Cabot Learning Federation

I am a scientist…

I am a scientist. I seek to explain the world around me. I build my theories based on evidence collected, by making observations in the natural and physical world. These theories are supported, modified or replaced as I find new evidence. My search for evidence in science occurs through an inquiry process that blends my curiosity, imagination, logic and serendipity. I am strongly influenced by the ideas which people currently hold. I understand that scientific knowledge is provisional: Although reliable and durable, scientific knowledge is subject to change as scientists learn more about phenomena. I learn about the theories and models that are used to describe the natural and physical world. These simplified theories or models help to describe the way the natural and physical world works. I use these models or theories to make predictions, test these predictions through experimentation and observation and use my results to revise and improve the models.

Key Concepts for Scientists

	Key Concepts	Contexts	
What is Physics? *About 13.8 billion years ago, matter, energy, time and space came into being in what is known as the Big Bang. The story of these fundamental features of our universe is called Physics.*	**The universe is made of matter and energy** At the smallest level, matter is made of elementary particles which have mass and charge. On a large scale, matter ranges from everyday objects to vast galaxy super-clusters. Energy has many different forms.	Y2 The Earth and its place in the solar system	Y5 Astronomy
	The universe evolves by means of interactions All interactions involve matter and energy and take place through forces, fields, and energy transformations.		Y6 Chemistry: Matter & Change
	Some quantities are conserved Underlying these interactions and transformations are laws of conservation – energy and charge cannot be created or destroyed. This means that overall they remain unchanged by an interaction or transformation.		Y4 Materials Y5 Chemistry
	There are four fundamental forces All interactions originate in four fundamental forces of nature. The force of gravity acts between all bodies and depends on their masses. The electromagnetic force acts between charged particles or between magnetic poles and is responsible for electric and magnetic fields and electric currents. The strong and weak nuclear forces operate between protons and neutrons in the nuclei of atoms, holding them together and sometimes resulting in radioactive decay.	Y1 Magnetism Y2 Electricity	Y3 Forces & Magnets Y4 Electricity Y5 Force
	Waves carry energy Energy propagates through materials and space by means of various types of waves, for example, sound waves in air, seismic waves through the earth, electromagnetic waves, including light that may travel through materials or empty space.		Y4 Sound; Light
What is Chemistry? *300, 000 years after their appearance matter and energy started to coalesce into complex structures called atoms, which then combined into molecules (13.2 billion years ago). The story of atoms, molecules and their interactions is called Chemistry.*	**All matter is made of particles** The fundamental particle from which all matter is made is the atom. There are approximately 115 different atoms which form the building blocks of the molecular and ionic structures that make up all the known substances.	Y2 Matter & Properties & Measurements	Y5 Chemistry Y6 Chemistry: Matter & Change
	The properties of materials derive from the identity and arrangement of particles Atoms come together to form bonds during chemical reactions. The properties of the resulting materials depend on which atoms are combined and the way they are arranged.	Y1 Everyday materials; Magnetism Y2 Matter & Properties & Measurements; Electricity	Y4 Electricity Y5 Chemistry Y6 Chemistry: Matter & Change
	Energy plays a key role in determining the changes that matter can undergo Energy changes occur during physical and chemical transformations as the bonds between atoms or molecules are broken and new bonds are formed. Since energy can be neither created nor destroyed, energy will determine the changes that matter can undergo.		Y4 Materials Y6 Chemistry: Matter & Change
	Chemistry is everywhere Chemical transformations maintain the world around us. Most natural processes are based on chemistry and can be understood at a molecular level. For example, the chemical reactions occurring in cells will determine their structure and function and ultimately the nature of the organism to which it belongs.		Y5 Chemistry Y6 Chemistry: Matter & Change
What is Earth and Space Science? *4.5 billion years ago a cloud of space dust coalesced to form a star surrounded by a group of planets and other material. The story of this is Earth and Space Science.* *The study of the Earth itself is Geography.*	**The Earth is a single system with four dynamically interconnected 'spheres'** These are the geosphere (rock of the crust, mantle, and core), the hydrosphere (solid, liquid, and gaseous water), the atmosphere (gases of the air) and the biosphere (living organisms).		Y3 What is inside the Earth? – Rocks Y5 Meteorology
	The Earth works in cycles The tectonic, rock and water cycles constantly reshape the surface of the Earth. Bio-geochemical cycles move the elements essential for life. These cycles also balance and regulate the Earth's climate.	Y1 Seasonal Changes;	Y3 What is inside the Earth? – Rocks; The Water Cycle Y5 Life cycles & Seasonal cycles; Meteorology
	All parts of the Earth system are constantly changing Earth systems interact with themselves, and with the Sun, Moon and the rest of the solar system and universe. Critical thresholds can be reached through natural variations in cycles and by human activity.		Y5 Meteorology
	Earth is dynamically part of the solar system and beyond The solar system comprises of objects that are gravitationally bound to the Sun. The solar system and all other planetary systems are formed during the life cycle of stars which have been born, lived and died in giant cycles since the Big Bang.	Y2 The Earth and its place in the solar system	Y5 Life cycles & Seasonal cycles; Astronomy
	Distance/time scales in Earth and space systems vary greatly In all Earth and space system processes and cycles, time scales can range from micro-seconds to billions of years, and distance scales range from microns to thousands of light years.	Y2 The Earth and its place in the solar system	Y5 Astronomy
Biology *About 3.8 years ago, on a planet called Earth, certain molecules combined to form particularly large and intricate structures called organisms. The story of organisms is called biology.*	**All organisms are classified based on how closely related they are on the tree of life** There are seven major levels of classification: Kingdom, Phylum, Class, Order, Family, Genus, and Species. The two main kingdoms we think about are plants and animals. Scientists also list four other kingdoms including bacteria, archaebacteria, fungi, and protozoa.	Year 1 Animals, Plants Y2 Living things and their habitats environment	Y3 Insects Y4 Classification of animals Y6 Plant Structures & Processes; Classifying Living Things
	All organisms share a common set of essential life processes Because of their shared evolutionary history, all organisms share a common set of essential life processes (movement, respiration, sensitivity, growth, reproduction, excretion, and nutrition) and use the same genetic system to maintain continuity. Many of these life processes are cyclical, e.g. growth, reproduction, excretion.	Y1 Animals; Humans; Plants; Y2 The Human Body & systems	Y3 Insects; Plants Y5 Life cycles & Seasonal cycles Y6 Plant Structures & Processes; Classifying Living Things Y6 Human Body: Hormones & Reproduction
	Organisms interact with each other and with their environment Living systems are organised and regulate themselves at the cell, organism, and ecosystem levels. Each of these dynamic systems maintains stability in response to a changing environment and their responses impact in turn upon the environment.	Y2 Living things and their habitats environment; The Human Body & systems	Y3 The human body: Cells, systems, and health Y4 Muscular & Skeletal system Y5 Circulatory and Respiratory System Y6 Plant Structures & Processes; Classifying Living Things; Human Body: Hormones & Reproduction
	Species arise, change, and become extinct over time Evolution results in diverse adaptations to ensure survival. This diversity allows organisms to occupy different niches within an ecosystem.		Y6 Evolution and Inheritance
	Genetics maintain continuity plus allow for change The inherited sequence of DNA underlies an organism's phenotype such as shape or blood type. Heritable mutations allow evolution or genetic change over time.		Y6 Evolution and Inheritance

Disciplinary Knowledge

This table is designed to allow for swifter assessment for learning. Then all students can be stretched as they develop their disciplinary knowledge at all key stages.

Age	Plan, and Ask Questions	Test	Observe and Measure	Record and Present	Conclude
Beyond	Independently plan a suitable and detailed investigation to answer a scientific question.	Carry out a fair test that produces accurate results to support or refute a scientific idea.	Independently collect accurate, precise, and relevant data using appropriate apparatus.	Independently design appropriate tables and collect accurate, precise, and relevant data. Independently choose an effective method for displaying data to support a conclusion (e.g. pie chart or line graph)	Independently draw scientific conclusion using examples from their data. Discuss the extent to which the data supports a conclusion and suggest further tests.
Upper KS2	• Plan an enquiry based on a relevant questions • Make a prediction based on scientific ideas • Ask more complex questions (what are the optimum conditions for plant growth) • Select appropriate and more advanced enquiry/equipment to help answer questions [e.g. range of websites/books, data loggers, digital scales, wind gauge, sound levels etc.	• Set up simple fair tests by controlling variables • Sort evidence into two categories: supporting or disproving a scientific idea	• Make careful observations • Take accurate measurements with repeats • Use a range of precise scientific equipment (e.g. digital thermometer measures 36.6^{o})	• Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Suggest detailed criteria for grouping, sorting and classifying/use a key • Write a scientific report using with a plan, method, results and conclusion that identifies causal relationships,	• Draw conclusions that support or refute an idea • Use higher tier scientific language in discussions (e.g. atria) • Look for and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results
Lower KS2	• Ask relevant questions (e.g. do plants need water), with a reasoned prediction. • Select appropriate equipment to help answer questions/enquiries	• Set up simple fair tests • Begin to discuss variables	• Make careful observations • Take accurate measurements • Use a range of equipment including thermometers and data loggers	• Collect, record and present results, using bar charts and tables • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	• Draw simple conclusions • Use scientific language in discussions (e.g. chamber of the heart) • Make further predictions • Look for patterns in results
KS1	• Ask a simple questions with a simple prediction • Recognise that questions can be answered in different ways	• Perform a simple test	• Observe using simple equipment	• Identify and Classify according to simple criteria • Use observations to suggest answers to questions • Gather and record data to help answer a question	• answer the question asked in the plan • attempt simple conclusions • begin to look for simple patterns

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 1

Working as a Scientist / Scientifically				
Plan, and Ask Questions Asking simple questions Recognise they can be answered in different ways	**Test** Perform a simple test	**Observe and measure** Observe using simple equipment	**Record and present** Use observations to suggest answers to questions Gather and record to help answer a question Sort and classify information	**Conclude** Say what you found out
question, idea, investigate, test, equipment, predict, observe, identify, classify, sort, group, record, table, graph, pictogram, answer, conclude.				

Key Concepts and Skills	Learning Checkpoints	Vocabulary	How to address potential misconceptions.	Tried and tested ideas.
Chemistry: Everyday Materials.	Different things are made of different <u>materials</u> based on their properties. <u>Materials</u> can be <u>natural</u> or <u>man-made</u>.			
Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses Explain why materials are chosen for specific tasks based on their properties. For example, wool for clothing, glass for windows, wood for tables, metal for bridges. Become aware that some materials are natural and some are man-made. - Distinguish between an object and the material from which it's made. **Scientific Skills** Perform a simple test Ask simple question	• Name a variety of materials • Compare and group materials on physical properties • **Perform a simple test of materials' suitability for a specific purpose.** • Explain why materials are chosen • Describe natural and man- made materials	suitable, materials, (wood, metal, plastic, glass, brick, rock, paper, cardboard), properties, natural, man-made, solid, changed, squash, bend, twist, stretch, hard/soft, stretchy/stiff, shiny/dull, rough/smooth, bendy/not bendy, waterproof/not waterproof, absorbent/not absorbent, opaque/transparent **Scientific Vocabulary** Predict, investigate, test, answer, conclude, record	***If** the misconception arises ensure children understand that:* *• materials are not just fabrics, building materials or writing materials. It is anything that something is made from.* *• 'rock' is a material, not just an object.* *• 'solid' does not always mean hard.*	• Test materials for discrete purposes (eg building a tent for a teddy bear) • Sensory exploration of objects and the materials they are made of, in the everyday environment.
Biology: Animals.	There are many different plants and animals. We can sort plants and animals in different ways (fish, bird, pet, plant). Plants and animals need to be looked after in different ways. Offspring (babies) of plants and animals normally look like their parents and can need extra special care.			
• Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals. • Describe and compare common features of different animal types *e.g. fins, wings, beaks, tails, eyes, skin type* • Identify and name a variety of common animals that are carnivores, herbivores and omnivores. • Make the connection that animals, like plants, need food, water and space to live and grow. • Recognise animals obtain food from eating plants or other living things. • Understand that offspring are very much (but not exactly) like their parents. • Understand that most animal babies need to be fed and cared for by their parents, or pets cared for by their owners; human babies are especially in need of care when young. **Scientific Skills** Identify and classify	• Identify and name a variety of animals • Sort animals that are carnivores, herbivores and omnivores • **Identify and classify** (Group and sort vertebrates according to recognisable features) • Describe and compare common features of different animals • Explain why animals need food, water and space to grow and live • Describe why animal offspring/babies need to be fed and cared for when they are young	common, fish, amphibians, reptiles, birds, mammals, vertebrate, invertebrate, herbivore, omnivore, carnivore, plants, offspring, parents, pets, fins, beaks, tails, fur, feathers **Scientific Vocabulary** Identify, classify, sort, group	***If** the misconception arises ensure children understand that:* *• There are many types of animals, not only four-legged mammals kept as pets (eg, ants, ladybird, slugs etc)* *• humans are animals* *• insects are animals* *• some 'bugs' or 'creepy crawlies', are insects, but others (eg spiders) are not.* *• amphibians and reptiles are different groups of vertebrates.* *• a baby mammal grows in a mother's womb, not tummy.*	Workshop or farm visit with real animals to classify

