

## Science



The science curriculum provides pupils with an understanding of the following **domains of knowledge**.  
Disciplinary knowledge is taught and embedded within the teaching of each unit of substantive knowledge.

### **Substantive Knowledge: Concepts, models, laws and theories**

#### **Biology**

- **Living things and their environment** (Animals, humans, plants, habitats)
- **Reproduction, inheritance and evolution** (Evolution, inheritance, life processes, life cycles)

#### **Chemistry**

- **States of matter** (Solids, liquids, gases)
- **Materials (properties and changes)** (Reversible/irreversible changes, rocks, fossils)

#### **Physics**

- **Energy** (Light, sound, electricity)
- **Forces** (Friction, air resistance, gravity, magnets)

#### **Earth Science**

- **Earth and space** (Seasons, day and night, solar system and beyond)

### **Disciplinary knowledge: Working scientifically**

- **Methods used to answer questions** (use of models, classification, correlations and patterns, experimentation, fair testing)
- **Using apparatus and techniques** (accurate measurement, collecting and recording data, carrying out procedures safely and accurately)
- **Data analysis** (processing and presenting data, exploring relationships, communicating results in tables / graphs, identifying correlations)
- **Using evidence to develop explanations** (using evidence / scientific knowledge to draw conclusions, explain laws, models, concepts and findings)

## Key concepts:

Through the science curriculum, pupils will develop an understanding of the following key concepts. These concepts are revisited through different units as pupils move through the school. By the end of primary school, children will know and understand these key concepts.

### Biology

- **Organisms require a supply of energy and materials:** Living things are special collections of matter that reproduce, use energy and grow. Food provides materials and energy for life and growth. Plants and bacteria use energy from the sun to generate food. Animals break down food and are ultimately dependant on green plants for energy. In any ecosystem there is competition for the energy and materials needed to live and reproduce.
- **Genetic information:** Genetic information is passed down from one generation of organisms to another. Genes determine the development and structure of organisms
- **Evolution:** The diversity of organisms is the result of evolution. Different kinds of life, animals, plants and microorganisms, have evolved into different forms best suited to the environments in which they live. Organisms not able to respond sufficiently to changes in their environment become extinct

### Chemistry

- All matter (stuff) in the universe is made of tiny building blocks.
- **Materials (properties and changes):** The arrangement, movement and types of building blocks of matter, and the forces that hold them together/push them apart, explain all the properties of matter (eg: hot/cold, soft/hard, light/heavy etc...)
- **States of matter:** Matter can change if the arrangement of these building blocks change (eg: chemical reactions)

### Physics

- The universe follows unbreakable rules that are all about forces, matter and energy
- **Forces** are different kinds of pushes and pulls that act on all the matter in the universe. Changing the movement of an object requires a force to be acting on it. Gravity is a universal force of attraction between all objects, however large or small
- **Energy:** There are many different forms of energy eg: light, sound, electricity, heat and wind. Energy can be transferred from one object to another and can cause changes. The total amount of energy in the universe is always the same but energy can be transformed when things change or are made to happen

### Earth Science

- **The earth in relation to the universe:** The Earth is one of 8 planets orbiting the sun. Our solar system is a very small part of one of millions of galaxies in the universe.
- **The earth spins on its axis:** The Earth is tilted and spins on its axis leading to day and night, the seasons and climate

## Enquiry strategies

As part of **working scientifically** which is embedded throughout all units, pupils will also learn to use a variety of **enquiry strategies** to answer scientific questions. Different questions lead to different types of enquiry and are not limited to fair testing. By the end of primary school, children will be able to use these enquiry strategies confidently and know that different strategies may be needed at different times.

