



Poulton Lancelyn
Science
Long Term Plan
2022/23

Science Rationale

Our high quality science education aims to excite and inspire pupil's natural curiosity to develop their scientific understanding of the world around them. Through building up a progression of knowledge and skills across the specific disciplines of biology, chemistry and physics, pupils will develop an appreciation of how scientific processes and methods are vital in understanding natural phenomena and what is occurring around us. We instil the understanding and appreciation of how past and future scientific discoveries have/had the potential to positively impact the world. Pupils will be encouraged to predict outcomes and analyse causes based on the knowledge that they have established. We ensure that pupils are fully equipped with the scientific knowledge and skills that they need to thrive in the wider world.

Science LTP

Year Group	Autumn		Spring		Summer	
F2	<u>Healthy Bodies</u> <i>Managing self</i> EQ: TBC George Crum	<u>Materials</u> <u>States of Matter</u> <i>Processes and Changes</i> EQ: What is a material? Ole Kirk Christiansen	<u>Forces and Magnets</u> <i>Processes and Changes</i> What is a magnet? John McAdam	<u>Living Things/Habitats</u> <i>Natural World</i> EQ: What happens when a caterpillar grows? David Attenborough	<u>Space</u> <i>Differences between other environments</i> EQ: What is beyond Earth? Mae Jemison	<u>Animals</u> <i>Natural World</i> EQ: How are animals similar and different? Cynthia Moss
	<u>Seasons</u> <i>Processes and Changes</i> EQ: What is the weather like? Anders Celsius					
1	<u>Parts of Animals</u> <i>Animals including humans</i> EQ: Are we all different or all we all the same? Beatrix Potter	<u>Types of Animals</u> <i>Animals including humans</i> EQ: What is the difference between the structure of animals? Jane Goodall	<u>Plants</u> <i>Plants</i> EQ: What is the basic structure of a plant? Joseph Banks	<u>Changing Seasons</u> <i>Seasons</i> EQ: Is the weather the same everyday? George James Symons	<u>Identify Materials</u> <i>Materials</i> EQ: What are the properties of everyday materials? Charles Mackintosh	<u>Comparing Materials</u> <i>Materials</i> EQ: Do some materials have the same properties? Maria Beasley
2	<u>Living Things/habitats</u> <i>Living Things</i> EQ: What are the differences between things dead, alive and never been alive? Sir Ernest Shackleton	<u>Animals (movement and feeding)</u> <i>Animals including humans</i> EQ: Do all animals eat the same thing? Louis Pasteur	<u>Humans</u> <i>Animals including humans</i> EQ: Is all food good for us? Edward Jenner	<u>Plants</u> <i>Plants</i> EQ: Do plants grow the same amount every day? Agnes Arber		<u>Materials/changing shapes of materials</u> <i>Materials</i> EQ: Can the shape of a solid object change? Cai Lun

3	Movement and feeding <i>Animals including humans</i> EQ: How does our body move and stand up? Marie Curie	Parts of Plants <i>Plants</i> EQ: Do all plants need exactly the same things? Stephen Hales	Rocks <i>Rocks</i> EQ: Are all rocks made in the same way? Rock solid Mary Anning	Forces and Magnets <i>Forces</i> EQ: Are all metals attracted to magnets? Opposites Attract Isaac Newton	Plants <i>Plants</i> EQ: What is the life cycle of a plant? Grow a plant of vegetable Jon Baptista van Helmont	Light <i>Light</i> EQ: Why do shadows change during the day? In the shadows Lewis Latimer
4	Living Things and their Habitats <i>Living Things</i> EQ: Are some animals more alike than others? Make a mini beast hotel Carl Linneaus	Electricity <i>Electricity</i> EQ: Does electricity flow easily through all objects? Hertha Ayrton	Sound <i>Sound</i> EQ: How do we hear sounds? Listen Up Miller Reese Hutchison Alexander Graham Bell	States of matter <i>States of Matter</i> EQ: Can materials change state? Antoine Lavoisier	Animals including humans <i>Animals including humans</i> EQ: Does food stay in the human body? Marie M.Daly	
5	Properties & Changes of Materials <i>Materials</i> EQ: Can we separate materials that have formed together? Stephanie Kwolek	Earth and Space <i>Earth and Space</i> EQ: Do planets, stars and moons in our solar system move? Space balloon project Galileo Galilei	Living Things/Life Cycles <i>Living Things</i> EQ: How are life cycles different across the animal kingdom? Mary Agnes Chase	Forces <i>Forces</i> EQ: Why do objects fall towards the ground? Albert Einstein	Properties & Changes of Materials <i>Types of change</i> <i>Materials</i> EQ: How do you know a chemical reaction is happening? Anders Celsius	Properties & Changes of Materials <i>Separating Mixtures</i> <i>Materials</i> EQ: Can we reverse chemical reactions? Nis Wallerius
6	Evolution <i>Evolution and Inheritance</i> EQ: Why do species of animals look different? From cave man to me Charles Darwin	Electricity <i>Electricity</i> EQ: Is it possible to change how bright a light bulb is or how loud a buzzer is? Michael Faraday	Living Things <i>Living Things</i> EQ: What is the best conditions for microorganisms to grow in? Fecal matters Rachel Carson	No science STEM – Antarctic Explorers	Light <i>Light</i> EQ: Why can I hear around corners but not see around corners? Thomas Edison	Humans <i>Animals including humans</i> EQ: Is our heart rate always the same? Why? Compete in a sporting event Heart dissection Alexander Fleming
	Oak Trees Challenge Link Hi Impact Links					

Science Implementation

In order to ensure that our intent of exciting and inspiring pupil's natural curiosity is met, at Poulton Lancelyn, we ensure that pupils are taught a minimum of one science lesson per week that has a clear focus and learning intention linked to the national curriculum. These clear learning intentions will be planned and assessed against progressive knowledge and skills; this ensures that all lessons build effectively upon children's prior knowledge so that the learning throughout our school is progressive for our pupils to be confident in retrieving prior scientific knowledge. In order for us to be able to inform our planning, and build on prior knowledge, we need to ensure clear assessments are in place. Formative assessments will take place each lesson through teacher observation of work and investigations, alongside a range questioning techniques, to build a detailed picture of a child's understanding throughout a topic. Summative assessments in the form of investigations or quizzes may take place (if necessary) at the end of each topic to clarify formative assessments. Throughout their science education, we aim to deliver adequate opportunities for pupils to work collaboratively and allow their inquisitiveness to guide their learning. All lessons will be planned with our intent in mind so that we provide pupils with motivating, engaging and exciting activities to feed their curiosity. In order to achieve these motivating and engaging lessons, we will ensure that lessons contain a combination of a wide variety of resources, websites, activities and hands-on investigations. Due to our intent of preparing our children for life in an ever-increasingly technological society, we will ensure that opportunities for pupils to develop their technology, maths and engineering skills are woven into our science curriculum and clearly evident in our planning. As well as this, we will ensure that our teaching is pertinent to science with a real life context and encourage pupils to ask relevant questions about the world around them. We will also aim to deliver a cross-curricular approach for English opportunities in science as well, ensuring that our pupils understand, and are able to use, a wide variety of scientific vocabulary. At Poulton Lancelyn, we believe enrichment opportunities can enhance pupils learning experiences and therefore, through working closely with companies such as Hi-Impact and local high schools, we will include as many enrichment opportunities as possible to develop our science teaching further for our pupils.