Earth and Space Science: Seasonal Changes	The four <u>seasons</u> are <u>winter</u> <u>spring</u> <u>summer</u> and <u>autumn</u>. There are different types of weather, each season has a different weather pattern (see Geog link) and <u>rain</u> and <u>snow</u> come from the <u>clouds</u>. The sun is the main thing that causes the weather on Earth.			
• Identify the four seasons: Autumn, winter, spring, summer • Be able to describe characteristic local weather patterns during the different seasons including approximate daily temperature. • Recognise the importance of the sun as a source of light and warmth. • Understand daily weather changes. (Temperature and thermometers ; Clouds and rainfall; Rainfall, the ground and rainbows; Thunderstorms; Snow and snowflakes) (Link to Geography Year 1 Seasons and daily weather patterns) **Scientific Skills** Gather and record to help answer a question Observe using simple equipment	• Understand that weather changes daily • Name the 4 seasons • Describe how weather changes within seasons • **Gather and record to help answer a question** (gather recordings of weather over time, across different seasons) • Explain that rain and snow comes from clouds	seasons, autumn, winter, spring, summer, daily, weather, sunlight, warmth, temperature, rainfall, clouds **Scientific Vocabulary** Record, observe, equipment	***If** the misconception arises ensure children understand that:* *• Whether it snows or rains depends on temperature and cloud condition, not season.* *• The sun is always there, in all the seasons (not just summer), but clouds sometimes come in between the sun and earth.* *• Different plants flower at different times of year.*	• Teach in short blocks / standalone lessons, talking about the seasons as they happen (eg Autumn Day) • Take opportunities as and when they happen in the weather (eg go outside when it snows) • Take measurements of temperature and rainfall over time, in different seasons. • Make a rainfall gauge and use to make measurements.
Biology: Humans	Humans have many senses (we teach five of them) that use different body parts. Humans need to look after their bodies with healthy lifestyles.			
• Identify, name, draw and label the basic parts of the human body. • Identify the five senses and associated body parts: • Sight: eyes; hearing: ears; smell: nose; taste: tongue; touch: skin • Review the importance of taking care of your body: exercise, cleanliness, healthy foods and rest. **Scientific Skills** Observe using simple equipment. Gather and record to help answer a question.	• Label and draw the basic parts of the human body. • Name and describe the importance of the 5 senses • Use scientific vocabulary to describe what is experienced by the senses. • **Observe how humans' different body parts sense the world** • Explain the importance of taking care of our bodies	sight, hearing, smell, taste, touch, exercise, cleanliness, health, rest, rough, smooth, sweet, sour, bright, dull, dark, colours, loud, quiet, high (pitch), low (pitch), head, neck, arms, elbows, legs, knees, face, ears, eyes, hair, mouth, teeth, nose **Scientific Vocabulary** Observe, equipment, question	***If** the misconception arises ensure children understand that:* • *We can experience touch through all parts of our bodies (not just hands)*	• Activities relating to senses eg: Sound walk • Food tasting / smelling
Biology: Plants	Plants make their own food and have different parts (stem, root, leaf, flower). <u>Evergreen</u> plants keep their leaves all year round but <u>Deciduous</u> plants lose their leaves in the winter. Some plants are used as food for humans.			
• Understand what plants need to grow: sufficient warmth, light and water. • Recognise basic parts of plants: seeds, roots, stems, branches and leaves. • Understand the basic function of parts of a plant (eg – roots absorb water, leaves use sunlight to make their own food) • Recognise the importance different parts of plants that we eat (eg Broccoli flower, asparagus stem, carrot root, fruit, and seeds for humans and animals) • Identify and name a variety of common wild and garden plants • Know that there are two kinds of plants: deciduous and evergreen. **Scientific Skills** Observe using simple equipment. Perform a simple test Identify and classify	• **Observe and label the parts of a plant** • Understand the basic function of parts of a plant • **Perform a simple test to explain what plants need to grow** • Describe the importance of a flower and a seed for reproduction. • **Identify and classify a variety of common plants.** • Describe the differences of Evergreen and Deciduous plants	seeds, roots, stems, branches, leaves, flowers, petals, daffodil, rose, daisy, deciduous, evergreen **Scientific Vocabulary** Observe, equipment, identify, classify, test, investigate	***If** the misconception arises ensure children understand that:* *• not all plants flower and plants <u>can</u> look different (e.g. trees)* *• not all leaves and stems are green* *• a trunk is a stem* *• blossom is a flower.* *• most, not all, plants start out as seeds* *• plants that grow from bulbs can have seeds* *• the flower has a function* *• plants need sunlight to create it's own food (not for warmth)* *• roots absorb water (not suck)* *• Plant feed isn't 'food for plants', it provides nutrients that the plant needs to make its own food.*	• Wildflower identification walk • Flower observations and dissection • Fruit and vegetable observation – identify which part of the plant that we eat. • Growing seeds in different conditions, testing which conditions support growth.

Physics: Magnetism	Magnets can attract some things but not others. A magnet can pull or push another magnet depending on the north pole and the south pole.			
• Identify familiar, everyday uses of magnets. For example: in toys, in cabinet locks, in refrigerator magnets, etc. • Classify materials according to whether they are or are not attracted by a magnet. **Scientific Skills** Ask simple questions Use observations to suggest answers to questions.	• Explore and ask simple questions about everyday magnets in toys, fridge magnets • Sort and classify magnetic and non-magnetic materials. • Understand that magnets attract other magnets	magnets, attract, repel, north pole, south pole **Scientific Vocabulary** Observe, answer, questions, investigate	*If the misconception arises ensure children understand that:* *•The stronger the magnetic field is, the stronger the magnet is (the size of the magnet does not always make it stronger).* *• Only some metals are magnetic.*	Opportunities for children to explore everyday materials with magnets and draw their own conclusions.

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 2

Working as a Scientist / Scientifically				
Plan, and Ask Questions Ask simple questions Recognise they can be answered in different ways	**Test** Perform a simple test	**Observe and measure** Observe using simple equipment	**Record and present** Use observations to suggest answers to questions Gather and record to help answer a question Sort and classify information	**Conclude** Say what you found out
question, idea, investigate, test, equipment, predict, observe, identify, classify, sort, group, record, table, graph, pictogram, answer, conclude.				

Key Concepts and Skills	Learning Checkpoints	Vocabulary	Common misconceptions	Tried and tested ideas.
Chemistry: Properties of Matter and Measurement	Everything is made from atoms. Water can easily be changed into ice (solid), water (liquid) and steam (gas). Materials can be squashed and stretched.			
• Basic concept of atoms: Everything (matter/materials) is made of tiny particles/pieces called atoms. • Water as an example of changing states of matter of a single substance: *Water changes to ice-solid (freezes) back to water-liquid (melts), and steam -gas (evaporates).* • Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching. • Begin to measure using different units of measurement: Length: centimetre, metre Volume: millilitre, litre. Temperature: degrees Celsius **Scientific Skills** Identify and classify Observe using simple equipment	• Identify, classify and group materials (solids, liquids or gases) • Understand that all matter is made of atoms. • Understand that some materials (water) can change state • Understand that temperature is recorded in degrees Celsius • Research how materials can be measured using simple equipment. • Explain how and why some solid objects can be changed (squashing, bending, twisting, stretching)	atoms, matter, particles, solid, liquid, gas, measurement: millilitre, litre, temperature, degrees, melt, freeze, steam, evaporate **Scientific Vocabulary** Observe, measure, sort, group, classify, identify, record, table	***If** the misconception arises ensure children understand that:* *• not all solids are hard, some can change shape* *• not all solids are opaque* *• substances made of very small particles like sugar or sand are solids* *• when air is pumped into balloons, they do not get lighter, they get heavier as matter is being added.* *• water in different forms – steam, water, ice – is all the same substance* *• Steam is invisible. When we boil a kettle, what we see is liquid water droplets forming (a mini cloud).* *• There are other states of matter (e.g., the sun is a plasma) but solid, liquid, gas are the common ones on Earth.*	• Research the temperature at which water freezes or evaporates.

Biology: Living things and their habitats and environments.	Different plants and animals live in different places so they can get what they need to stay alive. Some animals eat plants, some eat animals, and some eat both.			
Habitats: • Living things live in environments (habitats) to which they are particularly suited. • Re-cap from Year 1: Find out about and describe basic needs of animals, including humans, for survival (water, food and air) • Specific habitats and microhabitats and what lives there, for example: Forest (for example: oak trees, squirrels, foxes, badgers, snails, mice); Meadow and plains (for example: wildflowers, grasses, prairie dogs); Underground (for example: fungi, moles, worms); Desert (for example: cacti, lizards, scorpions); Water (for example: fish, oysters, starfish). Link to Y2 Geography: Habitat destruction/litter/pollution causing extinction. • Use simple food chains as a way of picturing the relationships between living things: Animals: big animals eat little ones, big animals die and are eaten by little ones Plants: nutrients, water, soil, air, sunlight Special classification of animals: • Identify differences between things that are living, dead and have never been alive. • Herbivores: plant-eaters (for example, elephants, cows, deer) • Carnivores: flesh-eaters (for example, lions, tigers) • Omnivores: plant and animal eaters (for example, bears) **Scientific Skills** Identify and classify Ask simple questions	• Identify, classify and compare things that are living, dead and never been alive. • As questions about and describe how animals live in habitats that provide the things they need. • Explain how habitats and microhabitats suit different animals and what happens when habitats are changed. • Classify animals into herbivore, carnivore, omnivore. • Explain what a food chain is • construct and interpret a variety of food chains, identifying producers, predators and prey • Describe how plants grow from seeds • State that plants need water, light, and a suitable temperature to grow.	environments, habitats, microhabitats, basic needs, survival, adapted, forest, meadow, plains, underground, desert, food chain, nutrients, soil, air, sunlight, herbivore, omnivore, carnivore, destruction, pollution, climate change, extinct, predator, prey, producer	***If** the misconception arises ensure children understand that:* *• an animal's habitat is the type of area it lives in, not a home.* *• plants and seeds are living things even though they cannot be seen to move* *• fire is not living* *• arrows in a food chain show the transfer of energy.* *• not all animals that live in the sea are fish (e.g., dolphins)* *• respiration is not breathing; it is using oxygen to create energy.* *• All parts of the food chain are connected, the death of one impacts the others.* *• environmental changes can affect how much food there is for wild animals.* *• animals can live in water, not just on land.* *• some environmental changes mean that animals become extinct as they cannot adapt.* *• Some changes to habitats can be positive, as well as negative.*	• Explore local microhabitats eg habitat of a woodlouse. • Create 3 types of pond habitat and explore which wildlife comes to each.
Biology The Human Body & health	We need to look after our body to keep it clean, fit, healthy, and free from <u>disease</u>.			
• Explain the basic needs for animal (including human) survival: food, water, air. • Describe the importance of exercise, rest and a balanced diet for humans. • Understand the importance of good hygiene in preventing diseases and illness: • Understand that a vaccination can prevent a disease or make it less serious. • Babies grow to adults in humans and other animals. **Scientific Skills** Perform a simple test. Gather and record to help answer a question.	• Describe why being healthy is important and what you can do to keep healthy • Explain what good hygiene is and why it's important. • Explain why vaccinations are important • Understand how to take care of our body through exercise and diet. • Explain that babies grow to be adults	exercise, balanced diet, food groups, germs, bacteria, disease, illness, hygiene **Scientific Vocabulary** Observe, record, identify, investigate, test, record, results, conclude.	***If** the misconception arises ensure children understand that:* *• when we exercise, our heart beats faster to get more blood and oxygen to our muscles.* *• We eat for nutrients, as well as energy.* *• Some fat/ dairy/ protein is necessary, but too much is bad for you.* *• Foods can contain fat, even if you can't see it.* *• Drugs include medicine like paracetamol or Calpol, but some drugs (or too much of a drug) are bad for you.* *• 'Diet' and fruit drinks (e.g. Diet Coke) are not good for you.*	• Germ/bacteria experiment – Touch bread with unclean/dirty hands. Then touch another piece of bread with clean, washed hands. Then whilst wearing gloves, touch another piece of bread. Keep them in clear bags to observe the difference in mould growth.

Biology: The Human Body & systems	Different parts of the body can work together in different groups called systems. These systems keep us healthy.			
(Each body system is covered is greater detail in KS2- this unit should provide an overview of the different systems and emphasise the concept that all work together to keep us healthy) • Identify basic parts of the following body systems: - Skeletal system: skeleton, bones - Muscular system: muscles - Digestive system: mouth, stomach - Circulatory system: heart and blood • The brain is part of the nervous system, which controls all the other systems in your body. • Skeletal system: Know the skeleton helps us move and keeps organs like the lungs and heart and brain safe. • Muscular system: Know muscles are attached to our bones and help us move. • Digestive system: We eat food, chew, swallow, goes to our stomach and then nutrients are taken to parts of the body that need it in the blood. • Circulatory system: Heart pumps blood which carries oxygen and nutrients to our body parts to help them work e.g., muscles, so beats faster when we exercise to give our muscles what they need **Scientific Skills** Perform a simple test. Observe using simple equipment	• Explain the role of the skeleton • Observe and locate some of the bones in our skeleton • Understand that muscles are attached to our bones (they help us move) • Understand what happens once we swallow food . • Understand that the heart pumps blood around our body and back again. (Perform a simple test)	skeleton, bones, heart, lungs, brain, muscles, attached, chew, swallow, stomach, digest, blood, energy, pumps, oxygen, **Scientific Vocabulary** test, predict, conclude, observe,	*If the misconception arises ensure children understand that:* *•Your stomach is a bag-like organ inside your body. It is not the same thing as your 'tummy'* *• All parts of the digestive system help digest food (not just the stomach)* *• When food 'goes down the wrong way' it can't go into your lungs* *• Both food and drink go down the same tube, which is part of the digestive system* *• Undigested food and other waste products do not become "poo" and excess water does not become "wee" (for example, your kidney filters water out of the blood)* *• Your heart is in the centre of your chest, but we feel it on the left side because this side is bigger.* *•The heart does not make blood - red blood cells are made in the bone marrow.* *• when we exercise, our heart beats faster to get more blood and oxygen to our muscles.* *• Although blood vessels can look blue through your skin, all blood is red.*	• Measure pulse or breathing rate before exercise and after – use measurements to explain how the circulatory system has worked.

