

# Progression of Substantive Knowledge in Science

## Animals Including Humans

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Key Stage 3
Substantive Concepts	<ul style="list-style-type: none"> <li>Learn about the life cycles of animals</li> <li>Compare adult animals to their babies</li> <li>Learn about how to take care of themselves</li> <li>Learn about their senses</li> </ul>	<ul style="list-style-type: none"> <li>Name and describe animals that live in different habitats.</li> <li>Describe different habitats</li> <li>Describe people who are familiar to them</li> <li>Learn about how to take care of themselves and people who help us to care for ourselves</li> <li>Learn about the life cycles of humans</li> </ul>	<ul style="list-style-type: none"> <li>Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.</li> <li>Identify and name a variety of common animals that are carnivores, herbivores and omnivores.</li> <li>Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets).</li> <li>Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.</li> </ul>	<ul style="list-style-type: none"> <li>Notice that animals, including humans, have offspring which grow into adults.</li> <li>Find out about and describe the basic needs of animals, including humans, for survival (water, food and air).</li> <li>Describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.</li> <li>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. (Y2 - Living things and their habitats)</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>Identify that humans and some other animals have skeletons and muscles for support, protection and movement.</li> </ul>	<ul style="list-style-type: none"> <li>Describe the simple functions of the basic parts of the digestive system in humans.</li> <li>Identify the different types of teeth in humans and their simple functions.</li> <li>Construct and interpret a variety of food chains, identifying producers, predators and prey.</li> </ul>	<ul style="list-style-type: none"> <li>Describe the changes as humans develop to old age.</li> <li>Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird. (Y5 - Living things and their habitats)</li> <li>Describe the life process of reproduction in some plants and animals. (Y5 - Living things and their habitats)</li> </ul>	<ul style="list-style-type: none"> <li>Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood.</li> <li>Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.</li> <li>Describe the ways in which nutrients and water are transported within animals, including humans.</li> <li>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. (Y6 - Living things and their habitats)</li> <li>Give reasons for classifying plants and animals based on specific characteristics. (Y6 - Living things and their habitats)</li> </ul>	<ul style="list-style-type: none"> <li>Reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta.</li> <li>The consequences of imbalances in the diet, including obesity, starvation and deficiency diseases.</li> <li>The effects of recreational drugs (including substance misuse) on behaviour, health and life processes.</li> <li>The structure and functions of the gas exchange system in humans, including adaptations to function.</li> <li>The mechanism of breathing to move air in and out of the lungs.</li> <li>The impact of exercise, asthma and smoking on the human gas exchange system</li> </ul>
Vocabulary	Head, body, eyes, ears, mouth, teeth, leg,	tail, wing, claw, fin, scales, feathers, fur, beak, paws, hooves, senses - touch, see, smell, taste, hear, fingers (skin), eyes, nose, ear and tongue	Head, body, eyes, ears, mouth, teeth, leg, tail, wing, claw, fin, scales, feathers, fur, beak, paws, hooves <ul style="list-style-type: none"> <li>Names of animals experienced first-hand from each vertebrate group</li> <li>Parts of the body including those linked to PSHE teaching</li> <li>Senses - touch, see, smell, taste, hear, fingers (skin), eyes, nose, ear and tongue</li> </ul>	Offspring, reproduction, growth, child, young/old stages (examples - chick/hen, baby/child/adult, caterpillar/butterfly), exercise, heartbeat, breathing, hygiene, germs, disease, food types (examples - meat, fish, vegetables, bread, rice, pasta	Nutrition, nutrients, carbohydrates, sugars, protein, vitamins, minerals, fibre, fat, water, skeleton, bones, muscles, joints, support, protect, move, skull, ribs, spine	Digestive system, digestion, mouth, teeth, saliva, oesophagus, stomach, small intestine, nutrients, large intestine, rectum, anus, teeth, incisor, canine, molar, premolars, herbivore, carnivore, omnivore, producer, predator, prey, food chain	Puberty - the vocabulary to describe sexual characteristics	Heart, pulse, rate, pumps, blood, blood vessels, transported, lungs, oxygen, carbon dioxide, nutrients, water, muscles, cycle, circulatory system, diet, exercise, drugs, lifestyle	
Misconceptions	All food is good for you. All animals are furry and have four legs. Animals live in the same habitat all year.	<ul style="list-style-type: none"> <li>only four-legged mammals, such as pets, are animals</li> <li>humans are not animals</li> <li>insects are not animals</li> <li>all 'bugs' or 'creepy crawlies', such as spiders, are part of the insect group</li> <li>amphibians and reptiles are the same.</li> </ul>	<ul style="list-style-type: none"> <li>an animal's habitat is like its 'home'</li> <li>all animals that live in the sea are fish</li> <li>respiration is breathing</li> <li>breathing is respiration.</li> </ul>	<ul style="list-style-type: none"> <li>certain whole food groups like fats are 'bad' for you</li> <li>certain specific foods, like cheese are also 'bad' for you</li> <li>diet and fruit drinks are 'good' for you</li> <li>snakes are similar to worms, so they must also be invertebrates</li> <li>invertebrates have no form of skeleton.</li> </ul>	<ul style="list-style-type: none"> <li>arrows in a food chains mean 'eats'</li> <li>the death of one of the parts of a food chain or web has no, or limited, consequences on the rest of the chain</li> <li>there is always plenty of food for wild animals</li> <li>your stomach is where your belly button is</li> <li>food is digested only in the stomach</li> <li>when you have a meal, your food goes down one tube and your drink down another</li> <li>the food you eat becomes "poo" and the drink becomes "wee".</li> </ul>	<ul style="list-style-type: none"> <li>a baby grows in a mother's tummy</li> <li>a baby is "made".</li> </ul>	<ul style="list-style-type: none"> <li>your heart is on the left side of your chest</li> <li>the heart makes blood</li> <li>the blood travels in one loop from the heart to the lungs and around the body</li> <li>when we exercise, our heart beats faster to work the muscles more</li> <li>some blood in our bodies is blue and some blood is red</li> <li>we just eat food for energy</li> <li>all fat is bad for you</li> <li>all dairy is good for you</li> <li>protein is good for you, so you can eat as much as you want</li> <li>foods only contain fat if you can see it</li> <li>all drugs are bad for you.</li> </ul>		
Famous Scientists			Dr Ranj Singh (doctor) Chris Packham Steve Irwin (wildlife expert)		Marie Curie (radiation) Eva Crane (beekeeper)		Joseph Lister (antiseptic medicine) Leonardo Da Vinci (anatomy)		