Poulton Lancelyn Science Knowledge Progression Map

	<u>Autumn1</u>	<u>Autumn2</u>	<u>Spring1</u>	<u>Spring2</u>	<u>Summer1</u>	<u>Summer2</u>
<u>Year 1</u>	<u>Parts of Animals</u> <ul style="list-style-type: none"> - Identify a variety of common animals including fish, amphibians, reptiles, birds and mammals - Describe and compare the structure of a variety of common animals (fish, mammals etc) - Compare features of humans with other animals - Name and identify the main human body parts - Name the five senses - Identify and label the basic parts of the human body and say which part of the body is associated with each sense 	<u>Types of Animals</u> <ul style="list-style-type: none"> - Identifying animals (including pets) - Identifying animals needs and how they vary based on type of animal - Identify and name a variety of common animals that are carnivores, herbivores and omnivores - Know that animals can be sorted into groups by different factors such as what they eat or the features they have 	<u>Plants</u> <ul style="list-style-type: none"> - Know that plants are living things - Identify and name the leaf, flower, root, and stem in plants - Understand the basic needs of caring for a plant - Identify and name common wild and garden plants (including grass and trees) - Identifying types of plants, leaves and trees (including evergreen and deciduous trees) 	<u>Changing Seasons</u> <ul style="list-style-type: none"> - Understand and recognise weather symbols - Record observations of the daily changes weather using symbols - Describe changes in the weather across seasons - Compare how dark or light it is at different points of the day during different seasons - Understand that day length varies in each season 	<u>Identify Materials</u> <ul style="list-style-type: none"> - 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 - Identifying objects made from specific materials - Describe the properties of a variety of materials 	<u>Comparing Materials</u> <ul style="list-style-type: none"> - Ensuring progression from identifying materials to begin to look at purpose of materials - Outline similarities and differences between two different materials - Comparing how materials react in situations (floating etc) - Sorting materials based on their simple physical properties
<u>Year 2</u>	<u>Living Things/habitats</u>	<u>Animals (movement and feeding)</u>	<u>Humans</u> <ul style="list-style-type: none"> - Recognise typical characteristics of and name distinct 	<u>Plants</u> <ul style="list-style-type: none"> - Develop their understanding further of how plants need water, light and a suitable temperature to grow. 	<u>Materials</u> <ul style="list-style-type: none"> - Identify and compare the suitability of a 	

	<ul style="list-style-type: none"> - Identifying living and non-living things - Understand that all living things share similar basic life processes (MRSGREN) - Know that most living things live in habitats which best provide for their basic needs - Recognise that different plants and animals live in different habitats - Know that it would be difficult for some living things to survive in habitats to which they are not suited - Understand that within habitats there may be smaller habitats called micro-habitats. - Identify and name a variety of plants and animals in their habitats, including micro-habitats. 	<ul style="list-style-type: none"> - Link to MRSGREN (from living things and humans topic) about the needs of animals. - Know that animals, including humans, need to eat, drink and breathe to stay alive. - Understand that different animals eat different food. (omnivore, carnivore, herbivore) developed from Y1 understanding (include food chains) - Life cycles of animals and humans - notice that animals, including humans, have offspring which grow into adults. 	<ul style="list-style-type: none"> - phases of human growth (baby, toddler, child, teenager and adult). - Understand the importance for humans of eating the right amount of different types of food. - Describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene. 	<ul style="list-style-type: none"> - Observe and describe how seeds and bulbs grow into mature plants - Understand that plant growth is a long process and that plants change their appearance over time as they grow. - Understand that plants can produce seeds and new plants without human intervention. 	<ul style="list-style-type: none"> - variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses - Develop vocabulary of classification of materials from Y1 (waterproof, absorbent, brittle etc) - Design their own product out of a specific material with reasoning - <u>Changing shapes of materials</u> - Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching - Compare materials that change their shape by squashing, bending, twisting or stretching
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Year 3	<u>Movement and feeding</u> <ul style="list-style-type: none"> - Identify that humans and some other animals have skeletons and muscles for support, protection and movement - Name some common bones - Describe how muscles and tendons contract and relax to help with movement - Know why we need different types of food to stay healthy - Detailed understanding of what makes a healthy lifestyle - Identify different food types and their importance in a balanced diet 	<u>Parts of plants</u> <ul style="list-style-type: none"> - Be able to identify the roots, stem/trunk, leaves and flowers of a plant - Be able to describe the functions of each part of the plant - Investigate and describe how water moves from the soil into a plant's roots and up through the stem - Know that flowers are the parts of the plant where reproduction (new seed production) happens 	<u>Rocks</u> <ul style="list-style-type: none"> - Understand that different rocks have different observable features, e.g. colour - Be able to describe some simple properties of rocks, e.g. hardness - Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties - Be able to describe how sedimentary rock is formed - Describe in simple terms how fossils are formed when things that have lived are trapped within rock - Understand that soil contains small parts of rocks 	<u>Forces and Magnets</u> <ul style="list-style-type: none"> - Notice that some forces need contact between two objects, but magnetic forces can act at a distance - Recall and use the terms 'attract' and 'repel' accurately - Identify materials that are magnetic and those which are non-magnetic - 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 - Recall that the poles of a magnet are described as North and South 	<u>Plants</u> <ul style="list-style-type: none"> - Continuation of what plants need – Know that without air, light, water and nutrients a plant will not thrive - Explore the requirements of plants for life and growth (air, light, water, nutrients, room to grow) and how they vary from plant to plant - Understand that soil provides the nutrients to help plants grow - Be able to sequence the life cycle of a flowering plant 	<u>Light</u> <ul style="list-style-type: none"> - Recognise that they need light in order to see things and that dark is the absence of light - Recognise that shiny objects can reflect light - Notice that light is reflected from surfaces - Know that the Sun is a powerful source of light - Recognise that light from the sun can be dangerous and that there are ways to protect their eyes - Know that some materials block light - Recognise that shadows are formed when the light from a light source is blocked by a solid object - Make and record observations and measurements of shadows - Find patterns in the way that the size of shadows change
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				<ul style="list-style-type: none"> - Predict whether two magnets will attract or repel each other, depending on which poles are facing 		
<u>Year 4</u>	<u>Living Things and their Habitats</u> <ul style="list-style-type: none"> - Recognise that there is a vast array of living things that can be grouped - Understand that environments can be changed in positive ways, e.g. the creation of nature reserves, and in negative ways, e.g. deforestation - Identify ways in which humans can reduce the effects of environmental change - Recognise that environments can change and that this can sometimes pose dangers to living things 	<u>Electricity</u> <ul style="list-style-type: none"> - 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 - Record in their own way how to make a bulb light and/or a buzzer buzz - Describe how to use a switch to turn off a light or to stop a buzzer buzzing - Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a 	<u>Sound</u> <ul style="list-style-type: none"> - Know that sound can travel through solids, liquids and gases - Recognise that vibrations from sounds travel through a medium to the ear - Recognise that sounds can be classified in different ways, e.g. loud, quiet, high, low - Know that the highness or lowness of a sound is called the pitch of the sound - Identify features of an object that can be changed to alter its pitch, e.g. length of tube, length of 	<u>States of matter</u> <ul style="list-style-type: none"> - Know that collectively, solids, liquids and gases are called the states of matter - Compare and group materials together, according to whether they are solids, liquids or gases - Be able to identify the state of matter of a material by its physical properties - Understand that the state of a material can be changed - Observe that some materials change state when they are heated or cooled, and measure or research the temperature at 	<u>Animals including humans</u> <ul style="list-style-type: none"> - Know that the human body has organs and be able to name some - Understand that some groups of organs work together in a system - Recognise that humans have a body system which digests (breaks down) food - Be able to name and describe the main organs of the digestive system: teeth, mouth, tongue, oesophagus, stomach, small and large intestines, rectum and anus - Be able to identify and name the main types of teeth in humans: incisor, canine, pre-molar, molar - Understand that the shape of a tooth is linked to its function, e.g. slicing, tearing, chewing or grinding food - Construct and interpret a variety of food chains, identifying producers, predators and prey - Know that food is a basic need and the availability of food affects the animals found in an environment - Know that green plants are producers because they make their own food 	

