Contents

Rationale

This scheme of work was reviewed and updated in line with research from the worlds of science education and cognitive science to ensure it meets the requirements of the Education Inspection Framework and National Curriculum.

The national curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future

In line with the aims of the National Curriculum, this scheme of work will give pupils the opportunity to learn about the products of science so that they can explain the material world and 'develop a sense of excitement and curiosity about natural phenomena' (National Curriculum). Pupils will also learn about the practices of science so that they know how scientific knowledge becomes established through scientific enquiry. Through this programme of study, pupils will combine these two distinct types of knowledge to ensure their substantive and disciplinary knowledge are building with context and purpose.

Knowledge and skills in this scheme of work have been carefully sequenced across units and years because we know that, 'when knowledge is well structured, it becomes meaningful, flexible and easier to access. This knowledge can then be used to solve complex, and interesting, scientific problems without overloading working memory' (Ofsted research review series: science). Within this scheme of work, therefore, sequential component knowledge is clearly broken down into steps and composite tasks outlined through which pupils will embed that knowledge. Although they are taught together, there is clarity about which knowledge is disciplinary and which is substantive.

Revisiting prior learning and carrying out retrieval practice is an important aspect of learning and will support pupils to commit their knowledge to their long-term memory. This scheme of work, therefore, outlines for each unit the prior knowledge that pupils will need to inform this unit.

'In science, pupils need their knowledge to be organised around the most important scientific concepts, which predict and explain the largest number of phenomena' (Ofsted research review series: science). Therefore, within this scheme, **ten big ideas** have been identified, underpinned by key concepts. As they move through this scheme of work, pupils will build comprehensive schemata for each of these big ideas so that new knowledge connects with prior knowledge and can be committed to the long-term memory.

This scheme of work makes the distinction between substantive and disciplinary knowledge and ensures that pupils use these side by side to develop expertise, apply and make sense of the knowledge learnt and understand how the knowledge developed and became accepted:

- **substantive knowledge** (knowledge of the products of science, such as concepts, laws, theories and models): this is referred to as scientific knowledge and conceptual understanding in the national curriculum

- **disciplinary knowledge** (knowledge of how scientific knowledge is generated and grows): this is specified in the 'working scientifically' sections of the national curriculum and it includes knowing how to carry out practical procedures

(Ofsted research review series: science)

This scheme of work acknowledges that acquiring disciplinary knowledge goes beyond practical work. Alongside the opportunity to work scientifically, pupils need to understand the concepts and procedures that scientists use to develop understanding and explanations and seek truth. Therefore, the disciplinary knowledge that will be covered in this scheme of work is:

- knowledge of methods that scientists use to answer questions
- knowledge of apparatus and techniques, including measurement
- knowledge of data analysis
- knowledge of how science uses evidence to develop explanations

Combining the substantive and disciplinary knowledge helps pupils to secure conceptual understanding which they can then transfer to procedural knowledge through application. We have considered carefully the best substantive contexts in which to teach the disciplinary concepts and procedures.

Teacher subject knowledge is key to ensuring that pupils build solid scientific understanding and, to this end, this scheme of work comes with teacher knowledge organisers which outline essential substantive and disciplinary knowledge for each unit of work.

This scheme of work takes account of what is taught in mathematics at a similar stage to support a cohesive curriculum across subjects. This includes reading, writing and talking and opportunities have been identified for pupils to learn about the different ways in which scientists engage in their work through reading, talking and writing. This way, pupils will begin to build disciplinary literacy.

Pupils learn best when teachers have identified and prepared for common misconceptions in science because these can form barriers to learning. Common misconceptions are therefore identified for each unit within this scheme of work. It is important to remember that, if a misconception is challenged too early, before pupils have a scientific conception…they may mistakenly identify the misconception as factually correct information' (Ofsted research review series: science). To avoid this, pupils' knowledge should be built incrementally and greater time should be spent on those concepts where misconceptions are likely to be held.

Within this scheme of work you will find suggestions for a range of practical activities. These have been carefully thought about to ensure that they are designed to help pupils learn substantive or disciplinary knowledge. Where the aim of the lesson is for pupils to understand a concept, the learning activity has been focused on the development of understanding about this concept. There may also be times when the activity itself may be the goal e.g. learning how to use a thermometer. Teachers can use alternative activities and tasks as they wish but should ensure this clarity of focus is maintained and that thinking hard is prioritised over task completion. Time should also be dedicated before and after the practical work to interpret and explain.

As outlined in the Ofsted Research Review for science, high-quality science education may have the following features which teachers should take into account when using this scheme of work:

- Activities are carefully chosen so that they match specific curriculum intent.
- Teachers use systematic teaching approaches, where learning is scaffolded using carefully sequenced explanations, models, analogies and other representations to help pupils to acquire, organise and remember scientific knowledge.
- Teaching takes account of the limited working-memory capacity of their pupils when planning lessons.
- Pupils are not expected to arrive at scientific explanations by themselves without sufficient prior knowledge.
- Systematic approaches, alongside carefully selected texts, are used to teach the most important vocabulary in science.
- Pupils have regular opportunities in the early years and primary classrooms to learn vocabulary through story and non-fiction books, rhymes, songs and oral rehearsal.

(Ofsted research review series: science)

The 10 Big Ideas

1	There is a relationship between structure and function
2	Living and non-living things can be grouped in a variety of ways
3	Humans move through different stages of growth and development
4	All matter on earth exists in one of three states: solid, liquid, gas and the state of matter can change
5	Living things have characteristics and requirements for life, growth and health
6	Changing the movement of an object requires a net force (push or pull) to be acting on it
7	Living things depend on each other and on the environment; humans can have both a positive and negative impact
8	The diversity of organisms, living and extinct, is the result of evolution
9	Energy makes things happen and can be seen by its effects; it can be transferred (but is not used up)
10	The movement of the Earth affects the seasons and times of day

The 10 Big Ideas of Primary Science
Links to the National Curriculum Programmes of Study

Big Idea 1: There is a relationship between structure and function		
Underpinning concepts: Materials, structure, function, properties		
National Curriculum Links	Year 1	- identify and describe the basic structure of a variety of common flowering plants, including trees - describe and compare the structure of a variety of common animals - identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense - describe the simple physical properties of a variety of everyday materials
	Year 2	- 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	- identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
	Year 4	- identify 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
	Year 5	- give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
	Year 6	- identify and name the main parts of the circulatory system, and describe the functions of the heart, blood vessels and blood.