# Progression of Substantive Knowledge in Science

## Plants

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Key Stage 3
Substantive Concepts	<ul style="list-style-type: none"> <li>Grow plants</li> </ul>	<ul style="list-style-type: none"> <li>Explore the plants in the surrounding natural environment .</li> <li>Plant seeds and care for growing plants.</li> <li>Understand the key features of the life cycle of a plant (Sunflower)</li> </ul>	Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees. <ul style="list-style-type: none"> <li>Identify and describe the basic structure of a variety of common flowering plants, including trees.</li> </ul>	Observe and describe how seeds and bulbs grow into mature plants. <ul style="list-style-type: none"> <li>Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.</li> <li>Identify and name a variety of plants and animals in their habitats, including microhabitats. (Y2 - Living things and their habitats)</li> </ul>	Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers. <ul style="list-style-type: none"> <li>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.</li> <li>Investigate the way in which water is transported within plants.</li> <li>Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.</li> </ul>	Recognise that living things can be grouped in a variety of ways. (Y4 - Living things and their habitats) <ul style="list-style-type: none"> <li>Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment. (Y4 - Living things and their habitats)</li> <li>Recognise that environments can change and that this can sometimes pose dangers to living things. (Y4 - Living things and their habitats)</li> </ul>	Describe the life process of reproduction in some plants and animals. (Y5 - Living things and their habitats)	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. (Y6 - Living things and their habitats) <ul style="list-style-type: none"> <li>Give reasons for classifying plants and animals based on specific characteristics. (Y6 - Living things and their habitats)</li> </ul>	Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms.
Vocabulary	leaf, flower,	petal, fruit, berry, root, seed,	blossom, trunk, branch, stem, bark, stalk, bud Names of trees in the local area Names of garden and wild flowering plants in the local area	light, shade, sun, warm, cool, water, grow, healthy	Photosynthesis, pollen, insect/wind pollination, seed formation, seed dispersal (wind dispersal, animal dispersal, water dispersal)				
Misconceptions	All plants have flowers, with coloured petals, green leaves and a stem.		<ul style="list-style-type: none"> <li>plants are flowering plants grown in pots with colored petals and leaves and a stem</li> <li>trees are not plants</li> <li>all leaves are green</li> <li>all stems are green</li> <li>a trunk is not a stem</li> <li>blossom is not a flower.</li> </ul>	<ul style="list-style-type: none"> <li>plants are not alive as they cannot be seen to move</li> <li>seeds are not alive</li> <li>all plants start out as seeds</li> <li>seeds and bulbs need sunlight to germinate.</li> </ul>	<ul style="list-style-type: none"> <li>plants eat food</li> <li>food comes from the soil via the roots</li> <li>flowers are merely decorative rather than a vital part of the life cycle in reproduction</li> <li>plants only need sunlight to keep them warm</li> <li>roots suck in water which is then sucked up the stem.</li> </ul>				
Famous Scientists			Beatrix Potter (Botanist)		Ahmed Mumim Warfa (botanist) Joseph Banks (botanist)				