- **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)

As well as this, pupils will learn about:

- **Using models:** (Developing or evaluating a model or analogy that represents a scientific idea, phenomenon or process)

## Second order concepts

Through each unit of science, the following second order concepts are explored:

- **Responsibility:** (working safely, how science can solve problems, climate change and sustainability)
- **Similarity and difference:** (making comparisons, finding patterns, noting differences and drawing conclusions)
- **Cause and consequence:** (models and laws, reactions between materials, observing processes)
- **Continuity and change:** (observing what changes and what stays the same)
- **Significance:** (significant scientists, discoveries, laws, models and theories)
- **Written and oral expression:** (Using scientific terminology, evaluation, drawing conclusions, objectivity, explaining processes, describing and explaining patterns, presenting and interpreting data)

## **End points:**

**By the end of EYFS**, children can identify similarities and differences between themselves and others, places, objects, materials and living things and are able to discuss past and present events in their own lives. They can make simple observations of animals and plants. They recognise that technology is used for particular purposes in different environments and can select technology appropriately. They can explore how to make things move.

**By the end of KS1**, the basic fundamentals of the biology strand have been established. Pupils explore animals, humans and changes within environments and begin to develop simple scientific vocabulary linked to this. Children use different types of scientific enquiry to answer a range of questions. Children are encouraged to ask questions, discuss their findings and present the ideas in a variety of ways.

**By the end of KS2**, pupils have a deep understanding of a range of scientific ideas. Children are able to link scientific ideas to the world around them and, through research, understand how scientific ideas are developed over time. Children use secondary sources of information and practical enquiry to draw conclusions and find things out.

1. Pupils have an understanding of the key domains of knowledge and can use key concepts to make links between the domains
2. Pupils can ask questions and make observations about the world around them using scientific knowledge
3. Pupils can analyse data and articulate evidenced conclusions
4. Pupils are able to follow and design scientific enquiries
5. Pupils have an understanding of some of the major issues facing our planet and an appreciation of the importance of science to wider society

## **Pedagogy in Science:**

The structure of a sequence of learning or an individual science lesson will vary, depending on the aspect of science being taught or the area of scientific enquiry that is required.

Science lessons are carefully sequenced to ensure that pupils can develop connections and embed their understanding across a range of scientific concepts. Science topics are covered in a cohesive order to ensure that pupils can fully access that aspect of learning and to build on prior knowledge. Some modules are revisited throughout to ensure that pupils fully understand complex concepts.

Scientific enquiry can be found at the heart of all science lessons and over time develops a range of skills. Pupils are challenged in their scientific thinking through a range of questions, investigations and problems. This carefully supports the scientific knowledge learnt through each unit further embeds pupil understanding. Pupils will be encouraged to develop a range of scientific enquiry skills, not just fair testing, and by the end of Key Stage 2 they will have a greater understanding of how to select the most appropriate skill to support their practical work.

Pupils are encouraged to discuss their understandings with one another and their class teacher. Pupils are encouraged to ask questions and suggest improvements for practical science enquiry.

Pupils record their science learning and understanding in a range of ways and are encouraged to do so during each science unit.

## Progressive objectives:

Our progressive objectives show what pupils should know and be able to do in each aspect of science by the end of each year group. The key concepts of science are developed through each unit of work. These are used to support planning and the ongoing assessments of pupils' work. *All objectives in red are taking directly from the STA teacher assessment exemplification*

<b>WORKING SCIENTIFICALLY</b>	<b>ENQUIRY STRATEGIES</b>	
	<ul style="list-style-type: none"> <li>• <b>Observing over time:</b> (observing or measuring how one variable changes over time)</li> <li>• <b>Identifying and classifying:</b> (identifying and naming materials/living things and making observations or carrying out tests to organise them into groups.)</li> <li>• <b>Looking for patterns:</b> (making observations or carrying out surveys of variables that cannot be easily controlled and looking for relationships between two sets of data)</li> <li>• <b>Comparative and fair testing:</b> (observing or measuring the effect of changing one variable when controlling others)</li> <li>• <b>Answering questions using secondary sources of evidence:</b> (answering questions using data or information that they have not collected first hand)</li> <li>• <b>Using models:</b> (Developing or evaluating a model or analogy that represents a scientific idea, phenomenon or process)</li> </ul>	
	EYFS	
	<i>Statement needed</i>	
	Year 1	I can identify and classify according to simple criteria (similarity and difference)
		I can perform simple tests, involving observations and the gathering and recording of data (similarity and difference)
		I can use observations and ideas to suggest answers to questions (continuity and change)
	Year 2	I can ask questions about what I notice (written and oral expression)
		I can use different types of Scientific enquiry to gather and record data, using simple equipment (responsibility)
		I can observe changes over time (continuity and change)
I notice patterns (similarity and difference)		
I can group and classify things (similarity and difference)		
I can carry out simple comparative tests (responsibility)		
I can find things out using secondary sources of information (significance)		
I communicate my ideas about what I do and what I find out in a variety of ways (written and oral expression)		
I can observe closely (continuity and change)		
I can gather and record data to help me answer questions (written and oral expression)		

