

Science Knowledge and Skills Progression Map

Key concepts (Big Ideas) in science

Pupils build substantive knowledge of the main concepts, **models**, **laws**, and **theories** across the three disciplines of science: biology, chemistry and physics. They will also learn about significant scientists and discoveries and the impact of these on our lives. Through each unit, pupils will develop their disciplinary knowledge as they learn how to work scientifically.

Working scientifically

This is embedded through all units. Pupils will learn how scientific enquiry is used to grow and develop knowledge in science. They will learn how scientists use a variety of enquiry strategies to answer scientific questions. Different questions lead to different types of enquiries and are not limited to fair testing. Pupils will learn to use these enquiry strategies confidently and know that different strategies may be needed at different times. Through different units of science, pupils will learn the following:

- **Observing over time:** (observing or measuring how one variable changes over time)
- **Identifying and classifying:** (identifying and naming materials/living things and making observations or carrying out tests to organise them into groups.)
- **Looking for patterns:** (making observations or carrying out surveys of variables that cannot be easily controlled and looking for relationships between two sets of data)
- **Comparative and fair testing:** (observing or measuring the effect of changing one variable when controlling others)
- **Answering questions using secondary sources of evidence:** (answering questions using data or information that they have not collected first hand)
- **Using models:** (Developing or evaluating a model or analogy that represents a scientific idea, phenomenon or process)

Biology: Animals including humans, plants, living things and their habitats

Pupils will develop an understanding of living things and their environments through the study of animals, humans, plants and habitats. They will learn about reproductions, inheritance, and evolution through the study of life processes and life cycles.

Chemistry: Materials, states of matter

Pupils will learn about states of matter through the study of solids, liquids, and gases. They will look at the properties of materials including rocks and fossils and will study reversible and irreversible changes in materials.

Physics: Energy, forces, Earth sciences

Pupils will develop an understanding of the concepts and laws that apply to physics. They will study the concept of energy by learning about light, sound, and electricity. They will develop an understanding of forces by studying and investigating friction, air resistance, gravity, and magnets. They will learn about Earth and space, studying seasons, day and night, the solar system and beyond.

Demonstrating Substantive Understanding: Knowledge and understanding								
		Birth-3 years 3 – 4 years Reception ELG	By the end of Year 1	By the end of Year 2	By the end of Year 3	By the end of Year 4	By the end of Year 5	By the end of Year 6
Chemistry	Materials Fossils Rocks & soils	Explore materials with different properties Explore natural materials indoors & outside. Use all of their senses in hands on exploration of natural materials. Explore collections of materials with similar/and/or different properties. Talk about the differences between materials & changes they notice (cause and consequence).	To distinguish between an object and the material from which it is made.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper, and cardboard for uses. To find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting, and stretching.	To compare and group together different kinds of rocks based on their appearance and simple physical properties. To describe in simple terms how fossils are formed when things that have lived are trapped within rock. To recognise that soils are made from rocks and organic matter.		To compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets	To recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago
			To identify, compare and group a variety of everyday materials based on their physical properties.				To give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic	
			To identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock				To demonstrate that dissolving, mixing and changes of state are reversible changes	
			.				To explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda	

Chemistry	States of Matter Properties of change States of matter					To compare and group materials together, according to whether they are solids, liquids or gases. To 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) To identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	To know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution To use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating	
Biology	Living things and their habitat (Life cycles, habitats, plants, animals, humans, reproduction, inheritance & evolution)	Explore & respond to different natural phenomena in their setting and on trips. Talk about what they see using a wide vocabulary. Explore how things work. Plants seeds & care growing plants. Understanding the key features of the life cycle of a plant & an animal. Begin to understand the need to respect & care for the natural environment & all living things. Explore the natural world around them. Describe what they see, hear & feel whilst outside.		To explore and compare the differences between things that are living, dead, and things that have never been alive. To identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other. To identify and name a variety of plants and animals in their habitats, including micro habitats.	To compare and group together different kinds of rocks based on their appearance and simple physical properties. To describe in simple terms how fossils are formed when things that have lived are trapped within rock. To recognise that soils are made from rocks and organic matter.	To recognise that living things can be grouped in a variety of ways. To explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment. To recognise that environments can change and that this can sometimes pose dangers to living things.	To describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird To describe the life process of reproduction in some plants and animals.	To describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals To give reasons for classifying plants and animals based on specific characteristics Pupils should be taught to recognise that living things have changed over time and that fossils provide information about living things that inhabited the