	<ul style="list-style-type: none"> - Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment (in preparation for branching in Y6) - Use more than one way to sort the same group of living things - Use a simple classification key to identify and name a living thing - 	<ul style="list-style-type: none"> - complete loop with a battery - Explain what an electrical conductor and insulator are - Test and then classify objects as those that conduct electricity and those that do not - Recognise some common conductors and insulators, and associate metals with being good conductors 	<ul style="list-style-type: none"> - string, tension of string - Know that the volume of sounds can be measured with a sound meter (data logger) - Find patterns between the volume of a sound and the strength of the vibrations that produced it - Know that the unit of measurement of volume is a decibel (dB) - Recognise that sounds gets fainter as the distance from the sound source increases 	<ul style="list-style-type: none"> - 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 - Know that temperature is a measure of how hot or cold something is and is measured in degrees Celsius using a thermometer (°C) - Be able to describe the changes of state in the water cycle - Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature 	<ul style="list-style-type: none"> - Define a predator as an animal that eats another animal and prey as an animal that gets eaten by another animal 	
<u>Year 5</u>	<u>Materials</u>	<u>Earth and Space</u>	<u>Living Things/Life Cycles</u>	<u>Forces</u>	<u>Types of change</u>	<u>Types of change</u>

	<ul style="list-style-type: none"> - Understand what is meant by a material's hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets - 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 a variety of materials may be suitable for an object based on the properties of the materials - Test properties of a material to establish their 	<ul style="list-style-type: none"> - Describe the sun, Earth and moon as approximately spherical bodies in the solar system - Know that the planets, including Earth, move around the Sun - Understand that by spinning on its axis, some parts of the Earth are in daylight when other parts are in darkness (link to seasons work in Y1 and light/shadows work in Y4/6) - 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 - Understand that a moon is a celestial body that orbits a planet 	<ul style="list-style-type: none"> - Recall the stages of a life cycle of a human as (progression from Y2) - Know that all life cycles have distinct stages - Be able to describe the process of metamorphosis - Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird - Be able to describe and sequence parts of plant and animal life cycles - Understand that sexual reproduction in plants and animals requires fertilisation to occur, i.e. between two parents - Know that some plants can reproduce without other plants 	<ul style="list-style-type: none"> - Know that gravity is an invisible force that pulls falling objects back to Earth - Describe how friction acts on moving objects to slow them down - Understand how friction can be used to improve how well an object grips to a surface - Describe how air resistance reduces the speed at which objects fall - Describe how water resistance slows down moving objects - Recall the terms 'spring', 'lever', 'pulley' and 'gear' ('cog') - Describe how the use of levers, pulleys and other simple machines reduces the amount of effort needed to move things 	<ul style="list-style-type: none"> - Recall the terms 'dissolving', 'mixing', 'melting', 'freezing', 'evaporation' and 'condensation' from earlier work - Know that some materials will dissolve in liquid to form a solution, describe how to recover a substance from a solution - Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating - Demonstrate that dissolving, mixing and changes of state are reversible changes - Explain that some changes result in the formation of new materials – this is usually not reversible (e.g. burning or acid on bicarb soda) 	<ul style="list-style-type: none"> - Recall the terms 'dissolving', 'mixing', 'melting', 'freezing', 'evaporation' and 'condensation' from earlier work - Know that some materials will dissolve in liquid to form a solution, describe how to recover a substance from a solution - Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating - Demonstrate that dissolving, mixing and changes of state are reversible changes - Explain that some changes result in the formation of new materials – this is usually not reversible (e.g. burning or acid on bicarb soda)
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	suitability or not for a given purpose				burning or acid on bicarb soda)	
<u>Year 6</u>	<u>Evolution</u> <ul style="list-style-type: none">- Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago- Know that living things reproduce offspring similar to themselves but not identical- Recognise that small inherited changes in physical characteristics, e.g. colour, size, shape of limbs etc. over time lead to variation in species- Know that some adaptations to the environment in plants or animals can be advantageous if they keep the species alive for	<u>Electricity</u> <ul style="list-style-type: none">- 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 (application of this through making a burglar alarm)- Understand the need for universally recognised symbols for electrical component (developed from Y4 identifying circuits)- Identify recognised electrical component	<u>Living Things</u> <ul style="list-style-type: none">- Know that germs and bacteria are living organisms called micro-organisms (developed from previous living things learning)- Identify the conditions needed to support the growth of micro-organisms- 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- Know that there is a scientific system for classifying living things (learning	<u>Light</u> <ul style="list-style-type: none">- Know that light can be reflected from shiny surfaces and be able to name some reflectors (developed from Y3)- Recognise that light appears to travel in straight lines- Know that without light we cannot see- 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- Understand that when opaque materials block the path of light a shadow can be cast- Know that shadows are similar in shape to the objects which make them (developed from shadows work in Y3)	<u>Humans</u> <ul style="list-style-type: none">- Know that the human body contains organs (developed from Y3 and 4)- Know that together the heart, blood vessels and blood form the circulatory system (link back to digestive system in Y4)- Understand that blood picks up oxygen from the lungs and transports it through blood vessels to all of our organs- Know that the substances in food that help us to grow and repair our bodies are termed 'nutrients' (developed from healthy lifestyle in Y2, 3 and 4)- Understand that it is the circulatory system that	