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 3

Working as a scientist/scientifically

Plan, and Ask Questions	Test	Observe and measure	Record and Present	Conclude
• Ask relevant questions • Answer relevant questions • Select appropriate equipment to help answer questions/enquiries	• Set up simple fair tests	• Make careful observations • Take accurate measurements • Use a range of equipment including thermometers and data loggers	• Collect, record and present results, using bar charts and tables • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	• Draw conclusions • Use scientific language in discussions • Make predictions • Look for patterns in results

Key Concepts and Skills	Learning Checkpoints	Vocabulary	Common misconceptions	Tried and tested ideas.
Physics: Forces and Magnets	Some things are attracted to magnets - even when the magnet is not touching them. Magnets have a North and a South pole. Like poles repel and unlike poles attract. A compass is a magnet that will point towards the Earth's North pole. Things move differently on different surfaces, because of friction (which needs things to touch).			
• Compare how things move on different surfaces due to friction • Notice that some forces need contact between two objects, but magnetic forces can act at a distance. • Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet and identify some magnetic materials. • Build on Y2: Magnetic poles: north-seeking and south-seeking poles • Build on Y2 Magnetic field (strongest at the poles) • Build on Y2 Law of magnetic attraction: unlike poles attract, like poles repel. • The Earth behaves as if it were a huge magnet: north and south magnetic poles (near, but not the same as, geographic North Pole and South Pole). • Magnetism demonstrates that there are forces we cannot see that act upon objects. • Orienteering: use of a magnetised needle in a compass, which will always point to the north	• Recognise that magnetic forces can act at a distance and can be 'invisible' • Compare and group materials as to whether they are magnetic or not including a range of metals (e.g. copper pipe, aluminium can, iron nail) • Identify a magnetic pole as being N or S. Identify a magnetic field as a place where a magnet is having an effect (e.g. an iron nail will start to move if there is a magnetic field) • Understand how a compass uses magnets to work • Friction investigation (e.g. which shoe has the most grip) • set up a simple fair test • make careful observations of force • record force data in tables and/or charts • draw conclusions about where the friction-force is bigger	Magnet, iron, attract, repel, metal, copper, aluminium, steel, brass, magnetic poles, magnetic field. Friction, resistance, force, smooth, rough, (force) acting on, push, pull **Scientific Vocabulary** question, equipment, Newton meter, surface, fair test, measurement, (data), table, graph/chart, conclusion	*If the misconception arises ensure children understand that:* *• bigger magnets are not necessarily stronger than smaller magnets.* *• only three metals are magnetic (iron {steel}, cobalt and nickel).* *• (if this comes up in questioning) the N pole of the Earth has a magnetic S-pole underneath it that is why the N-pole on a compass is attracted to it.* *• smooth surfaces have smaller frictional forces than rough surfaces (not "no friction")* *• objects do not always travel better on smooth surfaces* *• a moving object often stops because of friction pushing against the motion. If there was no friction, the object would carry on forever (e.g. a spanner dropped in space just keeps moving)* *• an object moving at a steady speed in a straight line does not need a forward force on it.* *• a non-moving object has balanced forces (not no forces)*	
Biology: Insects	There are many different kinds of insects and they do different things. Insects have a life cycle and can live on their own or in groups. Insects have different body parts to other animals.			
• Insects have six legs and three body parts (head, thorax and abdomen) • Life cycles: metamorphosis	• Give examples of a lifecycle of an insect • Write a simple scientific report about insect observations including a question, equipment choice, and a summary of the main findings (e.g. do all insects have wings, or how do ants build a colony)	Helpful, harmful, beeswax, pollination, (exoskeleton), (chitin), (head), (abdomen), (thorax), (wings), egg, (larva), (pupa), adult, metamorphosis, (moulting)	*If the misconception arises ensure children understand that:* • *Not all minibeasts are insects* • *Insects do not have a skeleton* • *Not all insects are harmful*	

Earth and Space Science: What is inside the Earth? - Rocks	There are different layers inside the Earth. A volcano can erupt lava, and a geyser can erupt water. There are different types of rock. Sometimes a living thing can leave a fossil behind, which is found inside a rock.			
• Inside the Earth - layers: crust, in-between (mantle), core; High temperatures • Volcanoes and geysers • Rocks and minerals. Formation and characteristics of different kinds of rocks: metamorphic, igneous, sedimentary. Important minerals in the Earth (such as quartz, gold, sulphur, coal, diamond, iron ore) • Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties. • Describe in simple terms how fossils are formed when things that have lived are trapped within rock. • Recognise that soils are made from rocks and organic matter	• Identify the three layers of the Earth • State that a volcano is made when hot rock comes through the Earth's crust. • State that a geyser is when water is heated by hot rocks underground and then sends streams of water/steam into the air. • Sort and compare different types of rock by naming the properties (crystals, layers, smooth, brown, etc.) • Give a basic description of how fossils are formed • Make careful observations of soils and draw conclusions about what they are made from (rocks and organic matter).	Earth, crust, (mantel), core, volcano, geysers, (metamorphic), (sedimentary) (igneous) rocks, crystals, layers, fossils, **Scientific Vocabulary** sort, properties, smooth, rough, observations, conclusions.	*If the misconception arises ensure children understand that:* *• not all rocks are hard (e.g. talc and chalk are softer)* *• rock-like, man-made substances such as concrete or brick are not rocks* *• materials which have been polished or shaped for use, such as a granite worktop, are still rocks even though they are no longer 'natural'* *• no found artefacts, like old bits of pottery or coins, are fossils* *• a fossil is not an actual piece of the extinct animal or plant* *• soil is different from compost.*	

Biology: Plants	Plants have roots, a stem/trunk, leaves and flowers and each part does a different thing to keep it alive and reproduce. A plant has a life cycle.			
• Know and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers. • Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal • Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant • Investigate the way in which water is transported within plants.	• Name the parts of a plant • Say what each part does • Investigate plant growth (e.g. smiley-face cress yoghurt pots) e.g. by allowing plants to grow without air, water, light, soil. • Make predictions, careful observations, and conclusions on what a plant needs to grow. • Explore how water is transported within a plant by making careful observations (e.g. of celery in ink) • Make careful observations to explore the lifecycle of a flowering plant (including pollination and seed dispersal)	Plant, flowering plants, root, stem, trunk, leaves, flowers, air, light, water, nutrients, soil, water transportation, pollination, seed formation, dispersal, **Scientific Vocabulary** prediction, fair test, observation, conclusion.	*If the misconception arises ensure children understand that:* *• not all plants are flowering plants grown in pots with coloured petals and leaves and a stem* *• trees are plants* *• not all leaves are green* *• not all stems are green* *• a trunk is a stem* *• a blossom is a flower.* *• plants are alive even though cannot be seen to move* *• seeds are alive* *• not all plants start out as seeds* *• seeds and bulbs do not need sunlight to germinate.* *• plants do not eat food* *• plant food does not come from the soil via the roots - plants make their own food and some nutrients are transported from the soil e.g. nitrogen* *• flowers form a vital part of the reproductive life cycle in plants (they are not for decoration)*	

Biology: The human body: Cells, systems, and health	Living things are made of cells (which are made of atoms - everything is made of atoms). The digestive system is a collection of body parts that make our food useful for our body. Each part has a different name and does a different job. To help our digestive system we need to eat a healthy diet.			
The Digestive System: • Explore with children what happens to the food we eat by studying body parts and functions involved in taking in food and getting rid of waste. Children should become familiar with the following: - Salivary glands, taste buds - Teeth: incisors, canines, premolars and molars and their role in eating food. - œsophagus, stomach, liver, small intestine, large intestine • There are different parts of the digestive system (organs). These are made of smaller parts (tissues). These are made of even smaller things called cells. A cell is the smallest living part of an organism. • ·Taking care of your body: A healthy diet • The 'food pyramid' • Vitamins and minerals	• State that body systems are made of smaller parts, and that the smallest part of a living thing is called a cell • Name and label the parts of the digestive system • Give a simple function of each part of the digestive system e.g. teeth chop food, stomach mixes digestive juices etc. • Name and label different teeth and explain the role that each one plays • Name the different food groups and give examples • Discuss the food pyramid and explain why it is important to have a healthy diet • Use scientific language in discussions • Make careful observations - e.g. explaining the parts of a diagram • Explain a model of the digestive system	Cell, tissue, organ, digestion, digestive system, saliva (salivary glands), taste buds, œsophagus, stomach, liver, small and large intestine, anus, teeth – incisors, canines, premolars, molars, tooth, root, decay, **Scientific Vocabulary** diagram, model,	*If the misconception arises ensure children understand that:* *• no whole food group, like fats, are 'bad' for you* *• no specific foods, like cheese, are 'bad' for you* *• no particular diet nor fruit drinks are 'good' for you* *• your stomach is not where your belly button is* *• different parts of the digestive system digest different parts of the food we eat (not "all food is digested in the stomach")* *• when you have a meal, your food and drink go down the same tube* *• "poo" is made inside the body; "wee" is made inside the body by extracting certain chemicals from the blood (this happens in our kidneys)- our food and drink you eat do not become "poo" and "wee"* *• (If asked) atoms are not alive, and make up all ordinary matter. Cells are much larger than atoms, however cells are the smallest living things. So everything is made up of atoms, but the smallest living thing is a cell*	

Chemistry, Earth Science: The Water Cycle	There is a water cycle on the Earth that uses evaporation and condensation.			
Introduce and explore the concept of the water cycle: • Most of the Earth's surface is covered by water The water cycle Evaporation and condensation Water vapour in the air, (humidity) Clouds: (cirrus, cumulus, stratus) Rain and snow (Precipitation), (groundwater)	• Understand the part that evaporation and condensation plays in the water cycle • Describe the basic role of clouds in the water cycle (types of clouds) • Know that most of the Earth's surface is covered in water • Make careful observations (for example of clouds) • Draw conclusions (for example about how water boils in a kettle, or their breath forms condensation on glass) • Answer relevant questions (for example where does the water inside clouds come from)	Water, evaporation, condensation, (precipitation), vapour, (humidity), clouds, (cirrus, cumulus, stratus), groundwater **Scientific Vocabulary** investigate, conclude, observation	*If the misconception arises ensure children understand that:* *• clouds are made of water vapour or steam* *• the condensation on windows etc. is water* *• the changing states of water (illustrated by the water cycle) are reversible* *• evaporating or boiling water does not make it vanish* *• the Sun does not suck up the water - neither during evaporation nor during water soaking into a porous surface.*	
Physics: Waves Carry Energy - Light	We can see things if they give out light, or reflect light into our eyes. Light is reflected from surfaces. Shadows form when the light source is blocked. Light from the sun can be dangerous so we need to protect our eyes.			
• Objects are seen because they give out or reflect light into the eye and that dark is the absence of light • Recognise that shadows are formed when the light from a light source is blocked by an opaque object • Find patterns in the way that the size of shadows change • Reflection from a mirror and shiny surfaces • Ask relevant questions • Make careful and accurate observations Draw conclusions	- Objects are seen because light enters the eye from a reflection or directly from a light source e.g. bulb. - Explain how shadows form - Reflection in a mirror produces an image (you can see yourself in a mirror, but not a table) - Describe an investigation into shadows - Look for patterns in results of a shadow investigation.	Light, light source, natural, man-made, artificial, shadow, dark, darkness, reflect, eyes **Scientific Vocabulary** test, measure, (translucent), transparent, (opaque)	*If the misconception arises ensure children understand that:* *• light has to travel from an object into our eyes (no light comes out of our eyes).* *• we cannot see in total darkness we need a source of light (we cannot see at night unless there is light e.g. from streetlamps, phone charger etc.)* *• reflections, including the moon, are not sources of light* *• transparent objects are not light sources* *• shadows are when light is blocked (nothing "gives off darkness").*	

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 4

Working as a scientist/scientifically

Plan, and Ask Questions	Test	Observe and measure	Record and Present	Conclude
• Ask relevant questions • Answer relevant questions • Select appropriate equipment to help answer questions/enquiries	• Set up simple fair tests	• Make careful observations • Take accurate measurements • Use a range of equipment including thermometers and data loggers	• Collect, record and present results, using bar charts and tables • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	• Draw conclusions • Use scientific language in discussions • Make predictions • Look for patterns in results

