SCIENCE

THE FOXTON CURRICULUM

Foxton Primary School

2024/25

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It is important to view knowledge as sort of a semantic tree – make sure you understand the fundamental principles, i.e. the trunk and big branches, before you get into the leaves/details or there is nothing for them to hang on to.
– Elon Musk

At Foxton Primary School, we are scientists.

Our Science Curriculum

Science is key to understanding the world around us, and we are fortunate to have an incredible setting at Foxton that really brings this to life. Our nature garden, pond, and forest area are home to a wide variety of plants and wildlife, all of which enrich our curriculum through real-life encounters and experiences. We even have a school YouTube channel where we upload videos of some of our visitors, including badgers, pheasants, rabbits, and squirrels. Science at Foxton also forms a key part of our global curriculum, as it is vital to the world's future prosperity.

At Foxton, we intend to develop a lifelong curiosity and interest in the sciences. We want our children to have the opportunity, wherever possible, to learn through varied systematic investigations, leading to them being equipped for life to ask and answer scientific questions about the world around them. As children progress through the school, they build on their skills in working scientifically, as well as their scientific knowledge, developing greater independence in planning and carrying out fair and comparative tests.

This begins in Fox Cubs, where children start learning about their bodies, forest animals, and what we can get from trees. This develops into learning about habitats and life cycles (with pond dipping and real caterpillars growing in the classroom!) to give the children a solid foundation of knowledge and understanding.

Further up the school, our children receive a varied, progressive, and well-mapped-out science curriculum that provides the opportunity for progression across the full breadth of the Science National Curriculum as detailed below. Each lesson has a clear focus; scientific knowledge and enquiry skills are developed with increasing depth and challenge as children move through the school, always building on previous learning. They complete investigations and hands-on activities while acquiring scientific knowledge for each unit. Activities are effectively differentiated so that all children have an appropriate level of support and challenge, with any misconceptions addressed.

Teachers use knowledge matrices and a knowledge planner to support their planning, which identify prior and future learning, what pupils need to know, key vocabulary, and common misconceptions. Every topic also has an accompanying child-friendly knowledge organiser that clearly sets out the key knowledge and vocabulary to be learnt and remembered.

Our curriculum ensures a coherent and comprehensive approach from Reception through Key Stage 2. In the early years, we specify essential knowledge about understanding the world, seamlessly connecting to the Year 1 science curriculum to build a strong foundation. We allocate ample time for pupils to learn and retain key scientific concepts, fostering connections with prior knowledge to develop a cohesive understanding.

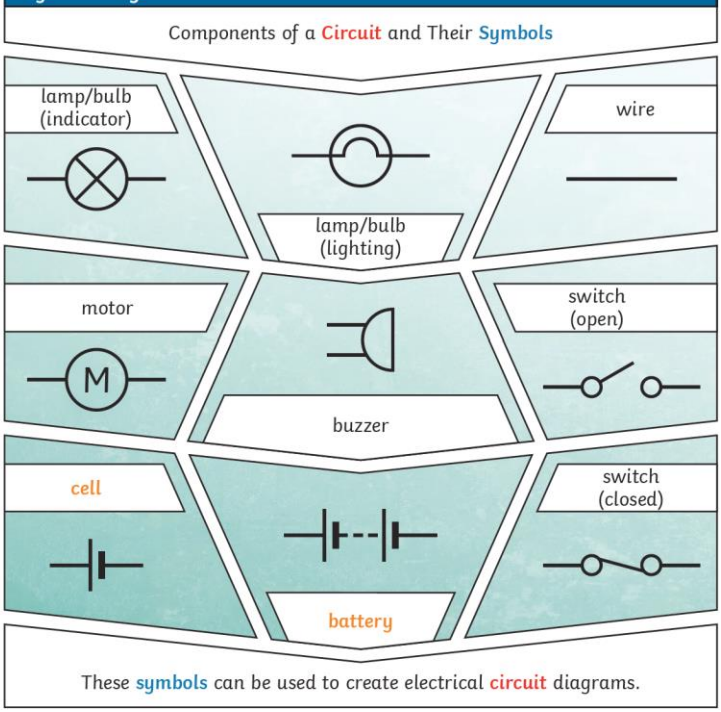
Our curriculum meticulously sequences disciplinary knowledge, emphasizing not only scientific techniques and data analysis but also broader scientific enquiry methods like pattern seeking and understanding evidence and accuracy. Practical work is integral, with structured, purposeful activities that align with curriculum goals, ensuring pupils engage in meaningful scientific investigations. We emphasize connecting new learning to existing knowledge during lessons and ensure pupils have a solid grasp of taught content before progressing. Our assessment