	<p>long enough to reproduce and pass on their features to a new generation</p> <ul style="list-style-type: none"> - Know that variation in offspring over time can make animals more or less able to survive in particular environments 	<p>symbols for a bulb, buzzer, battery (cell), wire, switch and motor</p> <ul style="list-style-type: none"> - Use recognised symbols when representing a simple circuit in a diagram (recap from Y4) - Link renewable energy via environment topic 	<p>about Carl Linnaeus)</p> <ul style="list-style-type: none"> - Give reasons for classifying plants and animals based on specific characteristics 		<p>transports water and nutrients around our bodies</p> <ul style="list-style-type: none"> - Understand that some aspects of a person's lifestyle, e.g. lack of exercise, taking narcotics, will have an effect on the way their body functions (developed from healthy lifestyle in Y2, 3 and 4)
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Poulton Lancelyn Science Progression Map

Working Scientifically



	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
<u>Observing and Measuring Changes Over Time</u>	<p>Understand that observation involves using our sense</p> <p>Use simple equipment (hand lenses) to make close and careful observations</p> <p>Select appropriate equipment to make observations</p>	<p>Recognise that some observable features can change over time (e.g. plant growth)</p> <p>Choose appropriate equipment to make observations</p> <p>Use equipment to correctly observe and measure</p>	<p>Make increasingly careful observations (focusing on accuracy)</p> <p>Accurately use standard measures</p> <p>Explain why particular equipment is an appropriate choice for a task</p> <p>Decide for how long to make observations for</p>	<p>Decide what is important and relevant to measure and observe</p> <p>Make systematic observations</p> <p>Use new equipment, such as data loggers, appropriately</p> <p>Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment</p>	<p>Choose the most appropriate equipment to make measurements and explain how to use it accurately</p> <p>Recognise that some measurements or observations may need to be repeated</p> <p>Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate</p>	<p>Recognise when measurements or data are unreliable and be able to take steps to improve this</p> <p>Explain how repeating measurements impacts on data collection</p> <p>Make their own decisions about what observations to make, what measurements to use and for how long to make them, and whether to repeat them</p>
<u>Comparative and Fair Tests</u>	<p>Be able to compare features of two objects</p> <p>Suggest a practical way to find something out</p>	<p>Be able to identify two variables in an investigation e.g. water and light in a plant investigation</p>	<p>Make decisions about which practical method is best to find something out</p>	<p>Identify variables to measure and variables to observe</p> <p>Understand how to make a test fair</p>	<p>Select and plan the most appropriate type of scientific enquiry to answer a scientific question</p>	<p>Be able to state clearly which is the change variable and which is the measurement</p>

	<p>Be able to identify things to observe and things to measure</p> <p>Understand what we mean by comparing</p> <p>Perform simple tests</p>	<p>Be able to set up a comparative test</p> <p>Start to recognise when a test isn't fair and suggest improvements</p>	<p>Recognise when a simple fair test is necessary to answer a scientific question</p> <p>Set up a fair test – identifying and understanding the variables involved</p>	<p>Set up simple practical enquiries, comparative and fair tests</p> <p>Be able to develop features of a test to give a better outcome</p>	<p>Recognise when and how to set up comparative and fair tests and explain which variables need to be controlled and why</p> <p>Be able to use their results to identify when further tests and observations might be needed</p> <p>Recognise the limitations of tests</p>	<p>variable in a fair test</p> <p>Systematically identify the effect of changing one variable at a time</p> <p>Using test results to make predictions to set up further comparative and fair tests</p> <p>Compare their own results with others' and suggest reasons why there may be differences</p>
<u>Identifying and Classifying</u>	<p>Sort and match objects and living things in their own way</p> <p>Recognise similarities and differences</p> <p>Use observable features of objects to sort them</p> <p>Explain which observable features have led them to classify in a particular way</p>	<p>Sort and group living things and objects in their own way</p> <p>Use simple observable features to compare objects and living things</p> <p>Be able to explain why they have sorted objects in that way</p> <p>Begin to classify and identify by linking observable features to already known objects or things</p>	<p>Be able to group objects and living things in different ways</p> <p>Use observable features of objects to identify them</p> <p>Begin to classify by behavioural features, e.g. is magnetic</p> <p>Talk about criteria for grouping, sorting and classifying</p>	<p>Use simple keys</p> <p>Begin to classify and identify by linking observable features to already known objects or things</p> <p>Identifying differences, similarities or changes related to simple scientific ideas or processes</p> <p>Be able, independently, to use simple databases or keys to identify or classify living</p>	<p>Suggest reasons for similarities and differences</p> <p>Create and use a variety of sources to identify and classify living things, objects and phenomena</p> <p>Use and develop keys and other information records to identify, classify and describe living things and materials</p>	<p>Create more complex forms of classification tools, e.g. databases, branching keys</p> <p>Begin to understand that broad groupings, such as micro-organisms, plants and animals can be subdivided</p> <p>Be able to discuss reasons why living things are placed in one group and not another</p>