Big Idea 2: Living and non-living things can be grouped in a variety of ways		
Underpinning concepts: Structure, deciduous, evergreen, amphibians, reptiles, mammals, birds, fish, classification, organisms		
National Curriculum Links	Year 1	- identify and name a variety of common wild and garden plants, including deciduous and evergreen trees - 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 - compare and group together a variety of everyday materials on the basis of their physical properties

	Year 2	- explore and compare the differences between things that are living, dead and things that have never been alive
	Year 3	- compare and group together different kinds of rocks on the basis of their appearance and simple physical properties - compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet
	Year 4	- 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 - *explore ways of grouping a wide selection of living things that include animals, flowering plants and non-flowering plants** - compare and group materials together, according to whether they are solids, liquids or gases
	Year 5	- compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity and response to magnets
	Year 6	- 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

Big Idea 3: Humans move through different stages of growth and development		
Underpinning concepts: Change, life cycle, reproduction, offspring, genetics		
National Curriculum Links	Year 2	➢ notice that animals, including humans, have offspring which grow into adults
	Year 5	➢ 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 ➢ Describe the changes as humans develop to old age

Big Idea 4: All matter on earth exists in one of three states: solid, liquid, gas and the state of matter can change		
Underpinning concepts: Mass, matter, states of matter, changing states of matter, water cycle, temperature, reversible and irreversible changes		
National Curriculum Links		Year 2: • Find out about the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching Year 4:

<table>
<tr><td></td><td></td><td>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
Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature
Year 5:
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
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</td></tr>
<tr><td colspan="3">Big Idea 5: Living things have characteristics and requirements for life, growth and health</td></tr>
<tr><td>Underpinning concepts</td><td colspan="2">Senses, carnivore, herbivore, omnivore, environment, life processes, reproduction, nutrition, survival, skeleton, muscles, digestive system, circulatory system, organs</td></tr>
<tr><td>National Curriculum Links</td><td></td><td>Year 2:
find out and describe how plants need water, light and a suitable temperature to grow and stay healthy
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
Year 3:
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
identify that animals, including humans, need the right types and amounts of nutrition, and that they cannot make their own food; the get nutrition from what they eat.
Identify that humans and some other animals have skeleton and muscles for support, protection and movement
Year 4:
Describe the simple functions of the basic parts of the digestive system in humans
Year 5:
Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird</td></tr>
</table>

		• Describe the life process of reproduction in some plants and animals Year 6: • 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
Big Idea 6: Changing the movement of an object requires a net force (push or pull) to be acting on it		
Underpinning concepts	Magnetism, air resistance, gravity, friction, water resistance, mechanisms	
National Curriculum Links		Year 3: • 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 Year 5: • 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
Big Idea 7: Living things depend on each other and on the environment; humans can have both a positive and negative impact on the environment		
Underpinning concepts	Climate change, sustainability, energy conservation, habitat, microhabitats, food chains, population, development	
National Curriculum Links		Year 2: • 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. • 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. Year 4: • Recognise that environments can change and that this can sometimes pose dangers to living things • Construct and interpret a variety of food chains, identifying producers, predators and prey
Big Idea 8: The diversity of organisms, living and extinct, is the result of evolution		
Underpinning concepts	Theory of evolution, organic matter, adaptation, variation, offspring, fossils	

National Curriculum Links		Year 3: • Describe in simple terms how fossils are formed when things that have lived are trapped within rock Year 6: • 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
Big Idea 9: Energy makes things happen and can be seen by its effects; it can be transferred (but is not used up)		
Underpinning concepts	Light, sound, electricity, waves, conductors and insulators	

National Curriculum Links		Year 3:
		• Recognise that they need light in order to see things and that dark is the absence of light
		• Recognise that shadows are formed when the light from a light source is blocked by an opaque subject
		• Find patterns in the way that the size of shadows change
		Year 4:
		• 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 vibrations that produced it
		• 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
		Year 6:
		• 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
		  ○ 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
Big Idea 10: The movement of the Earth affects the seasons and times of day		
Underpinning concepts	Seasons, weather, solar system, Earth	
National Curriculum Links		Year 1: • Observe changes across the 4 seasons Year 5: • 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

Long-term plan

	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Year 1	Everyday materials		Animals, including humans		Plants	
	Seasonal Changes 1		Seasonal Changes 2		Seasonal Changes 3	
	1 & 2					
Year 2	Living things and their habitats		Uses of everyday materials	Animals, including humans	Plants	
	5 & 7					
Year 3	Forces and Magnets		Light	Rocks	Plants	Animals, including humans
	2 & 6					
Year 4	Sound		States of matter	Electricity	Animals, including humans	Living things and their habitats
	9					
Year 5	Animals, including humans	Earth and space	Forces		Properties and changes of materials	Living things and their habitats
	3 & 5	**6 & 10**				
Year 6	Living things and their habitats	Evolution and inheritance	Electricity	Light	Animals including humans	
	2	**8**				

Suggested Planning Structure for Mixed Age Classes

If you are teaching in mixed age classes, we advise you follow this cycle so that pupils have the learning they need to access future units:

<table>
<tr><th></th><th>Autumn 1</th><th>Autumn 2</th><th>Spring 1</th><th>Spring 2</th><th>Summer 1</th><th>Summer 2</th></tr>
<tr><td rowspan="2">Year 1/2 A</td><td colspan="2" rowspan="2">Every day materials – Y1
Seasonal Changes 1</td><td colspan="2" rowspan="2">Animals including humans – Year 1
Seasonal Changes 1</td><td>Uses of everyday materials – Y2</td><td>Animals including humans – Y2</td></tr>
<tr><td colspan="2">Seasonal Changes 1</td></tr>
<tr><td>Year 1/2 B</td><td colspan="2">Plants – Y1</td><td colspan="2">Living things and their habitats – Y2</td><td colspan="2">Plants – Y2</td></tr>
<tr><td>Year 3/4 A</td><td colspan="2">Forces and magnets – Y3</td><td>Animals including humans – Y3</td><td>Light – Y3</td><td>Electricity – Y4</td><td>Animals including humans – Y4</td></tr>
<tr><td>Year 3/4 B</td><td>States of matter – Y4</td><td>Plants – Y3</td><td colspan="2">Sound – Y4</td><td>Living things and their habitats – Y4</td><td>Rocks – Y3</td></tr>
<tr><td>Year 5/6 A</td><td>Animals including humans – Y5</td><td>Forces – Y5</td><td colspan="2">Animals including humans – Y6</td><td>Properties and changes of materials – Y5</td><td>Evolution and inheritance (Y6)</td></tr>
<tr><td>Year 5/6 B</td><td>Living things and their habitats – Y5</td><td colspan="2">Electricity – Y6</td><td>Earth and Space – Y5</td><td>Light – Y6</td><td>Living things and their habitats – Y6</td></tr>
</table>

National Curriculum Programme of Study: Building Components for Substantive Knowledge

Building components for substantive knowledge – **Animals, including Humans**

Year 1

- What parts make up the human body?
- Which parts of our bodies do we need to see, hear, smell, taste and touch?
- What is an animal?
- How can we group animals?
- Do all animals eat the same things?

Year 2

- How do animals change as they get older?
- Do human body parts change with age?
- What do animals need to survive?
- Why should humans exercise?
- Why do we eat different types of food?

Year 3

- What food do humans need?
- How can we keep our pets healthy?
- Why do humans need a skeleton?
- How do muscles work?
- Do people who do more physical activity have stronger muscles?

Year 4

- Why do we have different shaped teeth?
- What can we tell about an animal from looking at its teeth?
- What happens to our food when we eat it?
- Can models help us understand human processes?
- Why are food chains important?

Year 5

- How do humans change over time?
- How can we investigate changes as we progress through the lifecycle?
- What happens to us during puberty?
- What can the size of animals incl. humans tell us about gestation periods?

Year 6

- What is the purpose of the circulatory system?
- Why is blood so important?
- How does exercise affect our circulatory system?
- How are nutrients and water transported within animals, including humans?
- How do diet, exercise, drugs and lifestyle impact our bodies?