strategies focus on both substantive and disciplinary knowledge, checking for understanding and application in scientific enquiries. Furthermore, we invest in continuous professional development for our staff, aligning with our curriculum and addressing specific needs to enhance their expertise. This systematic approach ensures our teachers are well-equipped to prioritize and effectively teach key scientific knowledge, supporting pupils in developing sophisticated, interconnected scientific understanding.

The Association for Science Education (ASE) argues that children should "…conceive the goals of science education, not in terms of the knowledge of a body of facts and theories, but as a progression towards understanding key ideas – 'big ideas' – of relevance to students' lives during and beyond school." In 2015, the ASE produced a document entitled "Working With Big Ideas in Science Education" (https://www.ase.org.uk/bigideas). This publication describes 10 big ideas of science and 4 big ideas about science. The 14 big ideas cover all the different concepts about science and how we understand it and apply it in our world. Teachers have mapped our curriculum to these big ideas (see Appendix B) to further show how every unit we teach relates to others.

Key Vocabulary	
circuit	A path that an electrical current can flow around.
symbol	A visual picture that stands for something else.
cell/battery	A device that stores chemical energy until it is needed. A cell is a single unit. A battery is a collection of cells.
current	The flow of electrons, measured in amps.
amps	How electric current is measured.
voltage	The force that makes the electric current move through the wires. The greater the voltage, the more current will flow.
resistance	The difficulty that the electric current has when flowing around a circuit.
electrons	Very small particles that travel around an electrical circuit.

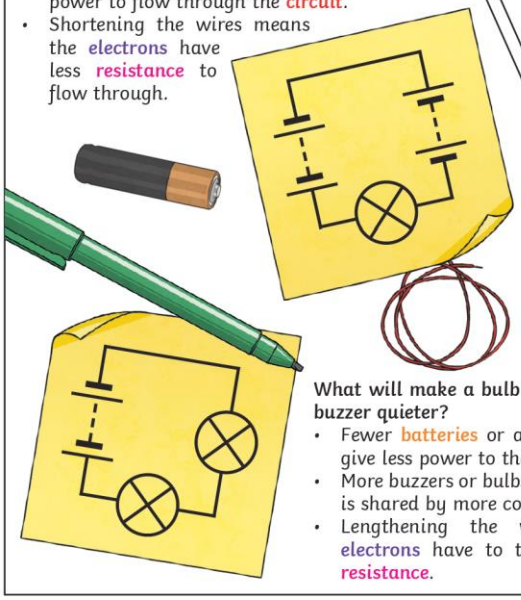
Key Knowledge



Key Knowledge

What will make a bulb brighter or a buzzer louder?

- More batteries or a higher voltage create more power to flow through the circuit.
- Shortening the wires means the electrons have less resistance to flow through.

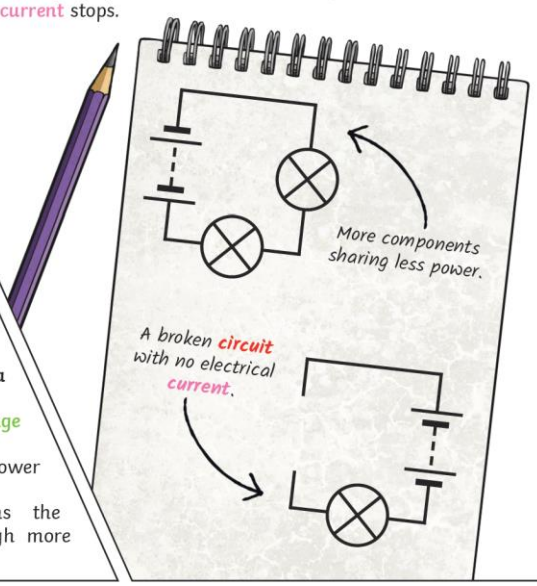


What will make a bulb dimmer or a buzzer quieter?

