup) into the inner ear. The inner ear is known as the cochlea and is shaped a bit like a snail. There are thousands of tiny hair cells inside the cochlea. These hair cells change the vibrations into electrical signals that are sent to the brain through the hearing nerve. The brain tells you that you are hearing a sound and what that sound is.



Y4 SCIENCE KNOWLEDGE - ORGANISER AUTUMN 2: HOW DO WE CLASSIFY LIVING THINGS AND WHAT DANGERS FACE THEM AND THEIR HABITATS?

THRESHOLD CONCEPT: BIOLOGY – INVESTIGATE LIVING THINGS

Key Vocabulary			
skeleton	The bones of the body form a framework called the skeleton. This framework supports and protects the softer tissues.	ecology	The study of organisms, and how living and non-living things interact with each other.
environment	The environment refers to the surroundings in which life exists on earth.	characteristics	A distinguishing quality.
classification key	To arrange or group things into categories depending on characteristics.	cold-blooded	An animal whose body temperature varies with the environment they are in, i.e. fish.
habitat	A natural environment for any type of living organism.	exoskeleton	An external covering of the body found in some invertebrates such a as arthropods.
species	A group of similar organisms that are able to reproduce.	warm blooded	Animals that maintain a regular body temperature
vertebrate	An animal with a backbone.	invertebrates	An animal without a backbone

There are millions of different **plant** and **animal species** in the world. It's currently estimated that there are around 1.3 million animal species (of which 1 million are insects!) and 320,000 plant species. We use the word 'species' to describe a group of living things that are so similar.

Insects are the only invertebrates that are able to fly. This has played a major role in their success.

Living things are divided into groups, with members of each group having similar features. The obvious first grouping is whether something is an animal or a plant (or fungus or microbe).

Why classify?
The process of classification makes it easier to identify a species when it is discovered, and to see whether it is an existing species or a new species. It can also help to see which species are closely related in evolutionary terms.

The animal kingdom can be divided into two broad groups based on whether they have a backbone **(vertebrate)** or not **(invertebrate)**. The five groups of vertebrates are fish, amphibian, reptile, bird and mammal. The plant kingdom can also be divided into two groups: flowering and non-flowering plants.

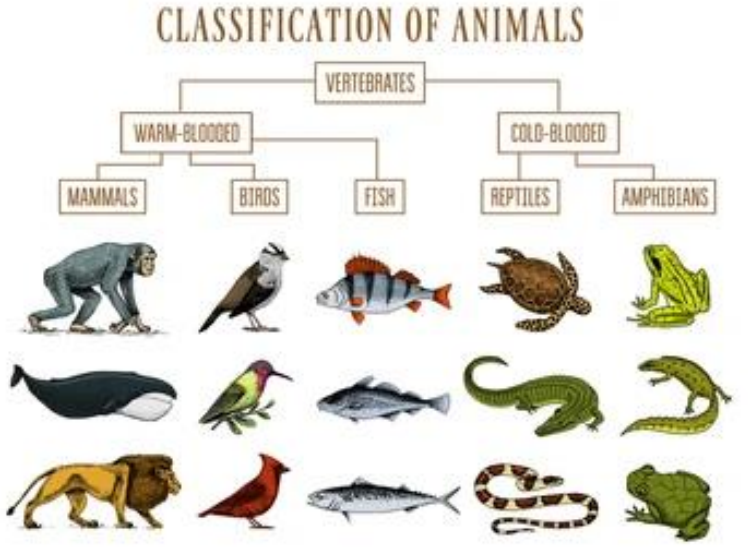
Fish, reptiles and amphibians are cold-blooded. **Amphibians** have lungs, which allow them to spend a lot of time out of water, but they return to water to lay lots of jelly-like eggs. **Reptiles** have dry scaly skin and live on land, where they lay their eggs – these look a lot like bird eggs. **Mammals** and **birds** are warm-blooded. Birds are covered in feathers and lay eggs with a hard shell. Mammals all have fur (or hair) – even if it is very fine, as in the case of whales and dolphins. They all give birth to live young and female mammals produce milk to feed them.