Key Concepts and Skills	Learning Checkpoints	Vocabulary	Common misconceptions	Tried and tested ideas.
Physics: Electricity	Electricity flows through complete circuits. If there is a gap, the electricity does not flow (devices will be off). Circuits can have batteries (make bulbs brighter), bulbs, switches, and other components. Some materials conduct and some insulate.			
• 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 • 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 Scientific skills • Make predictions • Observe • Draw conclusions • Classify	• Identify appliances that run on electricity • Construct a simple circuit and name the parts • Use symbols to represent a circuit in a diagram • Make predictions using knowledge of a complete and incomplete circuits • Group materials according to whether they are conductors or insulators • Draw conclusions about the brightness of bulbs, volume of buzzers, and position of switches.	Electricity, electric, motor, circuit, battery, lead, bulb, buzzer, conduct, conductor, insulate, insulator, switch, break **Scientific Vocabulary** predict, conclude, classification	*If the misconception arises ensure children understand that:* *• A larger voltage battery makes bulbs brighter (not larger-sized batteries)* *• complete circuits transfer energy, (electricity is not "used up")* *• the position of a component in a series circuit makes no difference to the electricity it receives. (being close to the battery does not give you more electricity)*	
Physics: Waves Carry Energy - Sound	Sounds are vibrations that we can hear. Sounds can be high/low (fast or slow vibrations), quiet/loud.(small or big vibrations). Humans make sounds in the voice box, and we hear sounds with our ears.			
• The basic physical phenomena of sound, with associated vocabulary. • Sound is caused by an object vibrating rapidly. • Sounds travel through solids, liquids and gases. • Sound waves are much slower than light waves. • Qualities of sound - Pitch: high or low, faster vibrations = higher pitch, slower vibrations = lower pitch • Intensity: loudness and quietness • Human voices come from vocal cords vibrating in the voice box (larynx) • Human hearing – ears detect sound vibrations when the ear drum vibrates. • Ear drums are delicate and can be damaged by loud sounds. • Make predictions • Make careful observations • Suggest criteria for grouping, sorting and classifying	• Understand that sound is caused due to vibrations and travels slower than light • Understand that sounds vibrations can travel through all the states of matter • Understand how pitch and loudness affect a sound and give examples of these e.g. a quiet high sound or a quiet low sound • Observe a range of sound-producing objects and classify into quiet/loud high/low • Predict whether an object will have a high/low loud/quiet sound e.g. shorter guitar string, or hitting a drum harder. • Understand that humans make and detect sounds in the voice box and ear. • We can protect our ears by moving further away from the source of the sound or using ear defender.	Sound, wave, travel vibrate, vibrations, fast/slow vibrations, pitch, high, low, volume, loud, quiet, travel through, solids, gases, liquids, frequency, speed of sound, speed of light, ear, hear, hearing, ear drum **Scientific Vocabulary** prediction, sorting	*If the misconception arises ensure children understand that:* *• sounds are heard by everyone (not just the listener)* *• sound travels outwards in all directions from the source (not only one direction)* *• sound travels better in most solids and liquids (not sound can't travel through solids and liquids)* *• high pitch sounds can be quiet or loud (not low sounds are quiet & visa versa).*	

Biology: Classification of Animals	Animals can be sorted in different ways. Some animals have <u>backbones</u> (vertebrates) and some do not (invertebrates). You can sort the backbone-animals (vertebrates) into <u>fish</u>, <u>amphibians</u>, <u>reptiles</u>, <u>birds</u>, and <u>mammals</u>.			
• Scientists classify animals according to the characteristics they share, for example: - Cold-blooded or warm-blooded - Vertebrates (have backbones and internal skeletons) or invertebrates (do not have backbone or internal skeletons. • Different classes of vertebrates • Recognise that environments can change and that this can sometime pose dangers to living things Characteristics of each class, such as: • Fish: aquatic animals, breath through gills, cold-blooded, most have scales, most develop from eggs that the female lays outside her body • Amphibians: live part of their life cycle in water and part on land, have gills when young, later develop lungs, cold-blooded, usually have moist skin • Reptiles: hatch from eggs, cold-blooded, have dry, thick, scaly skin • Birds: warm-blooded, most can fly, have feathers and wings, most build nests, hatch from eggs, most baby birds must be fed by parents and cared for until they can survive on their own (though some, like baby chickens and quail, can search for food a few hours after hatching) • Mammals: warm-blooded, have hair on their bodies, parents care for the young, females produce milk for their babies, breathe through lungs, most are terrestrial (live on land) though some are aquatic	· Sort and classify animals according to a variety of characteristics · Identify and sort a variety of vertebrates and invertebrates · List characteristics of different types of vertebrates and invertebrates · Name the 5 vertebrate groups · Give an example of an environmental change that could harm living things e.g. floods could kill worms and grass or drought could kill wheat, mice etc.	Living things, characteristics, features, similarities, differences, group, vertebrates, invertebrates, backbone, spine, mammals, fish, reptiles, birds, amphibians, insects, animal, insects, kingdom **Scientific Vocabulary** sort, key, classify	*If the misconception arises ensure children understand that:* *• humans are animals, because they are not plants! (Humans do <u>not</u> have a special category for themselves)* *• insects <u>are</u> animals* *• insects have six legs etc. (<u>not all</u> 'bugs' or 'creepy crawlies', such as spiders, are part of the insect group)* *• amphibians <u>are different</u> from reptiles (they <u>are not</u> the same).*	

Biology: organisms and their environment – Muscular & Skeletal system	Vertebrates (including humans) have <u>muscles</u> and <u>bones</u> <u>inside</u> their bodies. Muscles are joined to the bones and help us to move. Some muscles work even when we don't think about them, e.g. the heart (involuntary movement).			
The Muscular System: • Know that muscles are attached to our bones by tendons, bone attached to bone by ligaments and both help us to move. • Muscles: Involuntary and voluntary muscles • Some muscles are voluntarily moved e.g. biceps. Some muscles move involuntarily e.g. heart pumping constantly. The Skeletal system • Skeleton, bones • Musculo-skeletal connection: Ligaments; Tendons • Know location of Skull, Spine, Ribs, shoulder blades, pelvis, arm, leg, fingers, toes. • Broken bones, X-rays • Sort body parts into bone/muscle/joint	· Explain the basic function of a skeleton in humans · Recognise the difference between voluntary and involuntary muscle movements · Name the main bones in the human skeleton · Understand that x-rays are used to look at bones · Know that muscles are attached by tendons and cause movement	Skeleton, movement, support, protection, skull, jaw, spine, ribs, rib cage, hip, breastbone, shoulder, knee, pelvis, joints, elbow, knee, hip, muscles, ligaments, tendons, brain, heart, lungs, protects, voluntary muscles, involuntary muscles- heart, musculo-skeletal system, x-rays	*If the misconception arises ensure children understand that:* • *Bones and muscles hold up the body and when someone is standing, (the muscles <u>are</u> working).* • *The heart <u>is</u> a muscle*	• biceps and triceps - feel it/ can use elastic bands attached to card and a pivot split pin to show expand and contract to move arm and elbow joint up and down, feel muscles changing shape in arm

Physics Materials	Solids can change to liquids (melting) and liquids can change to gasses (boiling). We can measure the temperature that this happens.			
• 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), specifically water. • Suggest criteria for grouping, sorting and classifying/use a simple key • Make careful observations • Take accurate measurements • Use a range of equipment including thermometers • Collect, record and present results, using bar charts and tables	· Compare and group materials (solids, liquids or gases) · Observe that some materials can change state when heated or cooled · Understand that temperature is recorded in degrees Celsius · Investigate temperatures linked with changing state · Write a report on changing state e.g. which insulator keeps the ice cubes solid for the longest?	Material names, solid, liquid, gas, gases, fluid, runny, rigid, flexible, pour, maintains its shape, floaty, visible, invisible, heat, cold, cooled, evaporation, condensation, temperature, boiling point, freezing pint, melting point, reversible change, irreversible change, changing state, physical change **Scientific Vocabulary** classify, sort, measure, observe, collect, present, record, results, degrees Celsius and the unit recording, thermometer, plan, method, results, conclusion	*If the misconception arises ensure children understand that:* *• only water boils at 100 degrees (not all liquids - different liquids boil at different temperatures e.g. alcohol at 60 degrees, and nitrogen at -196 degrees)* *• melting is not dissolving (melting is a change of state but dissolving is not)* *• steam cannot be seen (we see water droplets condensing out of the steam - look very closely at the spout of a kettle - you cannot see the steam)*	

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 5

Working as a scientist/scientifically

Plan and Questions	Test	Observe and measure	Record and Present	Conclude
• Ask relevant questions • Answer relevant questions • Select appropriate enquiry to help answer questions/equipment	• Set up simple fair tests by controlling variables • Sort evidence into two categories: supporting or disproving a scientific idea	• Make careful observations • Take accurate measurements • Use a range of precise scientific equipment	• Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	• Draw conclusions • Use scientific language in discussions • Look and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results

Key Concepts and Skills	Learning Checkpoints	Vocabulary	Common misconceptions	Tried and tested ideas.
Biology: Life cycles	The life cycle of a living thing includes birth, growth, reproduction, and death. You can see this life cycle in different plants and animals, including humans.			
• The life cycle: birth, growth, reproduction, death • Describe the life process of reproduction in some plants and animals • Explain the differences in the life cycles of a mammal, an amphibian, an insect and a bird - From seed to seed with a plant - From egg to egg with a chicken; - From frog to frog; - From butterfly to butterfly: metamorphosis (Review Year 3 insects); - Describe the changes as humans develop from birth to old age. **Skills** -Make careful observations -Ask and answer relevant questions. - Observe and describe patterns and results. **** Refer to RSE delivery before teaching ******	• Explain the life cycle in humans • Describe the life processes of reproduction in plants and animals • Explain the differences in the life cycles of mammals, amphibians, insects (build from Y3) and birds • Describe the how humans change as they age, including old age • Explain and describe patterns in results e.g. observations of pupae and conclude your findings.	Life cycle, adult, baby, teenager, child, mature, immature, juvenile, flower, seed, anther, stamen, stigma, style, pollen, pollination, fertilisation, ovary, ovule, male, female, germination Scientific Vocabulary draw, record, conclude, observe.	*If the misconception arises ensure children understand that:* *• a baby grows in a mother's womb (not tummy).* *• a baby is conceived (not made).*	
Biology: Human Body: Hormones & Reproduction	During puberty human bodies change as part of their life cycle. There is a growth spurt, hair grows, breasts develop, and voices change. The reproductive system develops so that babies can be made.			
Human growth stages • Puberty: - Glands and hormones, growth spurt, hair growth, breasts, voice change The reproductive system: • Females: ovaries, (fallopian tubes), uterus, vagina, menstruation • Males: testes, (scrotum), penis, (urethra), semen • Sexual reproduction: intercourse, fertilisation, implantation in the uterus, pregnancy, embryo, newborn **Skills** • ask relevant questions • look and describe patterns • use scientific language to describe conclusions **** Refer to RSE delivery before teaching ******	• Describe what happens during puberty • Describe how the reproductive system is different in males and females • Give a basic description of sexual reproduction and what happens	Life cycle, baby, child, teenager, adolescent, adult, human, reproduce, reproduction, puberty, grow, growth, change, hormones, adrenal glands, pituitary gland, pancreas, insulin, male reproductive system, penis, testes, semen, erection, ejaculation, female reproductive system, vagina, womb, menstrual cycle, menstruation, period, blood, bleed, womb lining, ovary, ovaries, egg, sex, sexual intercourse, fertilisation, pregnancy , birth,	*If the misconception arises ensure children understand that:* *• fertilisation happens in the tube, not the womb or vagina*	

Physics: Forces	Force are pushes or pulls and can be measured with a Newtonmeter. Different situations have different forces. Forces can be increased or decreased using gears, levers, and pullies.			
Link to Y5 Designers - Mechanisms • identify the effects of **air resistance**, **water resistance** and **friction**, that act between moving surfaces • explain that unsupported objects fall towards the Earth because of the force of **gravity** acting between the Earth and the falling object. • When an object falls to the ground it is affected by two forces: the force of **gravity** pulling it down and the force of **air resistance**. • measure the force and **weight** of objects using newton meters • recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. **Plan and Questions** • Ask relevant questions • Answer relevant questions • Select appropriate enquiry to help answer questions/equipment **Test:** • Set up simple fair tests by controlling variables **Observe and measure:** • Make careful observations • Take accurate measurements • Use a range of precise scientific equipment **Record and Present:** • Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Write a simple scientific report with a plan, method, results and conclusion **Conclude:** • Draw conclusions • Look and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results	• Investigate the effects of air resistance, water resistance and friction that act on surfaces • Explain that unsupported objects fall as a result of gravity and explain how air resistance slows it down. • Explain how air resistance affects moving objects • Measure using a Newton meter • Explore mechanisms including levers, pulleys and gears • Write a simple scientific report with a plan, method, results and conclusion	Force, air resistance, water resistance, gravity, gravitational pull, push, pull, distance, Earth, object, affect, moving, direction, Newton, weigh, measure, gear, pulley, leaver, gear, mechanism **Scientific Vocabulary** plan, measure, newtonmeter, table, graph, conclusion, report, predict observe explain	*If the misconception arises ensure children understand that:* • *at a steady speed, the forces are balanced (balanced forces do not mean as object is stationary)* • *(only If children ask), upthrust is the force that makes things float in a fluid e.g. swimming pool.* • *forces are needed to: change shape, change direction, change speed.* *weight (force) is a force caused by gravity (mass is our kg, or stone - it should be called mass-watchers*	