# Progression of Substantive Knowledge in Science

## Living things and their habitats

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Key Stage 3
Substantive Concepts	Explore the surrounding natural environment • Explore natural objects from the surrounding environment	• Explore minibeasts in the surrounding natural environment	Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees. (Y1 - Plants) • Identify and describe the basic structure of a variety of common flowering plants, including trees. (Y1 - Plants) • Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals. (Y1 - Animals including humans) • Identify and name a variety of common animals that are carnivores, herbivores and omnivores. (Y1 - Animals including humans) • Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). (Y1 - Animals, including humans) • Observe changes across the four seasons. (Y1 - Seasonal change)	Explore and compare the differences between things that are living, dead, and things that have never been alive. • Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other. • Identify and name a variety of plants and animals in their habitats, including microhabitats. • Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food. • Notice that animals, including humans, have offspring which grow into adults. (Y2 - Animals including humans)	Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal. (Y3 - Plants)	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. • Construct and interpret a variety of food chains, identifying producers, predators and prey. (Y4 - Animals, including humans)	Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird. • Describe the life process of reproduction in some plants and animals	Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals. • Give reasons for classifying plants and animals based on specific characteristics. • Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents. (Y6 - Evolution and inheritance) • Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution. (Y6 - Evolution and inheritance)	Reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus • Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms. • Differences between species.
Vocabulary				• Living, dead, never been alive, suited, suitable, basic needs, food, food chain, shelter, move, feed • Names of local habitats e.g. pond, woodland etc. • Names of micro-habitats e.g. under logs, in bushes etc		Classification, classification keys, environment, habitat, human impact, positive, negative, migrate, hibernate	Life cycle, reproduce, sexual, sperm, fertilises, egg, live young, metamorphosis, asexual, plantlets, runners, bulbs, cuttings	Vertebrates, fish, amphibians, reptiles, birds, mammals, invertebrates, insects, spiders, snails, worms, flowering, non-flowering	
Misconceptions				• an animal's habitat is like its 'home' • plants and seeds are not alive as they cannot be seen to move • fire is living • arrows in a food chain mean 'eats'.		• the death of one of the parts of a food chain or web has no or limited consequences on the rest of the chain • there is always plenty of food for wild animals • animals are only land-living creatures • animals and plants can adapt to their habitats, however they change • all changes to habitats are negative	• all plants start out as seeds • all plants have flowers • plants that grow from bulbs do not have seeds • only birds lay eggs.	• all micro-organisms are harmful • mushrooms are plants.	