Building component knowledge – **Materials and States of Matter**

Everyday Materials – Year 1

- What materials are these objects made from?
- What properties do materials have?
- What material is best at absorbing water?
- What material is best at keeping us dry - is waterproof?

Uses of Everyday Materials – Year 2

- What do we know about everyday materials?
- Which material is best?
- How well do different materials bounce?
- Can solid objects change shape?
- Which fabric is the strechiest?

States of Matter – Year 4

- Is it helpful to group living things?
- What types of animals live in the local area?
- What is special about our local environment?
- What dangers are posed to habitats and the environment?
- How can we develop the local area to protect living things?

Properties and Changes of Materials - Year 5

- What material is most effective in keeping a cup of tea warm?
- Which material would be best to keep an ice lolly cold?
- When we change a material, is it always forever?
- How can we separate a mixture?
- When does a change make a new material?

Building components for substantive knowledge – **Sound**

Year 4

- How do we hear sounds?
- What patterns can you find between the strength of vibrations and volume of a sound?
- What happens to sound as the distance from the sound source increases?
- What material provides the best insulation against sound?
- How do the features of an object affect the pitch of the sound it makes?

Building components for substantive knowledge – **Light**

Year 3

- Can we see without light?
- How does light behave when it is reflected?
- Can we change how shadows are formed?
- How can we protect our eyes from the sun?
- Do shadows stay the same all day?

Year 6

- How does light travel?
- Is a shadow always the same shape as the object that casts it?
- How does a mirror reflect light?
- What is refraction and why is it a phenomenon?
- What colour is light? *Is this a phenomenan?*

Building components for substantive knowledge – **Electricity**

Year 4

- Where does electricity come from and what is it used for?
- How can we light a bulb using a simple, series electrical circuit?
- How does a simple switch work?
- What material is the best conductor of electricity?
- What components are needed to make a working circuit?

Year 6

- How can we represent a simple circuit in a diagram?
- How does the number of batteries affect the brightness of the bulb?
- What else impacts the brightness of a bulb in a circuit?
- What can effect the function of a component in a circuit?
- How can I use my knowledge of electrical components to make a device?

Building components for substantive knowledge – **Forces**

Forces and Magnets – Year 3

- What is a contact force?
- How do different surfaces affect the movement of objects?
- What is a magnet and how do they work?
- What materials are attracted to a magnet?
- Do all magnets have the same strength?

Forces – Year 5

- How does friction affect the amount of force required to move an object?
- What is gravity?
- How does air resistance affect the speed at which an object falls?
- What changes the effects of water resistance?
- What impact do gears, levers and pulleys have on forces?

Building components for substantive knowledge – **Living Things and Their Habitats**

Year 2

- What examples can I find of living things, things that are no longer alive and things that have never been alive?
- What microhabitats can we find in our school?
- Do plants need particular habitats too?
- How do different habitats provide for the basic needs of different kinds of animals and plants?
- How do animals obtain food from other animals and plants?

Year 4

- Is it helpful to group living things?
- What types of animals live in the local area?
- What is special about our local environment?
- What dangers are posed to habitats and the environment?
- How can we develop the local area to protect living things?

Year 5

- Are there any differences between the lifecycles of mammals, amphibians, insects and birds?
- How can we behave like naturalists?
- What is sexual reproduction in plants?
- Can plants reproduce without seeds?
- Do all animals reproduce in the same way?

Year 6

- Is the classification of animals helpful?
- Are there many similarities between animals in the local area?
- How can plants be classified?
- Is there a link between plant groups and the environment they grow in?
- Do microorganism s matter?

Building components for substantive knowledge – **Plants**

Year 1

- What plants do we know and where can we find them?
- What part of a plant is under the ground?
- Can we use a flower to name a plant?
- Are all tree trunks the same?
- What are the leaves like on different trees?

Year 2

- What do plants grow from?
- How do bulbs and seeds grow?
- What does a seed need to grow?
- How does a plant stay healthy?
- What is the lifecycle of a plant?

Year 3

How are seeds dispersed? → What are the main functions of the different parts of a flowering plant? → How do plants make food and how is water transported? → What does a plant need to stay alive? → Why does a plant need flowers?

Building components for substantive knowledge – **Rocks**

Year 3

What is rock and how can it be grouped? → How were rocks formed? → Why are different rocks suited for different purposes? → How are fossils made? → What is soil and how is it made?

Building components for substantive knowledge – **Evolution and Inheritance**

Year 6

How do scientists know that living things have changed over time? → How does variation explain the different features and characteristics of living things? → How has variation led to evolution? → Do all living things adapt in the same way? → How have plants in the local area adapted?

Building components for substantive knowledge – **Seasonal Changes / Earth and Space**

Year 1

What is our local area like in each season? → Are days always the same length? Is the weather always the same here?

Year 5

How does our position in the solar system impact life on Earth? → Does anything else orbit the sun? → How do we get night and day? → How can shadows show us that Earth is rotating?

Building components for Disciplinary Knowledge

Throughout this science scheme of work, pupils build their substantive and disciplinary knowledge of science.

The disciplinary knowledge comprises:

Conceptual knowledge (know that…because):

- Knowledge about the concepts and procedures that scientists use to develop scientific explanations
- Knowledge of how scientific knowledge is generated and grows e.g. asking questions, carrying out enquiries, observing, drawing conclusions, making predictions, evaluating
- Knowledge of methods that scientists use to answer questions e.g. pattern-seeking, models, experimentation, classification
- Knowledge of apparatus and techniques, including measurement.
- Knowledge of data analysis, including the different ways in which scientific data can be processed and presented, including the different types of tables and graphs
- Knowledge of how science uses evidence to develop explanations - how evidence is used alongside substantive knowledge to draw conclusions
- Knowledge of how scientific models, laws and theories develop over time

Procedural knowledge (know how to…and be able to…)

- Knowledge of how to carry out procedures and protocols safely and with proficiency (and be able to do this) e.g. comparative and fair tests, following the correct testing processes, observations
- Know how to form, ask and answer scientific questions (and be able to do this)
- Knowledge of how to accurately measure and record data (and be able to do this)
- Correctly use equipment, aware of any limitations
- Knowledge of how to process and present scientific data in a variety of ways and interpret results (and be able to do this) e.g. bar charts and tables
- Knowledge of how to use results to draw conclusions (and be able to do this)
- Knowledge of how to use scientific evidence to support or refute ideas (and be able to do this)