Physics: Astronomy	Astronomy is the oldest Science. It is the study of the night sky. We live on Earth, as part of the Solar System, as part of our galaxy, as part of the universe, which started with a Big Bang. With astronomy we can name the stars and planets, and explain day, night, eclipses and the seasons.			
• The 'Big Bang' theory as the start of the universe • The universe: an extent almost beyond imagining • Our solar system o Sun: source of energy (heat and light) o The eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune [Note that, in 2006, Pluto was classified as a dwarf planet] • Planetary motion: orbit and rotation: How day and night on Earth are caused by the Earth's rotation; sunrise in the east and sunset in the west; How the seasons are caused by the Earth's orbit around the sun, tilt of the Earth's axis • How a lunar eclipse happens • Name some common stars and constellations • Know that you can navigate using the stars. (North Star, Big Dipper) **Optional content:** • Exploration of space o Observation through telescopes: Rockets and satellites: from unmanned flights; Apollo 11, first landing on the moon: 'One small step for a man, one giant leap for mankind'; Space shuttle	• Name the eight planets and recognise their place in the solar system and in relation to the sun • Explain how we get day and night • Understand that seasons are caused by the Earth's orbit • Describe simply how the Earth's shadow causes a lunar eclipse • Name and recognise common constellations • Describe key terms and theories: Big bang, The universe, The solar system. • **Optional** Discuss space exploration using a specific mission.	Earth, sun, light source, Moon, sphere, revolve, orbit, spin, rotate, axis, sunrise, sunset, north south, east, west, seasons, day, night, shade/shadow, darkness, gravity, solar system, milky way, galaxy, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, star, eclipse, constellations, space, space exploration, satellites, shuttles, telescopes **Scientific Vocabulary** question, theory, idea, hypothesis, predict, predictions, observe, observations, record, classify, conclusions, evaluate	*If the misconception arises ensure children understand that:* *•The Earth is spherical (not flat, nor circular)* *• the Sun is a star (not a planet nor a special category by itself)* *• The Earth orbits the sun (not the other way round)* *• The Earth rotates to cause day and night (the Sun does not move across the sky)* *• The rotating Earth causes the Sun to rise (the sun does not move)* *• the moon is always present and can only be seen at night (not only appears at night)* *• night is caused by the rotation of the Earth (not the Moon getting in the way of the Sun or the Sun moving further away from the Earth.)* *• the phases of the moon are caused by the shadow of the moon*	

• **Chemistry**: Atoms, properties, solutions, and changes	Everything around us is made out of <u>atoms</u>. Atoms are too small to see, and there are about one hundred different kinds of atoms. If we have a material, we can measure the <u>mass</u> (grams) and the <u>volume</u> (litres), and we can sort materials using a range of <u>properties</u>. Some chemicals <u>dissolve</u> and some do not (solutions). Sometimes you can separate a mixture into its parts using <u>filtering</u>, <u>evaporating</u>, <u>sieving</u> and other methods. Some changes (physical) are <u>reversible</u> and some (chemical) are not.			
Atoms and Elements • All matter is made up of particles too small for the eye to see, called atoms • An Element is one type of atom, of which there are a little more than one hundred • Familiar elements include gold, copper, aluminium, oxygen, iron • Most things are made up of a combination of elements Properties of matter • Mass: the amount of matter in an object • Volume: the amount of space a thing fills • Density: how much matter is packed into the space an object fills • Vacuum: the absence of matter • Hardness: how easily a material can be scratched • Transparency: how much light goes through a material • Conductivity: does it allow heat or electricity to flow? • Magnetism: is the material attracted to magnets? Solutions • A solution is formed when a substance (the solute) is dissolved in another substance (the solvent), such as when sugar or salt is dissolved in water; the dissolved substance is present in the solution even though you cannot see it. • Describe how to recover a substance from a solution • Basic idea of concentration and saturation (as demonstrated through simple experiments with crystallisation) • Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating • Demonstrate that dissolving, mixing and changes of state are reversible changes Changes • some changes are not reversible (chemical changes) • these changes often result in new materials being made e.g. frying an egg, nail rusting, burning a candle, preparation of the cuprammonium ion etc.	• Understand that all materials are made up of atoms, that are sorted into elements. • Be able to use the terms mass, volume, density, elements, vacuum, hard, transparent, conduct, magnetic. • Give a reason why a material is chosen for a purpose e.g. use glass for windows because glass is transparent • Understand that a solution is formed when a substance is dissolved in another substance, typically a solid in a liquid • Recognise that some changes (physical) are <u>reversible</u> and some (chemical) are not. • State that when new substances are made, the change is normally <u>not</u> reversible. • Use prior knowledge to explain how mixtures may be separated • Be able to describe an experiment to demonstrate a reversible reaction e.g. dissolving salt in water and then evaporating the water (or copper sulphate) • Be able to write a report on which substances dissolve • Be able to test different material properties and group objects accordingly e.g. is it transparent / conductive / magnetic? etc. • Be able to record observations of reversible (physical) and non-reversible (chemical) changes.	matter, particles, atoms, elements, oxygen, O_2, water H_2O, Carbon-dioxide CO_2, solid, liquid, gas, state of matter, material, density, mass, volume, vacuum, chemical, solution, (solute), substance, mixture, **Scientific Vocabulary** reversible change, change state, dissolve, separate, filter, evaporate, condense, (saturation point), plan, observe, record, table, chart, conclude, sort, group.	*If the misconception arises ensure children understand that:* *• melting is <u>not</u> dissolving and vice versa.* *• mass is distinct from volume (two different ways of measuring how much "stuff" you have e.g. ice-cream is sold by volume - 1ltr tub - but flour is sold by mass - 1kg bags)* *• to compare densities, you would need equal volumes e.g. 1ltr of alcohol has a smaller mass than 1 ltr of olive oil which has a smaller mass than 1 ltr of water.* *• <u>solid</u> objects float because of a smaller <u>density</u>, not a smaller size (NB a ship is not solid so has a low <u>average</u> density) so a very heavy balsa-wood log will still float on water, and a very small nail will still sink.* *• surface tension supports very small objects, like pond-skaters, or even paper-clips, but if you add soap to break the surface tension, more dense objects will still sink* *• the particles of the solute do not "disappear" when dissolved in the solvent. E.g. the mass of undissolved sugar and water is the same as the solution of sugar and water formed.* *• Atoms are not "used up" in chemical reactions - you start and end with the same number of atoms.* *• a hard object can still break easily e.g. diamond is the hardest mineral, but will shatter if hit with a hammer* *• "sucking" is impossible e.g. a vacuum cleaner creates a partial-vacuum inside and the air pressure outside <u>pushes</u> the dust/air <u>into</u> the vacuum.*	

Key Concepts, Knowledge, Vocabulary and Skills - Scientists: Year 6

Working as a scientist/scientifically				
Plan and Questions • Ask relevant questions • Answer relevant questions • Select appropriate enquiry/equipment to help answer questions	**Test** • Set up simple fair tests by controlling variables • Sort evidence into two categories: supporting or disproving a scientific idea	**Observe and measure** • Make careful observations • Take accurate measurements • Use a range of precise scientific equipment	**Record and Present** • Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	**Conclude** • Draw conclusions • Use scientific language in discussions • Look for and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results

Key Concepts and Skills	**Learning Checkpoints**	**Vocabulary**	**Common misconceptions**	**Tried and tested ideas.**
Biology: Classifying Living Things	All living things are sorted (classified) into five kingdoms. These are Plants, Animals, Fungi, and two others (Prokaryotes, e.g. bacteria, and Protista, e.g. amœba). Each kingdom is sorted into small groups that have special names (kingdom, phylum, class, order, family, genus, species e.g. Genus-Homo Species-Sapiens). The vertebrate group contains fish, amphibians, reptiles, birds and mammals. All living things are made from cells. Plant cells are different from animal cells (e.g. they have chloroplasts). Different cells are different shapes so they can do different jobs; for example, skin cells are smooth and flat and fit together. Some living things are made of just one cell, but other things are made of lots of different groups of cells working together. Cells are grouped into structures (tissues), which are grouped into organs; organs are grouped into system, which make up an organism.			

• Study animal classifications; discuss: why do we classify? How does classification help us understand the natural world? • Scientists have divided living things into five large groups called kingdoms, as follows: Plant, Animal, Fungus (Mushrooms, yeast, mould, mildew), and two more kingdoms of microscopic creatures. (microorganisms) (Protist - algae, protozoans, amoeba, euglena; Prokaryote - blue-green algae, bacteria). • Each Kingdom is divided into smaller groupings (Kingdom; Phylum; Class; Order; Family; Genus; Species; Variety). • When classifying living things, scientists use special names made up of Latin words (or words made to sound like Latin words), which help scientists around the world understand each other and ensure that they are using the same names for the same living things; e.g. Homo Sapiens: the scientific name for the species to which human beings belong to (genus: Homo, species: Sapiens). • Taxonomists: biologists who specialise in classification. • Different classes of vertebrates and major characteristics: fish, amphibians, reptiles, birds, mammals (review from Year 4). **Cells: Structures and processes** • All living things are made up of cells. • Different cells have different features to do different jobs; for example, plant cells have green dots (chloroplasts) to help photosynthesis, and brain cells (neurons) have lots of connections (axon, dendrites) to connect to other brain cells. • Simple idea that cells can be organised into different structures (tissues), that can then form organs: - groups of cells can form structures (for example: in animals, skin (tissue) or muscle (tissue); in plants, the skin of an onion or the bark of a tree). - Structures (tissues) with similar functions form organs (for example: in some animals, the heart, stomach, or brain; in some plants, the root or flower). • Simple idea of an organism having organs that work together in a system (recall, for example, from earlier studies of the human body, the digestive, circulatory, and respiratory systems).	• Name the three of the five Kingdoms of living things and recognise that there are two more kingdoms of microscopic creatures (microorganisms). • Recognise different classifications of animals. • Name the five classes of vertebrates and give examples of the distinguishing features of each (e.g. feathers in birds) • Use a simple key to classify some invertebrates; e.g. has legs, 6 legs = insect, doesn't have legs, long and thin = worm, etc.) • Take careful observations of local animals, and pictures, to sort and classify a variety of vertebrates and/or invertebrates e.g. pond dipping. • Describe how classification helps us to understand the natural world. • Recall that scientists use special names of Latin words when classifying. • State that a cell is the smallest "building block" of living things. • Recognise a diagram of a cell. • Give one example of a specialised cell and say what its special feature is (e.g. a plant cell has green dots (chloroplast) for photosynthesis). • Recall that similar cells join together (tissue) to make part of the living thing (organism) (e.g. skin tissue), and that different types of cell can join together to make an organ (e.g. heart is made of muscle tissue and artery tissue), and that different organs make up organ systems (e.g. breathing system), and then the whole living thing (human - made of many organ systems).	Carl Linnaeus, Kingdom, Phylum, Class, Order, Family, Genus, Species, Latin, Latin name, fish, amphibians, reptiles, mammals, birds, insects, vertebrate, invertebrate, cells, organs, organisms, single celled animal/plant, bacteria, virus **Scientific Vocabulary** observe, record, classify, classification, sort, group, key	*If the misconception arises, ensure children understand that:* *• cells are <u>not</u> the smallest thing, but they are the smallest living thing.* *• humans are animals (humans do <u>not</u> have a special category for themselves).* *• insects <u>are</u> animals.* *• insects only have six legs (<u>not all</u> 'bugs' or 'creepy crawlies', such as spiders, are part of the insect group).* *• amphibians <u>are different</u> from reptiles (they <u>are not</u> the same).*	

Biology: Evolution and Inheritance	Living things have offspring that are similar but not identical (genetic variation). The offspring that are "better" are more likely to survive and have offspring of their own (better adapted to the environment, and hence a better "fit" leading to evolution by survival of the fittest). Fossils show how millions of years ago there were different species compared to today (evolution).			
• Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago. • Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents. • Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.	• Understand that fossils provide information about the past. • Give examples of animal offspring and recognise the role that genetics play (certain characteristics are "passed on"). • Explain how animals and plants have adaptations that make them suited to their environments. • Understand that variation can lead to evolution. • Look for patterns; e.g. in the fossil record. • Draw conclusions; e.g. on which habitat an animal came from; which is the parent using offspring characteristics or which animal was alive at the earliest time from fossil records.	fossil, past, prehistoric, dinosaur, Evolve, evolution, adapt, adaptation, genetics, hereditary, genes, DNA, reproduce, reproduction, offspring, characteristics, features, Charles Darwin, survival of the fittest, Galapagos islands, finches, variation, change over time, peppered moth, environment, environmental factors,	*If the misconception arises ensure children understand that:* • *adaptation **does not** occur during an animal's lifetime: giraffes' necks **do not** stretch during their lifetime to reach higher leaves and animals living in cold environments **do not** grow thick fur during their lifetime.* • *offspring **do not** most resemble their parents of the same sex, so that sons look like fathers.* • *only some characteristics, can be inherited (e.g. dyed hair or footballing skills cannot be inherited).* • *there are no such thing as "cavemen" - humans were never alive at the same time as dinosaurs.*	

