Year 4

Working scientifically

During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, **comparative** and **fair** tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to **draw simple conclusions**, **make predictions** for new values, **suggest improvements** and **raise further questions**
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Topic and objectives	Lesson ideas	Key Words	Misconceptions
Living things and their habitats Pupils should be taught to: • recognise that living things can be grouped in a variety of ways • explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment • recognise that environments can change and that this can sometimes pose dangers to living things	Use the local environment throughout the year to raise and answer questions that help them to identify and study plants and animals in their habitat. Identify how the habitat changes throughout the year. Explore possible ways of grouping a wide selection of living things that include animals, flowering plants and non-flowering plants. Children could begin to put vertebrate animals into groups, for example: fish, amphibians, reptiles, birds, and mammals; and invertebrates into snails and slugs, worms, spiders, and insects. Explore examples of human impact (both positive and negative) on environments, for example, the positive effects of nature reserves, ecologically planned parks, or garden ponds, and the negative effects of population and development, litter or deforestation. Learn about endangered and threatened species. Work scientifically by: using and making simple guides or keys to explore and identify local plants and animals; local living things. What is the common link between chocolate biscuits and orangutans? Find out by looking at rainforests in Sumatra and how deforestation has occurred in order to grow oil palm plantations and how this has affected orangutans. They name oils found in different foods and think about where they come from, then identify foods that contain palm oil. They also consider the effect of so much palm oil in the foods readily available to us. **Scientist – Jacques Cousteau – Marine Biology**	***Following on from Year 2 Key words*** environment, flowering, non-flowering **vertebrate** fish, amphibians, reptiles, birds, mammals **invertebrate** snails, slugs, worms, spiders, insects **human impact** positive – nature reserves, ecologically planned parks, garden ponds negative – population, development, litter, deforestation	Misconception: All ocean creatures are 'fish', e.g. whales, dolphins. Fact: Whales, dolphins, jellyfish and shellfish are not fish, but seahorses and sea dragons are fish! Misconception: All fishes lay eggs. Fact: Some fishes give birth to live young, e.g. guppy, molly, swordtail, most types of sharks Misconception: Differences between vertebrates and invertebrates Fact: Vertebrates are animals with backbones (vertebrae) or spinal column, e.g. birds, fishes, mammals, reptiles and amphibians; Invertebrates do not have backbones, e.g. insects, worms, molluscs Misconception: Spiders are insects; any tiny creepy crawlie is an insect. Fact: Spiders are not insects. They are arachnids, belonging to the same group as scorpions. They have four pairs of legs and two body segments. Insects have three pairs of legs and three body segments. Misconception: Turtles and penguins are amphibians. Fact: Turtles are reptiles and penguins are birds. Misconception: Only large land mammals are animals. Fact: There are many different types of animals such as worms, spiders, sea anemone and corals.
Animals, including humans	Children should be introduced to the main body parts associated with the digestive system, for example: mouth, tongue, teeth, oesophagus, stomach, and small and large intestine, and explore questions that help them to understand their special functions.	Human digestive system, mouth, oesophagus, small	Whilst teaching about food chains it may be confusing to say that energy is passed along food chains, as it is biomass (biological material). At each level most of the biomass is used by the