Year 1

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Everyday materials** **Seasonal Changes 1**		**Animals, including humans** **Seasonal changes 2**		**Plants** **Seasonal Changes 3**	
Planning and carrying out practical enquiries	Know that science is about asking questions. Ask and suggest answers to one key question: What properties does the material have? Ask a simple question: What material is best at absorbing water? Perform a simple test to find out which material is the most waterproof by comparing.		Carry out activities to identify which body part is used for each sense		Plant seeds and observe growth over time, drawing the different stages of growth that they see	
Observations	Make observations about living things in the local area in each season. Observe changes and link them to the seasons. Using observation of the different materials, suggest answers for their uses. Use observations to suggest what material is best at absorbing water?		Learn how scientists find answers by observing. Pupils use magnifying glasses to make closer observations using pictures of animals, looking for detail.		Know that by observing living things over time, we can monitor changes. Identify and describe the roots of a plant and the detail of leaves by observing closely using simple equipment – magnifying glasses/hand lenses. Identify similarities and differences. Use an identification chart to name plants we see in the local area.	
Sorting, grouping, identifying, classifying	Know how to sort objects according to the material they are made from.		Identify what is the same between animal groups and use this to sort mammals, reptiles, amphibians and birds, carnivores, herbivores and omnivores into the correct groups based on their common features		Classify plants as garden plants, wild plants, trees or weeds. Identify and classify common trees according to their physical features: leaves, bark, branches, trunk. Choose ways to sort leaves.	
Using equipment and taking measurements	Use simple equipment for measurement – a teaspoon to measure water.				Use magnifying glasses/hand lenses to observe and describe features of plants. Use string to measure trunks and then order them according to size.	
Collecting, recording, presenting data	*Measure the water gathered from each material and present this in a pictogram.*				Gather data about the thickness of tree trunks and compare and contrast to understand variation.	
Analysing and drawing conclusions	Draw conclusions about the characteristics of each season.		Draw up concluding statements based on investigations e.g. we use our ears to hear.			

	Collectively draw a conclusion about which material is best for keeping us dry.	Identify similarities and differences between animals and groups.	
Creating models			
Secondary sources		Pupils use books to identify whether animals have 5 senses.	
Learning from scientists	Know that scientists ask questions.	Scientists compare things such as the human body to find out what is different and what are common characteristics of living things Know that scientists understand the world by carrying out tests to see if things are true or find out answers e.g. which body part is required for each sense Know that scientists classify animals into different groups to understand how they are related to each other and to understand them e.g. into mammals, fish, birds. Scientists think about what is the same and what is different between different things. Scientists group living things according to their characteristics.	

Year 2

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Living things and their habitats**		**Uses of everyday materials**	**Animals, including humans**	**Plants**	
Planning and carrying out practical enquiries			Gather and record data in a simple test to help answer questions – finding out which material makes a ball bounce higher. Independently identify why it needs to be a fair test and how to ensure this. Use their observations and experimentation to suggest answers to questions – can solid objects change shape? Pupils make a prediction about which fabric they think will be stretchiest and collectively plan how to test this.	Pupils begin to suggest ways we could find out about how humans grow, using their observations. Pupils identify activities to carry out to help us find out which make us 'puff most'	Begin to develop the idea that we should keep some things the same when planning an experiment. Begin to make predictions. Observe seed germination closely; set up a simple test/ investigation following a model. Discuss the method together and have it scaffolded to enable them to plan.	
Observations	Use simple equipment (magnifying glasses) to observe closely the animals we find in local microhabitats. Observe the light, plants and dryness of the soil in different habitats.			Use observation to identify change and growth and order life cycles in response. Use knowledge of what animals need to survive and explore the school grounds, using observation to identify where animals could access food, water and shelter	Use observations and ideas (about seeds and bulbs) to suggest answers to questions. Take weekly photos to monitor change over time. See teachers modelling using observations to ask questions about what we see. Based on observations over time, predict what might happen to the plants in the future.	
Sorting, grouping, identifying, classifying	Identify and classify living and non-living things according to whether they are alive or dead or have never been alive.		Identify and classify the variety of uses of different materials	Using knowledge learnt about food, pupils sort healthy and		

	Sort animals and plants into food chains.	based on their properties. Identifying and classifying, using observations and ideas to suggest answers to questions – use knowledge of materials to select the correct one for a given purpose.	unhealthy food intake based on the impact on our bodies	
Using equipment and taking measurements	Use simple equipment (magnifying glasses) to observe closely the animals we find in local microhabitats.	Use tape or wool on the wall to measure the height of bounces. Use a metre stick to measure the stretchiness of fabric. Use weights to test them.	Accurately use rulers and tape measures to measure the lengths of arms and legs in cm Use stop watches to count the number of breaths in a minute	
Carrying out practical enquiries		Compare the suitability of a range of everyday materials.	Pupils carry out exercise for one minute, use a stopwatch and calculate puffs on a piece of paper for one minute to identify which makes us breathe harder.	Perform a simple comparative test to see whether seeds need water to grow. Carry out a simple comparative test to show that plants need water and light to stay healthy.
Collecting, recording, presenting data		Record results in a table and present them in a bar chart. Record data from observations in a table to help answer questions.	Record the length of arms and legs in a table using correct units of measure Pupils use time to record in a table the number of breaths taken in the minute after different physical activities	Keep a seed diary to track changes.
Analysing, explaining relationships and drawing conclusions	Observe the conditions in different microhabitats and draw conclusions about what minibeast need to survive	Draw conclusions against the initial question – which material is best for a bouncy ball?	Identify whether arms and legs get longer as we get older by comparing measurements	Suggest answers to questions (What does a seed need to grow?).

	Draw conclusions about what different plants need to survive.	In pairs draw a conclusion about whether a solid can change shape.	Looking at the number of breaths taken, pupils to identify which exercise made them work hardest	
Creating models	Create food chain diagrams			
Secondary sources	Use books and the internet to learn about different, unfamiliar habitats around the world and the animals that live there. Gather information from a range of sources and record the most useful and appropriate information for future reference.		Enq 1: Learn about life cycles of animals from videos and books chosen by the teacher	Enq 5: Ask simple questions and know that information can be found from secondary sources such as books. Use these to find out about plant life.
Learning from scientists	Scientists explore the world around them	Know that when scientists plan experiments, they try to keep some things the same.	Enq 2: Scientists might carry out tests using measurements to see how things change and grow Enq 5: Scientists have helped us learn what we should eat by sorting foods into groups with common benefits or negative impacts Enq 5: Know that scientists investigate food so that they can educate people about healthy choices.	Enq 1: Scientists record progress

Year 3

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Forces and magnets**		**Light**	**Rocks**	**Plants**	**Animals, including humans**
Planning and carrying out practical enquiries	Understand why tests should be fair and control all but one variable (the surface the car travels on). Predict whether two magnets will attract or repel each other, depending on which poles are facing. Independently set up an investigation when the method has been discussed collectively. Carry out a simple investigation and record results (bringing a range of materials near a magnet to test magnetism)		Set up a simple comparative test to see which materials can be seen in low light. Collectively set up a simple comparative and fair test to see how shadows change over the course of the day.	With support, carry out a comparative test to find out which rocks are permeable (absorb water) and which rocks are impermeable (do not absorb water).	Set up simple practical enquiries, comparative and fair tests to find out how quickly the roots of a seed grow. Set up a simple practical enquiry to explore the different requirements of plants to live and grow. Set up simple practical inquiries to show water transport through a stem, marking the changes on a jar. Set up a comparative test to see how plants in different situations grow.	Make predictions about whether doing more exercise makes our muscles stronger Carry out a pattern seeking investigation to find out if the amount of physical activity we do makes us stronger Ensure that a test is fair by ensuring the same activities are carried out by each person
Observations	Use observation to identify forces being used and to identify the effect these forces have on objects. Make systematic observations, testing the strength of magnetism from different distances.		Make systematic and careful observations to identify which objects can be seen in different lighting conditions. Make careful observations when using mirrors, to learn how light behaves when it is reflected .	Make careful observations about permeability Use observation and touch to identify types of soil.	Make systematic and careful observations of seeds to look for properties that will help us to understand how they are dispersed. Make systematic and careful observations and, where appropriate, use a	Watch videos to observe similarities and differences in the movement of animals with skeletons and animals without