				things, objects or events		
Looking for naturally occurring patterns and relationships	<p>Notice what has changed when observing things or events</p> <p>Talk about what they have found out or what they think may happen</p> <p>Using their observations and ideas to suggest answers to questions</p> <p>Say whether what happened was what they expected</p>	<p>Begin to recognise links between observations and answers to questions</p> <p>Begin to use simple scientific language to talk about what they have found out</p> <p>Be able to communicate their ideas to a range of audiences in a variety of ways</p> <p>Use evidence to suggest answers to questions and make predictions</p>	<p>Notice patterns and relationships</p> <p>With help, look for changes, patterns, similarities and differences in their data</p> <p>Use evidence to answer questions and make predictions</p> <p>With support, identify new questions arising from the data</p> <p>Find ways of improving what they have already done</p> <p>Link results to their own experiences</p>	<p>Look for naturally occurring patterns and relationships and decide what data to collect to identify them</p> <p>Be able to collect data from their own observations and measurements</p> <p>Make predictions for new values within or beyond the data they have collected</p> <p>Recognise when a result seems unusual when compared with other values</p>	<p>Identify patterns that might be found in the natural environment</p> <p>Look for different causal relationships in their data and identify evidence that refutes or supports their ideas</p> <p>Find out about how scientific ideas have changed and developed over time as new evidence is discovered, e.g. ideas about the solar system</p>	<p>Systematically investigate the relationship between phenomena, e.g. light and shadows</p> <p>Be able to identify and offer explanations for anomalous results</p> <p>Analyse functions, relationships and interactions more systematically</p>
<u>Recording and Reporting Findings</u>	<p>Be able to record their findings in charts</p> <p>Gathering and recording data to help in answering questions</p>	<p>Make some independent choices about appropriate ways to record data</p> <p>Select the best way of presenting information from a range of options</p>	<p>Identify relevant evidence to draw conclusions</p> <p>Using straightforward scientific evidence to answer questions or to support their findings</p>	<p>Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions</p> <p>Explain findings reported and recorded using</p>	<p>Decide how to record data from a choice of familiar approaches</p> <p>Justify what type of presentation is appropriate to use</p> <p>Explain findings using data to identify causal relationships</p>	<p>Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs</p>

			Use scientific language and facts to describe processes and what they have observed	more complex scientific language	Decide on the most appropriate method to present findings graphically, e.g. using a line graph or bar chart for different types of 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
<u>Researching</u> <u>Using</u> <u>Secondary</u> <u>Sources</u>	Use information from secondary sources to help answer a question	Use simple secondary sources, e.g. books, film, internet, to find information	Recognise when and how secondary sources might help answer questions that cannot be answered through practical investigations	Recognise when and how secondary sources might help answer questions that cannot be answered through practical investigations	Recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact	Use secondary sources, e.g. internet links to research objects, events and phenomena that cannot be experienced in the classroom, e.g. animals from around the world



Department
for Education

Science programmes of study: key stages 1 and 2

National curriculum in England

September 2013

Contents

Key stage 1	5
Key stage 1 programme of study – years 1 and 2	6
Year 1 programme of study	7
Year 2 programme of study	10
Lower key stage 2 – years 3 and 4	13
Lower key stage 2 programme of study	14
Year 3 programme of study	16
Year 4 programme of study	20
Upper key stage 2 – years 5 and 6	24
Upper key stage 2 programme of study	25
Year 5 programme of study	27
Year 6 programme of study	31

Purpose of study

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

Aims

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

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

Scientific knowledge and conceptual understanding

The programmes of study describe a sequence of knowledge and concepts. While it is important that pupils make progress, it is also vitally important that they develop secure understanding of each key block of knowledge and concepts in order to progress to the next stage. Insecure, superficial understanding will not allow genuine progression: pupils may struggle at key points of transition (such as between primary and secondary school), build up serious misconceptions, and/or have significant difficulties in understanding higher-order content.

Pupils should be able to describe associated processes and key characteristics in common language, but they should also be familiar with, and use, technical terminology accurately and precisely. They should build up an extended specialist vocabulary. They should also apply their mathematical knowledge to their understanding of science, including collecting, presenting and analysing data. The social and economic implications of science are important but, generally, they are taught most appropriately within the wider school curriculum: teachers will wish to use different contexts to maximise their pupils' engagement with and motivation to study science.

The nature, processes and methods of science

'Working scientifically' specifies the understanding of the nature, processes and methods of science for each year group. It should not be taught as a separate strand. The notes and guidance give examples of how 'working scientifically' might be embedded within the content of biology, chemistry and physics, focusing on the key features of scientific enquiry, so that pupils learn to use a variety of approaches to answer relevant scientific questions. These types of scientific enquiry should include: observing over time; pattern seeking; identifying, classifying and grouping; comparative and fair testing (controlled investigations); and researching using secondary sources. Pupils should seek answers to questions through collecting, analysing and presenting data. 'Working scientifically' will be developed further at key stages 3 and 4, once pupils have built up sufficient understanding of science to engage meaningfully in more sophisticated discussion of experimental design and control.

Spoken language

The national curriculum for science reflects the importance of spoken language in pupils' development across the whole curriculum – cognitively, socially and linguistically. The quality and variety of language that pupils hear and speak are key factors in developing their scientific vocabulary and articulating scientific concepts clearly and precisely. They must be assisted in making their thinking clear, both to themselves and others, and teachers should ensure that pupils build secure foundations by using discussion to probe and remedy their misconceptions.

School curriculum

The programmes of study for science are set out year-by-year for key stages 1 and 2. Schools are, however, only required to teach the relevant programme of study by the end of the key stage. Within each key stage, schools therefore have the flexibility to introduce content earlier or later than set out in the programme of study. In addition, schools can introduce key stage content during an earlier key stage if appropriate. All schools are also required to set out their school curriculum for science on a year-by-year basis and make this information available online.

Attainment targets

By the end of each key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the relevant programme of study.

Schools are not required by law to teach the content indicated as being 'non-statutory'.

Key stage 1

The principal focus of science teaching in key stage 1 is to enable pupils to experience and observe phenomena, looking more closely at the natural and humanly-constructed world around them. They should be encouraged to be curious and ask questions about what they notice. They should be helped to develop their understanding of scientific ideas by using different types of scientific enquiry to answer their own questions, including observing changes over a period of time, noticing patterns, grouping and classifying things, carrying out simple comparative tests, and finding things out using secondary sources of information. They should begin to use simple scientific language to talk about what they have found out and communicate their ideas to a range of audiences in a variety of ways. Most of the learning about science should be done through the use of first-hand practical experiences, but there should also be some use of appropriate secondary sources, such as books, photographs and videos.