Super Scientist
Carl Linnaeus was a Swedish botanist, physician, and zoologist who formalised the system for classifying organisms.

His work has influenced many generations of prominent scientists, including Charles Darwin and Gregor Mendel.

Myriapods (meaning 'many legs') have long, thin bodies with many segments and a hard exoskeleton (exo- meaning 'outside').
Centipedes have one pair of legs per body segment and can have between 20 and 300 legs.
Millipedes have two pairs of legs per segment and can have between 36 and 400 legs – not the million legs that you might think they have!

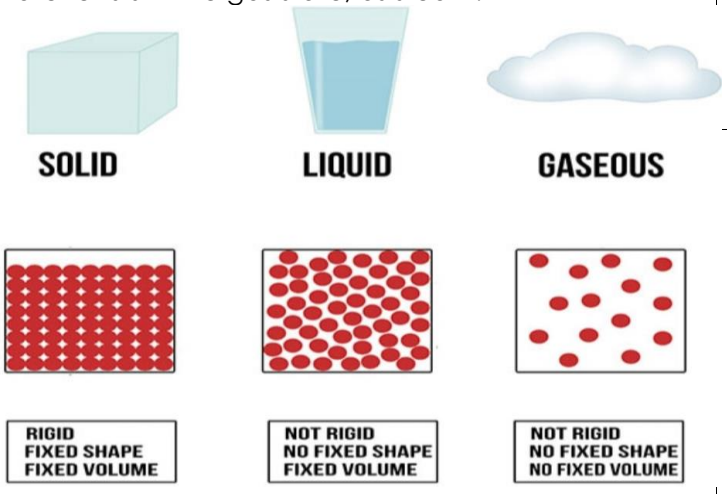
The **arachnids** (including spiders and scorpions) have four pairs of legs and a two-part body. They have a hard exoskeleton, which often forms lots of protective bristles.



Y4 SCIENCE KNOWLEDGE - ORGANISER SPRING 1: WHAT ARE THE STATES OF MATTER AND CAN THEY CHANGE?
THRESHOLD CONCEPT: CHEMISTRY – INVESTIGATE MATERIALS

Key Vocabulary			
solid	An object with a definite shape. The particles in a solid are tightly packed together, and cannot move about	temperature	A degree of hotness or coldness the can be measured using a thermometer.
liquid	A substance that flows freely but is of constant volume.	precipitation	Liquid or solid particles that fall from a cloud as rain, sleet, hail or snow.
gas	A substance which will expand freely to fill a whole container and has no fixed shape or volume.	heating	Heat is the transfer of energy from one object to another.
evaporation	The process of turning a liquid into a gas.	reversible	Materials can be changed back to how they were before the reaction took place.
condensation	The process of turning a gas into a liquid.	irreversible	A change is called irreversible if it cannot be changed back again.
particle	An extremely tiny piece of matter	freezing	A change of state from liquid to solid.
states of matter	Materials can be one of three states: solids, liquids or gases. Some materials can change from one state to another and back again.	melting point	The temperature at which a given solid will melt

A material may exist in **three states: solid, liquid, and gas.** The particles of these states all behave differently. 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.



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.

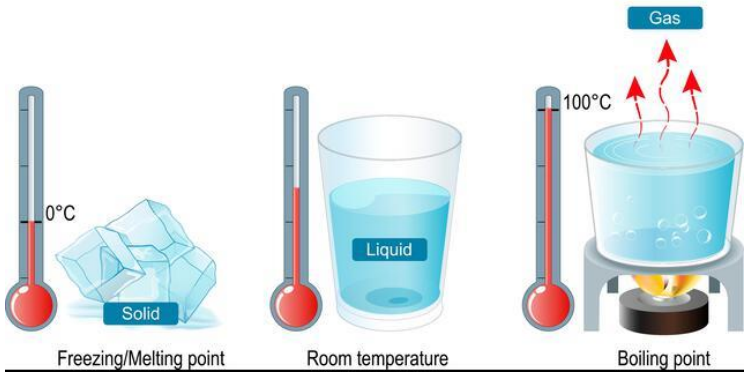
When a material is in the **liquid state**, you cannot hold it in your hands. It forms a pool, not a pile. Liquids take the shape of the bottom of the container they are in. Another misconception would be about sand being a solid but it runs through your fingers. You need to consider each grain as a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

Super Scientist
John Dalton
1766 – 1844
In 1803 he proposed matter is made up of atoms that are indivisible and indestructible.