Year 3	I can ask relevant questions and use different types of scientific enquiry to answer them, including comparative and fair tests (responsibility)
	I can make systematic and careful observations and record accurate measurements using standard units (continuity and change)
	I can record findings and present data using simple scientific language, written and oral explanations, diagrams, pictures, keys, bar charts and tables. (written and oral expression)
	I can use straightforward scientific evidence to answer questions or to support my findings (significance)
	I can identify differences, similarities or changes related to simple scientific ideas and processes (cause and consequence)
	I can gather, record, classify and present data in a variety of different ways to help me answer questions (written and oral expression)
	I can use results to draw simple conclusions, suggest improvements and ask new questions (written and oral expression)
Year 4	I make careful observations and take accurate measurements using standard units (continuity and change)
	I can record and present findings using simple scientific language, written and oral presentations, drawings, diagrams, keys, bar charts and tables (written and oral expression)
	I can identify differences, similarities or changes related to simple scientific ideas and processes (cause and consequence)
	I can ask relevant questions and use different types of scientific enquiry to answer them including comparative and fair tests (responsibility)
	I can use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions (written and oral expression)
	I can identify scientific evidence that has been used to support or refute ideas or arguments (significance)
Year 5	I can identify scientific evidence that has been used to support or refute ideas or arguments (significance)
	I can report and present findings from enquiries including conclusions, explanations, data and diagrams (written and oral expression)
	I can plan and carry out scientific enquiry using a range of scientific equipment and variables in order to answer questions (responsibility)
	I can use test results to make predictions to set up further comparative and fair tests (responsibility)
	I can take measurements, using a wider range of scientific equipment, with increasing accuracy and precision and taking repeat reading when appropriate (responsibility)
Year 6	I describe and evaluate my own and others' scientific ideas related to topics in the national curriculum (including ideas that have changed over time), using evidence from a range of sources (significance)
	I ask my own questions about the scientific phenomena that I am studying, and select the most appropriate ways to answer these questions, recognising and controlling variables where necessary (i.e. observing changes over different periods of time, noticing patterns, grouping and classifying things, carrying out comparative and fair tests, and finding things out using a wide range of secondary sources) (responsibility)
	I use a range of scientific equipment to take accurate and precise measurements or readings, with repeat readings where appropriate (responsibility)
	I record data and results using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs (written and oral expression)

	I draw conclusions, explain and evaluate my methods and findings, communicating these in a variety of ways (written and oral expression)
	I raise further questions that could be investigated, based on data and observations (cause and consequence)
	I can identify scientific evidence that has been used to support or refute ideas or arguments (significance)