		Recognise some environments that are different to the ones in which they live. Explore the natural world around them making observations & drawing pictures animals and plants. Know some similarities & differences between the natural world around them & contrasting environments, drawing on their experiences & what has been read in class.		To describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.				Earth millions of years ago To recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents To identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution
Biology	Animals including humans		To identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals. To identify and name a variety of common animals that are carnivores, herbivores and omnivores. To describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets) To identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.	To notice that animals, including humans, have offspring which grow into adults. To find out about and describe the basic needs of animals, including humans, for survival (water, food and air) To describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene	To identify that animal, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. To identify that humans and some other animals have skeletons and muscles for support, protection, and movement.	To describe the simple functions of the basic parts of the digestive system in humans. To identify the different types of teeth in humans and their simple functions. To construct and interpret a variety of food chains, identifying producers, predators, and prey.	To describe the changes as humans develop to old age	To identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood To recognise the impact of diet, exercise, drugs and lifestyle on the way their body's function To describe the ways in which nutrients and water are transported within animals, including humans

Biology	Plants		To identify and name a variety of common wild and garden plants, including deciduous and evergreen trees. To identify and describe the basic structure of a variety of common flowering plants, including trees.	To observe and describe how seeds and bulbs grow into mature plants. To find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.	To identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers. To 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. To investigate the way in which water is transported within plants. To explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.		To name, locate and describe the functions of the main parts of plants, including those involved in reproduction	
	Earth & Space	To name and identify some different types of weather	Observe changes across the four seasons Observe and describe weather associated with the seasons and how day length varies				Pupils should be taught to describe the movement of the Earth and other planets relative to the sun in the solar system To describe the movement of the moon relative to the Earth To describe the sun, Earth and moon as approximately spherical bodies To use the idea of the Earth's rotation to	

							explain day and night and the apparent movement of the sun across the sky	
	Energy Electricity Light Sound	Explore & talk about different forces they feel they can feel (magnets, stretchy elastic)			Light To recognise that they need light in order to see things and that dark is the absence of light. To notice that light is reflected from surfaces. To recognise that light from the sun can be dangerous and that there are ways to protect their eyes. To recognise that shadows are formed when the light from a light source is blocked by an opaque object. To find patterns in the way that the size of shadows change.	Electricity To recognise that there are lots of different types of energy e.g. light, sound, electrical, heat, wind. To identify common appliances that run on electricity. To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. To 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. To recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. To recognise some common conductors and insulators, and associate metals with being good conductors. Sound To identify how sounds are made, associating		Electricity To associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit To compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches To use recognised symbols when representing a simple circuit in a diagram Light To recognise that light appears to travel in straight lines To use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye To explain that we see things because light travels from light

						some of them with something vibrating. To recognise that vibrations from sounds travel through a medium to the ear. To find patterns between the pitch of a sound and features of the object that produced it. To find patterns between the volume of a sound and the strength of the vibrations that produced it. To recognise that sounds get fainter as the distance from the sound source increases.		sources to our eyes or from light sources to objects and then to our eyes. To use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them
Physics	Forces Magnets Forces	To explore how things work e.g. toys To explore pushes and pulls To talk about forces and concepts such as floating and sinking, magnetism and light			Forces To compare how things move on different surfaces. To notice that some forces need contact between two objects, but magnetic forces can act at a distance. To observe how magnets attract or repel each other and attract some materials and not others To compare and group together a variety of everyday materials on the basis of whether		Earth and space To explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object Forces Identify the effects of air resistance, water resistance and friction, that act between moving surfaces	