- Fewer batteries or a lower voltage give less power to the circuit.
- More buzzers or bulbs mean the power is shared by more components.
- Lengthening the wires means the electrons have to travel through more resistance.

Series Circuit

A circuit that has only one route for the current to take. If more bulbs or buzzers are added, the power has to be shared and so they will be dimmer or quieter. If just one part of this series circuit breaks, the circuit is broken and the flow of current stops.



Year A Overview (2022-23)

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Class 1	Plants		Living Things and their Habitats		Materials	
	Seasonal Change (on going)					
Class 2	Animals including Humans	Sound	Materials (Rocks)	Plants	Animals including Humans (Teeth & Digestion)	Living Things and their Habitats (Habitats)
Class 3	Forces	Living Things and their Habitats (Classification)	Electricity	Animals including Humans (Healthy Lifestyles and changes into old age)		

	Class 1	Class 2	Class 3
Animals including Humans		**Pupils should be taught to:** • 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; • identify that humans and some other animals have skeletons and muscles for support, protection and movement. **Pupils should be taught to:** • describe the simple functions of the basic parts of the digestive system in humans; • identify the different types of teeth in humans and their simple functions; • construct and interpret a variety of food chains, identifying producers, predators and prey.	**Pupils should be taught to:** • describe the changes as humans develop to old age. **Pupils should be taught to:** • identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood; • recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function; • describe the ways in which nutrients and water are transported within animals, including humans.

Plants	**Pupils should be taught to:** • observe and describe how seeds and bulbs grow into mature plants; • find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.		
Living Things and their Habitats	**Pupils should be taught to:** • explore and compare the differences between things that are living, dead, and things that have never been alive; • 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. • identify and name a variety of plants and animals in their habitats, including microhabitats; • 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.	**Pupils should be taught to:** • recognise that living things can be grouped in a variety of ways; • explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment; • recognise that environments can change and that this can sometimes pose dangers to living things.	**Pupils should be taught 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; • give reasons for classifying plants and animals based on specific characteristics.
Evolution and Inheritance			
Seasonal Change (on going)	**Pupils should be taught to:** • observe changes across the 4 seasons; • observe and describe weather associated with the seasons and how day length varies.		

Forces			**Pupils should be taught to:** • explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object; • identify the effects of air resistance, water resistance and friction, that act between moving surfaces; • recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect.
Light			
Sound		**Pupils should be taught to:** • identify how sounds are made, associating some of them with something vibrating; • recognise that vibrations from sounds travel through a medium to the ear; • find patterns between the pitch of a sound and features of the object that produced it; • find patterns between the volume of a sound and the strength of the vibrations that produced it; • recognise that sounds get fainter as the distance from the sound source increases.	
Earth and Space			

Electricity			**Pupils should be taught to:** • 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, the loudness of buzzers and the on/off position of switches; • use recognised symbols when representing a simple circuit in a diagram.
Materials	**Pupils should be taught to:** • identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses; • find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.	**Pupils should be taught to:** • 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	

Year B Overview (2023-24)

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Class 1	Animals including Humans	Seasonal change	Materials		Plants	Living Things and their Habitats (Life cycles)
	Seasonal Change (on going)					
Class 2	Forces and Magnets	Electricity	Light	Plants	Materials (States of Matter)	
Class 3	Materials (Properties and Changes)		Earth and Space	Evolution and Inheritance	Light	Living Things and their Habitats

	Class 1	Class 2	Class 3
Animals including Humans	**Pupils should be taught to:** • identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals; • identify and name a variety of common animals that are carnivores, herbivores and omnivores; • describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals including pets); • identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. **Pupils should be taught to:** • notice that animals, including humans, have offspring which grow into adults;		

