Science at Spring Bank Primary School

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At Spring Bank Primary School, we recognise the importance of Science in every aspect of daily life. Our intent is to give every child a broad and balanced science curriculum which enables them to confidently explore and discover what is around them, so that they have a deeper understanding of the world we live in. We want our children to love science. Our curriculum will enable children to become enquiry based learners collaborating through researching, investigating and evaluating experiences. It will develop the natural curiosity of the child, encourage respect for living organisms and the physical environment and provide opportunities for critical evaluation of evidence.

To achieve this we will provide exciting, practical hands on experiences that encourage curiosity and questioning. Our aim is that these stimulating and challenging experiences help every child secure and extend their scientific knowledge and vocabulary, as well as promoting a love and thirst for learning. At Spring Bank, we have a coherently planned and sequenced curriculum which has been carefully designed and developed with the need of every child at the centre of what we do. We want to equip our children with not only the minimum statutory requirements of the science National Curriculum but to prepare them for the opportunities, responsibilities and experiences of later life. We will introduce the children to various scientists showing equality and diversity in science, allowing children to understand the possibilities science offers them as a potential future career.

At Spring Bank Primary School, in conjunction with the aims of the National Curriculum, our science teaching offers opportunities for children to:

- 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;
- be equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future;
- develop the essential scientific enquiry skills to deepen their scientific knowledge;
- use a range of methods to communicate their scientific information and present it in a systematic, scientific manner, including I.C.T., diagrams, graphs and charts;
- develop a respect for the materials and equipment they handle with regard to their own, and other children's safety;
- develop an enthusiasm and enjoyment of scientific learning and discovery.

The National Curriculum will provide a structure and skill development for the science curriculum being taught throughout the school, which is now linked, where possible to the theme topics to provide a creative scheme of work, which reflects a balanced programme of study.

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Overview of Units

An overview of units is provided for teachers to understand the progress of units throughout the school. The units are broken down into Biology, Physics and Chemistry. A Leading Scientist is provided for each unit and further detail is given at the end of the document.

	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Autumn 1		Animals including Humans	Uses of everyday materials	Rocks	Sound	Forces	Animals including humans
Autumn 2		Materials	Plants	Animals including humans	Electricity	Earth and space	Electricity
Spring 1	Materials	Seasonal Changes	Animals including humans	Forces and magnets	Living things and their habitats	Properties and changes of materials	Evolution and inheritance
Spring 2	Plants	Animals including humans	Plants	Light			SATS revision
Summer 1	Materials Animals including Humans	Plants	Living Things and their Habitats	Plants	Animals including humans	Living things and their habitats	Living things and their habitats
Summer 2	Living Things and their Habitats	Materials		Soils	States of matter	Animals including humans	Light

- Reception and Year 1 study seasonal changes throughout the year.

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Working scientifically progress map

The purpose of these working scientifically maps is to give teachers an understanding of how working scientifically progresses throughout school. They show how each enquiry type is covered across the year groups and the coverage of the NC objectives across each phase. Working scientifically is assessed in KS1 (Year 1 &2), LKS2 (Year 3&4) and UKS (Year 5&6). Children will encounter working scientifically in all units, however they will be explicitly taught the working scientifically objectives below.

EYFS provide opportunities for the children to experience all 5 enquiry types through a combination of adult and child led activities.

Reception				
Identifying and Classifying	Observing over Time	Pattern Seeking	Comparative and Fair Testing	Research
• Show curiosity about similarities and differences. • With help, ask questions about similarities and differences. • Talk about ideas for sorting or matching things. • Use senses to sort and match things. • Match things that are the same. • Find things that are similar or different. • Sort or group things in their own way. • Use simple equipment to help sort things (e.g boxes, hoops) • Talk about how they have sorted or matched things.	• Show curiosity about things that change. • With help, ask questions about things changing. • Talk about their ideas for finding out how things change. • Use all senses to observe changes. • Look closely at how things change. • Make simple records of how things change (with help where necessary). • Use simple equipment to observe and record changes. • Talk about what they have done and noticed.	• Show curiosity about patterns. • With help, ask questions about patterns. • Talk about their ideas for finding out about patterns. • Use senses to look closely for patterns. • Observe more than one thing at a time. • Make simple records of what they have notice (with help where necessary). • Use simple equipment to observe and record patterns. • Talk about what they have done and the patterns they noticed.	• Show curiosity about how things behave. • With help, ask questions about things they can test. • Talk about ideas for testing and how things behave. • Use senses to look closely at how things behave. • Carry out simple tests. • Make simple records of what they have noticed (with help where necessary). • Use simple equipment to observe and record. • Talk about what they have done and noticed. • Talk about whether something makes a difference.	• Show curiosity about things in the surroundings. • With help, ask questions that can answer using secondary sources. • Listen carefully. • Know that information in books and electronic media can be used to answer questions. • Find pictures of things. • Talk to people about what they do and how things work. • Talk about thing they have found out.

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KS1					
	Identifying and Classifying	Observing over Time	Pattern Seeking	Comparative and Fair Testing	Research
Year 1					
Animals including Humans					
Seasons					
Plants					
Materials					
Year 2					
Animals including humans					
Living things and their habitats					
Uses of everyday materials					
Plants					

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KS2					
	Identifying and Classifying	Observing over Time	Pattern Seeking	Comparative and Fair Testing	Research
Year 3					
Animals including humans					
Light					
Rocks					
Plants					
Forces and Magnets					
Year 4					
Animals including humans					
Living things and their habitats					
Sound					
Electricity					
States of matter					
Year 5					
Animals including humans					
Living things and their habitats					
Forces					
Earth and space					
Properties and changes of materials					
Year 6					
Animals including humans					
Living things and their habitats					
Evolution an in inheritance					
Light					
Electricity					

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KS1 Working Scientifically							
Term	Unit						
Year 1							
		Asking simple questions and recognising that they can be answered in different ways	Observing closely, using simple equipment	Performing simple tests	Gathering and recording data to help in answering questions.	Identifying and classifying	Using their observations and ideas to suggest answers to questions
Autumn 1	Animals including humans						
Autumn 2	Materials						
Spring 1	Seasonal Changes						
Spring 2	Animals including humans						
Summer 1	Plants						
Summer 2	Materials						
Year 2							
Autumn 1	Uses of everyday materials						
Autumn 2							
	Plants						
Spring 1	Animals including humans						
Spring 2							
	Plants						
Summer 1	Living things and their habitats						
Summer 2							

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LKS2 Working Scientifically

Term	Unit									
Year 3										
		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.
Autumn 1	Rocks	■	■	■		■	■		■	■
Autumn 2	Animals including humans			■		■	■	■	■	■
Spring 1	Forces and Magnets	■	■	■	■	■	■	■	■	■
Spring 2	Light	■	■	■	■	■	■	■	■	■
Summer 1	Plants Rocks	■	■		■	■			■	■
Summer 2		■								
Year 4										
Autumn 1	Sound	■	■	■		■		■	■	
Autumn 2	Electricity	■	■			■				■
Spring 1	Living things and their habitats									
Spring 2					■	■				
Summer 1	Animals including humans			■	■	■	■		■	■
Summer 2	States of Matter	■	■	■	■	■	■	■	■	

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UKS2 Working Scientifically

Term	Unit						
Year 5							
		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 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.
Autumn 1	Forces						
Autumn 2	Earth, Space and the Moon						
Spring 1	Properties and changes of materials						
Spring 2							
Summer 1	Living things and their habitats						
Summer 2	Animals including humans						
Year 6							
Autumn 1	Animals including humans						
Autumn 2	Electricity						
Spring 1	Evolution and inheritance						
Spring 2							
Summer 1	Living things and their habitats						
Summer 2	Light						

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Science Age Related Expectations – Knowledge and Working Scientifically

This document lays out an overview of the science that is taught across school from Reception to Year 6. This include the EYFS statutory framework for 'Understanding the World' and the knowledge and working scientifically programmes of study from the National Curriculum that must be taught in KS1 and KS2. The programmes of study have been broken down into key knowledge, to support the teaching and learning of each topic. Key vocabulary, for each topic, that will be taught and used by the children in their learning is in bold.

Knowledge of science within EYFS focuses on Understanding of the World.

Understanding the world involves guiding children to make sense of their physical world and their community. The frequency and range of children's personal experiences increases their knowledge and sense of the world around them – from visiting parks, libraries and museums to meeting important members of society such as police officers, nurses and firefighters. In addition, listening to a broad selection of stories, non-fiction, rhymes and poems will foster their understanding of our culturally, socially, technologically and ecologically diverse world. As well as building important knowledge, this extends their familiarity with words that support understanding across domains. Enriching and widening children's vocabulary will support later reading comprehension.

