

Acomb First School Science Substantive and Disciplinary Knowledge

Our Curriculum

In Reception we work on a yearly plan:

Understanding the World Science	Healthy eating: How to keep our teeth healthy	Understanding changing states: making soup and recognising the differences between the vegetables when they are raw and cooked. The <u>affect</u> heat has on food.	Understanding changing states: freezing and melting as a reversible change, looking at ice.	Understanding changing states and making predictions: growing cress in different conditions (soil, cotton wool, paper towel, seeds only)	Animal habitats: Animals that live in a range of habitats(both local and wider) and their adaptations to survive.	Human impact on the environment: water/plastic pollution, how this affects the environment and how we can help.
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In Key Stage 1 and 2 we have a 2 year rolling programme due to our mixed classes. All children cover the whole Key Stage curriculum across the two year period.

In Key stage one the 2 year programme is:

Science	Animals including humans: comparing animals	Living things: habitats Forces and space: seasonal change	Materials: Everyday materials	Materials: Uses of everyday materials Living things: micro habitats	Plants: introduction to plants Plants: plant growth	Animals including humans: life cycles and health Animals including humans: sensitive bodies
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In Key Stage 2 the 2 year rolling programme is:

Science	Energy: light and shadows Materials: States of matter	Energy: Sound and vibrations Plants: plant reproduction	Materials: Rocks and soil Animals incl humans: Movement and nutrition	Forces and space: forces and magnets Making connections: how does wind force affect seed dispersal?	Living things: classification and changing habitats Animals and humans: digestion and food	Energy: Electricity and circuits Making connections: how does food affect muscle fatigue
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Our science curriculum provides pupils with an understanding of both substantive and disciplinary knowledge.

Substantive knowledge- is the subject knowledge and explicit vocabulary used to learn about the content

Disciplinary knowledge- this considers how scientific knowledge originates and is revised. It is through disciplinary knowledge that children gradually become more expert by thinking like a scientist.

Substantive Knowledge: Concepts, models, laws and theories

Biology

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

Chemistry

- States of matter (Solids, liquids, gases)
- Materials (properties and changes including reversible/irreversible changes,)

Physics

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

Earth Science

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

Science in EYFS

All areas of learning and development at the Foundation Stage are inter-connected. Through engaging in science activities, children not only learn about the world around them but develop disciplinary skills in all areas.

Characteristics of Effective Learning

The ways in which a child engages with other people and their environment - playing and exploring, active learning, and creating and thinking critically – underpin learning and development across all areas and support the child to remain an effective and motivated learner.

'Understanding the World'

This is a specific area of the Early Years Curriculum that includes essential skills and knowledge about the world and provides firm foundations on which children can build their scientific understanding. Early Years children will be actively involved in play and exploration and be encouraged to be creative. They will be supported to think critically and ask questions, which will help them to make sense of their world through well-planned play opportunities.

ELGs:

- Explore the natural world around them, making observations and drawing pictures of animals and plants.
- Know some similarities and differences between the natural world around them and contrasting environments, drawing on their experiences and what has been read in class.

- Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter
- Manage their own basic hygiene and personal needs, including dressing, going to the toilet and understanding the importance of healthy food choices.
- Listen attentively and respond to what they hear with relevant questions, comments and actions when being read to and during whole class discussions and small group interactions.
- Make comments about what they have heard and ask questions to clarify their understanding.

End points:

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

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

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

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

Biology		
Substantive Knowledge		
	EYFS	Year 1
Plants	<ul style="list-style-type: none"> Describe and comment on things they have seen whilst outside, including plants and animals. Know how to make a simple record of their observations of the natural world, including animals and plants Know how to discuss how we care for the natural world around us. Notice changes in the leaves, weather and seasons. 	<ul style="list-style-type: none"> Know, identify and name a variety of common wild and garden plants, including deciduous and evergreen trees Know, identify and describe the basic structure of a variety of common flowering plants, including trees
Living Things	<ul style="list-style-type: none"> Understand the key features of the life cycle of a plant and an animal. Begin to understand the need to respect and care for the natural environment and all living things 	
Animals including humans	<ul style="list-style-type: none"> Make healthy choices about food, drink, activity and toothbrushing. Begin to make sense of their own life-story and how they have grown and changed. Understand the key features of the life cycle of a plant and an animal. Know and talk about the different factors that support their overall health and wellbeing Describe and comment on things they have seen whilst outside, including plants and animals. Know how to record their observations of the natural world, Recognise some environments that are different to the one in which they live. Manage their own basic hygiene and personal needs, including dressing, going to the toilet and understanding the importance of healthy food choices 	<ul style="list-style-type: none"> 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) Know, identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.