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.
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.

Freezing, Melting and Boiling points of water



There are bonds between particles in a solid; as temperature increases, these bonds are partially overcome as the particles absorb energy and solids can change into liquids; with an increase in temperature the particles become even more energetic and the bonds are overcome entirely so the liquid changes into a gas.

Y4 SCIENCE KNOWLEDGE - ORGANISER SPRING 2: WHY ARE OUR TEETH AND DIGESTIVE SYSTEM IMPORTANT?
THRESHOLD CONCEPT: BIOLOGY – UNDERSTAND ANIMALS AND HUMANS

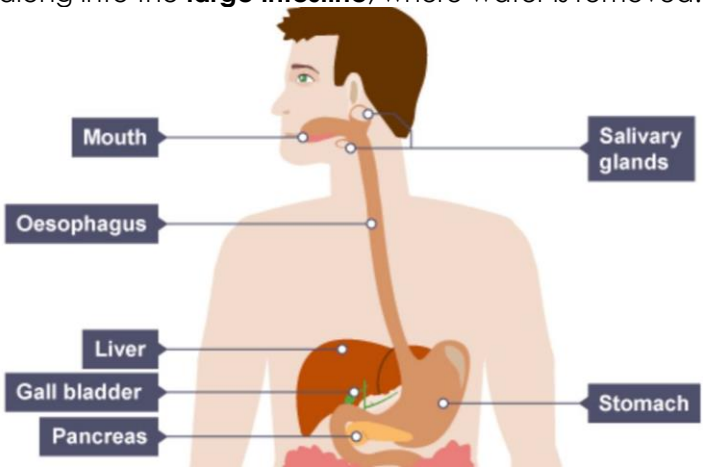
Key Vocabulary			
mouth	The place where food is chewed and mixed with a clear liquid called saliva.	nutrients	A substance that offers nourishment to the body. We need these to be healthy.
tongue	An organ, or body part, in the mouth. It is made up of a group of muscles.	stomach	An organ which helps to break down food.
teeth,	Teeth are the hardest substances in the human body. Besides being essential for chewing, the teeth play an important role in speech.	canine	The sharp pointy teeth in mammals' mouths.
oesophagus	A muscular tube connecting the throat and the stomach.	incisor	Teeth useful for biting because they cut sharply.
absorb	To take something in.	molar	Teeth used for grinding food.
small intestine	The small intestine breaks down food from the stomach and absorbs much of the nutrients from the food.	producer	The name given to a living thing that produces its own food, rather than consuming another living thing.
large intestine	Food material is turned into faeces, or solid waste.	salivary gland	A gland which produces saliva (spit) to help you digest your food.

Humans are **omnivores**, meaning we eat both plants and animals, and our teeth have evolved to suit our diet.

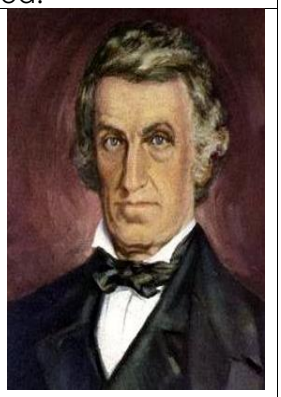
Our **digestive system** is made up of organs that take in food, including our mouth and teeth, which start off digestion as a mechanical process, to then digest it chemically to extract energy and nutrients, and expel the remaining waste.

Food contains large, complex chemicals such as carbohydrates, proteins and fats. To be of use to the body, they must be broken down into smaller chemicals:

Digestion starts in the mouth. Teeth provide mechanical breakdown of the food, then saliva moistens food so that it slides down the **oesophagus** into the stomach. The stomach is a bag of muscle that breaks up food by churning it around. It also contains hydrochloric acid, which kills off bacteria in the food, and enzymes, which further break down carbohydrates and proteins, starting the chemical breakdown of the food. After a few hours in the **stomach**, food travels down the **duodenum (small intestine)**, where it is broken down further and sends the nutrients around the body in the blood. The solid waste such as fibre that can't be digested continues along into the **large intestine**, where water is removed.