		Use observation (how does the height of light change shadows), tables of data (how does distance affect shadow size) and comparison (which objects create darker shadows) to answer questions.		range of equipment (e.g. microscope). Make systematic and careful observations of the plants each week for changes in condition. Make systematic and careful observations of flowers, recording colours in a table.	
Sorting, grouping, identifying, classifying	Sort into groups objects that are attracted to magnets and those that are not.		Classify rocks according to whether they have grains, crystals or layers	Sort seeds into groups according to dispersal method.	Organise foods into their food groups and use this knowledge to model a balanced diet
Using equipment and taking measurements	Use measuring tape to measure the distance the cars travel. Measure the strength of a magnet by working out how many sheets of paper need to be in the way before a paperclip is no longer attracted.	Take systematic and accurate measurements of length in cm, to measure how shadows change in size. Make careful observations of how position and size of shadows changes and take accurate measurements using standard units of the length.	Make careful observations of rocks using a hand lens or magnifying glass. Use a stopwatch or second hand on a clock to time the length the rocks are in the water	Use a ruler and measure in mm how much the root of a seed grows over time. Use measurements on a jar to calculate the growth rate. Measure different changes e.g. height and number of leaves over time.	
Collecting, recording, presenting data	Record results in a table and use this data to draw conclusions about which surface slowed down the moving object the most. Carry out a simple investigation, record results in a table and use these to present data in a bar chart.	Record findings in a table. Write a written explanation of the learning about light and reflection.	Record findings based on a model and using the scientific language.	Report on their findings and draw simple conclusions. Gather, record and presenting data in a graph that shows the	Present data in a scattergram to show the relationship between strength and the amount of physical activity pupils do

		Use a simple diagram to show how shadows are formed. Use an appropriate graph/chart to show how shadows change across a day. Identify and explain differences, similarities or changes related to simple scientific ideas and processes (how and why shadows change)		frequency of different colours in the plants.	
Analysing, explaining relationships and drawing conclusions	Record results in a table and use this data to draw conclusions about which surface slowed down the moving object the most. Discuss the factors that might influence magnet strength, such as the size, shape, and material of the magnet.	Report on findings and draw a conclusion about which materials are more visible in low light. Use results to draw simple conclusions about why distance and height changes the size of shadows.		Use results to draw simple conclusions and make predictions e.g. whyich colours are most common and why might that be?	Look for patterns in a scattergram to draw a conclusion about whether activity levels impacts muscle strength Monitor the effect of different liquids on teeth
Creating models			Create a model of a fossil to help understand the process of fossilisation		Create a model of the muscles in the arm to show how they contract and retract Create a model of teeth in different liquids to test the impact and draw conclusions
Secondary sources		Report findings about keeping eyes safe in the sun.	Use video to learn how rocks were formed. Record findings using simple scientific language,		Know that secondary sources can be used to find out information when we cannot carry out an experiment –

			drawings and labelled diagrams. Use pictures to understand a process e.g. different types of soil.		research the diets of animals
Learning from scientists		Over time, processes modernise and change e.g. from Thomas Edison's lightbulb to Isamu Akasaki's LEDs	There is a body of scientists who share work as Mary Anning did. Female scientists have not always been respected.		Scientists sort and group living things to identify common characteristics. This helps us to understand them and identify new species that are found

Year 4

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Sound**		**States of Matter**	**Electricity**	**Animals, including humans**	**Living things and their habitats**
Planning and carrying out enquiries	Set up a comparative test to identify how the strength of vibrations affect the volume of a sound. Independently choose control variables. Carry out an experiment three times to increase reliability.		explore the effect of temperature on some substances by investigating the temperature at which a range of solids change state and become liquids. Set up a simple practical enquiry, ensuring it is a fair test, to find out the answer to whether all liquids can change state to become a solid. Increasingly give pupils opportunities to answer, 'How can we find this. Set up comparative and fair tests to determine the effect of temperature on rates of evaporation. out?'	Pupils record the method and table they are going to use. Know how to be safe around electricity. Set up a simple, practical investigation – using all the components to light a bulb. Investigate questions e.g. does the order of components matter? Set up a comparative test to identify which materials make good electrical conductors and which make good electrical insulators.	Set up an experiment over time to compare the impact of different liquids on teeth, making regular observations Ensure fair tests by putting egg shells in the same place Make predictions about how our activity level affects our muscle strength	
Observations	Make careful observations about how we see, hear and feel sound (vibrations).			Make systematic and careful observations about how appliances convert electrical energy.	Over the course of a week, observe egg shell in different liquids to see the impact of drinks on our teeth Observe the teeth of animals to make	Use classification diagrams and careful observation to group living things according to their characteristics. Identify from observation and reading how

				judgements about the diet Explore the local area, looking for plants and wildlife that may form a food chain	environments change over time.
Sorting, grouping, identifying, classifying		Group and classify a variety of different materials according to whether they are a solid, liquid or gas.	Sort devices according to whether they use mains or battery electricity	Group animals with or without skeletons Sort living things according to whether they are producers or consumers in a food chain Categorise changes according to whether they happen to males or females during puberty	Reflect on why classification is a process followed in the world of science. Use dichotomous keys to identify living things and draw conclusions about what they are.
Using equipment and taking measurements	Use data loggers with teacher support to measure the sound. Use a ranking system to compare and measure e.g. rank the volume from quietest to loudest.	Make systematic and careful observations and take accurate measurements using standard units, using a range of equipment: thermometers or data loggers to measure the temperature of melting points. Make systematic and careful observations and take accurate measurements using standard units by measuring the amount of water in ml or the space taken up by the water in cm.	Use scientific language and knowledge of circuits to design diagrams and create functional objects.		Use observation and tools such as magnifying glasses to identify living things. Ensure to leave habitats as they were found.

Collecting, recording, presenting data	Independently respond to lesson question with lengthier responses.	Gather and record data in a table, using the correct unit of measure. Begin to choose an appropriate way to gather and record data to help in answering questions and draw simple conclusions Add diagrams to written explanations to explain processes e.g. whether all liquids can become solids. Gather and record data in a table and line graph to show changes in evaporation rates over time. Present results to the class.		Enq 5: Use process diagrams to show the transfer of energy in a food chain	Produce a guidebook to inform people about the local area and threats it faces.
Analysing, explaining relationships and drawing conclusions	Investigate how the strength of vibrations affect the volume of a sound. Use these results to draw simple conclusions, make links between vibrations and sounds and identify patterns, Use scientific language about pitch and sound waves to explain how to change the pitch of a sound. Draw conclusions about what affects the pitch of a sound. Find patterns between the pitch of a sound and features of the object that produced it.	Present simple scientific definitions for a solid, liquid and gas. Report on findings from enquiries in the form of a written conclusion. Use results to draw simple conclusions and raise further question e.g. What further experiments could be done to	Enq 3: Use scientific evidence to answer questions e.g. how do switches work? Enq 4: Use results from comparative tests to draw simple conclusions, make links and identify patterns		Explore the local area, using knowledge of pollution and urbanisation to identify issues that need resolving. Devise a plan of action to protect living things in the local area.