'Working scientifically' is described separately in the programme of study, but must **always** be taught through and clearly related to the teaching of substantive science content in the programme of study. Throughout the notes and guidance, examples show how scientific methods and skills might be linked to specific elements of the content.

Pupils should read and spell scientific vocabulary at a level consistent with their increasing word reading and spelling knowledge at key stage 1.

Key stage 1 programme of study – years 1 and 2

Working scientifically

Statutory requirements

During years 1 and 2, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking simple questions and recognising that they can be answered in different ways
- observing closely, using simple equipment
- performing simple tests
- identifying and classifying
- using their observations and ideas to suggest answers to questions
- gathering and recording data to help in answering questions.

Notes and guidance (non-statutory)

Pupils in years 1 and 2 should explore the world around them and raise their own questions. They should experience different types of scientific enquiries, including practical activities, and begin to recognise ways in which they might answer scientific questions. They should use simple features to compare objects, materials and living things and, with help, decide how to sort and group them, observe changes over time, and, with guidance, they should begin to notice patterns and relationships. They should ask people questions and use simple secondary sources to find answers. They should use simple measurements and equipment (for example, hand lenses, egg timers) to gather data, carry out simple tests, record simple data, and talk about what they have found out and how they found it out. With help, they should record and communicate their findings in a range of ways and begin to use simple scientific language.

These opportunities for working scientifically should be provided across years 1 and 2 so that the expectations in the programme of study can be met by the end of year 2. Pupils are not expected to cover each aspect for every area of study.

Year 1 programme of study

Plants

Statutory requirements

Pupils should be taught to:

- identify and name a variety of common wild and garden plants, including deciduous and evergreen trees
- identify and describe the basic structure of a variety of common flowering plants, including trees.

Notes and guidance (non-statutory)

Pupils should use the local environment throughout the year to explore and answer questions about plants growing in their habitat. Where possible, they should observe the growth of flowers and vegetables that they have planted.

They should become familiar with common names of flowers, examples of deciduous and evergreen trees, and plant structures (including leaves, flowers (blossom), petals, fruit, roots, bulb, seed, trunk, branches, stem).

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.

Animals, including humans

Statutory requirements

Pupils should be taught to:

- identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals
- identify and name a variety of common animals that are carnivores, herbivores and omnivores

Statutory requirements

- describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)
- identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.

Notes and guidance (non-statutory)

Pupils should use the local environment throughout the year to explore and answer questions about animals in their habitat. They should understand how to take care of animals taken from their local environment and the need to return them safely after study. Pupils should become familiar with the common names of some fish, amphibians, reptiles, birds and mammals, including those that are kept as pets.

Pupils should have plenty of opportunities to learn the names of the main body parts (including head, neck, arms, elbows, legs, knees, face, ears, eyes, hair, mouth, teeth) through games, actions, songs and rhymes.

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.

Everyday materials

Statutory requirements

Pupils should be taught to:

- distinguish between an object and the material from which it is made
- identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock
- describe the simple physical properties of a variety of everyday materials
- compare and group together a variety of everyday materials on the basis of their simple physical properties.

Notes and guidance (non-statutory)

Pupils should explore, name, discuss and raise and answer questions about everyday materials so that they become familiar with the names of materials and properties such as: hard/soft; stretchy/stiff; shiny/dull; rough/smooth; bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent; opaque/transparent. Pupils should explore and experiment with a wide variety of materials, not only those listed in the programme of study, but including for example: brick, paper, fabrics, elastic, foil.

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?'

Seasonal changes

Statutory requirements

Pupils should be taught to:

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

Notes and guidance (non-statutory)

Pupils should observe and talk about changes in the weather and the seasons.

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.

Year 2 programme of study

Living things and their habitats

Statutory requirements

Pupils should be taught to:

- explore and compare the differences between things that are living, dead, and things that have never been alive
- identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other
- identify and name a variety of plants and animals in their habitats, including 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.

Notes and guidance (non-statutory)

Pupils should be introduced to the idea that all living things have certain characteristics that are essential for keeping them alive and healthy. They should raise and answer questions that help them to become familiar with the life processes that are common to all living things. Pupils should be introduced to the terms 'habitat' (a natural environment or home of a variety of plants and animals) and 'micro-habitat' (a very small habitat, for example for woodlice under stones, logs or leaf litter). They should raise and answer questions about the local environment that help them to identify and study a variety of plants and animals within their habitat and observe how living things depend on each other, for example, plants serving as a source of food and shelter for animals. Pupils should compare animals in familiar habitats with animals found in less familiar habitats, for example, on the seashore, in woodland, in the ocean, in the rainforest.

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.

Plants

Statutory requirements

Pupils should be taught to:

- observe and describe how seeds and bulbs grow into mature plants
- find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

Notes and guidance (non-statutory)

Pupils should use the local environment throughout the year to observe how different plants grow. Pupils should be introduced to the requirements of plants for germination, growth and survival, as well as to the processes of reproduction and growth in plants.

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.

Animals, including humans

Statutory requirements

Pupils should be taught to:

- notice that animals, including humans, have offspring which grow into adults
- find out about and describe the basic needs of animals, including humans, for survival (water, food and air)
- describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.

Notes and guidance (non-statutory)

Pupils should be introduced to the basic needs of animals for survival, as well as the importance of exercise and nutrition for humans. They should also be introduced to the processes of reproduction and growth in animals. The focus at this stage should be on questions that help pupils to recognise growth; they should not be expected to understand how reproduction occurs.

Notes and guidance (non-statutory)

The following examples might be used: egg, chick, chicken; egg, caterpillar, pupa, butterfly; spawn, tadpole, frog; lamb, sheep. Growing into adults can include reference to baby, toddler, child, teenager, adult.

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.

Uses of everyday materials

Statutory requirements

Pupils should be taught to:

- identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses
- find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.

Notes and guidance (non-statutory)

Pupils should identify and discuss the uses of different everyday materials so that they become familiar with how some materials are used for more than one thing (metal can be used for coins, cans, cars and table legs; wood can be used for matches, floors, and telegraph poles) or different materials are used for the same thing (spoons can be made from plastic, wood, metal, but not normally from glass). They should think about the properties of materials that make them suitable or unsuitable for particular purposes and they should be encouraged to think about unusual and creative uses for everyday materials. Pupils might find out about people who have developed useful new materials, for example John Dunlop, Charles Macintosh or John McAdam.

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.