	• find out about and describe the basic needs of animals, including humans, for survival (water, food and air); • describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.		
Plants	**Pupils should be taught to:** • identify and name a variety of common wild and garden plants, including deciduous and evergreen trees; • identify and describe the basic structure of a variety of common flowering plants, including trees.	**Pupils should be taught to:** • identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers; • 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; • explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.	
Living Things and their Habitats			**Pupils should be taught to:** • describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird; • describe the life process of reproduction in some plants and animals.
Evolution and Inheritance			**Pupils should be taught 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;

			• 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.
Seasonal Change (on going)	**Pupils should be taught to:** • observe changes across the 4 seasons; • observe and describe weather associated with the seasons and how day length varies.		
Forces		**Pupils should be taught to:** • compare how things move on different surfaces; • notice that some forces need contact between 2 objects, but magnetic forces can act at a distance; • observe how magnets attract or repel each other and attract some materials and not others; • 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; • describe magnets as having 2 poles • predict whether 2 magnets will attract or repel each other, depending on which poles are facing.	

Light		**Pupils should be taught to:** • recognise that they need light in order to see things and that dark is the absence of light; • notice that light is reflected from surfaces; • recognise that light from the sun can be dangerous and that there are ways to protect their eyes; • 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.	**Pupils should be taught to:** • recognise that light appears to travel in straight lines; • 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; • 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; • use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
Sound			
Earth and Space			**Pupils should be taught to:** • describe the movement of the Earth and other planets relative to the sun in the solar system; • describe the movement of the moon relative to the Earth; • describe the sun, Earth and moon as approximately spherical bodies; • use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

Electricity		**Pupils should be taught to:** • identify common appliances that run on electricity; • construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers; • identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery; • 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.	
Materials	**Pupils should be taught to:** • distinguish between an object and the material from which it is made; • identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock; • describe the simple physical properties of a variety of everyday materials; • compare and group together a variety of everyday materials on the basis of their simple physical properties.	**Pupils should be taught to:** • compare and group materials together, according to whether they are solids, liquids or gases; • observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C); • identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	**Pupils should be taught 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; • know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution; • use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating; • give reasons, based on evidence from comparative and fair tests, for the

			particular uses of everyday materials, including metals, wood and plastic; • demonstrate that dissolving, mixing and changes of state are reversible changes; • 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.

Working Scientifically

Key Stage 1 National Curriculum Working Scientifically	
In Class 1, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content: • asking simple questions and recognising that they can be answered in different ways; • observing closely, using simple equipment; • performing simple tests; • identifying and classifying; • using their observations and ideas to suggest answers to questions; • gathering and recording data to help in answering questions.	
Lower Key Stage 2 National Curriculum Working Scientifically	**Upper Key Stage 2 National Curriculum Working Scientifically**
In Class 2, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content: • asking relevant questions and using different types of scientific enquiries to answer them; • setting up simple practical enquiries, comparative and fair tests; • making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers; • gathering, recording, classifying and presenting data in a variety of ways to help in answering questions; • recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables; • reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions; • using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions; • identifying differences, similarities or changes related to simple scientific ideas and processes; • using straightforward scientific evidence to answer questions or to support their findings.	In Class 3, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content: • planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary; • taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate; • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs; • using test results to make predictions to set up further comparative and fair tests; • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations; • identifying scientific evidence that has been used to support or refute ideas or arguments.