		explore the changing state of these items?			
Creating models	Create models of headphones to identify materials which act as the best insulators for sound. Scientists may create prototypes like these before creating a final product.	Create a model of the water cycle to understand how condensation forms.		Enq 3: Create a model of the stomach to identify the properties that a stomach needs to carry out its role Enq 4: Create a model of the digestive system to explain and describe a process – digestive system	
Secondary sources	Understand that there are science museums around the world which provide us with valuable learning opportunities. These museums conduct research but also share with us existing findings.				Identify from observation and reading how environments change over time. Use research and findings from the scientific community to understand how humans are negatively impacting the planet.
Learning from scientists			Enq 1: Identify scientific evidence that has been used to support or refute ideas or arguments (Erik Bystrup). Enq 1: Identify how science helps engineers improve the world. Enq 2: Scientists use their knowledge and experience to form hypotheses which they then test out.	Enq 4: Know that scientists often create models to show or explore how something works Scientists make predictions about what they think will happen based on their experiences, knowledge or observations Enq 6: Scientists think about the impact environmental	Scientists are often committed to protecting the planet from the danger posed by human behaviour.

			Enq 4: Learn how scientists have explored, sought proof and used electricity (Benjamin Franklin) and how this has helped people (attracting lightning).	changes will have on living things	

Year 5

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Animals including humans**	**Earth and space**	**Forces**		**Properties and changes of materials**	**Living things and their habitats**
Planning and carrying out enquiries	Pupils to devise a comparative enquiry question to find out how people change as they get older Pupils to plan their own experiment about how people change as they get older – write the method and design a table for recording Carry out a pattern seeking investigation to identify relationships between mass of animals and their gestation period	Plan a pattern-seeking investigation to identify how shadows change throughout the day.	Plan a scientific enquiry to answer a question about friction. Decide the variables to be controlled. Plan a scientific enquiry, making choices about the variables to be changed to test the impact of air resistance. Make independent decisions about repeat readings. Use knowledge of water resistance to make predictions. Plan a scientific enquiry to test the effects of shape and surface area on water resistance.		Decide how to measure which cup is the best thermal insulator – how will it be measured? What will be used? What method will be followed? Use previous test results (from enquiry 1) to make a prediction to set up further fair tests. Plan an enquiry (fair test) answer a question to find thermal conductors and insulators, including recognising and controlling variables.	Ask questions about the local area and plan different types of scientific enquiries to answer them, including recognising and controlling variables where necessary Plan an enquiry to monitor and observe which plants flower at different times of the year. Plan a scientific enquiry to answer questions about which parts of a plant will lead to asexual reproduction. Form a hypothesis and then try to grow new plants from different parts of the parent plant, using knowledge of how plants grow and reproduce. Control variables e.g. amount of water and location of pots.
Using equipment and		Take accurate measurements and record results in a table of their own design.	Take accurate measurements using a force-meter. Calculate speed of a fall using a stopwatch. Pupils take readings from newton-meters.		take measurements using a thermometer with increasing accuracy.	

taking measurements					
Collecting, recording, presenting data	Carry out an interview and record and summarise answers about how we change as we grow Take measurements to show how people grow as they age. Present this in a line graph, identify patterns and draw conclusions about how we change as we grow	Present data in a line graph and identify the pattern.	Use scientific diagrams to show the direction of forces.	Report and present findings from enquiries, including conclusions, in oral and written forms. Report using first-hand observations and findings from demonstrations in written forms.	Label diagrams using a range of scientific language related to reproduction in plants. Choose how to record findings – this does not need to be in a table and could be photos, diagrams, measurements.
Analysing, explaining relationships and drawing conclusions	Use venn diagrams to show how some changes in puberty are the same and some are different for males and females Experiments can be used to create a general rule e.g. bigger animals have a longer gestation period Pupils to think about how the evidence that has been collected might be useful to scientists – what can they find out from this data? Pupils will come up with rules based on questions about their data e.g. can you estimate the gestation period of these animals, is there a	Draw conclusions from this pattern and link this to historic views of the movement of the Earth and sun.	Measure speed and identify relationships between water resistance and shape. Explain causal relationships in the components of levers, gears and pulleys.	Read an existing graph that shows cooling speeds and interpret.	Compare and contrast life cycles of different animals to identify similarities and differences. Devise a conclusion about asexual reproduction in plants.

	relationship between the size of the animal and the number of offspring it has?					
Creating models		Create a model to understand the movement of Earth in relation to the sun and moon. Create a to-scale model of the Solar System to understand distances and sizes. Use a model to understand the movement of the Earth				Build a classification diagram
Secondary sources	Interview people at different stages of life to find out about changes that we experience as we grow Enq 6: Pupils take more ownership of their research into animal gestation period	Use secondary sources to find out information about planets in the solar system.				
Learning from scientists	Enq 1: Know that scientists might use interviews to find out information from people who have experienced it Enq 3: Know that scientists ask questions to prove hypotheses Enq 4: Know that scientists classify to help them understand	Identify scientific evidence that has been used to support or refute ideas or arguments e.g. heliocentric universe.	Identify the scientific evidence that has been used to support or refute ideas about gravity (*Galileo Galilei and Isaac Newton* *Identify the scientific evidence that has been used to support or refute ideas (Elon Musk)*			Understand the considerations when working as a naturalist, e.g. taking care of the area whilst researching.

	how living things work and so knowledge can be applied to unknowns Enq 5: Scientists try to come up with rules or generalisations based on finding patterns from lots of examples. This helps them to make estimations and assumptions about unknowns					

Year 6

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
UNIT	**Living things and their habitats**	**Evolution and inheritance**	**Electricity**	**Light**	**Animals, including humans**	
Planning and carrying out enquiries	Use prior knowledge to select three locations where they think mould will spread fastest. Set up an experiment to prove this.		Recognise which variable to control in a fair test and carry out a fair test to see how the number of cells in a circuit affects the brightness. Devise a question based on their own experience e.g. what else impacts the brightness of a bulb? Plan their own fair test to answer the question. Come up with their own questions. Make predictions about what will happen in a range of circuit set-ups and test the accuracy of these. Plan a specific scientific enquiry, which recognises and controls variables, to make a working device.	Plan a scientific enquiry to answer the question: Is a shadow always the same shape as the object that casts it? Prove hypotheses with evidence.	Plan a pattern-seeking experiment to explore the relationship between the types of exercise we can do and heart rate Identify the variables that need to be controlled Write a hypothesis Plan a method independently for how they will keep this a fair test, how they will measure and record	
Observations	Use classification charts in the school grounds/local area to look for living things.	Observe closely to identify inherited characteristics in a range of living things.				