Lower key stage 2 – years 3 and 4

The principal focus of science teaching in lower key stage 2 is to enable pupils to broaden their scientific view of the world around them. They should do this through exploring, talking about, testing and developing ideas about everyday phenomena and the relationships between living things and familiar environments, and by beginning to develop their ideas about functions, relationships and interactions. They should ask their own questions about what they observe and make some decisions about which types of scientific enquiry are likely to be the best ways of answering them, including observing changes over time, noticing patterns, grouping and classifying things, carrying out simple comparative and fair tests and finding things out using secondary sources of information. They should draw simple conclusions and use some scientific language, first, to talk about and, later, to write about what they have found out.

'Working scientifically' is described separately at the beginning of the programme of study, but must **always** be taught through and clearly related to substantive science content in the programme of study. Throughout the notes and guidance, examples show how scientific methods and skills might be linked to specific elements of the content.

Pupils should read and spell scientific vocabulary correctly and with confidence, using their growing word reading and spelling knowledge.

Lower key stage 2 programme of study

Working scientifically

Statutory requirements

During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Notes and guidance (non-statutory)

Pupils in years 3 and 4 should be given a range of scientific experiences to enable them to raise their own questions about the world around them. They should start to make their own decisions about the most appropriate type of scientific enquiry they might use to answer questions; recognise when a simple fair test is necessary and help to decide how to set it up; talk about criteria for grouping, sorting and classifying; and use simple keys. They should begin to look for naturally occurring patterns and relationships and decide what data to collect to identify them. They should help to make decisions about what observations to make, how long to make them for and the type of simple equipment that might be used.

Notes and guidance (non-statutory)

They should learn how to use new equipment, such as data loggers, appropriately. They should collect data from their own observations and measurements, using notes, simple tables and standard units, and help to make decisions about how to record and analyse this data. With help, pupils should look for changes, patterns, similarities and differences in their data in order to draw simple conclusions and answer questions. With support, they should identify new questions arising from the data, making predictions for new values within or beyond the data they have collected and finding ways of improving what they have already done. They should also recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations. Pupils should use relevant scientific language to discuss their ideas and communicate their findings in ways that are appropriate for different audiences.

These opportunities for working scientifically should be provided across years 3 and 4 so that the expectations in the programme of study can be met by the end of year 4. Pupils are not expected to cover each aspect for every area of study.

Year 3 programme of study**Plants****Statutory requirements**

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.

Notes and guidance (non-statutory)

Pupils should be introduced to the relationship between structure and function: the idea that every part has a job to do. They should explore questions that focus on the role of the roots and stem in nutrition and support, leaves for nutrition and flowers for reproduction.

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.

Animals, including humans

Statutory requirements

Pupils should be taught to:

- identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat
- identify that humans and some other animals have skeletons and muscles for support, protection and movement.

Notes and guidance (non-statutory)

Pupils should continue to learn about the importance of nutrition and should be introduced to the main body parts associated with the skeleton and muscles, finding out how different parts of the body have special functions.

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.

Rocks

Statutory requirements

Pupils should be taught to:

- compare and group together different kinds of rocks on the basis of their appearance and simple physical properties
- describe in simple terms how fossils are formed when things that have lived are trapped within rock
- recognise that soils are made from rocks and organic matter.

Notes and guidance (non-statutory)

Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.

Notes and guidance (non-statutory)

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.

Light

Statutory requirements

Pupils should be taught to:

- recognise that they need light in order to see things and that dark is the absence of light
- notice that light is reflected from surfaces
- recognise that light from the sun can be dangerous and that there are ways to protect their eyes
- recognise that shadows are formed when the light from a light source is blocked by an opaque object
- find patterns in the way that the size of shadows change.

Notes and guidance (non-statutory)

Pupils should explore what happens when light reflects off a mirror or other reflective surfaces, including playing mirror games to help them to answer questions about how light behaves. They should think about why it is important to protect their eyes from bright lights. They should look for, and measure, shadows, and find out how they are formed and what might cause the shadows to change.

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.

Forces and magnets

Statutory requirements

Pupils should be taught to:

- 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.

Notes and guidance (non-statutory)

Pupils should observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe).

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.

Year 4 programme of study

Living things and their habitats

Statutory requirements

Pupils should be taught to:

- recognise that living things can be grouped in a variety of ways
- explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment
- recognise that environments can change and that this can sometimes pose dangers to living things.

Notes and guidance (non-statutory)

Pupils should use the local environment throughout the year to raise and answer questions that help them to identify and study plants and animals in their habitat. They should identify how the habitat changes throughout the year. Pupils should explore possible ways of grouping a wide selection of living things that include animals and flowering plants and non-flowering plants. Pupils could begin to put vertebrate animals into groups such as fish, amphibians, reptiles, birds, and mammals; and invertebrates into snails and slugs, worms, spiders, and insects.

Note: Plants can be grouped into categories such as flowering plants (including grasses) and non-flowering plants, such as ferns and mosses.

Pupils should explore examples of human impact (both positive and negative) on environments, for example, the positive effects of nature reserves, ecologically planned parks, or garden ponds, and the negative effects of population and development, litter or deforestation.

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.

Animals, including humans**Statutory requirements**

Pupils should be taught to:

- describe the simple functions of the basic parts of the digestive system in humans
- identify the different types of teeth in humans and their simple functions
- construct and interpret a variety of food chains, identifying producers, predators and prey.

Notes and guidance (non-statutory)

Pupils should be introduced to the main body parts associated with the digestive system, for example, mouth, tongue, teeth, oesophagus, stomach and small and large intestine and explore questions that help them to understand their special functions.

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.

States of matter**Statutory requirements**

Pupils should be taught to:

- compare and group materials together, according to whether they are solids, liquids or gases
- observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)
- identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.

Notes and guidance (non-statutory)

Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter (solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container). Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled.

Notes and guidance (non-statutory)

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.

Sound**Statutory requirements**

Pupils should be taught to:

- identify how sounds are made, associating some of them with something vibrating
- recognise that vibrations from sounds travel through a medium to the ear
- find patterns between the pitch of a sound and features of the object that produced it
- find patterns between the volume of a sound and the strength of the vibrations that produced it
- recognise that sounds get fainter as the distance from the sound source increases.

Notes and guidance (non-statutory)

Pupils should explore and identify the way sound is made through vibration in a range of different musical instruments from around the world; and find out how the pitch and volume of sounds can be changed in a variety of ways.

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.

Electricity

Statutory requirements

Pupils should be taught to:

- identify common appliances that run on electricity
- construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
- identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery
- recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
- recognise some common conductors and insulators, and associate metals with being good conductors.