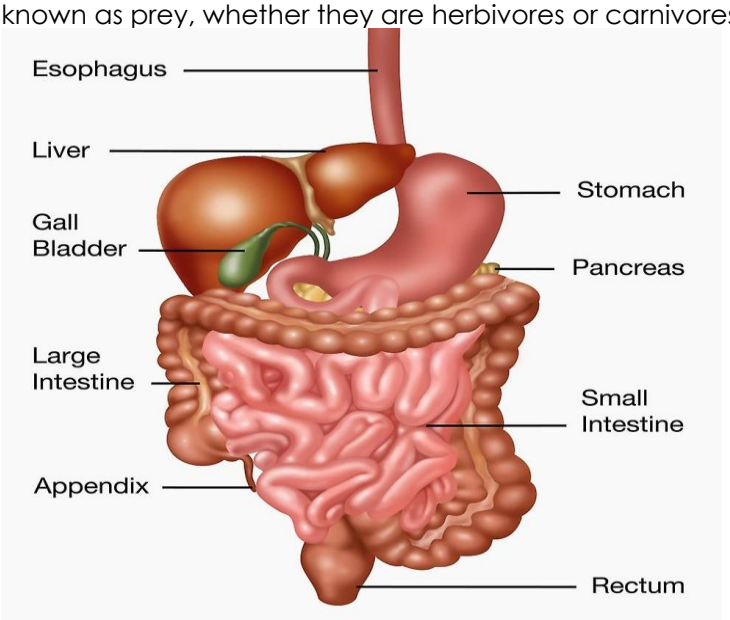


Super Scientist
William Beaumont
1785 – 1853
Beaumont was a U.S. army surgeon, the first person to observe and study human digestion as it occurs in the stomach.
Most of the experiments were conducted by tying a piece of food to a string and inserting it through the hole in a patient's stomach.
Every few hours, Beaumont would remove the food and observe how well it had been digested.



All living things need energy to survive. Plants are able to use the energy from the Sun to produce their own food. Animals are unable to make their own food so have to eat other living things to get their energy.

Other animals have adapted to eating only other animals and get their energy from meat. These animals are known as carnivores. Animals that eat other animals are known as predators, with the animals that they eat known as prey, whether they are herbivores or carnivores.



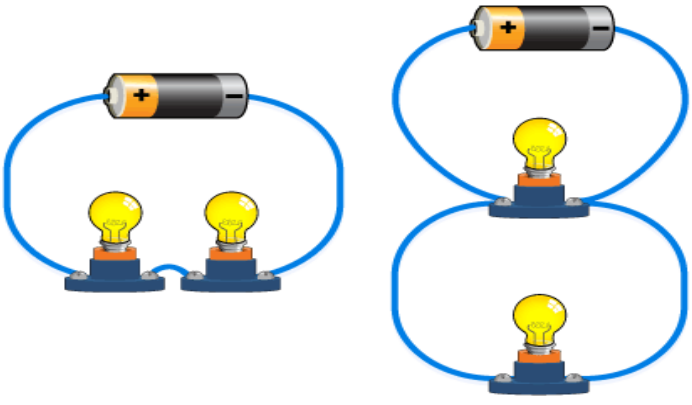
Y4 SCIENCE KNOWLEDGE - ORGANISER SUMMER 1: WHAT ARE ELECTRICAL CIRCUITS AND HOW DO THEY WORK?
THRESHOLD CONCEPT: PHYSICS – UNDERSTAND ELECTRICAL CIRCUITS