Biology		
Substantive Knowledge		
	Year 1	Year 2
Plants	<ul style="list-style-type: none"> • Know, identify and name a variety of common wild and garden plants, including deciduous and evergreen trees • Know, identify and describe the basic structure of a variety of common flowering plants, including trees 	<ul style="list-style-type: none"> • Plants can grow from seed or bulbs. Seeds and bulbs germinate and grow into seedlings. Seedlings grow into mature plants • Plants need light, water, space, suitable temperature in order to grow
Living Things		<ul style="list-style-type: none"> • Identify the differences between things that are living, dead, and things that have never been alive, using some of the 7 life processes. • Identify that most living things live in habitats to which they are suited • Name a variety of plants and animals in their habitats, including micro-habitats. • Describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other • Know and explain 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
Animals including humans	<ul style="list-style-type: none"> • 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) • Know, identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. 	<ul style="list-style-type: none"> • 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

Biology		
Substantive Knowledge		
	Year 3	Year 4
Plants	<ul style="list-style-type: none"> • Know and identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers • Know what plants need for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant • Know how water is transported within plants 	
		<ul style="list-style-type: none"> • Know the 7 life processes of living organisms and use them to determine if an organism is living. • Describe similarities and differences between examples of plants and animals. • Group living things in a variety of ways using key characteristics. • Use classification keys to help group and identify a variety of living things in their local and wider environment. • Recognise that environments can change, and this can sometimes pose dangers to living things. • Understand that human actions can impact on the environment and suggest some solutions to the issues
	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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

Chemistry		
Substantive Knowledge		
	EYFS	Year 1
Materials	<ul style="list-style-type: none"> Use all their senses in hands-on exploration of natural materials. Explore collections of materials with similar and/or different properties. Talk about what they see, using a wide vocabulary. Talk about the differences between materials and changes they notice. Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter. 	Everyday materials: <ul style="list-style-type: none"> Know the difference between objects from the material from which it is made Know, identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock Know and describe the simple physical properties of a variety of everyday materials: hard/soft, flexible/rigid, waterproof/ absorbent. Group together a variety of everyday materials on the basis of their simple physical properties. Know the similarities and differences between some everyday materials.

Chemistry		
Substantive Knowledge		
	Year 1	Year 2
	Everyday materials: <ul style="list-style-type: none"> Know the difference between objects from the material from which it is made Know, identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock Know and describe the simple physical properties of a variety of everyday materials: hard/soft, flexible/rigid, waterproof/ absorbent. Group together a variety of everyday materials on the basis of their simple physical properties. Know the similarities and differences between some everyday materials. 	Uses of everyday materials: <ul style="list-style-type: none"> Identify what properties a material needs for a particular purpose. Name the materials from which different objects are made. Recognise suitable and unsuitable choices of materials for particular purposes based on physical properties Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. Know that materials can be either man-made or naturally occurring. Group objects into man-made or natural categories. Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching

Chemistry		
Substantive Knowledge		
	Year 3	Year 4
		States of Matter: <ul style="list-style-type: none"> Know that all things are made up of particles which are arranged differently in solids, liquids and gases. Name the properties of solids, liquids and gases. Compare and group materials according to if they are solids, liquids and gases, giving reasons to justify their choices.

		<ul style="list-style-type: none">• Observe that some materials change state when heated or cooled, and give everyday examples of melting and freezing.• Understand that melting and freezing are a state change between solids and liquids.• Measure or research the temperature at which melting and freezing occurs for some materials.• Know that water freezes at 0°C and boils at 100°C.• Understand that condensation is a state change from a gas to a liquid.• Understand that evaporation is a state change from liquid to gas.• Understand that boiling and evaporation are the same state change from liquid to gas but at different temperatures.• Know that the speed of evaporation depends on a number of variables including the temperature.• Describe the water cycle.• Identify the parts played by evaporation and condensation in the water cycle.
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Physics		
Substantive Knowledge		
	EYFS	Year 1
Forces	<ul style="list-style-type: none"> • Explore how things work • Explore and talk about different forces they can feel • Talk about the differences between materials and changes they notice • Explore the natural world around them Describe what they see, hear, and feel whilst outside.	