The National Curriculum working scientifically programmes of study develop an understanding of the nature, processes and methods of science discovery for each year group. Working scientifically is not taught as a separate entity but alongside knowledge. It is important to stress that knowledge should not be taught through working scientifically. Children will experience lots of working scientifically but those identified below should be explicitly taught.

The knowledge below has been written in the following order:

Biology (Study of living organisms, including humans, animals and plants)

- Animals including humans
- Living things and their habitats
- Plants
- Evolution and inheritance
- Seasonal change

Chemistry (Study of substances of which matter is made, the investigation of their properties and how reactions form new substances.)

- Materials
- Rocks
- States of matter

Physics (Study of properties of matters and energy. This includes, light, sound, electricity and magnetism.)

- Forces and magnets
- Electricity
- Light
- Sound
- Earth and space

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Biology – Animals including Humans

Reception	
Knowledge: • Children interact with the outdoors through hands-on experiences and the freedom to touch, smell and hear the natural world. • Have discussions about how we can care for the natural world around us. • Observe and draw pictures of the natural world, including animals. • Observe children describing and commenting on things that they have seen outside, including animals. • Name and describe some animals that children are likely to see and encourage them to recognise these when outside. • Learn about the range of animals on a farm through reading and also a farm visit. • Begin to sort animals into groups based on their observations. • Take children outside to observe the natural world and encourage children to observe how animals behave different as the seasons change. • Watch the development of eggs to chicks in class and record what they observe. • Observe the changes in a butterfly life cycle and record what they see.	Supporting Materials from EYFS Development Matters: Describe what they see, hear and feel whilst outside. Encourage focused observation of the natural world. Listen to children describing and commenting on things they have seen whilst outside, including plants and animals. Name and describe some plants and animals children are likely to see, encouraging children to recognise familiar plants and animals whilst outside

Year 1 – Humans – Autumn 1	
National Curriculum: • identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: using their observations to compare and contrast animals at first hand or through videos and photographs, describing how they identify and group them; grouping animals according to what they eat; and using their senses to compare different textures, sounds and smells.
Example enquiry questions: What are the main parts of the body? What are the 5 senses? Which part of the body is associated with which sense?	

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Knowledge:	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:
Humans: • Know that we are **humans** and that we are an **animal** • Know what the **human body** is • **Identify**, **name** and label parts of the body - **Head, neck, arms, elbow, legs, knees, ears, face, eyes, hair, mouth, teeth, nose** • Know how to draw the basic parts of the body. • There are 5 **senses** • We **smell** with our **nose** • We **see** with our **eyes** – that people may have glasses, use braille, may have a guide dog if eyes do not work how they should • We **hear** with our **ears** – that people might use a hearing aid, communicate with sign language if their ears do not work how they should • We **feel/touch** with our **hands/skin** • We **taste** with our **tongue/mouth**	• Asking simple questions and recognising that they can be answered in different ways • Gathering and recording data to help in answering questions. • Identifying and classifying • Using their observations and ideas to suggest answers to questions

Year 1 – Animals – Spring 2	
National Curriculum: • 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)	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: using their observations to compare and contrast animals at first hand or through videos and photographs, describing how they identify and group them; grouping animals according to what they eat; and using their senses to compare different textures, sounds and smells.
Example enquiry questions: What are animals called and how are they similar/ different? What do animals eat? How can we classify animals?	
Knowledge: Animals: • There are lots of different **animals** in the world and they all have different names. • Not all animals can be kept as **pets**.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking simple questions and recognising that they can be answered in different ways • Identifying and classifying

• There are different animal groups – **fish, birds, amphibians, reptiles, mammals.** • **Fish** are animals that live and breathe under water. They have scaly skin, fins to help them swim and they breathe through gills • All **birds** have a beak, two legs, feathers and wings • **Amphibians** live in the water as babies and on land as they grow older. They have smooth, slimy skin. • **Mammals** are animals that breathe air, grow hair or fur and feed on their mother's milk as a baby. • All **reptiles** breathe air. They have scales on their skin. • Different animals have different diets. • **Carnivores** are animals that mostly eat other animals (meat). • **Herbivores** are animals that only eat plants. • **Omnivores** are animals that eat both plants and other animals. • All animals have different structures and do not all have the same 'body parts'.	• Using their observations and ideas to suggest answers to questions

Year 2	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: observing, through video or first-hand observation and measurement, how different animals, including humans, grow; asking questions about what things animals need for survival and what humans need to stay healthy; and suggesting ways to find answers to their questions.
Example enquiry questions: What are offspring and what do they grow into? What are the six different stages of life? What do animals and humans need to survive? What do humans need to grow into healthy adults? What is good hygiene and why do we need it?	
Knowledge: • **Humans** need **food, water**, **air** and shelter from extreme heat or cold to **survive**.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking simple questions and recognising that they can be answered in different ways

• **Animals** have similar needs to **humans**. Some animals (e.g. pets) may be reliant on **humans** for what they need to **survive**. • **Humans** and **animals** have **offspring** that grow into **adults**. • There are six different stages in the life cycles of **humans** and **animals**. - **Humans** are a **baby, toddler, child, teenager, adult** then **old age**. - Some **animals** change considerably during their life cycle e.g. **egg - caterpillar – pupa - butterfly** • Good **hygiene** is important for keeping us healthy. - Hand washing - Cleaning teeth - Having a bath/ shower/ washing • We can eat healthily by having a balanced diet (eat well plate). - Fruit and vegetables - Carbohydrates - Proteins - Dairy/alternatives - Oils/fats • **Exercise** helps to keep us healthy and strong. • When you **exercise**, you can feel some changes in your body - your heart pumps faster, - you feel warmer, - you may begin to sweat, - you may feel tired.	• Observing closely, using simple equipment • Performing simple tests • Identifying and classifying • Using their observations and ideas to suggest answers to questions

Year 3	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: identifying and grouping animals with and without skeletons and observing and comparing their movement; exploring ideas about what would happen if humans did not have skeletons. They might compare and contrast the diets of different animals (including their pets) and decide ways of grouping them according to what they eat. They might research different food groups and how they keep us healthy and design meals based on what they find out.
Example enquiry questions: What kind of foods do humans need?	

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Do all living things need the same nutrients as humans?
What is a skeleton and what does it do?
What is a muscle and what do they do?

Knowledge:

- Understand that **animals**, unlike plants which can make their own **food**, need to eat to get the **nutrients** they need from food.
- **Food** contains a range of different **nutrients** that are needed by the body to stay healthy:
  carbohydrates including sugars - provide energy
  protein - helps with growth and repair
  vitamins - keep you healthy
  minerals - keep you healthy
  fibre – helps you to digest food
  fat – provide energy
  water – moves the **nutrients** around
- Understand that a piece of **food** will often provide a range of **nutrients**.
- **Humans** and some other **animals** have **skeletons** and **muscles** which help them with **movement** and provide **protection** and **support**
  - Understand the importance and purpose of a **skeleton**.
  - **Protects** organs inside the body
  - Allows for **movement**
  - **Supports** the body to stop it falling to the floor
- Compare, contrast and classify **skeletons** of different **animals**.
  - Invertebrate – animals without a back bone
  - Vertebrates – animals with a back bone
  - Endoskeleton – inside of the body
  - Exoskeleton – outside of the body
  - Hydrostatic skeleton – a skeleton made up of a fluid filled compartment, usually in soft bodied animals

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- 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.

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Year 4	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: comparing the teeth of carnivores and herbivores, and suggesting reasons for differences; finding out what damages teeth and how to look after them. They might draw and discuss their ideas about the digestive system and compare them with models or images.
Example enquiry questions: What are the basic parts of the digestive system? How does the digestive system work? What causes tooth decay and how can it be prevented? What are the roles of different plants and animals within a food chain?	
Knowledge: • **Teeth** are used for **cutting** and **chewing** food. • They start the **digestive process** which gives us the **energy** we need to live. • **Humans** look after their **teeth** by brushing and flossing and ensuring that they do not eat foods high in sugar. • Not looking after **teeth** can lead to an increase in **plaque** and **tooth decay**. • **Canines** are pointed for tearing and ripping food - these are usually used when chewing meat. • **Incisors** are shovel shaped and help bite lumps out of and cutting food. • **Premolars** and **molars** are flat and they grind and crush food. The Digestive System: • The smell of food triggers **saliva** to be produced. • **The digestive system** begins with the **mouth** and **teeth** where food is **ingested** and chewed. • **Saliva** is mixed with the food which helps to break it up. • When the food is small enough to be swallowed, it is pushed down **the oesophagus** by muscles to **the stomach**. • In **the stomach**, food is mixed further with digestive acids and enzymes.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • 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 - *I can use a key to record my findings.* • Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions • Identifying differences, similarities or changes related to simple scientific ideas and processes • Using straightforward scientific evidence to answer questions or to support their findings.