<b>BIOLOGY</b>	<p><b>LIVING THINGS IN THEIR ENVIRONMENTS</b> (Animals, humans, plants, habitats)  <b>REPRODUCTION, INHERITANCE AND EVOLUTION</b> (Evolution, inheritance, life processes, life cycles)</p> <p><b>Key concepts:</b></p> <ul style="list-style-type: none"> <li>• <b>Organisms require a supply of energy and materials:</b> Living things are special collections of matter that reproduce, use energy and grow. Food provides materials and energy for life and growth. Plants and bacteria use energy from the sun to generate food. Animals break down food and are ultimately dependant on green plants for energy. In any ecosystem there is competition for the energy and materials needed to live and reproduce.</li> <li>• <b>Genetic information:</b> Genetic information is passed down from one generation of organisms to another. Genes determine the development and structure of organisms</li> <li>• <b>Evolution:</b> The diversity of organisms is the result of evolution. Different kinds of life, animals, plans and microorganisms, have evolved into different forms best suited to the environments in which they live. Organisms not able to respond sufficiently to changes in their environment become extinct</li> </ul>
	<b>Living things in their environment</b>
EYFS	<i>Statement needed</i>
Year 2	I can identify whether things are alive, dead or have never lived
	I can name different plants and animals and describe how they are suited to different habitats
Year 3	I can describe how animals get their food from plants and other animals, using the idea of a simple food chain to describe this relationship
Year 3	I can describe in simple terms how fossils are formed when things that have lived are trapped within rock.
Year 4	I can explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.
	I recognise that living things can be grouped in a variety of ways
Year 4	I recognise that environments can change and that this can sometimes pose dangers to living things.
Year 5	I can describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird.
	I can describe the life process of reproduction in some plants and animals.
Year 6	I can group, classify and identify plants, animals and micro-organisms using keys or other methods based on their observable features
	I can describe how living things have changed over time and evolved using the basic ideas of inheritance, variation and adaptation
	I can give evidence for evolution
Year 6	I can recognise that living things produce offspring of the same kind but that offspring normally vary and are not identical to their parents.

	<b>Animals including humans</b>
EYFS	<i>Statement needed</i>
Year 1	I can describe and compare the features of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets).
	I can identify, name, draw and label the basic parts of the human body.
	I can say which part of the body is associated with each sense.
	I can group animals according to what they eat
Year 2	I can describe the basic needs of animals for survival and the main changes as young animals (including humans) grow into adults
	I notice that animals, including humans, have offspring that grow into adults.
	I can describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.
Year 3	I can identify that animals, 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.
	I can identify that humans and some other animals have skeletons and muscles for support, protection and movement.
Year 4	I can describe the simple functions of the basic parts of the digestive system in humans.
	I can identify the different types of teeth in humans and their simple functions.
	I can construct and interpret a variety of food chains, identifying producers, predators and prey.
Year 5	I can describe the changes as humans develop to old age.
Year 6	I can identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.
	I can describe the effects of diet, exercise, drugs and lifestyle on how the body functions
	<b>Plants</b>
EYFS	<i>Statement needed</i>
Year 1	I can name, identify and describe the basic structure of a variety of common flowering plants including trees.
Year 2	I can describe the basic needs of plants for survival and the impact of changing these
	I can observe and describe the main changes as seeds and bulbs grow into mature plants.
Year 3	I can identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
	I can 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
	I understand the way in which water is transported within plants
	I can explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.
Year 5	I can name, locate and describe the functions of the main parts of plants, including those involved in reproduction

<b>CHEMISTRY</b>	<p><b>STATES OF MATTER</b> (Solids, liquids, gases)  <b>MATERIALS - PROPERTIES AND CHANGES</b> (Reversible/irreversible changes, rocks, fossils)</p> <p><b>Key concepts</b></p> <ul style="list-style-type: none"> <li>All matter (stuff) in the universe is made of tiny building blocks.</li> <li><b>Materials (properties and changes):</b> The arrangement, movement and types of building blocks of matter, and the forces that hold them together/push them apart, explain all the properties of matter (eg: hot/cold, soft/hard, light/heavy etc...)</li> <li><b>States of matter:</b> Matter can change if the arrangement of these building blocks change (eg: chemical reactions)</li> </ul>	
	EYFS	<i>Statement needed</i>
	Year 1	I can name, compare and group a variety of everyday materials and describe their simple, physical properties.
		I can distinguish between an object and the materials from which it is made
	Year 2	I can identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.
	Year 3	I can compare and group together different kinds of rocks and soil on the basis of their appearance and simple physical properties.
	Year 4	I can describe the characteristics of different states of matter and group materials on this basis
		I can describe how materials change state at different temperatures
		I can 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.
		I can identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.
Year 5	I can compare and group together everyday materials on the basis of their properties	
	I know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.	
	I can use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.	
	I can identify, with reasons, whether changes in materials are reversible or not	
	I can give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.	
Year 5	I can explain that some changes of state result in the formation of new material and that this kind of change is not usually reversible.	