					they are attracted to a magnet and identify some magnetic materials. To describe magnets as having two poles. To predict whether two magnets will attract or repel each other, depending on which poles are facing.		Recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect	
Scientific skills	Questioning & observations	Copy your gestures and words. Start to develop conversation, often jumping from topic to topic. Start a conversation with a peer or adult and continue it for many turns. Be able to express a point of view and to debate when they disagree with an adult or a friend. Use new vocabulary. Ask questions to find out more and to check that they understanding what has been said to them. Articulate ideas & thoughts. Describe events in some detail. Use talk to help work out problems & organise thinking & activities & to explain how things work and why they might happen. Participate in small group, class and one-to-	With prompts, pupils can ask simple, relevant questions. Pupils can use their observations & ideas to suggest answers to questions.	Pupils can ask simple, relevant questions. Pupils can use their observations & ideas to suggest answers to questions.	Pupils can ask simple, relevant questions & recognise that they can be answered in different ways. Pupils can use their observations & prior knowledge to suggest answers to questions. Pupils can start to make accurate comparisons.	Pupils can ask simple, relevant questions & recognise that they can be answered in different ways. Pupils can use their observations & prior knowledge to suggest answers to questions. Pupils can make accurate comparisons.	Pupils can ask relevant questions & recognise that they can be answered in different ways. Pupils can use their observations & prior knowledge to accurately answer question. Pupils can make accurate comparisons & find casual relationships in their investigation.	Pupils can ask relevant questions & recognise that they can be answered in different ways. Pupils can use their observations & prior knowledge to accurately answer question. Pupils can make accurate comparisons & find casual relationships in their investigation.

		one discussions, offering their own ideas, using recently introduced vocabulary. Offer explanations for why things might happen, making use of recently introduced vocabulary.						
	Analyse data & form a conclusion		Pupils should be able to identify & classify. Use their observations & ideas to draw conclusions.	Pupils can identify & classify. Use their observations & ideas to draw conclusions	Pupils can start to identify differences, similarities or changes related to simple scientific ideas & processes. Report findings from enquiries, including oral & written explanations, displays or presentations of results & conclusions. Use straight forward scientific evidence to answer questions or to support their findings. Use results to draw simple conclusions, make predictions for new values, suggest improvements & raise further questions.	Pupils can identify differences, similarities or changes related to simple scientific ideas & processes. Report findings from enquiries, including oral & written explanations, displays or presentations of results & conclusions. Use straight forward scientific evidence to answer questions or to support their findings. Use results to draw simple conclusions, make predictions for new values, suggest improvements & raise further questions.	Pupils can independently identify scientific evidence that has been used to support or refute ideas or arguments. Report findings from enquiries, including oral & written explanations, displays or presentations of results & conclusions. Use straight forward scientific evidence to answer questions or to support their findings & discuss & manage variable. Use results to simple conclusions, make predictions for new values, suggest improvements & raise further questions.	Pupils can independently identify scientific evidence that has been used to support or refute ideas or arguments. Report findings from enquiries, including oral & written explanations, displays or presentations of results & conclusions. Use straight forward scientific evidence to answer questions or to support their findings & discuss & manage variable. Use results to draw conclusions, make predictions for new values, suggest improvements & raise further questions
	Follow & design scientific enquiry		Pupils are able to observe closely, using simple equipment. Pupils can perform simple tests. Gather & record data to help in answering questions.	Pupils can observe closely, using simple equipment. Pupils can perform comparative tests. Gather & record data to help in answering questions.	Pupils can set up simple practical enquiries, comparative & fair tests. Make systematic & careful; observations & where appropriate, take accurate measurements. Pupils can gather, record, classify & present data in a variety	Pupils can set up simple practical enquiries, comparative & fair tests. Make systematic & careful; observations & where appropriate, take accurate measurements. Pupils can gather, record, classify & present data in a variety	Pupils can observe closely, using a range of equipment. Pupils plan different types of scientific enquiries to answer questions, including recognising & controlling variables. Take measurements, using a range of	Pupils can observe closely, using a range of equipment. Pupils plan different types of scientific enquiries to answer questions, including recognising & controlling variables. Take measurements, using a range of