• The mixed food is then sent to the **small intestine - ileum** which **absorbs nutrients** from the food. • Any leftover broken down food then moves on to the **large intestine – colon.** • The food minus the nutrients arrives in the **rectum** where muscles turn it into **faeces**. • It is stored here until it is pushed out by the anus. This is called **excretion**. Food Chains: • The teeth of an **animal** are designed to eat different foods depending on the diet of the **animal**. Examples of a **herbivore, a carnivore and an omnivore.** • Interpret and build a basic food chain using the terms below. • A **herbivore** is an animal that eats plants. • A **carnivore** is an animal that feeds on other animals. • An **omnivore** is an animal that eats plants and animals. • A **producer** is an organism, such as a plant, that produces its own food using **light from the sun/photosynthesis**. • A **predator** is an animal that hunts and eats other animals. • **Prey** is an animal that gets hunted and eaten by another animal. • **Primary consumers** are **herbivores.** • **Secondary consumers** are **carnivores** that eat **herbivores.** • **Tertiary consumers** are **carnivores** that eat **carnivores.**	

Year 5	
National Curriculum: • describe the changes as humans develop to old age.	Non- statutory guidance to support working scientifically: Pupils could work scientifically by researching the gestation periods of other animals and comparing them with humans; by finding out and recording the length and mass of a baby as it grows
Example enquiry questions: What is the gestation period of humans and how do they compare to other animals? What are the changes that happen during childhood? How do our bodies change during puberty? How does the body change during adulthood and old age?	

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Knowledge:	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

• There are six different **stages** of **human development**.
  - Baby –
  - Toddler
  - Child
  - Teenager
  - Adult
  - **Elderly**
• Late adulthood Babies grow in height and weight
• **Puberty** results in changes to the body. These changes happen over a few years and enable reproduction in adulthood.
(Changes at puberty taught as part of RSE lesson and additional lesson on reproduction as SRE)
• The **gestation period** of a baby is nine months. **Gestation periods** differ between mammals.
	• Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
	  - *I can use a bar chart to present my data.*
	• Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

Year 6	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: exploring the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health.
Example enquiry questions: What does the blood/blood vessels do in the circulatory system? What do the heart and lungs do in the circulatory system? How are water and nutrients transported within animals? What effect does exercise have on the body? What is the impact of drugs/ cigarettes and alcohol on the body? How does our diet affect the way we feel?	
Knowledge: • The **circulatory system** includes veins, arteries and **blood** and **transports** gases, **water**, **nutrients** and waste products around the body. • The **heart** constantly pumps **blood** around the **circulatory system**.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- There are three types of **blood vessels** that carry **blood** through the tissues and organs: veins, arteries and capillaries.
- Oxygenated blood has more oxygen. It comes from the lungs and is pumped from the **heart** to the rest of the body so the muscles can use the oxygen
- Deoxygenated blood has already been transferred to the rest of the body
- Mammals have hearts with four chambers.
- Arteries carry oxygenated blood away from the **heart**.
- Veins carry deoxygenated blood toward the **heart**.
- If you linked up all of the body's **blood vessels**, including arteries, capillaries and veins, they would measure over 60,000 miles.
- **Blood** is made up of:
  - Plasma is a liquid that helps carry the other cells. The other parts of your blood are solid.
  - Platelets help you stop bleeding when you get hurt.
  - Red blood cells carry oxygen throughout your body.
  - White blood cells fight infection when you're sick.
  - nutrients to help growth and health
  - waste products which it takes to the kidneys and liver
- Alcohol, smoking and some **drugs** have negative effects on the body.
- A healthy **diet** involves eating the right types of **nutrients** in the right amounts.
- Regular **exercise** keeps you healthy because it strengthens muscles (including the heart muscles) and bones, improves circulation, increases the amount of oxygen around the body and helps you sleep more easily.

- 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
  - *I can use a scatter graph to record my findings.*
- 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 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.

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Biology – Living things and their habitats

Reception	
Knowledge: • Children interact with the outdoors through hands-on experiences and the freedom to touch, smell and hear the natural world. • Have discussions about how we can care for the natural world around us. • Observe and draw pictures of the natural world, including animals and plants. • Provide opportunities to contrast two different environments, such as pond and tree. • Observe children describing and commenting on things that they have seen outside, including plants and animals. • Begin to sort animals into groups based on their observations.	**Supporting Materials from EYFS Development Matters:** Describe what they see, hear and feel whilst outside. Encourage focused observation of the natural world. Listen to children describing and commenting on things they have seen whilst outside, including plants and animals. Name and describe some plants and animals children are likely to see, encouraging children to recognise familiar plants and animals whilst outside

Year 2	
National Curriculum: • 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 micro-habitats • 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.	**Non- statutory guidance to support working scientifically:** Pupils might work scientifically by: sorting and classifying things according to whether they are living, dead or were never alive, and recording their findings using charts. They should describe how they decided where to place things, exploring questions for example: 'Is a flame alive? Is a deciduous tree dead in winter?' and talk about ways of answering their questions. They could construct a simple food chain that includes humans (e.g. grass, cow, human). They could describe the conditions in different habitats and micro-habitats (under log, on stony path, under bushes) and find out how the conditions affect the number and type(s) of plants and animals that live there.
Example enquiry questions: Hoe do you know if something is living, dead or has never been alive? Why do living things need to live in suitable habitats? What is a micro-habitat? Why do living things live together?	

Spring Bank Primary School

Knowledge:	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:
• All objects are either **living**, **dead** (once lived) or have **never been alive**. - **Living** things include **plants** (and seeds) and **animals**. - **Dead** things include dead **animals** and **plants** and parts of **plants** and **animals** that are no longer attached. • MRS NERG can help us to characterise living things. - Movement - Respiration - Sensitivity - Nutrition - Excretion - Reproduction - Growth • A **habitat** is a place where **animals** and **plants** live, where they can find everything they need to stay alive including **food**, shelter and water. **Animals** and **plants** are suited to their **habitats**. • Within a **habitat** there are **micro-habitats**, they are a very specific, small home environment for **plants, animals** and insects, • These **micro-habitats** have different conditions and can affect **animals** and **plants** living there. • Organisms (**animals and plants**) can survive in their **habitat** because they are adapted to living there. They have different body **characteristics** that let them take advantage of their environment • **Animals** obtain their **food** from **plants** and other **animals**. A **food chain** shows how **animals** get their **food**. • The **plants** and **animals** in a **habitat** depend on each other for **food** and shelter.	• Asking simple questions and recognising that they can be answered in different ways • Observing closely, using simple equipment • Gathering and recording data to help in answering questions. • Identifying and classifying • Using their observations and ideas to suggest answers to questions

Year 4	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: **Note:** Plants can be grouped into categories such as flowering plants (including grasses) and non-flowering plants, such as ferns and mosses. Pupils might work scientifically by: using and making simple guides or keys to explore and identify local plants and animals; making a guide to local living things;

	raising and answering questions based on their observations of animals and what they have found out about other animals that they have researched.
Example enquiry questions: How can living things be classified and identified? What is a classification key? What is the impact of natural events on the environment? What is the impact of humans on the environment?	
Knowledge: • Use MRSNERG to identify the 7 characteristics of all living things and what they refer to. - Movement - Respiration - Sensitivity - Nutrition - Excretion - Reproduction - Growth • Living things can be **group**ed in lots of different ways based on their **characteristics**. - **Vertebrates – mammals, fish, birds, amphibians, reptiles** - **Invertebrates – insects, spiders, worms, slugs and snails.** - **Flowering plants and non-flowering plants.** • Understand how a basic **classification key** works using concrete resources. For example, leaves from around school. • Use concrete resource to develop a basic **classification key**. For example, native invertebrates. • How humans affect the **environment**, positive and negative. - **Deforestation** - **Pollution** - Protecting **endangered species**	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • 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

Year 5	
National Curriculum: • describe the life process of reproduction in some plants	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around

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- describe the life process of reproduction in some animals
- describe the differences in the life cycles of mammals, an amphibian, an insect and a bird

</td><td>the world (in the rainforest, in the oceans, in desert areas and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences. They might try to grow new plants from different parts of the parent plant, for example, seeds, stem and root cuttings, tubers, bulbs. They might observe changes in an animal over a period of time (for example, by hatching and rearing chicks), comparing how different animals reproduce and grow.</td></tr>
<tr><td colspan="2">Example enquiry questions:
How do plants reproduce?
How do animals reproduce?
Do all animals have the same life cycle?</td></tr>
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Knowledge:

- There are key structures of a flower.
  - The stamen consists of the antler and the filament
  - The carpel consists of the stigma, style and ovary
  - The pistil is a fused group of carpels
  - The receptable is a thickened part of the **stem** from which the flower organs grow.
- **Reproduction** is the process by which a **plant** produces **seeds** to make a new **plant**
- Some plants reproduce **sexually** and some plants reproduce **asexually**. There are advantages and disadvantages to **asexual** and **sexual reproduction**.
  - **Asexual reproduction** – One parent is needed to create an offspring, which is an exact copy of the parent – the egg does not need to be fertilised to produce a **seed**.
  - **Sexual reproduction** - Two parents are needed to make offspring which are similar but not identical to either parent – pollination.
- Most animals reproduce **sexually** but **asexual reproduction** does occur in the **animal** world e.g. starfish

Amphibians

- **Amphibians** are cold blooded, smooth skinned vertebrates which during part or all of their life can move and breathe under water.
- **Amphibians** undergo metamorphosis during their **life cycle**.
  - Metamorphosis is a stage in the growth of an **animal** where the new form looks completely different from the old.