<b>PHYSICS</b>	<b>FORCES</b> <b>ENERGY</b> (Light, sound, electricity)  <b>Key concepts:</b> <ul style="list-style-type: none"> <li>• The universe follows unbreakable rules that are all about forces, matter and energy</li> <li>• <b>Forces</b> are different kinds of pushes and pulls that act on all the matter in the universe. Changing the movement of an object requires a force to be acting on it. Gravity is a universal force of attraction between all objects, however large or small</li> <li>• <b>Energy:</b> There are many different forms of energy eg: light, sound, electricity, heat and wind. Energy can be transferred from one object to another and can cause changes. The total amount of energy in the universe is always the same but energy can be transformed when things change or are made to happen</li> </ul>
	<b>FORCES</b>
EYFS	I can explore moving objects at different speeds
Year 3	I notice contact and non-contact forces and observe similarities and differences.
	I can describe how magnetic forces act at a distance
	I can describe magnets as having two poles.
	I can compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet
	I can predict and explain whether two magnets will attract or repel each other, depending on which poles are facing.
Year 5	I can explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.
	I can identify the effects of air resistance, water resistance and friction that act between moving surfaces.
	I recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
	<b>Light</b>
EYFS	<i>Statement needed</i>
Year 3	I recognise and understand the properties of light.
	I recognise that shadows are formed when the light from a light source is blocked by a solid object.
	I can find patterns in the way that the size of shadows changes.
Year 6	I can use the idea that light travels in straight lines and enters our eyes to explain how we see things
	I can use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
	I can explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes

	<b>Sound</b>
EYFS	<i>Statement needed</i>
Year 4	I can identify how sounds are made, associating some of them with something vibrating.
	I recognise that vibrations from sounds travel through a medium to the ear.
	I recognise that sounds get fainter as the distance from the sound source increases
	I can describe the relationship between the pitch of a sound and the features of its source
	I can describe the relationship between the volume of a sound, the strength of the vibrations and the distance from its source
	<b>Electricity</b>
EYFS	<i>Statement needed</i>
Year 4	I can construct and name the basic parts of a simple series circuit, including cells, wires, bulbs, switches and buzzers.
	I can identify whether or not a lamp will light in a simple series circuit, based on whether a lamp is part of a complete loop with a battery
	I recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a series circuit
	I can recognise and can explain why materials are good conductors and insulators.
	I can identify common appliances that run on electricity.
Year 6	I can use simple apparatus to construct & control a series circuit, and describe how the circuit may be affected when changes are made to it
	I can use recognised symbols when representing a simple circuit in a diagram.

<b>EARTH SCIENCE</b>	<b>EARTH AND SPACE</b> (Seasons, day and night, solar system and beyond) <b>Key concepts:</b>	
	<ul style="list-style-type: none"> <li>• <b>The earth in relation to the universe:</b> The Earth is one of 8 planets orbiting the sun. Our solar system is a very small part of one of millions of galaxies in the universe.</li> <li>• <b>The earth spins on its axis:</b> The Earth is tilted and spins on its axis leading to day and night, the seasons and climate</li> </ul>	
	EYFS	I can name and identify some different types of weather
	Year 1	I can explain how the weather changes throughout the year and name the seasons (link to geography)
		I can use a globe to identify the equator and north and south poles (Link to geography)
	Year 5	I can describe the movement of the Earth, and other planets, relative to the Sun in the solar system.
		I can describe the movement of the Moon relative to the Earth.
		I can use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.
	Year 6	I can describe and explain the key physical features of different climate zones and biomes (link to geography)