# Progression of Substantive Knowledge in Science

Famous Scientists			David Attenborough (conservationist)	Alice Roberts (biologist) Joan Beauchamp (zoologist)	Jane Goodall (naturalist)	
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## Evolution and Inheritance

	Year 2	Year 3	Year 4	Year 5	Year 6	Key Stage 3
Substantive Concepts	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. (Y2 - Living things and their habitats) • Notice that animals, including humans, have offspring which grow into adults. (Y2 - Animals, including humans)	Describe in simple terms how fossils are formed when things that have lived are trapped within rock. (Y3 - Rocks) • Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal. (Y3 - Plants)	Recognise that environments can change and that this can sometimes pose dangers to living things. (Y4 - Living things and their habitats)	Describe the life process of reproduction in some plants and animals. (Living things and their habitats - Y5)	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.	Heredity as the process by which genetic information is transmitted from one generation to the next. • A simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model. • The variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection. • Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
Vocabulary					Offspring, sexual reproduction, vary, characteristics, suited, adapted, environment, inherited, species, fossils	
Misconceptions					• adaptation occurs during an animal's lifetime: giraffes' necks stretch during their lifetime to reach higher leaves and animals living in cold environments grow thick fur during their life • offspring most resemble their parents of the same sex, so that sons look like fathers • all characteristics, including those that are due to actions during the parent's life such as dyed hair or footballing skills, can be inherited • cavemen and dinosaurs were alive at the same time.	
Famous Scientists					Charles Darwin (evolution) Rosalind Franklin (DNA)	

# Progression of Substantive Knowledge in Science

## Materials/States of Matter

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Key Stage 3
Substantive Concepts	<ul style="list-style-type: none"> <li>• Explore a range of materials</li> <li>• Shape and join materials</li> <li>• Combine and mix ingredients</li> <li>• Change materials by heating and cooling</li> </ul>	<ul style="list-style-type: none"> <li>• Explore a range of materials, including natural materials</li> <li>• Make objects from different materials, including natural materials</li> <li>• Change materials by heating and cooling, including cooking</li> </ul>	Distinguish between an object and the material from which it is made. <ul style="list-style-type: none"> <li>• Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock.</li> <li>• Describe the simple physical properties of a variety of everyday materials.</li> <li>• Compare and group together a variety of everyday materials on the basis of their simple physical properties.</li> </ul>	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. <ul style="list-style-type: none"> <li>• Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.</li> </ul>	<p style="color: red;">Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties. (Y3 - Rocks)</p> <p style="color: red;">• Describe in simple terms how fossils are formed when things that have lived are trapped within rock. (Y3 - Rocks)</p> <p style="color: red;">• 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. (Y3 - Forces and magnets)</p>	Compare and group materials together, according to whether they are solids, liquids or gases. <ul style="list-style-type: none"> <li>• 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).</li> <li>• Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.</li> <li>• Recognise some common conductors and insulators, and associate metals with being good conductors. (Y4 - Electricity)</li> </ul>	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. <ul style="list-style-type: none"> <li>• Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.</li> <li>• Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.</li> <li>• Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.</li> <li>• Demonstrate that dissolving, mixing and changes of state are reversible changes.</li> <li>• 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</li> </ul>	Chemical reactions as the rearrangement of atoms. <ul style="list-style-type: none"> <li>• Representing chemical reactions using formulae and using equations.</li> <li>• Combustion, thermal decomposition, oxidation and displacement reactions.</li> <li>• Defining acids and alkalis in terms of neutralisation reactions.</li> <li>• The pH scale for measuring acidity/alkalinity; and indicators.</li> </ul>
Vocabulary	water, rock, brick, paper, hard, soft,	material, wood, plastic, glass, metal, card/cardboard, wool,	Object, material, wood, plastic, glass, metal, water, rock, brick, paper, fabric, elastic, foil, card/cardboard, rubber, wool, clay, hard, soft, stretchy, stiff, bendy, floppy, waterproof, absorbent, breaks/tears, rough, smooth, shiny, dull, see-through, not see-through	Wood, metal, plastic, glass, brick, rock, paper, cardboard opaque, transparent and translucent, reflective, nonreflective, flexible, rigid Shape, push/pushing, pull/pulling, twist/twisting, squash/squashing, bend/bending, stretch/stretching		solid, liquid, gas, state change, melting, freezing, melting point, boiling point, evaporation, temperature, water cycle	Thermal/electrical insulator/conductor, change of state, mixture, dissolve, solution, soluble, insoluble, filter, sieve, reversible/non-reversible change, burning, rusting, new material	
Misconceptions			<ul style="list-style-type: none"> <li>• only fabrics are materials</li> <li>• only building materials are materials</li> <li>• only writing materials are materials</li> <li>• the word 'rock' describes an object rather than a material</li> <li>• 'solid' is another word for hard.</li> </ul>	<ul style="list-style-type: none"> <li>• only fabrics are materials</li> <li>• only building materials are materials</li> <li>• only writing materials are materials</li> <li>• the word rock describes an object rather than a material</li> <li>• solid is another word for hard.</li> </ul> Ap		<ul style="list-style-type: none"> <li>• 'solid' is another word for hard or opaque</li> <li>• solids are hard and cannot break or change shape easily and are often in one piece</li> <li>• substances made of very small particles like sugar or sand cannot be solids</li> <li>• particles in liquids are further apart than in solids and they take up more space</li> <li>• when air is pumped into balloons, they become lighter</li> <li>• water in different forms - steam, water, ice - are all different substances</li> <li>• all liquids boil at the same temperature as water (100 degrees)</li> <li>• melting, as a change of state, is the same as dissolving</li> <li>• steam is visible water vapour (only the condensing water droplets can be seen)</li> <li>• clouds are made of water vapour or steam</li> <li>• the substance on windows etc. is condensation rather than water</li> <li>• the changing states of water (illustrated by the water cycle) are irreversible</li> <li>• evaporating or boiling water makes it vanish</li> <li>• evaporation is when the Sun sucks up the water, or when water is absorbed into a surface/material</li> </ul>	<ul style="list-style-type: none"> <li>• thermal insulators keep cold in or out</li> <li>• thermal insulators warm things up</li> <li>• solids dissolved in liquids have vanished and so you cannot get them back</li> <li>• lit candles only melt, which is a reversible change.</li> </ul>	
Famous Scientists			Charles Macintosh (waterproofing) Joseph Gay Lussac (fire retardant)			Anders Celsius (temperature)	Jamie Garcia (new plastic) Ruth Benerto (cotton)	