	Class 1	Class 2	Class 3
Asking Questions and Carrying Out Fair and Comparative Tests	Asking simple questions and recognising that they can be answered in different ways. Performing simple tests. Children can: a) explore the world around them, leading them to ask some simple scientific questions about how and why things happen; b) begin to recognise ways in which they might answer scientific questions; c) ask people questions and use simple secondary sources to find answers; d) carry out simple practical tests, using simple equipment; e) experience different types of scientific enquiries, including practical activities; f) talk about the aim of scientific tests they are working on.	Asking relevant questions and using different types of scientific enquiries to answer them. Setting up simple practical enquiries, comparative and fair tests. Children can: a) start to raise their own relevant questions about the world around them in response to a range of scientific experiences; b) start to make their own decisions about the most appropriate type of scientific enquiry they might use to answer questions; c) recognise when a fair test is necessary; d) help decide how to set up a fair test, making decisions about what observations to make, how long to make them for and the type of simple equipment that might be used; e) set up and carry out simple comparative and fair tests.	Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. Using test results to make predictions to set up further comparative and fair tests. Children can: a) with growing independence, raise their own relevant questions about the world around them in response to a range of scientific experiences; b) with increasing independence, make their own decisions about the most appropriate type of scientific enquiry they might use to answer questions; c) explore and talk about their ideas, raising different kinds of scientific questions; d) ask their own questions about scientific phenomena; e) select and plan the most appropriate type of scientific enquiry to use to answer scientific questions; f) make their own decisions about what observations to make, what measurements to use and how long to make them for, and whether to repeat them; g) plan, set up and carry out comparative and fair tests to answer questions, including recognising and controlling variables where necessary;

			h) use their test results to identify when further tests and observations may be needed; i) use test results to make predictions for further tests.
Observing and Measuring Changes	Observing closely, using simple equipment. Children can: a) observe the natural and humanly constructed world around them; b) observe changes over time; c) use simple measurements and equipment; d) make careful observations, sometimes using equipment to help them observe carefully.	Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers. Children can: a) make systematic and careful observations; b) observe changes over time; c) use a range of equipment, including thermometers and data loggers; d) ask their own questions about what they observe; e) where appropriate, take accurate measurements using standard units using a range of equipment.	Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate. Children can: a) choose the most appropriate equipment to make measurements and explain how to use it accurately; b) take measurements using a range of scientific equipment with increasing accuracy and precision; c) make careful and focused observations; d) know the importance of taking repeat readings and take repeat readings where appropriate.
Identifying, Classifying, Recording and Presenting Data	Identifying and classifying. Gathering and recording data to help in answering questions. Children can: a) use simple features to compare objects, materials and living things; b) decide how to sort and classify objects into simple groups with some help;	Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions. Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables. Children can: a) talk about criteria for grouping, sorting and classifying; b) group and classify things;	Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs. Children can: a) independently group, classify and describe living things and materials; b) use and develop keys and other information records to identify, classify

	c) record and communicate findings in a range of ways with support; d) sort, group, gather and record data in a variety of ways to help in answering questions such as in simple sorting diagrams, pictograms, tally charts, block diagrams and simple tables.	c) collect data from their own observations and measurements; d) present data in a variety of ways to help in answering questions; e) use, read and spell scientific vocabulary correctly and with confidence, using their growing word reading and spelling knowledge; f) record findings using scientific language, drawings, labelled diagrams, keys, bar charts and tables.	and describe living things and materials; c) decide how to record data from a choice of familiar approaches; d) record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar graphs and line graphs.
Drawing Conclusions, Noticing Patterns and Presenting Findings	Using their observations and ideas to suggest answers to questions. Children can: a) notice links between cause and effect with support; b) begin to notice patterns and relationships with support; c) begin to draw simple conclusions; d) identify and discuss differences between their results; e) use simple and scientific language; f) read and spell scientific vocabulary at a level consistent with their increasing word reading and spelling knowledge at key stage 1; g) talk about their findings to a variety of audiences in a variety of ways.	Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions. Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions. Children can: a) draw simple conclusions from their results; b) make predictions; c) suggest improvements to investigations; d) raise further questions which could be investigated; e) first talk about, and then go on to write about, what they have found out; f) report and present their results and conclusions to others in written and oral forms with increasing confidence.	Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations. Children can: a) notice patterns; b) draw conclusions based in their data and observations; c) use their scientific knowledge and understanding to explain their findings; d) read, spell and pronounce scientific vocabulary correctly; e) identify patterns that might be found in the natural environment; f) look for different causal relationships in their data; g) discuss the degree of trust they can have in a set of results; h) independently report and present their conclusions to others in oral and written forms.