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Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

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Insects • **Insects** are arthropods that have a body divided into 3 main parts: head, thorax and abdomen, an exo-skeleton, 6 legs, 2 antennae and 2 pairs of wings. • **Insects** undergo metamorphosis during their **life cycle**. - Metamorphosis is a stage in the growth of an animal where the new form looks completely different from the old. Mammals • A **mammal** is an **animal** that has mammary glands which in the female develop and produce milk for the young. • **Mammals** are warm blooded, normally have hair (fur) on their skins and have live births. • **Mammals** reproduce using **sexual reproduction** • The gestation period is the time the foetus forms inside the mother's uterus. There are different gestation periods for different **mammals** and **birds** and for how long they live on average. Birds • **Birds** have wings, feathers on their bodies and lay eggs. • There are different gestation periods for different **birds** and for how long they live on average. • Many **animals** and **birds** have different names at different stages of **reproduction** e.g. chick • Some mammalian **lifecycles** are unusual e.g. penguin, dolphin, salamander • A **naturalist**, or natural scientist studies natural history and the study of **plants** and **animals** by observation rather than experimentation. • An **animal behaviourist** makes a scientific study of everything an **animal** does. • It is important to understand how **plants** and **animals** live to understand conservation and look after the environment.	

Year 6	
National Curriculum:	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: using classification systems and keys to identify some animals and plants in the immediate environment. They could

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- 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

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research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.

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Example enquiry questions:

How are animals classified?
How are plants classified?
How can we help others to identify common plants/animals/birds?
What is the same and different about micro-organisms?

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Knowledge:

- **Living things** can be formally **group**ed according to **characteristics**.
- **Plants** and **animals** are two main **groups** but there are other **livings things** that do not fit into these groups e.g. **micro-organisms** such as bacteria and yeast, and toadstools and mushrooms. **Plants** can make their own food whereas **animals** cannot.
- **Animals** can be divided into two main **group**s – those that have backbones (**vertebrates**) and those that do not (**invertebrates**).
- **Vertebrates** can be divided into five small groups – **fish, amphibians, reptiles, birds and mammals**. Each group has common **characteristics**.
- **Invertebrates** can be divided into a number of groups including **insects, spiders, snails and worms**.
- **Plants** can be divided broadly into two main groups – flowering plants and non-flowering plants.
- In 1735, Swedish Scientist **Carl Linnaeus** first published a system for **classifying** all **living things**. An adapted version of this system is still used today: The Linnaeus System.
- **Living things** can be **classified** by these eight levels. The number of **living things** in each level gets smaller until the one **animal** is left in its species level.

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Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
  - *I can use classification keys to record my findings.*
- Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

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Biology – Plants

Reception	
Knowledge: • Encourage children to interact with the outdoors through hands-on experiences and the freedom to touch, smell and hear the natural world. • Have discussions about how we can care for the natural world around us. • Observe and draw pictures of the natural world, including plants. • Observe children describing and commenting on things that they have seen outside, including plants. • Name and describe some plants that children are likely to see and encourage them to recognise these when outside. • Understand and observe how seeds grow into plants. Draw what they observe.	Supporting Materials from EYFS Development Matters: Describe what they see, hear and feel whilst outside. Encourage focused observation of the natural world. Listen to children describing and commenting on things they have seen whilst outside, including plants and animals. Name and describe some plants and animals children are likely to see, encouraging children to recognise familiar plants and animals whilst outside

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Year 1	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: observing closely, perhaps using magnifying glasses, and comparing and contrasting familiar plants; describing how they were able to identify and group them, and drawing diagrams showing the parts of different plants including trees. Pupils might keep records of how plants have changed over time, for example the leaves falling off trees and buds opening; and compare and contrast what they have found out about different plants.
Example enquiry questions: Do all trees lose their leaves? What are the different parts of the plant or tree called? What are the names of the plants in the local area?	
Knowledge: • **Flowering plants** grow from a **bulb** or a **seed**. • **Plants** can be found in a garden or in the wild – such as woods, fields, meadows • **Garden plants** are **plants** that people to choose to have in their garden. They have to plant them and care for them. • **Wild plants** are **seeds** that grow where they fall. They do not need to be planted or cared for. • **Plants** can look different but they have similar structures that can include **roots, leaves, stem, petals, flowers, petals, fruit**. • **Trees** can be found in gardens or in the wild. • **Trees** can look different but have similar structures that include **roots, leaves, branches, trunk, flowers/blossom, fruit**. • **Evergreen** trees keep their **leaves** all year round, even in Winter. • **Deciduous** trees lose their **leaves** each year, usually in Autumn.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking simple questions and recognising that they can be answered in different ways • Observing closely, using simple equipment • Performing simple tests • Gathering and recording data to help in answering questions. • Identifying and classifying • Using their observations and ideas to suggest answers to questions

Year 2	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: **Note:** Seeds and bulbs need water to grow but most do not need light; seeds and bulbs have a store of food inside them.

	Pupils might work scientifically by: observing and recording, with some accuracy, the growth of a variety of plants as they change over time from a seed or bulb, or observing similar plants at different stages of growth; setting up a comparative test to show that plants need light and water to stay healthy.
Example enquiry questions: What happens when a bulb or seed is planted? What do plants need to stay healthy?	
Knowledge: • **Plants grow** from a **seed** or a **bulb**. • **Seeds** and **bulbs grow** and change throughout the year and at different rates e.g. daffodil bulbs are planted in the autumn and will flower in the spring • Plants need **water light** and a **suitable temperature** to **grow** and stay **healthy**. If a plant is missing one of these, it will not be able to stay **healthy**. • There are different stages in the life cycle of a plant.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking simple questions and recognising that they can be answered in different ways • Performing simple tests • Gathering and recording data to help in answering questions. • Using their observations and ideas to suggest answers to questions

Year 3	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: **Note:** Pupils can be introduced to the idea that plants can make their own food, but at this stage they do not need to understand how this happens. Pupils might work scientifically by: comparing the effect of different factors on plant growth, for example, the amount of light, the amount of fertiliser; discovering how seeds are formed by observing the different stages of plant life cycles over a period of time; looking for patterns in the structure of fruits that relate to how the seeds are dispersed. They might observe how water is transported in plants, for example, by putting cut, white carnations into coloured water and observing how water travels up the stem to the flowers.
Example enquiry questions: What are the different parts of the plant called and what do they do? What role do flowers play in the lifecycle of a plant?	

Spring Bank Primary School

Why and how are seeds dispersed?
What do plants need for growth?

Knowledge:

- Can name and **describe** the **function** of the parts of a **flowering plant**
  - **Stem/trunk**
  - **Leaves**
  - **Flowers**
  - **Roots**
- **Describe** the **life cycle** of **flowering plants**, including **pollination**, **seed formation, seed dispersal, and germination.**
- Understand the part that **flowers** plat in the **life cycle** of **flowering plant**, including:
  - **pollination**
  - **seed dispersal (water, wind, animals, bursting)**
  - **seed formation**
- Explain observations made during investigations:
  - **plants** in different types of soil (link to Rocks topic)
  - plants with differing conditions for growth: removal of **air, light, water, nutrients** from soil, room to grow or warmth)
- Look at the features of **seeds** to decide on their method of **dispersal** (water, wind, animals, bursting).
- Can draw and label a diagram of their created **flowering plant** to show its parts, their role and the method of **pollination and seed dispersal**

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Asking relevant questions and using different types of scientific enquiries to answer them
- Setting up simple practical enquiries, comparative and fair tests
- 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
  - *I can draw a labelled diagram to record my findings.*
- Identifying differences, similarities or changes related to simple scientific ideas and processes
- Using straightforward scientific evidence to answer questions or to support their findings.