Key Vocabulary			
appliance	A machine in your home that you use to do a job such as cleaning or cooking.	series	A looped circuit where the electricity flows from the positive to negative terminal of the battery.
battery power	The main source of energy that provides a voltage, which allows the current to flow through.	motor	An electrical machine that converts electrical energy into mechanical energy.
main power	The term used to refer to the electricity supply from power stations to households.	switch	A component within an electrical circuit, which enables the flow of electricity to be turned on and off.
circuit	A complete path around which electricity can flow.	break in circuit	A break along the circuit, which stops the current travelling.
insulator	Materials that do not allow electricity to pass through them with ease	conductor	Materials which allow electricity to flow through them with ease.
cell	Part of a battery.	wire	Wire used to carry electricity
battery	A device that can make electricity	bulb	A device used to create light (illumination)

Electricity is the most useful form of energy. It can be transformed into other forms of energy relatively easily. It makes things turn using motors, heats and lights up places like our homes, and produces sound in loudspeakers. Most mains electricity is produced in power stations and carried to users by overhead power lines.

Batteries contain chemicals, which react in a special way to produce an electric current. Voltage indicates the amount of energy delivered by a source of electricity. The **voltage** of the most common household batteries varies from around 1.5V to 12V, Mains electricity in this country is 230V. Overhead power cables carrying sufficient supply for thousands of users can carry voltages as high as 400,000V.

There are two types of circuit. A **series circuit** has all its components wired into one simple circuit: all the components are one after another, as in a series on television. A **parallel circuit** is one with different branches which behave like mini-circuits and can work independently of each other.

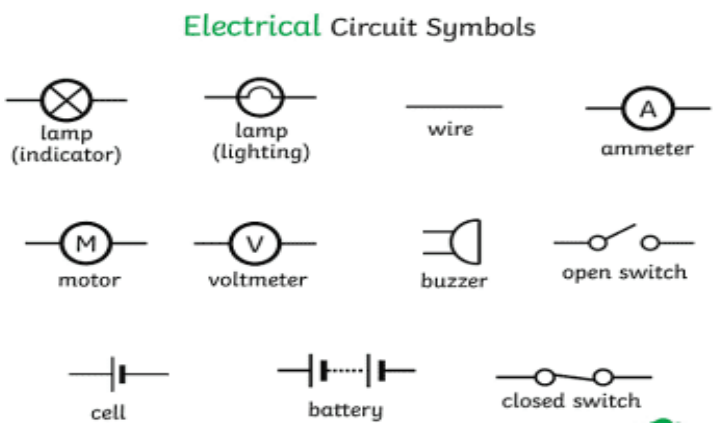


Super Scientist
Maria Telkes
1900 – 1995
Maria is a famous scientist who made lots of discoveries around solar power. She is best known for creating the first house built with a heating system that ran completely on solar energy.

Metals are good **conductors** of electricity. Most non-metals do not conduct electricity. They are **insulators.**

Conventional bulbs contain a filament made from wire. As electrons flow through the wire, they encounter resistance. When a wire is very thin, it has a large resistance. The electrons get hot as they try to move through it (just as people do going through a small doorway!) and we can feel this. If it gets very hot, it glows – as in the filament of a light bulb.

When investigating the changing of components in a circuit, the brightness of a bulb depends on the current or number of electrons passing through it. The more bulbs you have, the slower the electricity flows because the battery 'runs out of push', so the electrons flow more slowly, due to the resistance through the wires, and the bulbs, so the dimmer the light.