# Progression of Substantive Knowledge in Science

## Rocks

	Year 1	Year 2	Year 3	Year 6	Key Stage 3
Substantive Concepts	Distinguish between an object and the material from which it is made. (Y1 - Everyday materials) <ul style="list-style-type: none"> <li>Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock. (Y1 - Everyday materials)</li> <li>Describe the simple physical properties of a variety of everyday materials. (Y1 - Everyday materials)</li> <li>Compare and group together a variety of everyday materials on the basis of their simple physical properties. (Y1 - Everyday materials)</li> </ul>	Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. (Y2 - Uses of everyday materials)	Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties. <ul style="list-style-type: none"> <li>Describe in simple terms how fossils are formed when things that have lived are trapped within rock.</li> <li>Recognise that soils are made from rocks and organic matter.</li> </ul>	Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago. (Y6 - Evolution and inheritance)	The composition of the Earth. <ul style="list-style-type: none"> <li>The structure of the Earth.</li> <li>The rock cycle and the formation of igneous, sedimentary and metamorphic rocks</li> </ul>
Vocabulary			sedimentary rock, igneous rock, metamorphic rock, permeable, impermeable, magma, lava, sediment, fossilisation, erosion		
Misconceptions			<ul style="list-style-type: none"> <li>rocks are all hard in nature</li> <li>rock-like, man-made substances such as concrete or brick are rocks</li> <li>materials which have been polished or shaped for use, such as a granite worktop, are not rocks as they are no longer 'natural'</li> <li>certain found artefacts, like old bits of pottery or coins, are fossils</li> <li>a fossil is an actual piece of the extinct animal or plant</li> <li>soil and compost are the same thing.</li> </ul>		
Famous Scientists			Mary Anning (fossils)		