Pupils should be taught to: • describe the simple functions of the basic parts of the digestive system in humans • identify the different types of teeth in humans and their simple functions • construct and interpret a variety of food chains, identifying producers, predators and prey	Work scientifically by: comparing the teeth of carnivores and herbivores and suggesting reasons for differences; finding out what damages teeth and how to look after them. They might draw and discuss their ideas about the digestive system and compare them with models or images. (use tights and food to demonstrate how the digestion system works. Work in small groups to identify and construct food chains within five different habitats. These are British woodland, British coastal waters and the less familiar habitats of African savannah, Arctic tundra and Antarctic Investigate the effect of sugar in different drinks. Test the effectiveness of a range of toothpastes. Children find out about different nutrients and the effects they have on our bodies. They then look at models which help them to understand digestion and carry out a comparative test to investigate why calcium is important for our bones. Longer term projects such as: growing cress, investigating growth of mould on bread, food miles, growing crystals and using dyes from foodstuffs. **Scientist – Washington & Lucius Sheffield – Toothpaste in a tube** **Joseph Lister – Discovered the first antseptics**	intestine, large intestine, transports, stomach, acid, enzymes, carnivore, herbivore, food chain, producers, prey, predators **tongue** mixes, moistens, saliva **teeth** incisors, canines, molars, floss, brush	animal as fuel, and some is used to build the cells of the animal. Food has to be respired (with oxygen) to transfer energy. Misconception: Digestion starts in the stomach. Fact: Digestion starts in the mouth, where the salivary amylase (a digestive enzyme) acts on the starch in food. Misconception: Digestion ends in the stomach or large intestine. Fact: Digestion ends in the small intestine, where carbohydrates, proteins and fats are digested. Proteins are digested in the stomach. Water and minerals are absorbed into the bloodstream in the large intestine. Misconception: The digestive system has two outlets – one for faeces and one for urine. Fact: The digestive system has one outlet – the anus through which undigested food is discharged from the body. Misconception: Digestion is the process which releases usable energy from food. Fact: Digestion is the breakdown of large food molecules into smaller ones. Respiration is the process by which energy is released from food.
States of matter Pupils should be taught to: • 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)	Explore a variety of everyday materials and develop simple descriptions of the states of matter (solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container). Children should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled. Explore the part evaporation plays in the water cycle. *Avoid using materials where heating is associated with chemical change, for example, through baking or burning.* Work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream (for example, to make food such as chocolate crispy cakes and ice-cream for a party). They could research the temperature at which materials change state, for example, when iron melts or when oxygen	**Solid** iron, ice, melt, freeze, liquid, evaporate, condense, gas, container **changing state** heated, heat, cooled, cool, degrees Celsius, thermometer **water cycle**	Misconception: Sand and rice take the shape of containers, therefore they are not solids. Fact: Each individual grain of sand and rice have definite shape, therefore they are solids. Misconception: Plasticine is not a solid as it has no definite shape. Fact: A solid can change its shape if a force acts on it. Plasticine changes its shape when it is moulded (a force acted on it). It remains in its new shape because it is inelastic. Misconception: Solids are hard, strong and non-malleable.

• identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature	condenses into a liquid. They might observe and record evaporation over a period of time, for example, a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting. **Famous Scientist – Joseph Priestly – gases** **Lord Kelvin – Discovered absolute zero (temperature)**	evaporate, evaporation, condense, condensation, temperature, melting, melt, ice, warm, cool, water vapour	Fact: Different solids have different degree of hardness, strength and malleability. Misconception: Mass is associated with the term 'massive' and thus related to the size or volume of an object. Fact: Mass is the amount of matter in an object. Misconception: The liquid form of a matter is lighter than the same mass of its solid state, and heavier than its gaseous state. Fact: All states have the same mass as they have the same amount of matter although their volumes, and hence their densities, differ. Misconception: Air is good, but gas is bad because it is poisonous, dangerous or flammable. Fact: Air is made up of different types of gases. Not all gases are poisonous, dangerous or flammable. Misconception: Air is one substance. Fact: Air is made up of a mixture of gases. Misconception: Gases do not have mass or weight. Fact: Gases are matter, and thus they have mass and weight. Misconception: Confusion between melting and dissolving, e.g. sugar 'melts' into water. Fact: Melting involves only one substance while dissolving involves at least two substances. Melting takes place at a fixed temperature, but not dissolving. Misconception: Matter disappears when it decays. Fact: Matter breaks down into simpler substances which are released into the environment when it decays.