Using Scientific Evidence and Secondary Sources of Information		Identifying differences, similarities or changes related to simple scientific ideas and processes. Using straightforward scientific evidence to answer questions or to support their findings. Children can: a) make links between their own science results and other scientific evidence; b) use straightforward scientific evidence to answer questions or support their findings; c) identify similarities, differences, patterns and changes relating to simple scientific ideas and processes; d) recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations.	Identifying scientific evidence that has been used to support or refute ideas or arguments. Children can: a) use primary and secondary sources evidence to justify ideas; b) identify evidence that refutes or supports their ideas; c) recognise where secondary sources will be most useful to research ideas and begin to separate opinion from fact; d) use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas; e) talk about how scientific ideas have developed over time.

Knowing more and remembering more

Every science lesson starts with retrieval practice in order to combat the forgetfulness curve. This retrieves the most recent learning, when appropriate, as well as relevant prior units. For example, children starting a unit on plants in Class 2 will recall knowledge from their experience of plants in Class 1. Through responsive teaching, staff continuously monitor pupils' progress against expected attainment for their age and provide in-lesson feedback in order to move the learning forward. Additional support and challenge is provided as required. Children have their own science book in which their science work and investigations are recorded. Every unit has a summative outcome that is marked in depth and used for teacher assessment purposes.

A Global Curriculum

Central to our global curriculum, science occupies a pivotal role in fostering knowledge, innovation, and global awareness. Projects that explore the journey from "farm to fork" and seek to end hunger align with Goal 2: Zero Hunger. By delving into the intricacies of food production and distribution, students develop an appreciation for sustainable practices that support both nutrition and environmental well-being.

The promotion of good health and well-being, another cornerstone of our science curriculum, is a direct embodiment of Goal 3: Good Health and Wellbeing. By fostering an understanding of healthy living, disease prevention, and the impact of lifestyle choices, we empower students to make informed decisions for their well-being.

Our curriculum also underscores the significance of affordable and clean energy, resonating with Goal 7: Affordable and Clean Energy. Through the exploration of energy sources and conservation methods, students become cognizant of the pivotal role of sustainable energy in driving global progress.

Climate action, life below water, and life on land—all intricately woven into our science curriculum—align with Goals 13, 14, and 15: Climate Action, Life Below Water, and Life on Land. By delving into these topics, students gain a deeper understanding of the critical need for environmental stewardship and the preservation of Earth's ecosystems.

Ultimately, our primary science curriculum functions as a catalyst for cultivating informed, eco-conscious, and innovative individuals. By aligning with the SDGs, our curriculum empowers students to explore the interconnectedness of scientific principles and global challenges, fostering a generation of problem solvers and responsible stewards of our planet.

Appendix A

National Curriculum

You can access the full Science Programmes of Study here.

Appendix B

Big ideas of science

1. All matter in the Universe is made of very small particles

Atoms are the building blocks of all matter, living and non-living. The behaviour and arrangement of the atoms explains the properties of different materials. In chemical reactions atoms are rearranged to form new substances. Each atom has a nucleus containing neutrons and protons, surrounded by electrons. The opposite electric charges of protons and electrons attract each other, keeping atoms together and accounting for the formation of some compounds.

2. Objects can affect other objects at a distance

All objects have an effect on other objects without being in contact with them. In some cases the effect travels out from the source to the receiver in the form of radiation (e.g. visible light). In other cases action at a distance is explained in terms of the existence of a field of influence between objects, such as a magnetic, electric or gravitational field. Gravity is a universal force of attraction between all objects however large or small, keeping the planets in orbit round the Sun and causing terrestrial objects to fall towards the centre of the Earth.