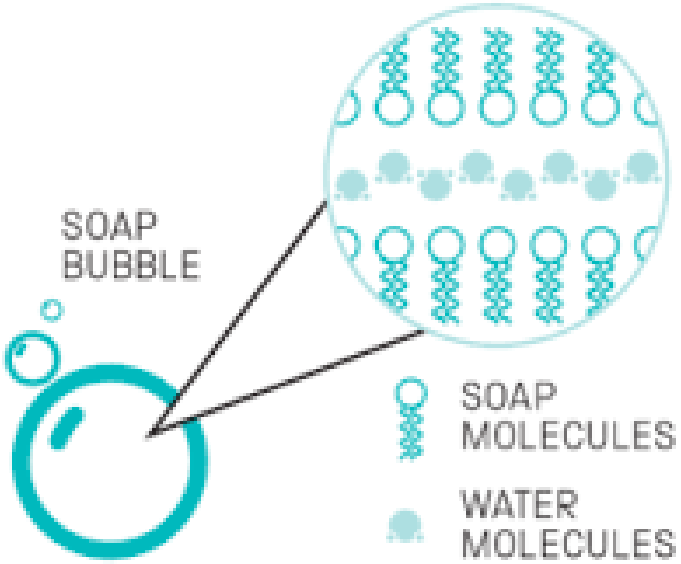


Y4 SCIENCE KNOWLEDGE - ORGANISER SUMMER 2: WHAT IS THE SCIENCE BEHIND BUBBLES?
THRESHOLD CONCEPT: CHEMISTRY – INVESTIGATE MATERIALS

Key Vocabulary			
diluted	A solution with a lot of water	concentration	The ratio of water (solvent) to substance (solute).
solute	A substance that has been dissolved in another substance	bubble	A thin sphere of liquid enclosing air or another gas.
solution	A mixture of one or more solutes dissolved in a solvent.	mixture	A substance made by mixing other substances together.
solvent	The substance that does the dissolving.	carbon dioxide	Gas found in the air and in fizz
concentrated	A solution with a small amount of water	sphere	A shape that's round like a ball.

A **bubble** is a thin film of soapy water filled with gas. Most bubbles are filled with air, but you can use other gases, such as carbon dioxide.

The film that makes the bubble has three layers. A thin layer of water is sandwiched between two layers of soap molecules.



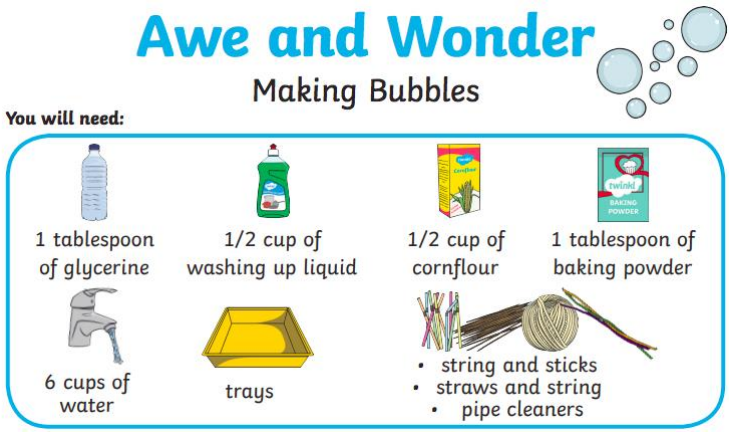
When you blow a bubble, the film expands outwards. The forces acting between the molecules of the bubble cause it to form the shape that encloses the most volume with the least surface area – in other words, a sphere. No matter what shape a bubble has initially, it will try to become a sphere. This is the shape that requires the least energy to achieve.

Bubbles pop all of a sudden because the water in the bubble mix simply evaporates. Glycerine/ glycerol gives the mixture extra strength, by making the soap layer thicker, which slows down the evaporation process.

Bubbles don't stay as spheres. When two bubbles meet, they merge their walls to minimise their surface area. If bubbles that are the same size meet, then the wall that separates them will be flat.

Super Scientist
Robert Hooke
In 1672, the English scientist Robert Hooke made a mass of bubbles, which was created in a soap solution by blowing into it through a glass tube.

Yeast is a single celled fungus that is 50% protein and is a rich source of vitamin B. It is always floating around in the air but is often too small for the human eye to see. Yeast grows best on foods with a lot of sugar or starch, such as fruit. Like every living thing, yeast produces carbon dioxide as it grows and requires oxygen to survive. It also respires, and is the ingredient, which makes champagne fizzy and makes bread rise.



Aero bars are made from chocolate in a liquid state that's just on the verge of solidifying. The exact recipe for making the bubbles so evenly spaced is a closely guarded commercial secret. Maltesers are made in two stages, which again are a closely guarded secret. The inner crunchy part is made from small pellets of a dough-like mixture. This is placed in a low-pressure container, which forces the bubbles in the mixture to expand, making the pellets larger. The pellets are then coated with chocolate and polished.