• **Biology**: Circulatory and Respiratory System	The heart pumps blood round the body as part of the circulatory-system. The blood flows in different tubes. Blood is made of different parts and each part has a job to do. We breathe through our mouth and nose and the air goes to our lungs. The lungs form part of the respiratory system. We need to look after our heart and lungs by staying healthy.			
Circulatory • Heart: four chambers (atrium/atria or atriums [plural] and ventricle/ventricles), aorta. • Blood has different parts: (Red blood cells, white blood cells, platelets, haemoglobin, plasma). Blood vessels: arteries, veins, capillaries • Blood pressure, pulse. • Fatty deposits can clog blood vessels and cause a heart attack. **Respiratory system** • Nose, throat, voice box, windpipe trachea. • Lungs, bronchi, bronchial tubes, diaphragm, ribs, alveoli (air sacs). • Smoking causes damage to lung tissue, lung cancer.	• Explain the function of the heart. • Label a diagram to show the structure of the heart. • Recognise that blood is the transport system of the human body, including transporting nutrients. • Describe simply how the diaphragm and ribs move air in and out the lungs. • Recognise that oxygen goes into the body from the lungs, and Carbon Dioxide comes out of the body and into the lungs (and hence is breathed out) • ask and answer relevant questions about the circulatory and respiratory systems; e.g. how does blood get around the body? What is the difference between arteries and veins?	The respiratory system, the circulatory system, heart, blood, red blood cells, white blood cells, platelets, plasma, blood vessel, arteries, veins, capillaries, blood pressure, pulse, oxygen, carbon dioxide, lungs, ribs, windpipe (trachea), nutrients, air pipes (bronchioles), air sacs (alveoli), **Scientific Vocabulary** question	*If the misconception arises ensure children understand that:* • *your heart is on the left side of your chest.* • *the heart pumps blood (blood is not made in the heart).* • *the blood travels in two loops (figure of eight) from the heart to the lungs and from the heart around the body (not one loop).* • *when we exercise, our heart beats faster to provide oxygen and glucose faster (not work the muscles more).* • *If asked about this, all blood in our bodies is red - the veins just look blue because of the way light passes through the skin.* • *food provides nutrients and energy (not just energy).* • *fats, dairy and protein are an important part of a varied diet (not all fat is bad for you).* • *some foods contain hidden fats (you can't always see how fatty a food is).* • *Not all drugs are bad for you.*	

Physics: Waves Carry Energy - Light 2023/2024 use <u>with</u> extended topic	<u>Light</u> travels in <u>straight lines</u>. We can see things if they give out light, or <u>reflect</u> light into our <u>eyes</u>. Some things let the light travel through them (transparent) and some things do not (opaque). <u>Mirrors</u> reflect light. White light can be split up into a rainbow (dispersed to form a spectrum). Primary colours of light can be mixed to make white light.			
• Light travels at an amazingly high speed. • Light travels in straight lines (as can be demonstrated by forming shadows). • objects are seen because they give out or reflect light into the eye • Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. • Transparent and opaque objects • Reflection from a mirror and shiny surfaces • The spectrum: use a prism to demonstrate that white light is made up of a spectrum of colours. • The eye detects three primary colours of light (NB NOT paint): Red, Green, Blue. These mix to make secondary colours: Yellow, Magenta, Cyan • Ask relevant questions • Make careful and accurate observations • Draw conclusions	- Understand that light travels at high speed in straight lines - Objects are seen because light enters the eye from a reflection or directly from a light source e.g. bulb. - Be able to simply describe opaque and transparent objects and sort accordingly - Explain how shadows form - Reflection in a mirror produces an image (you can see yourself in a mirror, but not a table) - Mixing light is different to mixing paint - when we mix all colours of light we get white light, (when we mix paint we get black). - Name the primary colours of <u>light</u>. - Use a prism to demonstrate that white light is made up of a spectrum colours - Use coloured torches to mix primary colours of light. - Describe an investigation into shadows	Light, light source, natural, man-made, artificial, travel, wave, straight lines, speed of light, shadow, dark, darkness, transparent, translucent, opaque, shadow, reflect, eyes, prism, light spectrum **Scientific Vocabulary** test, measure Agreed common language with the ART curriculum: "**In Art** we use... but **in Physics/Science there are different primary colours**" "**The eye** has detectors... but **in Art we use the subtractive primary colours, which are different**"	*If the misconception arises ensure children understand that:* *• light has to travel <u>from</u> an object <u>into</u> our eyes (<u>no light</u> comes <u>out</u> of our eyes).* *• we <u>cannot</u> see in total darkness we need a source of light (we <u>cannot</u> see at night unless there is light e.g. from streetlamps, phone charger etc.)* *• reflections, including the moon, are <u>not sources</u> of light* *• transparent objects are <u>not</u> light sources* *• shadows are when light is blocked (<u>nothing</u> "gives off darkness").* *• The eye detects red, green, and blue light. This means the primary colours of light (additive mixing) are not the same as the primary colours of paint (subtractive mixing)* *• Mixing all colours of light together makes white light*	

Physics: Electricity 2023/2024 use <u>with</u> extended topic	Electricity makes light bulbs light if you connect a <u>circuit</u>. Some things do not <u>conduct</u> electricity. We			
• Understand that a battery supplies electrical energy when it's in a circuit and trace the flow of electricity around a circuit with their finger. • Name the basic parts of simple electric circuits (for example, batteries, wire, bulb or buzzer, switch) • Conductive and non-conductive materials • Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • Compare and give reasons for variations in how components function, including the brightness of bulbs and the on/off position of switches • Use recognised symbols when representing a simple circuit in a diagram. • Know some safety rules for electricity (for example, never put your finger or anything metallic in an electrical outlet, never touch a switch or electrical appliance when your hands are wet or when you're in the bathtub, never put your finger in a lamp socket, etc.) **Scientific Skills** • Recognise that questions can be answered in different ways. • Perform a simple test. • Gather and record to help answer a question.	• Describe what is needed to make an electric circuit • Draw an electrical circuit and trace the current. • **Investigate** conductive and non-conductive materials **and record the results.** • Describe and explain the safety rules for electricity	flow, electrical, circuit, battery, wire, lightbulb, buzzer, switch, energy, connected, disconnected, conductive, non-conductive, safety, electric shock, electrical appliance, wire casing, metal, non-metal **Scientific Vocabulary** Observe, record, identify, investigate, test, record, results, conclude.	***If** the misconception arises ensure children understand that:* *• electricity flows through bulbs and not to them* *• electricity flows out of the positive end of the battery and back to the negative end (not out of both ends)* *• Electricity only flows from the battery when it's part of a complete circuit.*	• Test materials for conductivity, including a write up. • Create and draw circuits using equipment

Key Concepts and Skills	**Learning Checkpoints**	**Vocabulary**	**How to address potential misconceptions.**	**Tried and tested ideas.**
Light - enrichment topic	After re-teaching the light topic, follow on with: Light travels in straight lines to make shadows. White light can be split into colour, and light-colours can be mixed to make other colours. Art-paint and Printers use different primary colours to light. We can carry out investigations using light to collect data and display this in appropriate ways.			
• Formation of shadows • Formation of a spectrum • Colour detection and colour mixing • Ask relevant questions • Make careful and accurate observations • Display data • Draw conclusions	**Specific enrichment content**: • State the colours of the rainbow (spectrum) • Describe how to make a rainbow (spectrum) using a prism, using water (e.g. a glass of water, spray from hosepipe etc), and any other method. • Explain how raindrops/mist act like a mirror while splitting white light and hence the sun needs to be on your back in order to see a rainbow, with the rain in front. • State that rainbows form when there is both sun (to provide white light) and rain (to split the white into colours and reflect the light back to the eye). • Describe Newton's Wheel (a coloured spinner) and explain how it works (light-colours combine to make white) • State that the eye detects only the red, green, and blue primary colours. • Describe how colours of light (RGB) combine to make secondary colours (cyan, magenta, yellow), and, ultimately combine to make white. • Have an awareness of different primary colours: art (using subtractive mixing) uses red, yellow, blue; printer ink (using subtractive mixing) uses cyan, magenta, and yellow. • Design and carry out an investigations into colour / rainbows (see "ideas" column if needed). • State that light travels in straight lines and that shadows form when the light-source is blocked by an (opaque) object. • Design and carry out investigations into shadows including data analysis and a written report with conclusions (see "ideas" column if needed).	Light, light source, natural, man-made, artificial, travel, wave, straight lines, speed of light, shadow, dark, darkness, transparent, translucent, opaque, shadow, reflect, eyes, prism, light spectrum **Scientific Vocabulary** test, measure Agreed common language with the ART curriculum: "**In Art** we use yellow, blue, and red but **in Physics/Science there are different primary colours**" "**The eye** has red, green, and blue detectors but **in Art we use the subtractive primary colours, which are different.**"	*If the misconception arises ensure children understand that:* *• light has to travel <u>from</u> an object <u>into</u> our eyes (<u>no light</u> comes <u>out</u> of our eyes).* *• we <u>cannot</u> see in total darkness we need a source of light (we <u>cannot</u> see at night unless there is light e.g. from streetlamps, phone charger etc.)* *• reflections, including the moon, are <u>not sources</u> of light* *• transparent objects are <u>not</u> light sources* *• shadows are when light is blocked (<u>nothing</u> "gives off darkness").* *• The eye detects red, green, and blue light. This means the primary colours of light (additive mixing) are not the same as the primary colours of paint (subtractive mixing)* *• Mixing all colours of light together makes white light* *• Infinity is not a number, it is something that goes on forever e.g. a shadow without an end*	• "What is the best position for a prism to make a rainbow (spectrum), <u>and</u> what is the exact order of the colours that I can see?" (NB most pupils can see between 4 and 6 colours). • "What kind of weather makes a rainbow, <u>and</u> what is the location of the person, sun, rain, and rainbow?" • "How many different ways are there of making a rainbow <u>and</u> how can I observe and record these?" • "What are the primary and secondary colours of light?" (NB you need to use strongly-coloured filters, not just sweet-wrappers in order to get a good red/green/blue beam, of light - could borrow from a local secondary school, or just try out before class. A dark room is useful. • Use a piece of card or wooden block to block the light from a light-bulb, or projector. Make sure that you can see the shadow clearly - consider using a darkened room. "How does the <u>distance from the bulb</u> change (affect) the <u>size of the shadow</u>?" If the block is near the wall, the shadow will be nearly the same size as the block. As the block moves towards the bulb, the shadow-size increases. The shadow will eventually be bigger than the room, and eventually bigger than the Earth. Data can be displayed in tables, bar charts, or line-graphs. Conclusions should include a mention that the increase in shadow-size is increasing i.e. the bars on the bar chart are forming a curved pattern. • "How can shadows be used in drama?" Shadow puppets - open ended cross-curricular investigation.

Electricity - enrichment topic	After re-teaching the electricity topic, follow on with: Circuits can be designed to do different things. We can carry out investigations into circuits to collect data and display this in appropriate ways. Electricity (current) flows through complete circuits. We can measure the flow of electricity (current), and display this in appropriate ways to draw conclusions			
• Understand that a battery generates electricity when it's in a circuit and trace the flow of electricity around a circuit with their finger. • Name the basic parts of simple electric circuits (for example, batteries, wire, bulb or buzzer, switch) • Conductive and non-conductive materials • Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • Compare and give reasons for variations in how components function, including the brightness of bulbs and the on/off position of switches • Use recognised symbols when representing a simple circuit in a diagram. • Know some Safety rules for electricity (for example, never put your finger or anything metallic in an electrical outlet, never touch a switch or electrical appliance when your hands are wet or when you're in the bathtub, never put your finger in a lamp socket, etc.) • Ask relevant questions • Make careful and accurate observations • Display data • Draw conclusions	**Specific enrichment content**: • Describe what is needed to make an electric circuit including naming components, and describing the need for a complete "loop". • Describe electricity (current) as flowing around a circuit. • Know that electricity (current) can be measured (using an ammeter). • Design and build circuits for different scenarios (see ideas column) • Analyse switches to predict, observe, and explain the layout of a hidden circuit (puzzle boxes). • Design and carry out investigations into series circuits including numerical data collection, analysis and a written report with conclusions	flow, electrical, circuit, battery, wire, lightbulb, buzzer, switch, energy, connected, disconnected, conductive, non-conductive, safety, electric shock, electrical appliance, wire casing, metal, non-metal **Scientific Vocabulary** Observe, record, identify, investigate, test, record, results, conclude.	***If** the misconception arises ensure children understand that:* *• electricity flows through bulbs and not to them* *• electricity flows out of the positive end of the battery and back to the negative end (not out of both ends)* *• Electricity only flows from the battery when it's part of a complete circuit.* *• Electricity (current) is not used up - it simply delivers electrical energy and then returns to the battery to pick up some more.*	• Ask students to make circuits for different scenarios, e.g. a torch, a lighthouse, car headlights, your stairs at home (switch at the bottom and switch at the top of the stairs), Christmas-tree lights, etc. etc. • Collect e.g. shoe boxes and make holes for light bulbs and switches so they can bee seen and manipulated when the box is closed. Students (or teacher) make a secret circuit inside the box. Then give the box to a new group. Students must try to work out how the switches are connected and make a prediction. After the prediction, pupils can open the box, observe the circuit, and explain if they were right or not. Good circuits include: not connected; a simple switch and bulb; a switch with two bulbs; two bulbs but only one is connected to the switch and the other is on all the time. Harder circuits could include: two switches in parallel with one bulb; two switches in series with one bulb; combinations of two switches and two bulbs. • Place an ammeter in series with a battery and a bulb to measure the current. "How does the number of bulbs (in series) change (affect) the current?" "How does the number of cells change the current?" • Build a series circuit with several light bulbs and cells. Place an ammeter in the circuit next to the battery. Predict "How does the current change in a circuit?" Observe - plug the ammeter in at different positions. You should find that the current is the same everywhere. Explain - electricity (current) flows around the circuit and back to the battery; it is not "used up".