Biology – Evolution and inheritance

Year 6	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: **Note:** At this stage, pupils are not expected to understand how genes and chromosomes work. Pupils might work scientifically by: observing and raising questions about local animals and how they are adapted to their environment; comparing how some living things are adapted to survive in extreme conditions, for example, cactuses, penguins and camels. They might analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.
Example enquiry questions: Are the offspring of living things the same as their parents? How do we know that plants and animals have changed overtime?	

Spring Bank Primary School

How have specific animals and plants adapted to suit their environments in different ways?
What do plants and animals evolve?

Knowledge:

- **Animals** and **plants** produce **offspring** which are similar but **not identical** to them.
- **Offspring** often look like their **parents** because features are passed on.
- In the same way that there is **variation** between parents and their **offspring**, you can see **variation** within any species, even **plants**.
- **Adaptive** traits are characteristics that are influenced by the **environment living things** live in. These **adaptations** can develop as a result of many things, such as food and climate.
- Eye colour is an example of an inherited trait and so are things like hair colour, the shape of your ear lobes, whether or not you can smell certain flowers, etc.
- A good **habitat** should provide shelter, water, enough space and plenty of food.
- There are many types of **environment** around the world: polar regions, deserts, rainforests, oceans, rivers and grasslands are all **environments**.
- **Fossils** are the preserved remains, or partial remains, of ancient **animals** and **plants**. **Fossils** let scientists know how **plants** and **animals** used to looks millions of years ago. This is proof that **living things** have **evolved** over time.
- **Evolution** is the gradual process by which different kinds of living organism have developed from earlier forms over millions of years. Scientists have proof that **living things** are continuously **evolving** – even today.
- Natural selection is a process by which a species changes over time in response to changes in the **environment**, or competition between organisms, in order for the species to survive. The members of the species with the most desirable **characteristics** are able to produce the best-**adapted offspring**.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use tables to record my findings.*
- Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

Biology – Seasonal Changes

Reception	
Knowledge: • Encourage children to interact with the outdoors through hands-on experiences and the freedom to touch, smell and hear the natural world. • Draw children's attention to the weather and seasonal features. • Help children to understand some of the changes that signify when a season has arrived. • Provide children with opportunities to note and record the weather. Read texts with the children about the changing seasons. • Take children outside to observe the natural world and encourage children to observe how animals behave different as the seasons change.	Supporting Materials from EYFS Development Matters: Understand the effect of changing seasons on the natural world around them. Guide children's understanding by draw children's attention to the weather and seasonal features. Provide opportunities for children to note and record the weather. Select texts to share with the children about the changing seasons. Throughout the year, take children outside to observe the natural world and encourage children to observe how animals behave differently as the seasons change. Look for children incorporating their understanding of the seasons and weather in their play.

Year 1	

Spring Bank Primary School

National Curriculum:

- Observe changes across the four seasons
- Observe and describe weather associated with the seasons and how the day length varies

Non- statutory guidance to support working scientifically:

Note: Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.

Pupils might work scientifically by: making tables and charts about the weather; and making displays of what happens in the world around them, including day length, as the seasons change.

Example enquiry questions:

what is it like in autumn?
What is it like in winter?
What is it like in spring?
What is it like in summer?
What can we say about the changes that take place over the year?

Knowledge:

The **seasons** are **observed** and described throughout the year so that the children can experience the **season** before they describe the **changes**/ weathers that they have seen.

- There are **4 seasons** in each year – **spring, summer, autumn, winter**
- The **weather** is different in each **season**, but some **seasons** can have the same **weathers**.
- **Weather** is the temperature outside as well as rain, wind, sun, snow, cloud.
- **Daylight** is when it is light outside and the amount **changes** in each **season**. The **daylight** is less in the colder **seasons**.
- **Night time** is when there is no **daylight** and the amount **changes** in each **season**. The **night time** is longer in the colder **seasons** and longer in the warmer **seasons**.

Autumn -

- Autumn follows summer and comes before winter.
- It starts to get **colder**.
- The leaves on the deciduous trees begin to **change** colour and fall off.
- The amount of **daylight** becomes less so that means the daytimes are **shorter** and the night times are **longer**.
- Some animals begin to collect food ready for **hibernating**.
- The autumn months are September, October, November

Winter –

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Observing closely, using simple equipment
- Gathering and recording data to help in answering questions.
- Using their observations and ideas to suggest answers to questions

- Winter follows autumn and come before spring.
- It is much **colder** in winter.
- The deciduous trees have bare branches.
- Sometimes it is cold enough for it to freeze, leave frost or snow.
- The daytimes are the **shortest** and the night times are the **longest**.
- The winter months are December, January, February.

Spring –

- Spring follows winter and comes before Summer.
- It starts to get **warmer**.
- The leaves begin to grow on the deciduous trees and some of them blossom (flowers).
- Plants begin to **grow**.
- You might be able to see baby animals such as lambs.
- The daytimes begin to get longer and the night times begin to get shorter.
- The spring months are March, April, May.

Summer –

- Summer follows spring and comes before autumn.
- It is **hotter**.
- There are lots of flowers bees, butterflies and other insects.
- The **daytimes** are at their longest and the **night times** are at their shortest.
- The summer months are June, July, August.

Chemistry – Materials

Reception	
Knowledge: • Encourage children to interact with the outdoors through hands-on experiences and the freedom to touch, smell and hear the natural world. • Observe natural processes, such as how ice is formed and melts as well as objects casting shadows. • Learn about changes of matter through melting chocolate.	Supporting Materials from EYFS Development Matters: Describe what they see, hear and feel whilst outside.

Year 1 – Autumn 2	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: performing simple tests to explore questions, for example: 'What is the best material for an umbrella? …for lining a dog basket? …for curtains? …for a bookshelf? …for a gymnast's leotard?'

• compare and group together a variety of everyday materials on the basis of their simple physical properties.	
Example enquiry questions: What kind of materials can we see around us? What are objects made from?	
Knowledge: • Objects are things that can be used e.g. chair, table, door. • Materials are what objects are made from. • All objects are made of one or more materials • There are different types of materials and objects can be made from **metal, glass, wood, water, rock, plastic** • The same type of object can be made from different types of material e.g. spoon – **metal, wood, plastic** • One object can be made up of different materials e.g. a pair of scissors – plastic and metal • Some materials can be made in different forms with very different properties e.g. plastic	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Identifying and classifying

Year 1 – Summer 2	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: performing simple tests to explore questions, for example: 'What is the best material for an umbrella? ...for lining a dog basket? ...for curtains? ...for a bookshelf? ...for a gymnast's leotard?'
Example enquiry questions: What are the properties of different materials? How can we group the materials together?	
Knowledge: • Different materials have different properties such as **hard/soft, stretchy/stiff, shiny/dull, rough/smooth, bendy/not bendy, waterproof/not waterproof, absorbent/not absorbent, opaque/transparent**	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Observing closely, using simple equipment • Performing simple tests • Identifying and classifying

• Objects made from the same material can have different properties	

Year 2	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: comparing the uses of everyday materials in and around the school with materials found in other places (at home, the journey to school, on visits, and in stories, rhymes and songs); observing closely, identifying and classifying the uses of different materials, and recording their observations.
Example enquiry questions: What are objects made from? What materials are used in our classroom? Why are objects made from certain materials? How can objects change shape? Do all objects keep their shape after they have been bent, twisted, stretched, or squashed?	
Knowledge: • Everyday materials can be used for different objects. • Objects can be made from different materials e.g. a ruler can be made from **metal, plastic or wood**. • Objects are made from everyday materials due to their **suitability**. • The **suitability** of a material for an object depends on the material's **properties** and the purpose of the object e.g. plastic is suitable for a spoon for a toddler because it is soft. • Some, but not all, everyday materials can change shape by **squashing, bending, twisting and stretching.** • Everyday materials can be used for more than one object e.g. metal can be used for tins, coins, cars and table legs. • Inventors have developed useful new materials. John McAdam invented tarmac through a process called macadamisation.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking simple questions and recognising that they can be answered in different ways • Gathering and recording data to help in answering questions. • Identifying and classifying

Year 5	
National Curriculum:	Non- statutory guidance to support working scientifically:

• 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	**Note:** Pupils are not required to make quantitative measurements about conductivity and insulation at this stage. It is sufficient for them to observe that some conductors will produce a brighter bulb in a circuit than others and that some materials will feel hotter than others when a heat source is placed against them. Safety guidelines should be followed when burning materials. Pupils might work scientifically by: carrying out tests to answer questions, for example, 'Which materials would be the most effective for making a warm jacket, for wrapping ice cream to stop it melting, or for making blackout curtains?' They might compare materials in order to make a switch in a circuit. They could observe and compare the changes that take place, for example, when burning different materials or baking bread or cakes. They might research and discuss how chemical changes have an impact on our lives, for example, cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.