			Misconception: There is a loss in mass when matter burns. Fact: Mass is conserved. Gases produced by burning have masses.
Sound Pupils should be taught to: • identify how sounds are made, associating some of them with something vibrating • recognise that vibrations from sounds travel through a medium to the ear • find patterns between the pitch of a sound and features of the object that produced it • find patterns between the volume of a sound and the strength of the vibrations that produced it • recognise that sounds get fainter as the distance from the sound source increases	Explore and identify the way sound is made through vibration in a range of different musical instruments from around the world; and find out how the pitch and volume of sounds can be changed in a variety of ways. Carry out a class survey on different sounds to discover their favourite Create their own instruments out of everyday materials thinking about the different pitch and volume they make. Work scientifically by: finding patterns in the sounds that are made by different objects such as saucepan lids of different sizes or elastic bands of different thicknesses. They might make earmuffs from a variety of different materials to investigate which provides the best insulation against sound. They could make and play their own instruments by using what they have found out about pitch and volume. They can create telephones using cups and string, then investigate if the length of the string affects the volume. **Famous scientists – Alexander Graham Bell – invented the telephone**	pitch, volume, vibrate, vibration, faint, loud, quiet, sound, travel, tension, sound, ear, hear, tuning	Misconception: sound is a type of energy Fact: sound is a type of energy transfer caused by the vibration of air. Misconception: Loud sounds are made of more vibrations Fact: loud sounds are made by larger vibrations or vibrations with larger amplitude. Misconception: Humans can hear all sounds that are made Fact: Humans can only hear the 20Hz to 2000Hz other sounds below (infrasound) and above (ultrasound) are inaudible.
Electricity Pupils should be taught to: • identify common appliances that run on electricity • construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers • identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery	Construct simple series circuits, trying different components, for example, bulbs, buzzers and motors, and including switches, and use their circuits to create simple devices. Draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols at this stage; these will be introduced in year 6. Note: pupils might use the terms current and voltage, but these should not be introduced or defined formally at this stage. Pupils should be taught about precautions for working safely with electricity. Work scientifically by: observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors of electricity, and that some materials can and some cannot be used to connect across a gap in a circuit.	appliances, electricity, electrical circuit, cell, wire, bulb, buzzer, danger, electrical safety, sign, switch, open, close **insulators** wood, rubber, plastic, glass **conductors** metal, water	Misconception: Electric current flows from the negative to the positive terminal. Fact: The conventional current flows from the positive to the negative terminal, although in actual fact, current in a wire in a circuit is due to the flow of electrons from the negative to the positive terminal. Misconception: Electric current is 'used up' by an electric bulb in a circuit, so there is less current 'going back' to the battery in the wire after the electric bulb in a series circuit. Fact: Electric current in the wires on both sides of the electric bulb is the same. Misconception: The second bulb is less bright than the first bulb in a series circuit because

• recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit • recognise some common conductors and insulators, and associate metals with being good conductors	**Famous scientist – Michael Faraday – Discovered the relationship between magnets and electricity**		electric current has been 'used up' by the first bulb in the circuit. Fact: Both bulbs are equally bright if they are identical. The current flowing through both bulbs is the same in a series circuit and depends on the voltage and total effective resistance of the two bulbs. Misconception: In an open circuit, current flows to the part where there is a gap and 'turns back' to the battery when it finds that it cannot flow through the gap. Fact: In an open circuit, current does not flow at all. Misconception: An electric cell is called a battery. Fact: A battery is made up of two or more electric cells connected in series. Misconception: An electric cell delivers a constant current in a closed circuit. Fact: An electric cell maintains a constant voltage or potential difference. The current delivered depends on the voltage and the effective resistance of the circuit. Misconception: Electric current is the same as electrical energy. Fact: Electric current is the rate of flow of electric charges. Misconception: A change in one place of a circuit only affects the parts 'downstream' from the change (sequential model). Fact: An electric circuit is a complete system and different parts of the circuit interact so that a change in one place affects the whole circuit. Misconception: When electric current increases, voltage increases; there is no voltage when there is no current flowing.

			Fact: Voltage is a precondition for current to flow, not a property of current. Voltage is present even when no current is flowing.