Appendix 1: Four Specific Opportunities to go Beyond the Curriculum: Investigations into Light, Investigations into Electricity, Details of Insects, Chemical Reactions

Key Concepts and Skills	Learning Checkpoints	Vocabulary	How to address potential misconceptions.	Tried and tested ideas.
Light - enrichment topic	Light travels in straight lines to make shadows. White light can be split into colour, and light-colours can be mixed to make other colours. Art-paint and Printers use different primary colours to light. We can carry out investigations using light to collect data and display this in appropriate ways.			
• Formation of shadows • Formation of a spectrum • Colour detection and colour mixing • Ask relevant questions • Make careful and accurate observations • Display data • Draw conclusions	**Specific enrichment content**: • State the colours of the rainbow (spectrum) • Describe how to make a rainbow (spectrum) using a prism, using water (e.g. a glass of water, spray from hosepipe etc), and any other method. • Explain how raindrops/mist act like a mirror while splitting white light and hence the sun needs to be on your back in order to see a rainbow, with the rain in front. • State that rainbows form when there is both sun (to provide white light) and rain (to split the white into colours and reflect the light back to the eye). • Describe Newton's Wheel (a coloured spinner) and explain how it works (light-colours combine to make white) • State that the eye detects only the red, green, and blue primary colours. • Describe how colours of light (RGB) combine to make secondary colours (cyan, magenta, yellow), and, ultimately combine to make white. • Have an awareness of different primary colours: art (using subtractive mixing) uses red, yellow, blue; printer ink (using subtractive mixing) uses cyan, magenta, and yellow. • Design and carry out an investigations into colour / rainbows (see "ideas" column if needed). • State that light travels in straight lines and that shadows form when the light-source is blocked by an (opaque) object. • Design and carry out investigations into shadows including data analysis and a written report with conclusions (see "ideas" column if needed).	Light, light source, natural, man-made, artificial, travel, wave, straight lines, speed of light, shadow, dark, darkness, transparent, translucent, opaque, shadow, reflect, eyes, prism, light spectrum, **Scientific Vocabulary** test, measure Agreed common language with the ART curriculum: "**In Art** we use yellow, blue, and red but **in Physics/Science there are different primary colours**" "**The eye** has red, green, and blue detectors but **in Art we use the subtractive primary colours, which are different.**"	*If the misconception arises ensure children understand that:* *• light has to travel from an object into our eyes (no light comes out of our eyes).* *• we cannot see in total darkness we need a source of light (we cannot see at night unless there is light e.g. from streetlamps, phone charger etc.)* *• reflections, including the moon, are not sources of light* *• transparent objects are not light sources* *• shadows are when light is blocked (nothing "gives off darkness").* *• The eye detects red, green, and blue light. This means the primary colours of light (additive mixing) are not the same as the primary colours of paint (subtractive mixing)* *• Mixing all colours of light together makes white light* *• Infinity is not a number, it is something that goes on forever e.g. a shadow without an end*	• "What is the best position for a prism to make a rainbow (spectrum), and what is the exact order of the colours that I can see?" (NB most pupils can see between 4 and 6 colours). • "What kind of weather makes a rainbow, and what is the location of the person, sun, rain, and rainbow?" • "How many different ways are there of making a rainbow and how can I observe and record these?" • "What are the primary and secondary colours of light?" (NB you need to use strongly-coloured filters, not just sweet-wrappers in order to get a good red/green/blue beam, of light - could borrow from a local secondary school, or just try out before class. A dark room is useful. • Use a piece of card or wooden block to block the light from a light-bulb, or projector. Make sure that you can see the shadow clearly - consider using a darkened room. "How does the distance from the bulb change (affect) the size of the shadow?" If the block is near the wall, the shadow will be nearly the same size as the block. As the block moves towards the bulb, the shadow-size increases. The shadow will eventually be bigger than the room, and eventually bigger than the Earth. Data can be displayed in tables, bar charts, or line-graphs. Conclusions should include a mention that the increase in shadow-size is increasing i.e. the bars on the bar chart are forming a curved pattern. • "How can shadows be used in drama?" Shadow puppets - open ended cross-curricular investigation.
Electricity - enrichment topic	Circuits can be designed to do different things. We can carry out investigations into circuits to collect data and display this in appropriate ways. Electricity (current) flows through complete circuits. We can measure the flow of electricity (current), and display this in appropriate ways to draw conclusions			
• Name the basic parts of simple electric circuits (for example, batteries, wire, bulb or buzzer, switch) • Compare and give reasons for variations in how components function, including the brightness of bulbs and the on/off position of switches • Use recognised symbols when representing a simple circuit in a diagram. • Know some Safety rules for electricity (for example, never put your finger or anything metallic in an electrical outlet, never touch a switch or electrical appliance when your hands are wet or when you're in the bathtub, never put your finger in a lamp socket, etc.) • Ask relevant questions • Make careful and accurate observations • Display data • Draw conclusions	**Specific enrichment content**: • Describe what is needed to make an electric circuit including naming components, and describing the need for a complete "loop". • Describe electricity (current) as flowing around a circuit. • Know that electricity (current) can be measured (using an ammeter). • Design and build circuits for different scenarios (see ideas column) • Analyse switches to predict, observe, and explain the layout of a hidden circuit (puzzle boxes). • Design and carry out investigations into series circuits including numerical data collection, analysis and a written report with conclusions	flow, electrical, circuit, battery, wire, lightbulb, buzzer, switch, energy, connected, disconnected, conductive, non-conductive, safety, electric shock, electrical appliance, wire casing, metal, non-metal **Scientific Vocabulary** Observe, record, identify, investigate, test, record, results, conclude.	***If** the misconception arises ensure children understand that:* *• electricity flows through bulbs and not to them* *• electricity flows out of the positive end of the battery and back to the negative end (not out of both ends)* *• Electricity only flows from the battery when it's part of a complete circuit.* *• Electricity (current) is not used up - it simply delivers electrical energy and then returns to the battery to pick up some more.*	• Ask students to make circuits for different scenarios, e.g. a torch, a lighthouse, car headlights, your stairs at home (switch at the bottom and switch at the top of the stairs), Christmas-tree lights, etc. etc. • Collect e.g. shoe boxes and make holes for light bulbs and switches so they can bee seen and manipulated when the box is closed. Students (or teacher) make a secret circuit inside the box. Then give the box to a new group. Students must try to work out how the switches are connected and make a prediction. After the prediction, pupils can open the box, observe the circuit, and explain if they were right or not. Good circuits include: not connected; a simple switch and bulb; a switch with two bulbs; two bulbs but only one is connected to the switch and the other is on all the time. Harder circuits could include: two switches in parallel with one bulb; two switches in series with one bulb; combinations of two switches and two bulbs. • Place an ammeter in series with a battery and a bulb to measure the current. "How does the number of bulbs (in series) change (affect) the current?" "How does the number of cells change the current?"

				• Build a series circuit with several light bulbs and cells. Place an ammeter in the circuit next to the battery. Predict "How does the current change in a circuit?" Observe - plug the ammeter in at different positions. You should find that the current is the same everywhere. Explain - electricity (current) flows around the circuit and back to the battery; it is not "used up".
Insects - enrichment topic	• There are many different kinds of <u>insects</u> and they do different things. Insects have a <u>life cycle</u> and can live on their own or in groups. Insects have different body parts to other animals.			
• Insects can be helpful and harmful to people: Helpful: pollination; products like honey, beeswax, and silk; eat harmful insects; Harmful: destroy crops, trees, wooden buildings, clothes; carry disease; bite or sting • Insects have certain features (characteristics) - Skeleton on the outside (exoskeleton) - Six legs and three body parts: head, thorax and abdomen - Most <u>but not all</u> insects have wings • Life cycles: metamorphosis • Some insects look like miniature adults when born from eggs, and they moult to grow (for example: grasshopper, cricket) - Some insects go through distinct stages of egg, larva, pupa, adult (for example: butterflies, ants) • Social Insects - Most insects live solitary lives, but some are social (for example: ants, honeybees, termites, wasps)	• Group insects according to their characteristics • Understand the difference between insect skeletons and other animal skeletons (endoskeleton and an exoskeleton) • Give examples of a lifecycle of an insect • Explain why some insects are helpful and some are harmful • Make careful observations of insects including a colony (if possible) • Write a simple scientific report about insect observations including a question, equipment choice, and a summary of the main findings (e.g. do all insects have wings, or how do ants build a colony)	Helpful, harmful, beeswax, pollination, (exoskeleton), (chitin), head, abdomen, thorax, wings, egg, (larva), (pupa), adult, metamorphosis, moulting	*If the misconception arises ensure children understand that:* • *Not all minibeasts are insects* • *Insects do not have a skeleton* • *Not all insects are harmful*	•
Chemistry - enrichment topic: Matter & Change (would suit KS3 teacher support e.g. with chemicals)	Everything is made out of <u>atoms</u>. Atoms can join together to make new <u>chemicals</u>. (Atoms join to make molecules, and compounds.) <u>Chemists</u> use special names for chemicals (chemical formulæ). Atoms can be sorted into <u>metals</u> and <u>non-metals</u> which do different things (properties). About 2/3 of all the types of atoms are metals. Scientists list all the atoms in the <u>Periodic Table</u> of the atoms (Elements). Each atom has a <u>chemical symbol</u>. There are two main types of change: a <u>physical change</u> and a <u>chemical change</u> (reaction). Physical changes do not change what the thing is made of (e.g. ice to water) but a chemical change results in new chemicals being made (e.g. wood burns to make carbon dioxide and water and soot).			
Atoms, molecules and compounds: • Basic idea of atoms - smallest building blocks of matter - everything is made of atoms • Atoms may join together to form molecules or compounds. • Common compounds and their formulas: Water H_2O Table Salt NaCl Carbon Dioxide CO_2 **Elements**: • Elements have atoms of only one kind, (having the same number of protons). There are a little more than 100 different elements. • The periodic table lists all the known elements. The elements are listed according to chemical properties. • Some well-known elements and their symbols: Hydrogen H ; Helium He ; Carbon C ; Nitrogen N ; Oxygen O ; Sodium Na ;Aluminium Al ;Silicon Si ;Chlorine Cl ; Iron Fe ;Copper Cu ;Silver Ag ;Gold Au • Two important categories of elements: metals and non-metals; Metals comprise about 2/3 of the known elements; Properties of metals: most are shiny, ductile, malleable, conductive **Chemical and Physical change**:	• Know that atoms make up all matter, and are indivisible • Recognise that some atoms join together to form molecules and compounds • Name at least three common compounds and know their formulas • Have an understanding of the periodic table and name some symbols of known elements • Name properties of metals • Give examples of chemical and physical changes and describe how these occur • Know that atoms are constantly in motion • Testing for metals and/or testing for chemical changes • Select appropriate enquiry/equipment to help answer questions. • Make careful observations draw conclusions	Matter, particles, atoms, molecules, elements, bond, compound, oxygen, O_2, water H_2O, Carbon- dioxide CO_2, solid, liquid, gas, state of matter, material, mass, volume, chemical, chemical reaction, physical reaction, reversible change, irreversible change, change state, dissolve, solution, solute, substance, mixture, periodic table, elements, Hydrogen (H_2) Carbon (C) Oxygen (O_2) Metal, **Scientific Vocabulary** properties, shiny, magnetic, conductive (thermal and electrical), malleable, opaque, sonorous- metallic sound, observation, conclusion, plan.	*If the misconception arises ensure children understand that:* • *an element is one kind of atom, a compound is different types of atom bonded together, a molecule is any atoms bonded together.* • *Molecules can be compounds (with different kinds of atoms e.g. H_2O). Molecules can also be elements (one kind of atom e.g. O_2)* • *a candle has a physical <u>and</u> a chemical change: the wax melts (physical) <u>and</u> the wax burns to make carbon dioxide and water (chemical).* • *Chemical formulae must be written exactly, for example water is H_2O, carbon dioxide is CO_2 and table salt is NaCl (NB choose good font if using the letter L) Na NOT NA. The numbers MUST be lower-case in exactly the right position H2O is explosive **and** would cause humans to spontaneously combust after the explosion whereas H_2O is water; CO is a deadly invisible gas but Co is a used to make Cobalt-blue paint.* • *Atoms are not "used up" in chemical reactions - you start and end with the same number of atoms.*	

• Chemical change results in a new substance being made. Examples of chemical change: rusting of iron, burning of wood, milk turning sour Physical change changes only the properties or appearance of the substance, but does not change what the substance is made up of. Examples of physical change: cutting wood or paper, breaking glass, freezing water				

Appendix 2: Year summaries

Year 1

Plan, and Ask Questions Asking simple questions Recognise they can be answered in different ways	**Test** Perform a simple test	**Observe and measure** Observe using simple equipment	**Record and present** Use observations to suggest answers to questions Gather and record to help answer a question Sort and classify information	**Conclude** Say what you found out
Chemistry: Everyday Materials.	Different things are made of different materials based on their properties. Materials can be natural or man-made.			
Biology: Animals.	There are many different plants and animals. We can sort plants and animals in different ways (fish, bird, pet, plant). Plants and animals need to be looked after in different ways. Offspring (babies) of plants and animals normally look like their parents and can need extra special care.			
Earth and Space Science: Seasonal Changes	The four seasons are winter spring summer and autumn. There are different types of weather, each season has a different weather pattern (see Geog link) and rain and snow come from the clouds. The sun is the main thing that causes the weather on Earth.			
Biology: Humans	Humans have many senses (we teach five of them) that use different body parts. Humans need to look after their bodies with healthy lifestyles.			
Biology: Plants	Plants make their own food and have different parts (stem, root, leaf, flower). Evergreen plants keep their leaves all year round but Deciduous plants lose their leaves in the winter. Some plants are used as food for humans.			
Physics: Magnetism	Magnets can attract some things but not others. A magnet can pull or push another magnet depending on the north pole and the south pole.			