## Seasonal Changes

	Nursery	Reception	Year 1	Year 3	Year 5	Key Stage 3
Substantive Concepts		Observe living things throughout the year	Observe changes across the four seasons. Observe and describe weather associated with the seasons and how day length varies	Recognise that light from the sun can be dangerous and that there are ways to protect their eyes. (Y3 - Light)	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the Sun across the sky. (Y5 - Earth and space)	The seasons and the Earth's tilt, day length at different times of year, in different hemispheres
Vocabulary	Weather (sunny, rainy, windy, snowy etc.)	Seasons (winter, summer, spring, autumn)	Weather (sunny, rainy, windy, snowy etc.) Seasons (winter, summer, spring, autumn) Sun, sunrise, sunset, day length	Rock, stone, pebble, boulder, grain, crystals, layers, hard, soft, texture, absorb water, soil, fossil, marble, chalk, granite, sandstone, slate, soil, peat, sandy/chalk/clay soil		
Misconceptions	That ice is not water		<ul style="list-style-type: none"> <li>it always snows in winter</li> <li>it is always sunny in the summer</li> <li>there are only flowers in spring and summer</li> <li>it rains most in the winter.</li> </ul>			
Famous Scientists		Holly Green (meteorologist)				

# Progression of Substantive Knowledge in Science

## Light

	Year 1	Year 3	Year 5	Year 6	Key Stage 3
Substantive Concepts	Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. (Y1 - Animals, including humans) • Describe the simple physical properties of a variety of everyday materials. (Y1 - Materials)	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.	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. (Y5 - Properties and changes of materials)	Recognise that light appears to travel in straight lines. • Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye. • Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes. • Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them	The similarities and differences between light waves and waves in matter. • Light waves travelling through a vacuum; speed of light. • The transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface. • Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye. • Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras. • Colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.
Vocabulary		Light, light source, dark, absence of light, transparent, translucent, opaque, shiny, matt, surface, shadow, reflect, mirror, sunlight, dangerous		straight lines, light rays	
Misconceptions		• we can still see even where there is an absence of any light • our eyes 'get used to' the dark • the moon and reflective surfaces are light sources • a transparent object is a light source • shadows contain details of the object, such as facial features on their own shadow • shadows result from objects giving off darkness.		• we see objects because light travels from our eyes to the object	
Famous Scientists		Thomas Edison (the light bulb)		James Clerk Maxwell (waves of light)	

## Forces

	Year 2	Year 3	Year 5	Key Stage 3
Substantive Concepts	Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching. (Y2 - Uses of everyday materials)	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	Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. • Identify the effects of air resistance, water resistance and friction, that act between moving surfaces. • Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.	Magnetic fields by plotting with compass, representation by field lines. • Earth's magnetism, compass and navigation. • Forces as pushes or pulls, arising from the interaction between two objects. • Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces. • Moment as the turning effect of a force. • Forces: associated with deforming objects; stretching and squashing - springs; with rubbing and friction between surfaces; with pushing things out of the way; resistance to motion of air and water. • Forces measured in Newtons, measurements of stretch or compression as force is changed
Vocabulary		Force, push, pull, twist, contact force, non-contact force, magnetic force, magnet, strength, bar magnet, ring magnet, button magnet, horseshoe magnet, attract, repel, magnetic material, metal, iron, steel, poles, north pole, south pole	Force, gravity, Earth, air resistance, water resistance, friction, mechanisms, simple machines, levers, pulleys, gears	
Misconceptions		• the bigger the magnet the stronger it is • all metals are magnetic. • Big magnets are stronger than smaller ones • All naturally found metals are magnetic • The shape of a magnet changes how strong it is.	• the heavier the object the faster it falls, because it has more gravity acting on it • forces always act in pairs which are equal and opposite • smooth surfaces have no friction • objects always travel better on smooth surfaces • a moving object has a force which is pushing it forwards and it stops when the pushing force wears out • a non-moving object has no forces acting on it • heavy objects sink and light objects float.	
Famous Scientists		Michael Faraday ( magnets and forces)	Isaac Newton (gravity) Albert Einstein (relativity)	