Example enquiry questions:

Do all materials dissolve?
How might different materials be separated from their solutions?
What changes are reversible?
What changes are irreversible?

Knowledge:

- **Hardness** is a property of materials. It is a measure of how difficult it is to permanently change the shape of a material by compressing it.
- Materials can be grouped on the basis of their properties:
  Transparency – A material is transparent if it allows light to pass through it, letting us see through it.
  Electrical Conductivity – a material is an electrical conductor if it allows electricity to pass through it, letting us see through it.
  Magnetism – a material is magnetic is it is attracted to a magnet.
- Some materials are **thermal conductions** because they allow heat to pass through them easily. **Thermal conductors** and **insulators** have different uses.
- Some materials are better **electrical conductors** than others resulting in a brighter bulb.
- Materials such as wood, ceramics, leather and metal have been used by humans for thousands of years in different ways due to their properties.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use a line graph and a table to record my findings.*
- Using test results to make predictions to set up further comparative and fair tests

In recent times, scientists have created new materials which have some advantages over traditional ones. • A **mixture** is made when two or more different materials are mixed together. Sometimes we need to separate **mixtures** so that we can get back one or more of the **mixtures**. • **Mixtures** can be separated **by sieving, filtering** and **magnets**. • Some materials can **dissolve** in a liquid to form a solution. The materials which dissolves is called a **solute**. Water is a **solvent** and the mixture of water and material is called a **solution.** • Temperature is a factor which can affect the speed of **dissolving**. • A **solution** can not be **separated** through **sieving** and **filtering** as the pieces of solute are too small to be stopped by a sieve or a filter. **Solutions** need to be separated by **evaporation**. • **Dissolving**, mixing and changes of state are **reversible changes**. 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.	• Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

Chemistry – Rocks

Year 3	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: observing rocks, including those used in buildings and gravestones, and exploring how and why they might have changed over time; using a hand lens or microscope to help them to identify and classify rocks according to whether they have grains or crystals, and whether they have fossils in them. Pupils might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed. Pupils could explore different soils and identify similarities and differences between them and investigate what happens when rocks are rubbed together or what changes occur when they are in water. They can raise and answer questions about the way soils are formed.
Example enquiry questions: What are rocks? How can we group rocks based on their properties?	

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What is soil made from?
What are fossils and how are they formed?

Knowledge:

- **Rock** is a naturally occurring material.
  - Igneous - Rock that has been formed from magma or lava.
  - Sedimentary - Rock that has been formed by layers of sediment being pressed down hard and sticking together. You can see the layers of sediment in the rock.
  - Metamorphic - Rock that started out as igneous or sedimentary rock but changed due to being exposed to extreme heat or pressure.
- There are different types of rock e.g. sandstone, limestone, slate etc. which have different **properties**.
- **Properties**:
  - Rocks can be hard or soft.
  - They have different sizes of **grain** or **crystal**.
  - They may absorb water.
- **Rocks** can be different shapes and sizes (stones, pebbles, boulders).
- Some rocks contain **fossils**.
- **Fossils** were formed millions of years ago. When plants and animals died, they fell to the seabed. They became covered and squashed by other material. Over time the dissolving animal and plant matter is replaced by minerals from the water.

  <u>Covered in Plants topic:</u>
- **Soils** are made up of pieces of ground down rock which may be mixed with plant and animal material (**organic matter**).
- The type of rock, size of rock piece and the amount of **organic matter** affect the **property** of the **soil**.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
- 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
- Identifying differences, similarities or changes related to simple scientific ideas and processes
- Using straightforward scientific evidence to answer questions or to support their findings.

Chemistry – States of matter

Year 4	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: **Note:** Teachers should avoid using materials where heating is associated with chemical change, for example, through baking or burning. Pupils might work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream (for example, to make food such as chocolate crispy cakes and ice-cream for a party). They could research the temperature at which materials change state, for example, when iron melts or when oxygen condenses into a liquid. They might observe and record evaporation over a period of time, for example, a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting.
Example enquiry questions:	

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How do we know if a material is a solid, a liquid or a gas?
Can we change materials from being a solid to a liquid and a liquid to a solid?
How can we change a liquid to a gas and a gas to a liquid?
What is the water cycle?

Knowledge:

- Characteristics of a **solid**, a **liquid** and a **gas**.
- That all materials can be one of these three states of matter.
- A **solid** is a material that keeps its shape unless a force is applied to them. They can be hard, soft or even squashy. **Solids** take up the same amount of space no matter what has happened to them. **Particles** in a solid are close together and cannot move. They can only **vibrate**.
- **Liquids** take the shape of their container. They can change shape but do not change the amount of space they take up. They can flow or be poured. **Particles** in a liquid are close together but can move around each other easily.
- **Gases** can spread out to completely fill the container or room they are in. They do not have any fixed shape but they do have a mass. **Particles** in a gas are spread out and can move around very quickly in all directions.
- That states of matter can be changed by **heating** and **cooling**.
- If a **solid** is heated to its **melting point,** it **melts** and changes to a **liquid**. This is because the particles start to move faster and faster until they are able to move over and around each other.
- When **freezing** occurs, the particles in the **liquid** begin to slow down as they get colder and colder. They can then only move gently on the spot, giving them a **solid** structure.
- **Evaporation** occurs when water turns into water vapour.
- **Condensation** is when water vapour is cooled down and turns into water.
- **Water vapour** is water that takes the form of a **gas**. When water is boiled, it **evaporates** into a **water vapour**.
- Water **freezes** at 0°C
- Water **evaporates** at 100°C.

Water Cycle:

- Water from lakes, puddles, rivers and seas is **evaporated** by the sun's heat, turning it into water vapour.
- This water vapour rises, then cools down to form water droplets in clouds (**condensation**).

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use a bar chart to record my findings.*
- 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

• When the droplets get too heavy, they fall back to the earth as rain, sleet, hail or snow (**precipitation**). • Water **evaporates** more quickly when it is warmer.	

Physics – Forces and magnets

Year 3	
National Curriculum: • compare how things move on different surfaces • notice that some forces need contact between two 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 two poles • predict whether two magnets will attract or repel each other, depending on which poles are facing.	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: comparing how different things move and grouping them; raising questions and carrying out tests to find out how far things move on different surfaces and gathering and recording data to find answers their questions; exploring the strengths of different magnets and finding a fair way to compare them; sorting materials into those that are magnetic and those that are not; looking for patterns in the way that magnets behave in relation to each other and what might affect this, for example, the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets.
Example enquiry questions:	

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How can we move objects by touching them?
Does an object move differently over different surfaces?
What are the poles on a magnet and how do they react when put together?
Which kind of materials does a magnet attract?

Knowledge:

- Identify the **forces** of **pushes and pulls**. **Group** materials on basis of whether they can be moved by pushing or pulling.
- **Compare** how things move on different **surfaces** by measuring how far an object rolls from a ramp.
- **Predict**, test and observe whether **magnets** will **repel** or **attract** different materials.
- Investigate **magnetic poles**. Describe **magnets** as having two **poles**. **Predict,** test and explain which **magnetic poles attract** or **repel** each other. Look for and identify a pattern in the way that magnets behave in relation to each other.
- Identify contact and non-contact forces. **Predict,** test, conclude and explain that **magnetic forces** can act at a distance.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use a table to record my findings.*
  - *I can use a labelled diagram to record my findings.*
- 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.

Year 5

National Curriculum:

- 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

Non- statutory guidance to support working scientifically:

Pupils might work scientifically by: exploring falling paper cones or cup-cake cases, and designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore resistance in water by making and testing boats of different shapes. They might

• recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect	design and make products that use levers, pulleys, gears and/or springs and explore their effects

Example enquiry questions:

What is a force?
What impact does friction have on a force needed for travel?
Does the size of a parachute affect the rate of the decent?
Does the shape of an object in water affect the way it moves?