Year 2

Plan, and Ask Questions Ask simple questions Recognise they can be answered in different ways	**Test** Perform a simple test	**Observe and measure** Observe using simple equipment	**Record and present** Use observations to suggest answers to questions Gather and record to help answer a question Sort and classify information	**Conclude** Say what you found out
Chemistry: Properties of Matter and Measurement	Everything is made from atoms. Water can easily be changed into ice (solid), water (liquid) and steam (gas). Materials can be squashed and stretched.			
Biology: Living things and their habitats and environments.	Different plants and animals live in different places so they can get what they need to stay alive. Some animals eat plants, some eat animals, and some eat both.			
Biology The Human Body & health	We need to look after our body to keep it clean, fit, healthy, and free from disease.			
Biology: The Human Body & systems	Different parts of the body can work together in different groups called systems. These systems keep us healthy.			

Year 3

Plan, and Ask Questions • Ask relevant questions • Answer relevant questions • Select appropriate equipment to help answer questions/enquiries	**Test** • Set up simple fair tests	**Observe and measure** • Make careful observations • Take accurate measurements • Use a range of equipment including thermometers and data loggers	**Record and Present** • Collect, record and present results, using bar charts and tables • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	**Conclude** • Draw conclusions • Use scientific language in discussions • Make predictions • Look for patterns in results
Physics: Forces and Magnets	Some things are attracted to magnets - even when the magnet is not touching them. Magnets have a North and a South pole. Like poles repel and unlike poles attract. A compass is a magnet that will point towards the Earth's North pole. Things move differently on different surfaces, because of friction (which needs things to touch).			
Biology: Insects	There are many different kinds of insects and they do different things. Insects have a life cycle and can live on their own or in groups. Insects have different body parts to other animals.			
Chemistry, Earth Science: The Water Cycle	There is a water cycle on the Earth that uses evaporation and condensation.			
Earth and Space Science: What is inside the Earth? - Rocks	There are different layers inside the Earth. A volcano can erupt lava, and a geyser can erupt water. There are different types of rock. Sometimes a living thing can leave a fossil behind, which is found inside a rock.			
Biology: Plants	Plants have roots, a stem/trunk, leaves and flowers and each part does a different thing to keep it alive and reproduce. A plant has a life cycle.			
Biology: The human body: Cells, systems, and health	Living things are made of cells (which are made of atoms - everything is made of atoms). The digestive system is a collection of body parts that make our food useful for our body. Each part has a different name and does a different job. To help our digestive system we need to eat a healthy diet.			
Physics: Waves Carry Energy - Light	We can see things if they give out light, or reflect light into our eyes. Light is reflected from surfaces. Shadows form when the light source is blocked. Light from the sun can be dangerous so we need to protect our eyes.			

Year 4

Plan, and Ask Questions • Ask relevant questions • Answer relevant questions • Select appropriate equipment to help answer questions/enquiries	**Test** • Set up simple fair tests	**Observe and measure** • Make careful observations • Take accurate measurements • Use a range of equipment including thermometers and data loggers	**Record and Present** • Collect, record and present results, using bar charts and tables • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	**Conclude** • Draw conclusions • Use scientific language in discussions • Make predictions • Look for patterns in results
Physics: Electricity	Electricity flows through complete circuits. If there is a gap, the electricity does not flow (devices will be off). Circuits can have batteries (make bulbs brighter), bulbs, switches, and other components. Some materials conduct and some insulate.			
Physics: Waves Carry Energy - Sound	Sounds are vibrations that we can hear. Sounds can be high/low (fast or slow vibrations), quiet/loud.(small or big vibrations). Humans make sounds in the voice box, and we hear sounds with our ears.			
Biology: Classification of Animals	Animals can be sorted in different ways. Some animals have backbones (vertebrates) and some do not (invertebrates). You can sort the backbone-animals (vertebrates) into fish, amphibians, reptiles, birds, and mammals.			
Biology: organisms and their environment – Muscular & Skeletal system	Vertebrates (including humans) have muscles and bones inside their bodies. Muscles are joined to the bones and help us to move. Some muscles work even when we don't think about them, e.g. the heart (involuntary movement).			
Physics Materials	Solids can change to liquids (melting) and liquids can change to gasses (boiling). We can measure the temperature that this happens.			

Year 5

Plan, and Ask Questions • Ask relevant questions • Answer relevant questions • Select appropriate enquiry to help answer questions/equipment	**Test** • Set up simple fair tests by controlling variables • Sort evidence into two categories: supporting or disproving a scientific idea	**Observe and measure** • Make careful observations • Take accurate measurements • Use a range of precise scientific equipment	**Record and Present** • Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	**Conclude** • Draw conclusions • Use scientific language in discussions • Look and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results
Biology: Life cycles	The life cycle of a living thing includes birth, growth, reproduction, and death. You can see this life cycle in different plants and animals, including humans.			
Biology: Human Body: Hormones & Reproduction	During puberty human bodies change as part of their life cycle. There is a growth spurt, hair grows, breasts develop, and voices change. The reproductive system develops so that babies can be made.			
Physics: Forces	Force are pushes or pulls and can be measured with a Newtonmeter. Different situations have different forces. Forces can be increased or decreased using gears, levers, and pullies.			
Physics: Astronomy	Astronomy is the oldest Science. It is the study of the night sky. We live on Earth, as part of the Solar System, as part of our galaxy, as part of the universe, which started with a Big Bang. With astronomy we can name the stars and planets, and explain day, night, eclipses and the seasons.			
Chemistry: Atoms, properties, solutions, and changes	Everything around us is made out of atoms. Atoms are too small to see, and there are about one hundred different kinds of atoms. If we have a material, we can measure the mass (grams) and the volume (litres), and we can sort materials using a range of properties. Some chemicals dissolve and some do not (solutions). Sometimes you can separate a mixture into its parts using filtering, evaporating, sieving and other methods. Some changes (physical) are reversible and some (chemical) are not.			

Year 6

Plan, and Ask Questions • Ask relevant questions • Answer relevant questions • Select appropriate enquiry/equipment to help answer questions	**Test** • Set up simple fair tests by controlling variables • Sort evidence into two categories: supporting or disproving a scientific idea	**Observe and measure** • Make careful observations • Take accurate measurements • Use a range of precise scientific equipment	**Record and Present** • Collect, record and present results, including the use of line graphs, scatter graphs, bar charts and tables where appropriate • Suggest criteria for grouping, sorting and classifying/use a simple key • Write a simple scientific report with a plan, method, results and conclusion	**Conclude** • Draw conclusions • Use scientific language in discussions • Look for and describe patterns in results • Use patterns to make predictions and design further tests • Reflect on the reliability of results

Biology: Classifying Living Things	All living things are sorted (classified) into five kingdoms. These are Plants, Animals, Fungi, and two others (Prokaryotes, e.g. bacteria, and Protista, e.g. amœba). Each kingdom is sorted into small groups that have special names (kingdom, phylum, class, order, family, genus, species e.g. Genus-Homo Species-Sapiens). The vertebrate group contains fish, amphibians, reptiles, birds and mammals. All living things are made from cells. Plant cells are different from animal cells (e.g. they have chloroplasts). Different cells are different shapes so they can do different jobs; for example, skin cells are smooth and flat and fit together. Some living things are made of just one cell, but other things are made of lots of different groups of cells working together. Cells are grouped into structures (tissues), which are grouped into organs; organs are grouped into system, which make up an organism.
Biology: Evolution and Inheritance	Living things have offspring that are similar but not identical (genetic variation). The offspring that are "better" are more likely to survive and have offspring of their own (better adapted to the environment, and hence a better "fit" leading to evolution by survival of the fittest). Fossils show how millions of years ago there were different species compared to today (evolution).
Biology: Circulatory and Respiratory System	The heart pumps blood round the body as part of the circulatory-system. The blood flows in different tubes. Blood is made of different parts and each part has a job to do. We breathe through our mouth and nose and the air goes to our lungs. The lungs form part of the respiratory system. We need to look after our heart and lungs by staying healthy.
Physics: Waves Carry Energy - Light 2023/2024 use with extended topic	Light travels in straight lines. We can see things if they give out light, or reflect light into our eyes. Some things let the light travel through them (transparent) and some things do not (opaque). Mirrors reflect light. White light can be split up into a rainbow (dispersed to form a spectrum). Primary colours of light can be mixed to make white light.
Physics: Electricity 2023/2024 use with extended topic	Electricity makes light bulbs light if you connect a circuit. Some things do not conduct electricity. We
Light - enrichment topic	After re-teaching the light topic, follow on with: Light travels in straight lines to make shadows. White light can be split into colour, and light-colours can be mixed to make other colours. Art-paint and Printers use different primary colours to light. We can carry out investigations using light to collect data and display this in appropriate ways.
Electricity - enrichment topic	After re-teaching the electricity topic, follow on with: Circuits can be designed to do different things. We can carry out investigations into circuits to collect data and display this in appropriate ways. Electricity (current) flows through complete circuits. We can measure the flow of electricity (current), and display this in appropriate ways to draw conclusions

Appendix 3: Curriculum Rationale and Development over time.

Why have particular contexts been chosen? Why is it organised in this way? Why will it help children?
The answers to these questions are rooted in the rationale of the design and curation of the curriculum.

This curriculum is coherent, which means it has been carefully considered and each context follows a deliberate order. That order starts with some of the knowledge that is directly observable and builds on some of the understanding of the world children will come to school with. As our children grow up, the curriculum will introduce them to ideas and knowledge that are not necessarily obvious through direct observation. The more abstract the curriculum content gets the greater the need for "book learning" (knowledge gained from books or study rather than personal experience) becomes. However, the scientific skills that children need to use to gain an understanding of the content are described so that children get opportunities to experience things first-hand with opportunities to observe, experiment and get their hands dirty.

The key concepts outlined will be revisited at different times throughout the curriculum when they are relevant. The depth to which the key concepts need to be covered is dependent on the age and the amount of knowledge the children have. A systematic approach to exploring these key concepts helps to provide the essential building blocks for deeper understanding at a later time.

Contexts have been organised to allow pupils to learn, building up their learning year on year, to develop breadth and depth in a variety of the sciences. Contexts in Science have been deliberately constructed and aligned to other curriculum areas such as Geography, which supports children to make connections and construct meaning.

Curation July 2022
We have emphasised the core learning in the curriculum by:
- adding a yearly skills summary;
- adding a topic summary;
- adding key skills next to the relevant content, and highlighting these in blue;
- re-phrasing the misconceptions as positive knowledge to highlight;
- adding space for teaching ideas.

Curation March 2023
We have moved topics to align with the timings of the National Curriculum.
We have maintained some differences to allow for certain concepts to build. Examples include humans and magnets in Y1, skeletal system in Y2, insects and the water cycle in Y3 (with the digestive system replacing skeletal).
We have kept the curriculum intact with exceptions listed below.
We have made space for increased disciplinary knowledge by removing some elements including:
vascular plants; endocrine system; meteorology; chemical reactions (some now in year 5); Y2 space.
We have kept our ambitious curriculum by:
a) going deeper than the NC by including the heart of scientific concepts e.g. introducing the concept of atoms;
b) going broader than the NC e.g. by covering all the major body-systems so that pupils leave school with a sound general knowledge of how their bodies work;
c) being academic with our language e.g. exposing students to real academic terms such as cells, tissues, œsophagus, etc.

As an interim in 23/24 and 24/25 we will build on year 4 learning using a combination of reteaching and enrichment for the "light" and "electricity" topics

Going forwards, our curriculum will include four specific opportunities to go beyond the curriculum, which are designed to complement other local enrichment opportunities. These are the "insects", "light", "electricity", and "chemical reactions" topics.

Research sources:

- Sapiens: A Brief History of Humankind Harari, Y. N. (2015) New York, NY: HarperCollins.
- The Curriculum: Gallimaufry to coherence Mary Myatt, John Catt Publication
- New Zealand Ministry of Education https://seniorsecondary.tki.org.nz/Science/Key-concepts
- Core Knowledge http://www.coreknowledge.org.uk/
- Ofsted Intention and substance: https://www.gov.uk/government/publications/intention-and-substance-primary-school-science-curriculum-research