					of ways to help in answering questions.	of ways to help in answering questions Pupils plan different types of scientific enquiries to answer questions, including recognising & controlling variables. With guidance, take measurements, using a range of scientific equipment, with increasing accuracy & precision, taking repeat readings when appropriate. Record data & results of increasing complexity.	scientific equipment, with increasing accuracy & precision, taking repeat readings when appropriate. Record data & results of increasing complexity. Independently, take measurements, using a range of scientific equipment, with increasing accuracy & precision, taking repeat readings when appropriate. Record data & results of increasing complexity (line graphs, scatter graphs, labelled diagrams, tables & charts).	scientific equipment, with increasing accuracy & precision, taking repeat readings when appropriate. Record data & results of increasing complexity. Independently, take measurements, using a range of scientific equipment, with increasing accuracy & precision, taking repeat readings when appropriate. Record data & results of increasing complexity. (line graphs, scatter graphs, labelled diagrams, tables & charts).
	Understand the major issues facing our planet & the importance of science on the wider society.	Understand the effect of changing seasons on the natural world around them. Understand some important processes & changes in the natural world around them, including seasons & changing states of matter.	Pupils understand one of the major issues affecting our planet (plastic pollution). Pupils understand that everyday choices such as the use of transport & materials affect the planet.	Pupils understand two of the major issues affecting our planet (plastic pollution & deforestation). Pupils understand that everyday choices such as the use of transport & materials affect the planet.	Pupils should understand a few of the major issues affecting our planet. Science has brought many benefits to society such as organ donations, clean water & medicine. Everyday choices such as diet & health affect our health.	Pupils should understand many of the major issues facing our planet. Pupils are aware that some resources are renewable & some are unrenewable.	Pupils will understand the science helps to solve problems and creates technology. Knowledge of how we can live sustainably on this world & positively impact environmental change.	Pupils will understand the science helps to solve problems and creates technology. Knowledge of how things live & works on this world. Knowledge of how we can live sustainably on this world & positively impact environmental change.

Main Order Concepts

- Organisms- require a source of energy & materials
- Materials- property and change
- Energy-strength and power (There are many forms such as thermal (heat), radiant (light) or kinetic (movement))
- Forces- cause & effect
- States of matter- change from one material/state to another
- Genetic information- reproduction of plants, animals & life cycles
- Evolution- the way that living things change over time

Second Order Concepts

Second order concepts are fundamental knowledge and skills which are transferable across a range of curriculum subjects. For example, we introduce pupils to the concept of 'similarity and difference' early in their education, developing the observational skills and language needed to make comparisons. This is developed and applied as pupils move through the school so they can confidently apply this in all areas of the curriculum by upper Key Stage Two. A summary of the second order concepts and how they apply to different subjects are provided in the table below:

Curriculum subject	Significance	Similarity and difference	Cause and consequence	Continuity and change	Responsibility	Communication	Enquiry
Science	Significant scientists, discoveries, laws, models and theories	Making comparisons, finding patterns, noting differences, drawing conclusions	Models and laws, reaction between materials, observing process	Observing what changes and what stays the same	Working safely, climate change and sustainability, how science solves problems	Using scientific terms, evaluating, drawing conclusions, explaining patterns and processes, presenting and interpreting data	Working scientifically, observing, classifying, patterns, fair testing, using evidence