# Progression of Substantive Knowledge in Science

## Sound

	Year 1	Year 4	Key Stage 3
Substantive Concepts	Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. (Y1 - Animals, including humans)	Identify how sounds are made, associating some of them with something vibrating. <ul style="list-style-type: none"> <li>Recognise that vibrations from sounds travel through a medium to the ear.</li> <li>Find patterns between the pitch of a sound and features of the object that produced it.</li> <li>Find patterns between the volume of a sound and the strength of the vibrations that produced it.</li> <li>Recognise that sounds get fainter as the distance from the sound source increases</li> </ul>	Waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel - superposition. <ul style="list-style-type: none"> <li>Frequencies of sound waves, measured in Hertz (Hz); echoes, reflection and absorption of sound.</li> <li>Sound needs a medium to travel, the speed of sound in air, in water, in solids.</li> <li>Sound produced by vibrations of objects, in loud speakers, detected by their effects on microphone diaphragm and the ear drum; sound waves are longitudinal.</li> <li>Auditory range of humans and animals.</li> <li>Pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound.</li> <li>Waves transferring information for conversion to electrical signals by microphone</li> </ul>
Vocabulary		Sound, source, vibrate, vibration, travel, pitch (high, low), volume, faint, loud, insulation	
Misconceptions		<ul style="list-style-type: none"> <li>sound is only heard by the listener</li> <li>sound only travels in one direction from the source</li> <li>sound can't travel through solids and liquids</li> <li>high sounds are loud and low sounds are quiet.</li> </ul>	
Famous Scientists		Alexander Graham Bell (telephone)	

## Electricity

	Year 4	Year 6	Key Stage 3
Substantive Concepts	Identify common appliances that run on electricity. <ul style="list-style-type: none"> <li>Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.</li> <li>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.</li> <li>Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.</li> <li>Recognise some common conductors and insulators, and associate metals with being good conductors.</li> </ul>	Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit. <ul style="list-style-type: none"> <li>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.</li> <li>Use recognised symbols when representing a simple circuit in a diagram.</li> </ul>	Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge. <ul style="list-style-type: none"> <li>Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current.</li> <li>Differences in resistance between conducting and insulating components (quantitative).</li> <li>Static electricity</li> </ul>
Vocabulary	electricity, generate, renewable, non -renewable, appliances, battery, circuit, insulator, conductor	Circuit, complete circuit, circuit diagram, circuit symbol, cell, battery, bulb, buzzer, motor, switch, voltage	
Misconceptions	Electricity is pushed out of both ends of a cell at the same time	<ul style="list-style-type: none"> <li>larger-sized batteries make bulbs brighter</li> <li>a complete circuit uses up electricity</li> <li>components in a circuit that are closer to the battery get more electricity.</li> </ul>	
Famous Scientists	Thomas Edison (lightbulb)	Nikola Tesla (electric system) Alessandro Volta (electric battery)	

## Earth & Space

	Year 1	Year 5	Key Stage 3
Substantive Concepts	Observe changes across the four seasons. (Y1 - Seasonal changes) <ul style="list-style-type: none"> <li>Observe and describe weather associated with the seasons and how day length varies. (Y1 - Seasonal changes)</li> </ul>	Describe the movement of the Earth, and other planets, relative to the Sun in the solar system. <ul style="list-style-type: none"> <li>Describe the movement of the Moon relative to the Earth.</li> <li>Describe the Sun, Earth and Moon as approximately spherical bodies.</li> <li>Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.</li> </ul>	Gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only). <ul style="list-style-type: none"> <li>Our Sun as a star, other stars in our galaxy, other galaxies.</li> <li>The seasons and the Earth's tilt, day length at different times of year, in different hemispheres.</li> <li>The light year as a unit of astronomical distance</li> </ul>
Vocabulary		Earth, Sun, Moon, (Mercury, Jupiter, Saturn, Venus, Mars, Uranus, Neptune), spherical, solar system, rotates, star, orbit, planet	
Misconceptions		<ul style="list-style-type: none"> <li>the Earth is flat</li> <li>the Sun is a planet</li> <li>the Sun rotates around the Earth</li> <li>the Sun moves across the sky during the day</li> <li>the Sun rises in the morning and sets in the evening</li> <li>the Moon appears only at night</li> <li>night is caused by the Moon getting in the way of the Sun or the Sun moving further away from the Earth.</li> </ul>	
Famous Scientists		Stephen Hawking Tim Peake	