3. Changing the movement of an object requires a net force to be acting on it

A force acting on an object is not seen directly but is detected by its effect on the object's motion or shape. If an object is not moving the forces acting on it are equal in size and opposite in direction, balancing each other. Since gravity affects all objects on Earth there is always another force opposing gravity when an object is at rest. Unbalanced forces cause change in movement in the direction of the net force. When opposing forces acting on an object are not in the same line they cause the object to turn or twist. This effect is used in some simple machines.

4. The total amount of energy in the Universe is always the same but can be transferred from one energy store to another during an event

Many processes or events involve changes and require an energy source to make them happen. Energy can be transferred from one body or group of bodies to another in various ways. In these processes some energy becomes less easy to use. Energy cannot be created or destroyed. Once energy has been released by burning a fossil fuel with oxygen, some of it is no longer available in a form that is as convenient to use.

5. **The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate**

Radiation from the Sun heats the Earth's surface and causes convection currents in the air and oceans, creating climates. Below the surface heat from the Earth's interior causes movement in the molten rock. This in turn leads to movement of the plates which form the Earth's crust, creating volcanoes and earthquakes. The solid surface is constantly changing through the formation and weathering of rock.

6. **Our solar system is a very small part of one of billions of galaxies in the Universe**

Our Sun and eight planets and other smaller objects orbiting it comprise the solar system. Day and night and the seasons are explained by the orientation and rotation of the Earth as it moves round the Sun. The solar system is part of a galaxy of stars, gas and dust, one of many billions in the Universe, enormous distances apart. Many stars appear to have planets.

7. **Organisms are organised on a cellular basis and have a finite life span**

All organisms are constituted of one or more cells. Multi-cellular organisms have cells that are differentiated according to their function. All the basic functions of life are the result of what happens inside the cells which make up an organism. Growth is the result of multiple cell divisions.

8. **Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms**

Food provides materials and energy for organisms to carry out the basic functions of life and to grow. Green plants and some bacteria are able to use energy from the Sun to generate complex food molecules. Animals obtain energy by breaking down complex food molecules and are ultimately dependent on green plants as their source of energy. In any ecosystem there is competition among species for the energy resources and materials they need to live and reproduce.

9. **Genetic information is passed down from one generation of organisms to another**

Genetic information in a cell is held in the chemical DNA. Genes determine the development and structure of organisms. In asexual reproduction all the genes in the offspring come from one parent. In sexual reproduction half of the genes come from each parent.

10. The diversity of organisms, living and extinct, is the result of evolution

All life today is directly descended from a universal common ancestor that was a simple one-celled organism. Over countless generations changes resulting from natural diversity within a species lead to the selection of those individuals best suited to survive under certain conditions. Species not able to respond sufficiently to changes in their environment become extinct.

Big ideas about science

11. Science is about finding the cause or cause of phenomena in the natural world

Science is a search to explain and understand phenomena in the natural world. There is no single scientific method for doing this; the diversity of natural phenomena requires a diversity of methods and instruments to generate and test scientific explanations. Often an explanation is in terms of the factors that have to be present for an event to take place as shown by evidence from observations and experiments. In other cases supporting evidence is based on correlations revealed by patterns in systematic observation.

12. Scientific explanations, theories and models are those that best fit the evidence available at a particular time

A scientific theory or model representing relationships between variables of a natural phenomenon must fit the bservations available at the time and lead to predictions that can be tested. Any theory or model is provisional and subject to revision in the light of new data even though it may have led to predictions in accord with data in the past.

13. The knowledge produced by science is used in engineering and technologies to create products to serve human ends

The use of scientific ideas in engineering and technologies has made considerable changes in many aspects of human activity. Advances in technologies enable further scientific activity; in turn this increases understanding of the natural world. In some areas of human activity technology is ahead of scientific ideas, but in others scientific ideas precede technology.

14. Applications of science often have ethical, social, economic and political implications

The use of scientific knowledge in technologies makes many innovations possible. Whether or not particular applications of science are desirable is a matter that cannot be addressed using scientific knowledge alone. Ethical and moral judgments may be needed, based on such considerations as justice or equity, human safety, and impacts on people and the environment.

Reference

Harlen, W. (2010) Principles and Big Ideas of Science Education. Association for Science Education. Herts