	Observe the habitat of living things, making notes. Observe adaptations to different conditions.	Observe and raise questions about how local plants are adapted to their environment; if possible, use microscopes to look at roots.			
Sorting, grouping, identifying, classifying	Use classification keys. Use prior knowledge from all previous year groups to classify animals in ways of their choosing. Create own classification charts. Use and compare different systems e.g. classification chart vs dichotomous key				
Using equipment and taking measurements		Use microscopes to look at roots.	Use a data logger to measure the brightness of a bulb. Create a scale to compare light according to brightness. Reflect on accuracy of measuring methods. Be confident in the reliability of results and explain why.	Take measurements of angles of incidence and reflection, using a protractor, with increasing accuracy and precision, taking repeat readings when appropriate	Use a heart monitor/pulse meter to take measurements Monitor sleep over time in a diary.
Carrying out practical enquiries					

Collecting, recording, presenting data			Record and represent findings, including drawing conclusions. Record with increasing complexity using scientific diagrams and labels the different ways to affect the function of a component in a circuit. Plan and design own table for results.	Record results of light model using scientific diagrams and labels. Report findings and share conclusions. Report and present findings about the refraction of light (as per pencil and glass demonstration) being an example of scientific phenomenon.	Use scientific diagrams and annotate them to explain a process – the circulatory system Create and annotate the process of the human circulatory system Present findings in a graph that pupils consider appropriate to show the relationship between exercise and heart rate
Analysing, explaining relationships and drawing conclusions		Analyse how cross/selective breeding has led to animals with certain inherited characteristics. Consider the advantages and disadvantages of selective breeding. Analyse how different circumstances may lead to natural selection and evolution. Use and apply knowledge of climate change to consider what this means for the adaptation of living things. Compare the adaptations of animals in different habitats.	Ensure results are accurate and reliable. Report findings and provide clear explanations.	Report and present findings from enquiries, including conclusions about the angles of incidence and reflection	Draw conclusions and suggest further investigations Investigate nutritional values on packaging and draw conclusions about the health benefits of different foods Draw conclusions about the impact of sleep on our lives

Creating models			Create circuits of increasing complexity and represent them using diagrams, annotated with scientific diagrams and labels.		Build on prior understanding of how scientists use models by creating a model of blood to show the proportions of component parts
Learning from scientists	Scientists classify living things to help explain their relationships to each other and to help us learn things about newly discovered organisms by noting their similarities to known organisms. Know that Carl Linnaeus' taxonomy was significant and has an impact today. Botanists study plants. There is a body of work taking place now around how plants across the world are responding to climate change. Discuss how people consider whether the work of scientists is significant e.g. Joseph Lister – what are the criteria for significance?	Understand how scientists examine fossils to find out about the evolution of different species. Know how Charles Darwin conducted scientific studies to inform his theory of evolution. Use a range of fossils and/or images of fossils over time and both identify changes and observe changes identified by scientists.	Know how scientists have developed ideas over time and improved efficiency (Nikolas Tesla). Understand why scientists use symbols i.e. international understanding, efficiency Identify how scientists build on the work of other scientists (M. Stanley Whittingham designing lithium-ion batteries).	Identify scientific evidence that has been used to support or refute ideas or arguments – Isaac Newton's discovery about the colours of light.	Know that scientists can challenge discoveries from other scientists and can prove these in a variety of ways (William Harvey) Know some ways in which scientists experimented on living things before technology developed (William Harvey) Learn about scientific evidence that has been used to refute ideas (William Harvey's work on the circulatory system)

Significant contributors within the field of science

Research into primary science has shown that when pupils learn about the work of specific scientists that link closely to the content they are learning at the time, this helps them to develop an accurate and genuine understanding of science: for example knowing that scientific research is not just carried out by men in white coats working in laboratories (Ofsted, 2023).

Within each unit there is specific reference to two significant individuals - one beyond living memory and one within living memory. These have been carefully selected to illustrate how scientific knowledge within the topic has developed over time and continues to shape new discoveries and innovations to this day. There has been careful consideration to ensure representation across the globe and around the different protected characteristics as defined by The Equality Act, 2010.

Please note that it is not the intention for pupils to remember each of the significant individuals or their specific achievements referenced throughout the units of work. As stated above, these have been included to provide context and build a sense of capital within the subject.

Year 1

Everyday materials		Animals, including humans		Plants		Seasonal Changes	
Charles Macintosh	Charlotte McCurdy	David Attenborough	Steve Backshall	David Douglas	Alan Titchmarsh	Robert Fitzroy	Carol Kirkwood
Scottish inventor of the modern waterproof raincoat	American designer and researcher who blends science and design to reframe existential threats.	British biologist and naturalist famous for his educational broadcasts about the natural world	British naturalist, explorer, presenter and writer, best known for BBC TV's Deadly 60	Scottish botanist who changed the British landscape and timber industry by introducing non-native conifers	English gardener who was awarded an MBE for services to horticulture and broadcasting	British founder of the Met Office and creator of the first public weather forecast.	Scottish weather presenter, trained by the Met Office, and employed by the BBC

Year 2

Living things and their habitats		Uses of everyday materials		Animals, including humans		Plants	
Jacques Cousteau	David Attenborough	Caroline Haslett	Stella McCartney	Florence Nightingale	Edward 'Bear' Grylls	Jane Colden	David Hickmott
French ocean explorer and ecologist who introduced millions of people to the underwater world	British biologist and naturalist famous for his educational broadcasts about the natural world	English electrical engineer, safety expert and advocate for science education for girls	English fashion designer known for using sustainable initiatives and ethically sourced materials	Italian nurse who raised the importance of hygiene to prevent the spread of disease and infections	British adventurer and explorer famous for his ability to survive in challenging conditions and environments	First known American female botanist who was regarded by many prominent botanists of the time	British seed collections assistant at the world's largest seed bank (Millenium Seed Bank)

Year 3

Topic	Scientist	Description
Forces and Magnets	Leonardi Da Vinci	Italian inventor and first known person to plan and carry out tests on friction
Forces and Magnets	Masato Sagawa	Japanese creator of the strongest permanent magnet in wide scale use today.
Light	Thomas Edison	American inventor who created the first working electric light bulb
Light	Isamu Akasaki	Japanese engineer & joint inventor of LEDs used in energy-saving lighting
Rocks	Mary Anning	English fossil hunter who discovered several dinosaur specimens.
Rocks	Sanjeev Gupta	Indian-born geologist who explores different landscapes on Earth & beyond
Plants	George W. Carver	American scientist who promoted ways to prevent soil depletion
Plants	Luciano Scandian	Italian research technician at the Laboratory of Apiculture and Social Insects
Animals, including humans	Louis Pasteur	French microbiologist who is renowned for his discovery of pasteurisation
Animals, including humans	Charlotte Armah	British-Ghanaian scientist who tests how food can help protect us from diseases

Year 4

Topic	Scientist	Description
Sound	Alexander G. Bell	Scottish-American inventor who patented the first telephone
Sound	Jaap Haartsen	Dutch inventor who contributed to the specification of Bluetooth
States of matter	Anders Celsius	Swedish astronomer who created the temperature scale, 'degrees'
States of matter	Heston Blumenthal	British chef and pioneer of multi-sensory cooking and experimental techniques
Electricity	Benjamin Franklin	American scientist who proved lightening was a form of electricity
Electricity	Erik Bystrup	Danish designer of a new T-shape pylon being installed by the UK National Grid
Animals, including humans	Pierre Fauchard	French physician, credited as being a pioneer and the 'father of modern dentistry'
Animals, including humans	Zhaoming Liu	Chinese doctor and researcher into the reproduction of tooth enamel
Living things and their habitats	Carl Linnaeus	Swedish botanist who came up with a method for classifying all living things
Living things and their habitats	Vanessa Nakate	Ugandan climate justice activist who campaigned to save the Congo rainforest