Knowledge:

- A **force** is the pushing or pulling effect that something has on something else.
- **Forces** are shown by arrows in diagrams. The direction of the arrow shows the direction in which the force is acting. The bigger the arrow, the bigger the force.
- **Gravity** is a force which pulls objects to the centre of the Earth.
- Isaac Newton developed the theory of **Gravity**.
- A forcemeter measures the **force** of **gravity** pulling on objects in Newtons.
- An object's **mass** stays the same even if it is in a place with weaker **gravity** than the moon.
- Gravi**ty** causes objects of the same size and shape but of a different mass to fall at the same time.
- Air pushes against any object moving against it on Earth. This is known as **air resistance**.
- **Air resistance** can have a useful and unhelpful effect on objects.
- Water pushes against any object moving through it. This is called **water resistance** and it can have a helpful and an unhelpful effect on objects.
- Objects which do not experience much water or air resistance are described as **streamlined**.
- All surfaces create **friction** on an object moving over them. **Friction** can have a helpful and unhelpful effect on objects.
- **Levers, pulleys** and **gears** are different types of **mechanisms**
  A **lever** consists of a beam and a fulcrum. The beam rotates along the fulcrum allowing weights to be lifted by applying a smaller **force**.
  A **pulley** is a machine which allows us to lift weights using less **force**.
  A **gear** is a wheel with raised parts called teeth. They work together so that by rotating one **gear** another **gear** can be made to rotate.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
  - *I can take repeat readings.*
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
  - *I can use tables to record my findings.*
- 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 degree of trust in results, in oral and written forms such as displays and other presentations

Physics - Electricity

Year 4	
National Curriculum: • 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.	Non- statutory guidance to support working scientifically: **Note:** Pupils might use the terms current and voltage, but these should not be introduced or defined formally at this stage. Pupils should be taught about precautions for working safely with electricity. Pupils might work scientifically by: observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors of electricity, and that some materials can and some cannot be used to connect across a gap in a circuit.
Example enquiry questions: How are appliances powered? What components are needed to build an electrical circuit?	

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Are some materials better at conducting electricity than others?	
Knowledge: • **Electricity** is a form of energy that can be carried by **wires** to provide power for devices or **common appliances**. • **Electricity** is generated using energy from natural sources such as the sun, oil, water and wind. • These sources are either **fossil fuels** or a **renewable source**. • **Nuclear energy** can be used to generate **electricity**. • **Geothermal energy** is heat from the Earth that is converted into **electricity**. • **Electricity** can be used to produce sound, heat, movement and light. • **Devices** can be mains **electricity** or battery powered. • Basic safety rules for using electrical **appliances**. • A **battery** stores **electricity**. Batteries store chemicals which produce an electric current. • **Mains electricity:** power stations send an electric charge through wires to transformers and pylons. Then, underground wires carry the **electricity** into our homes via wires in the walls and out through plug sockets. • A **circuit** is a pathway that **electricity** can flow around. It includes **wires** and a **power supply** and may include **bulbs/lamp, switches, motors or buzzers**. • **Electricity** can only flow around a **complete circuit** that has no gaps. There must be **wires** connected to both the positive and negative end of the power supply/battery. • A **switch** can break or reconnect a **circuit**. • A **switch** controls the flow of the **electrical current** around the **circuit**. When the **switch** is off, the current cannot flow. This is not the same as an incomplete circuit. • An **electrical conductor** is a material that will allow electricity to flow through it as part of a circuit. Metal is a good **conductor**. • An **electrical insulator** is a material that does not allow electricity to flow through it when it is part of a circuit. Wood and plastic are examples of **insulators**.	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • Asking relevant questions and using different types of scientific enquiries to answer them • Setting up simple practical enquiries, comparative and fair tests • Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables - *I can use labelled diagrams to record my findings.* • Using straightforward scientific evidence to answer questions or to support their findings.

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Year 6	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Note: Pupils are expected to learn only about series circuits, not parallel circuits. Pupils should be taught to take the necessary precautions for working safely with electricity. Pupils might work scientifically by: systematically identifying the effect of changing one component at a time in a circuit; designing and making a set of traffic lights, a burglar alarm or some other useful circuit.
Example enquiry questions: How can you show electrical components in a diagram? How does adding bulbs affect a circuit? How does adding more motors affect a circuit? What is voltage?	
Knowledge: • A series **circuit** 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. • 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. • 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. • We use scientific symbols to represent the **components** (parts) of a **circuit**	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically: • 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 - *I can use tables and diagrams to record my findings.* • Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

Physics - Light

Year 3	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: **Note:** Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses. Pupils might work scientifically by: looking for patterns in what happens to shadows when the light source moves or the distance between the light source and the object changes.
Example enquiry questions: Why do we need light and what is dark? Which surfaces are best for reflecting light? Why and how do we protect our eyes from the sun? Do all objects make a dark shadow?	

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Knowledge:	Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:
• Know that we see objects because our eyes can sense **light**. • Know that some objects, for example the sun, light bulbs and candles are **sources of light**. • Know that we can see **light sources** shining directly into our eyes but to see other objects, light from a source must first shine on the object and then be **reflected** into our eyes • Understand that some objects are easier to see as they are more **reflective** or shiny than other objects. • Understand that objects are easier to see if there is more light. • Understand that **dark** is the absence of **light**. Know that we cannot see anything in complete darkness. • Explain why different objects are more or less visible in different lighting and for different object surfaces. e.g. shiny vs matt. • Understand how **shadows** vary as the distance between a **light source** and an object is changed. • Understand how **shadows** are formed on a **surface** when an opaque or translucent object is between a **light source** and the **surface** and blocks some of the **light**. • Recognise that the size of the **shadow** depends on the position of the **source**, object and **surface**. If the **light source** and object move closer to each other, the **shadow** will become larger.	• 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 - *I can use a bar chart to record my findings.* • 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.

Year 6	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: deciding where to place rear-view mirrors on cars; designing and making a periscope and using the idea that light appears to travel in straight lines to explain how it works. They might investigate the relationship between light sources, objects and shadows by using shadow puppets. They could extend their experience of light by looking a range of phenomena

• use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them	including rainbows, colours on soap bubbles, objects looking bent in water and coloured filters (they do not need to explain why these phenomena occur).

Example enquiry questions:

How does light travel?
How do we see objects?
Do shadows always have the same shape?
How can we see colours?

Knowledge:

- We need **light** to be able to see things. **Light** waves **travel** out from **sources of light** in **straight lines**. These lines are often called rays or beams of light.
- **Light** from the sun **travels** in a **straight line** and hits an object. The light ray is then reflected off the object and **travels** in a **straight line** to our eyes, enabling us to see the object.
- The law of **reflection** states that the angle of incidence is equal to the angle of **reflection**. Whenever **light** is **reflected** from a surface, it obeys this law.
- The angle of **reflection** is the angle between the normal line and the **reflected** ray light.
- The angle of incidence is the angle between the normal line and the incident ray of light.
- **Light travels** as a wave. But unlike waves of water or sound waves, it does not need a medium to **travel** through. This means **light** can **travel** through a vacuum - a completely airless space.
- Isaac Newton shone a **light** through a transparent prism, separating out light into the colours of the rainbow (red, orange, yellow, green, blue, indigo and violet) - the colours of the spectrum. All the colours together merge and make visible **light**.
- A **shadow** is always the same shape as the object that casts it. This is because when an opaque object is in the path of **light travelling** from a **light source,** it will block the light rays that hit it, while the rest of the **light** can continue **travelling**.
- **Shadows** can also be elongated or shortened depending on the angle of the **light source**. A **shadow** is also larger when the object is closer to the **light source**. This is because it blocks more of the **light**.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use a table to record my findings.*
- 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 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.

Physics - Sound

Year 4	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: Pupils might work scientifically by: finding patterns in the sounds that are made by different objects such as saucepan lids of different sizes or elastic bands of different thicknesses. They might make earmuffs from a variety of different materials to investigate which provides the best insulation against sound. They could make and play their own instruments by using what they have found out about pitch and volume.

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Example enquiry questions:

How is sound made?
What is volume and how can we change it?
What is pitch and how can it be changed?

Knowledge:

Sound

- When objects **vibrate**, a **sound** is made.
- The **vibration** makes the **air particles** around the object **vibrate** and the **vibrations** enter your ear. These are called **sound waves**.
- When there are no **air particles**, as in a **vacuum**, **sound** cannot travel at all.
- If an object is making a **sound**, a part of it is **vibrating**, even if you cannot see the **vibrations**.
- **Sound waves** travel through a **medium** (a solid, liquid or gas such as air, water, glass, stone, and brick).
- The **sound** waves travel to the **ear (outer and inner ear)** and make the **eardrum vibrate**.
- **Messages** are sent to the brain which recognises the **vibrations** as sounds.

Pitch

- The **pitch** of a sound is how **high** or **low** a sound is.
- A squeak of mouse has a **high pitch**.
- The rumble of a lorry has a **low pitch**.
- **High pitched** sounds are created by **short sound waves**.
- **Low pitched** sounds are created by **long sound waves**.
- **Pitch** can be changed

Volume:

- The **volume** of a **sound** is how **loud** or **quiet** it is.
- When a **sound** is created by a little amount of **energy**, a weak **sound wave** is created which does not travel far. This makes a **quiet sound**.
- A **vibration** with lots of **energy** makes a powerful **sound** wave and therefore a **loud** sound.
- **Volume** can be changed.