Physics		
Substantive Knowledge		
	Year 1	Year 2
Forces		

Physics		
Substantive Knowledge		
	Year 3	Year 4
Forces	<ul style="list-style-type: none"> • Compare how things move on different surfaces • Notice that some forces need contact between two objects, but magnetic forces can act at a distance • Describe magnets as having two poles • Observe how magnets attract or repel each other and attract some materials and not others • Predict whether two magnets will attract and repel each other, depending on which poles are facing • 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 	
Light	<ul style="list-style-type: none"> • 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 	

	<ul style="list-style-type: none"> • find patterns in the way that the size of shadows change 	
<p style="text-align: center;">Sound</p>		<ul style="list-style-type: none"> • 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
<p style="text-align: center;">Electricity</p>		<ul style="list-style-type: none"> • Electricity is a form of energy, used for lighting, heating, making sound and making machines and appliances work. • Some appliances run on electricity; some plug into the mains electricity and others run on batteries. • An electrical circuit consists of a cell or battery connected to a component using wires. • A series circuit is where all the components of the circuits are joined in one loop. If one part of the loop is incomplete, then the circuit will not work • Names of components include cells, wires, bulbs/ lamps, switches and buzzers • A cell is a single unit, and a battery is a collection of cells • Know how to test a circuit using a bulb. • Switches open and close circuits. When a switch is open the bulb/lamp will not light up as the series circuit is incomplete. • Wires are made from metals as they are good conductors of electricity e.g., iron, copper and steel • Insulators are materials that do not allow electricity to pass through them easily e.g., plastic, wood, rubber and glass. • Thomas Edison invented the first practical incandescent light bulb

Earth Sciences		
Substantive Knowledge		
	EYFS	Year 1
Earth and Space	<ul style="list-style-type: none"> • Learn about the solar system and stars • Learn about space travel • Explore the natural world around them • Describe what they see, hear and feel whilst outside 	<ul style="list-style-type: none"> • Name the 4 seasons and say when in the year they occur • Observe and describe weather associated with the seasons • Observe changes across the 4 seasons • Describe some other features that change throughout the year that are

	<ul style="list-style-type: none"> • Understand the effect of change in seasons on the natural world around them • Name the 4 seasons 	<p>caused by the change in weather e.g. numbers of mini beasts found outside, seed and plant growth, leaves on trees, clothes worn by people,</p> <ul style="list-style-type: none"> • Explain how day light (from the sun rising to sun setting)length varies across the year (longer in summer, shorter in winter)
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Earth Sciences		
Substantive Knowledge		
	Year 1	Year 2
Earth and Space	<ul style="list-style-type: none"> • Name the 4 seasons and say when in the year they occur • Observe and describe weather associated with the seasons • Observe changes across the 4 seasons • Describe some other features that change throughout the year that are caused by the change in weather e.g. numbers of mini beasts found outside, seed and plant growth, leaves on trees, clothes worn by people, • Explain how day light (from the sun rising to sun setting)length varies across the year (longer in summer, shorter in winter) 	

Earth Sciences		
Substantive Knowledge		
	Year 3	Year 4
Earth and Space		
Rocks and Soils	<p>Rocks and Soils</p> <ul style="list-style-type: none"> • Name and describe 3 different kinds of rocks. • Group and compare different kinds of rocks on the basis of appearance and simple physical properties, basis of appearance and simple physical properties. • Describe how each rock type is formed within the rock cycle. • Understand different uses for selected rocks and how they change over time. • Explain simply how a fossil is formed. • Recognise that soils are made from rocks and organic matter, (living and dead) and be introduced to different soil types. 	

Disciplinary knowledge: Working scientifically

Disciplinary knowledge is taught and embedded within the teaching of each unit of substantive knowledge.

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

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

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

As well as this, pupils will learn about:

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

Disciplinary knowledge		
EYFS children can	Year 1 children can	Year 2 children can
<ul style="list-style-type: none"> ask simple questions about the world around them ask teachers or adults within school about things they observe make observations about things they see around them conduct guided investigations with supervision make choices when performing simple identifying and classifying make some comparison between objects or living things make some predictions about living things based on prior knowledge make suggestions about how things work based on their own observations use basic observations to help answer questions with help from the teacher explore the natural world around me, making observations and drawing pictures of plants and animals. identify some similarities and differences between the natural world around me and contrasting environments, drawing on their experiences and what has been read in class 	<ul style="list-style-type: none"> ask simple questions and recognise that they can be answered in different ways (fair tests, comparative tests, observation over time, research, pattern seeking) observe closely, using simple equipment (hand lenses, egg timers) perform simple tests to investigate the answer to a given question perform simple identifying and classifying, grouping task using basic observations use observations and ideas to suggest answers to questions, using simple sentences to describe the answer gather and record data to help in answering questions, using given tables or data formats 	<ul style="list-style-type: none"> ask simple questions and recognise that they can be answered in different ways (fair tests, comparative tests, observation over time, research, pattern seeking) research the answers to questions using books, tablets or computers observe closely, using simple equipment (hand lenses, egg timers, rulers, stopwatches etc) perform simple tests to investigate the answer to a given question begin to design their own tests to investigate the answer to a given question perform simple identifying and classifying, grouping using basic observations begin to group using prior knowledge use observations and ideas to suggest answers to questions, using simple sentences to describe the answer to a question give basic conclusions with simple reasoning gather and record data to help in answering questions, using given tables or data formats drawing own tables, deciding how to record

Disciplinary knowledge			
Year 3 children can	Year 4 children can	Year 5 children can	Year 6 children can
<ul style="list-style-type: none"> ask relevant questions and use different types of scientific enquiries to answer them (fair tests, comparative tests, observation over time, research, pattern seeking) begin to select their own methods to find the answer to a scientific question set up simple practical enquiries, comparative and fair tests begin to design their own tests and manage variables make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers, rulers, stopwatches, measuring cylinders and jugs. gather record, classify and present data in a variety of ways to help in answering questions begin to use simple keys for classification record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions explain findings from investigations to rest of class use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions draw clear conclusions from findings and make predictions based on this, suggest improvements to the investigation identify differences, similarities or changes related to simple scientific ideas and processes use straightforward scientific evidence 	<ul style="list-style-type: none"> ask relevant questions and use different types of scientific enquiries to answer them (fair tests, comparative tests, observation over time, research, pattern seeking) select their own methods to find the answer to a scientific question begin to combine research with their own investigations to confirm conclusions. set up simple practical enquiries, comparative and fair tests design their own tests & identify and manage variables. make systematic and careful observations and, where appropriate, take accurate measurements using standard units, using a range of equipment, including thermometers, rulers, stopwatches, measuring cylinders/jugs and data loggers. begin to make decisions about what equipment is appropriate for investigations gather, record, classify and present data in a variety of ways to help in answering questions identify criteria for classification and use and create simple keys record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions explain findings from investigations to rest of class be able to comment on the findings of other investigations compared to their own and how they support or contradict. use results to draw simple conclusions, make predictions for new values, 	<ul style="list-style-type: none"> plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary (fair tests, comparative tests, observation over time, research, pattern seeking) select and plan the most appropriate type of scientific enquiry to use to answer scientific questions; recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why. take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate make their own decisions about what observations to make, repeat readings and learn about reliability record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs (in line with Year 5 maths curriculum learning) use test results to make predictions to set up further comparative and fair tests make predictions and complete further investigation report 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, including giving an explanation of trust in results, with reasons identify scientific evidence that has been used to support or refute ideas or arguments, including identifying which evidence they have produced 	<ul style="list-style-type: none"> plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary (fair tests, comparative tests, observation over time, research, pattern seeking) select and plan the most appropriate type of scientific enquiry to use to answer scientific questions; recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why. plan and execute appropriate investigations based on a given or student-led question take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate make their own decisions about what observations to make, repeat readings & learn about reliability, developing an increased level of precision and accuracy record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs (in line with Year 6 maths curriculum learning) use test results to make predictions to set up further comparative and fair tests make predictions and complete further investigation – combine with research report 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, including giving an explanation of trust in results, with

<p>to answer questions or to support their findings</p>	<p>suggest improvements and raise further questions</p> <ul style="list-style-type: none">• draw conclusions and support with clear evidence, suggest improvements, raise further questions and possible next investigations• identify differences, similarities or changes related to simple scientific ideas and processes• use straightforward scientific evidence to answer questions or to support their findings	<p>supports or refutes ideas or arguments</p>	<p>reasons</p> <ul style="list-style-type: none">• identify causal relationships in investigations• identify scientific evidence that has been used to support or refute ideas or arguments, including identifying which evidence they have produced• supports or refutes ideas or arguments• begin to research evidence to support or refute ideas/arguments & begin to separate opinion from fact
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