Year 5

Animals, including humans		Earth and Space		Forces		Properties and changes of materials		Living things and their habitats	
Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!
Alexander Fleming	Rosalind Franklin	Nicolaus Copernicus	Tim Peake	Isaac Newton	Elon Musk	Albert Einstein	Hugh Bradner	Gregor Mendel	Jane Goodall
Scottish scientist who discovered the first anti-biotic drug, penicillin	British chemist whose work led to discovery of DNA structure	Polish astronomer who developed idea of a 'heliocentric universe'	First British astronaut to walk in space in over 20 years.	English physicist who established 3 laws of motion & law of gravity	South-African born physicist and entrepreneur - founder of Space X & Tesla	German physicist who showed matter can be turned into energy and back	American physicist who invented the first modern neoprene wetsuit	Austrian botanist who discovered how features are passed down in different plants	English primatologist famous for her work with chimpanzees

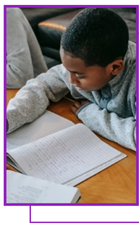
Year 6

Living things and their habitats		Evolution and inheritance		Electricity		Light		Animals including humans	
Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!	Click me!
Carl Linnaeus	Tanisha Williams	Charles Darwin	Sylvia Earle	Nikola Tesla	M. Stanley Whittingham	Ibn al-Haytham	Jo Shien Ng	William Harvey	Donald Palmer
Swedish botanist who came up with a method for classifying all living things	Native American botanist who studies how plants respond to climate change	English naturalist who showed how animals changed over generations (aka evolution)	American marine biologist, activist & world record holder for deepest sea walk	Serbian inventor famous for contributions to the AC electricity supply system	British chemist & Nobel Prize winner for the evolution of the lithium-ion battery	Arabian physicist & mathematician who proved light travels in straight lines	Malaysian professor whose research helps to develop electro light detection	English physician known for describing the circulation of blood in the body	British-Jamaican scientist who researches the human immune system

Using the planning materials

Black text - this is guidance for teachers that aims to support lesson design and delivery

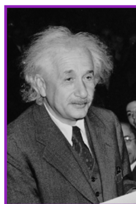
Pink text - this highlights prior knowledge and gives ideas for retrieving previous learning



Bold text - this is the tier 2 and 3 **substantive vocabulary** pupils need to know

Purple text - this shows the **disciplinary vocabulary** pupils need to know

Green text - this inidcates what pupils need to do or record as part of the enquiry



Orange text - this provides an opportunity for links to be made with a significant person

Look closely at the **'Big Ideas'** linked to this unit (see below). What knowledge can be added to each of the ideas based on the learning from each of our enquires? Encourage pupils to look back in their science books, revisit the **'little ideas'** and add this information (along with any supporting photos or pictorial prompts) to '**Our Class Science Book of Big Ideas**'.

Assessment

The Ofsted Handbook, when referencing impact, states that the curriculum has had a positive impact if:

- Learners develop detailed knowledge and skills across the curriculum
- Learners are ready for the next stage of education

Common assessment practice in primary schools has been for grids of objectives to be populated with the names of pupils who have met them or are working towards them. Subject leaders and school leaders then calculate the percentage of pupils who are on track.

The problems these grids present are:

- Future teachers may not have the same shared understanding of what achieving these objectives looks like.
- It may not be clear from these objectives what the detailed knowledge and skills are that pupils have secured. Assessment is only useful if we know the detail and exactly what each pupil needs to work on.

Many schools also complete end of unit assessments and, based on these outcomes, assume that pupils are secure with the knowledge and objectives. However, as shown by the Ebbinghaus forgetting curve, pupils may remember much of the content close to the point of learning but, within days and weeks of the unit finishing, much of it is forgotten. We can only be sure that pupils have learnt when we know the knowledge has been committed to their long-term memories. An assessment at the end of a unit will not tell teachers if pupils are retaining the knowledge over time.

Therefore, this curriculum has been designed to be the progression model. By planning knowledge and skills that builds incrementally and sequentially, we are supporting pupils to make connections and links between knowledge and, therefore, commit it to their long-term memories. This means that by mapping carefully sequenced, clear essential knowledge, ensuring components build towards composite end points and identifying concepts in line with schema theory, the curriculum is structured so that pupils learn the content. A curriculum developed in this way will be remembered.

‘What we teach children is inherently meaningful and does not acquire worth or value through being assessed in a potentially deceiving way.’

Primarytimery.com, Don’t Mix the Six!

Ongoing formative assessment is key to helping teachers identify where whole classes or individuals need to revisit learning or misconceptions need to be addressed. Regularly revisiting prior learning is also key to supporting pupils to make links.

The assessment recommendations for this scheme are as follows:

Pupil Voice/Knowledge checks

Subject leaders should meet with groups of pupils from each year group twice a year. Using the curriculum documents, questions should be asked to check the essential knowledge has been remembered e.g. What is a carnivore? What do humans need to survive? How have you built on your learning about animals from last year? Choose a concept and ask pupils to talk about what they have learnt about that during their time at the school.

Meaningful Work

The work pupils produce in itself should tell teachers and subject leaders whether deep learning has taken place. The tasks identified within this scheme of work are meaningful and ensure that learning the knowledge and skills has been prioritised over task completion. All the activities pupils complete will ensure they are having opportunities to practise, use and show their knowledge.

Low Stakes Quizzes

Pupils will regularly complete low stakes quizzes which give them the opportunity to consolidate prior learning. These quizzes will include questions from a range of units over time. Multiple choice questions will include misconceptions to ensure teachers can identify and address these. Pupils will also answer questions about prior learning at the start of a new related unit so that teachers can assess the prior knowledge they are approaching the unit with.

Assessment Grids

These assessment grids for each unit will outline the essential knowledge that the majority of pupils should secure because the curriculum has been designed as the progression model. The purpose of these grids is to identify those pupils who have not secured that knowledge and for teachers to think carefully about how this will be addressed. Teachers should timetable in where this knowledge will be revisited after 6 months and one year so that there is certainty that pupils have secured this knowledge in their long-term memory and teachers receiving the class will know exactly the knowledge that has been secured by pupils, those who do not have the knowledge and what has been done about this. Subject leaders can then use these sheets to understand attainment at a deeper level.

Essential Substantive Knowledge				
Essential Ways of Knowing				
Pupils who are not secure with this knowledge at the point of learning	Pupils: Actions taken:			
Pupils who are not secure with this knowledge after 6 months	Pupils: Actions taken:			
Pupils who are not secure with this knowledge after 12 months	Pupils: Actions taken:			

Useful websites

https://www.kiddle.co/

https://www.stem.org.uk/resources/collection/4372/inspiring-scientists

https://www.dkfindout.com/uk/science/famous-scientists/

https://www.nobelprize.org/

https://www.bbc.co.uk/bitesize/subjects/zkqmhyc

https://www.twinkl.co.uk/teaching-wiki/famous-scientists

https://school-learningzone.co.uk/key_stage_two/ks2_science/famous_scientists/famous_scientists.html

Primary Science Scheme of Work

www.theeducationpeople.org

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hello@theeducationpeople.org