Measuring Sound

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- 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
  - *I can use data loggers to take measurements.*
- Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
  - *I can use a table to record my findings.*
- 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

• **Amplitude** measures how strong a **sound** wave is. • **Decibels** measure how loud a **sound** is. • **Frequency** measures the number of times per second that the **sound wave** cycles. • As **sound waves** travel further from the source, they become weaker and so the sound is **fainter**.	

Physics – Earth and space

Year 5	
National Curriculum: • 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	Non- statutory guidance to support working scientifically: **Note:** Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses. Pupils might work scientifically by: comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; finding out why some people think that structures such as Stonehenge might have been used as astronomical clocks.
Example enquiry questions: How does Earth and other planets move around our Solar System?	

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How do we get day and night?
How does the Moon move in relation to the Earth?

Knowledge:

- Our **solar system** is made up of a star, the **sun** and countless different bodies which move around it. These bodies include **planets, moons**, asteroids, lumps or ice, rocks and dust.
- A **planet** is a large roughly **spherical body** which moves in a path directly around a star. This movement is called an **orbit**.
- There are eight planets orbiting the sun.
  - **Mercury, Venus, Earth** and **Mars** are terrestrial planets.
  - **Jupiter** and **Saturn** are gas giants.
  - **Uranus** and **Neptune** are ice giants.
  - Their orbits vary in length.
- Ideas about how the **solar system** have developed over time. The **geocentric** model of the **solar system** gave way to the **heliocentric** model.
- The **moon** is the only natural **satellite** of **Earth**. It **orbits** the **Earth** approximately once every thirty days. One side of the **moon** always faces **Earth** and the other faces away. The **moon** has been explored by humans.
- The **moon** is not a light source. We see the **moon** because it **reflects** light from the sun. As the **moon orbits** the **Earth**, we can see all, some or none of the **moon**. This change in appearance is called the **phases of the moon**.
- We use the word **waxing** to describe the moon getting bigger and **waning** to describe the moon getting smaller.
- The **Earth**'s rotation causes the **sun** to appear to move across the sky. A **sundial** is a device which uses a shadow cast by sunlight to tell the time from the shape and size of shadows.

Working Scientifically that must be addressed and what children should be doing for EXS working scientifically:

- Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

Leading Scientists

Each year group has a scientist that they will introduce to the children per topic.

Year 1				
Term	Unit	Name	Job Role	Description
Autumn 1	Animals including humans	Linda Brown Buck	Biologist	Linda Brown Buck is an American biologist. She discovered that mammals have odorant receptors in their noses. This means they can smell over 10,000 different smells.
Autumn 2	Materials	Ole Kirk Christiansen Noah McVicker	Inventor Inventor	Ole Kirk Christiansen invented Lego in 1949. Invented Playdough. It was originally designed to clean coal from wall paper but was then changed to be a toy.
Spring 1	Seasonal Changes	N/A		
Spring 2	Animals including humans	George Mottershead		Founded Chester Zoo in 1931. It was unusual as at the time animals did not live in cages.
Summer 1	Plants	Francis Darwin	Biologist	Francis Darwin experimented with plants to see how they reacted to sunlight. He found that they followed and grew in the direction of the light.

Summer 2	Materials			

Year 2				
Term	Unit	Name	Job Role	Description
Autumn 1	Uses of everyday materials	John McAdam	Inventor	John McAdam is a Scottish civil engineer. He invented tarmac in the early 1800s.
		Charles Macintosh	Inventor	Charles Macintosh invented the first waterproof fabric.
Autumn 2	Plants	Jane Colden	Botanist	Jane Coldenis thought to be America's first woman botanist. A botanist is a person who studies plants.
Spring 1	Animals including humans	Louis Pasteur	Microbiologist and chemist	Louis Pasteur discovered that germs are living things can be spread by touch or through the air.
Spring 2	Plants			
Summer 1	Living things and their habitats	Rachel Carson	Biologist	Rachel Carson was a scientist who studied ocean habitats.She discovered that pollution from farms was affecting the oceans and the animals in them.
Summer 2				

Year 3				
Term	Unit	Name	Job Role	Description
Autumn 1	Rocks	Mary Anning	Paleontologist	Mary Anning was a famous English fossil hunter. The cliffs near where she lived in Dorset, England, are rich in fossils from the Jurassic Period. Anning spent months uncovering the body of her first fossil, a marine reptile that swam in the time of the dinosaurs.
Autumn 2	Animals including humans	Elsie Widdowson	Nutritionist and dietician	Elsie Widdowson was partly responsible for overseeing the government-mandated addition of vitamins to food and wartime rationing in Britain during World War II.
Spring 1	Forces and Magnets	William Gilbert	Physicist	William Gilbert was the first to propose that the Earth's core contains iron and that magnets point north because the Earth itself is a giant magnet.
Spring 2	Light	Thomas Edison		Thomas Edison was a famous American inventor. He is best known for inventing 'domestic' lightbulbs to go in houses, and the electric power system that allows them to work.
		Lewis Howard Latimer		Lewis Latimer played an important role in the development of the modern lightbulb. He improved other's inventions to produce a lightbulb with a carbon filament.
Summer 1	Plants	George Washington Carver	Agricultural scientist and inventor	George Washington Carver was an American agricultural scientist and inventor who promoted alternative crops to cotton and methods to prevent soil depletion. He was the most prominent black scientist of the early 20th century. He wanted poor farmers to grow
Summer 2				

	Rocks			other crops, such as peanuts and sweet potatoes, as a source of their own food and to improve their quality of life.

Year 4				
Term	Unit	Name	Job Role	Description
Autumn 1	Sound	James West Gerhard M.Sessler	Inventor	James West and Gerhard M Sessler invented an efficient microphone which is used in most modern phones.
Autumn 2	Electricity	Maria Telkes	Biophysicist	Maria Telkes was a famous scientist who made a lot of discoveries around solar power.
Spring 1	Living things and their habitats	Gerald Durrell	Naturalist	Gerald Durrell was a conservationist who worked hard to save Madagascar's unique plants and animals.
Spring 2				
Summer 1	Animals including humans	Washington Sheffield	Dental Surgeon	Washington Sheffield was an American dentist and he was famous for inventing the first modern toothpaste in a tube.
Summer 2	States of Matter	Lord Kelvin	Mathematical Physicist	William Thomson, who is better known as Lord Kelvin, determined the temperature of absolute zero (the coldest possible temperature).

Year 5				
Term	Unit	Name	Job Role	Description
Autumn 1	Forces	Isaac Newton	Physicist	Isaac Newton is known for discovering gravity.
Autumn 2	Earth, Space and the Moon	Christina Koch Maggie Aldrin-Pocock	Astronaut Space Scientist	Christina Koch is known for spending the longest time in space for a woman. Maggie Aldrin-Pocock taught people about space.
Spring 1	Properties and changes of materials	Wilbert and Robert Gore	Inventors	Wilbert Gore and his son Robert Gore invented Gore-Tex in 1969. A waterproof material used in ski jackets and spacesuits.
Spring 2				
Summer 1	Living things and their habitats Animals including humans	Jane Goodall Eva Crane	Primatologist Physicist	Jane Goodall is know for her studies into wild chimpanzees in Tanzania. Eva Crane was interested in bees' behaviour and their life cycle. She studied bees all around the world.
Summer 2				

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Year 6				
Term	Unit	Name	Job Role	Description
Autumn 1	Animals including humans	James Lind	Doctor	James Lind is a pioneer for naval hygiene in the Royal Navy. He developed the theory that citrus fruits cured scurvy.
Autumn 2	Electricity	Michael Faraday	Chemist and Physicist	Michael Faraday invented the electric motor.
Spring 1	Evolution and inheritance	Charles Darwin	Naturalist and biologist	Charles Darwin is known for his theory of evolution by natural selection. Living things pass down traits to their young that are helpful for survival in their environment. In this way living things change and evolve over a number of years.
Spring 2				
Summer 1	Living things and their habitats	Carl Linnaeus	Botanist and Zoologist	Carolus Linnaeus was a Swedish naturalist. He created two scientific systems: the system for classifying plants and animals and the system for naming all living things.
Summer 2	Light	Isaac Newton	Physicist	Newton was interested in light and colour. He experimented in a dark room with light and prisms and discovered that light could be split into lots of different colours – a rainbow. He also discovered that something appears to be a certain colour because of the amount of light that it absorbs and/or reflects.
		Ibn al-Haytham	Physicist	He carried out important experiments on light and how eyes work, field called optics. He disagreed with Greek Philosophers and correctly argued that we see when light enters our eyes, rather than as a result of light being omitted.