Notes and guidance (non-statutory)

Pupils should construct simple series circuits, trying different components, for example, bulbs, buzzers and motors, and including switches, and use their circuits to create simple devices. Pupils should draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols at this stage; these will be introduced in year 6.

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.

Upper key stage 2 – years 5 and 6

The principal focus of science teaching in upper key stage 2 is to enable pupils to develop a deeper understanding of a wide range of scientific ideas. They should do this through exploring and talking about their ideas; asking their own questions about scientific phenomena; and analysing functions, relationships and interactions more systematically. At upper key stage 2, they should encounter more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates. They should also begin to recognise that scientific ideas change and develop over time. They should select the most appropriate ways to answer science questions using different types of scientific enquiry, including observing changes over different periods of time, noticing patterns, grouping and classifying things, carrying out comparative and fair tests and finding things out using a wide range of secondary sources of information. Pupils should draw conclusions based on their data and observations, use evidence to justify their ideas, and use their scientific knowledge and understanding to explain their findings.

'Working and thinking scientifically' is described separately at the beginning of the programme of study, but must **always** be taught through and clearly related to substantive science content in the programme of study. Throughout the notes and guidance, examples show how scientific methods and skills might be linked to specific elements of the content.

Pupils should read, spell and pronounce scientific vocabulary correctly.

Upper key stage 2 programme of study

Working scientifically

Statutory requirements

During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and 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.

Notes and guidance (non-statutory)

Pupils in years 5 and 6 should use their science experiences to: explore ideas and raise different kinds of questions; 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. They should use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment. They should make their own decisions about what observations to make, what measurements to use and how long to make them for, and whether to repeat them; choose the most appropriate equipment to make measurements and explain how to use it accurately. They should decide how to record data from a choice of familiar approaches; look for different causal relationships in their data and identify evidence that refutes or supports their ideas. They should use their results to identify when further tests and observations might be needed; recognise which secondary sources will be most useful to research their ideas and begin to separate opinion from fact. They should use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas and should talk about how scientific ideas have developed over time.

Notes and guidance (non-statutory)

These opportunities for working scientifically should be provided across years 5 and 6 so that the expectations in the programme of study can be met by the end of year 6. Pupils are not expected to cover each aspect for every area of study.

Year 5 programme of study

Living things and their habitats

Statutory requirements

Pupils should be taught to:

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

Notes and guidance (non-statutory)

Pupils should study and raise questions about their local environment throughout the year. They should observe life-cycle changes in a variety of living things, for example, plants in the vegetable garden or flower border, and animals in the local environment. They should find out about the work of naturalists and animal behaviourists, for example, David Attenborough and Jane Goodall.

Pupils should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals.

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 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.

Animals, including humans

Statutory requirements

Pupils should be taught to:

- describe the changes as humans develop to old age.

Notes and guidance (non-statutory)

Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty.

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.

Properties and changes of materials

Statutory requirements

Pupils should be taught to:

- compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets
- know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
- use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating
- give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
- demonstrate that dissolving, mixing and changes of state are reversible changes
- explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.

Notes and guidance (non-statutory)

Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.

Notes and guidance (non-statutory)

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.

Earth and space**Statutory requirements**

Pupils should be taught to:

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

Notes and guidance (non-statutory)

Pupils should be introduced to a model of the Sun and Earth that enables them to explain day and night. Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a 'dwarf planet' in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).

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

Notes and guidance (non-statutory)

Pupils should find out about the way that ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus.

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.

Forces**Statutory requirements**

Pupils should be taught to:

- explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
- identify the effects of air resistance, water resistance and friction, that act between moving surfaces
- recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

Notes and guidance (non-statutory)

Pupils should explore falling objects and raise questions about the effects of air resistance. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists, for example, Galileo Galilei and Isaac Newton helped to develop the theory of gravitation.

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 design and make products that use levers, pulleys, gears and/or springs and explore their effects.

Year 6 programme of study

Living things and their habitats

Statutory requirements

Pupils should be taught to:

- describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals
- give reasons for classifying plants and animals based on specific characteristics.

Notes and guidance (non-statutory)

Pupils should build on their learning about grouping living things in year 4 by looking at the classification system in more detail. They should be introduced to the idea that broad groupings, such as micro-organisms, plants and animals can be subdivided. Through direct observations where possible, they should classify animals into commonly found invertebrates (such as insects, spiders, snails, worms) and vertebrates (fish, amphibians, reptiles, birds and mammals). They should discuss reasons why living things are placed in one group and not another.

Pupils might find out about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.

Pupils might work scientifically by: using classification systems and keys to identify some animals and plants in the immediate environment. They could research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.

Animals including humans

Statutory requirements

Pupils should be taught to:

- identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood
- recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function
- describe the ways in which nutrients and water are transported within animals, including humans.

Notes and guidance (non-statutory)

Pupils should build on their learning from years 3 and 4 about the main body parts and internal organs (skeletal, muscular and digestive system) to explore and answer questions that help them to understand how the circulatory system enables the body to function.

Pupils should learn how to keep their bodies healthy and how their bodies might be damaged – including how some drugs and other substances can be harmful to the human body.

Pupils might work scientifically by: exploring the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health.

Evolution and inheritance

Statutory requirements

Pupils should be taught to:

- recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago
- recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents
- identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Notes and guidance (non-statutory)

Building on what they learned about fossils in the topic on rocks in year 3, pupils should find out more about how living things on earth have changed over time. They should be introduced to the idea that characteristics are passed from parents to their offspring, for instance by considering different breeds of dogs, and what happens when, for example, labradors are crossed with poodles. They should also appreciate that variation in offspring over time can make animals more or less able to survive in particular environments, for example, by exploring how giraffes' necks got longer, or the development of insulating fur on the arctic fox. Pupils might find out about the work of palaeontologists such as Mary Anning and about how Charles Darwin and Alfred Wallace developed their ideas on evolution.

Note: At this stage, pupils are not expected to understand how genes and chromosomes work.

Notes and guidance (non-statutory)

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.

Light**Statutory requirements**

Pupils should be taught to:

- recognise that light appears to travel in straight lines
- use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye
- explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes
- use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

Notes and guidance (non-statutory)

Pupils should build on the work on light in year 3, exploring the way that light behaves, including light sources, reflection and shadows. They should talk about what happens and make predictions.

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 at a range of phenomena including rainbows, colours on soap bubbles, objects looking bent in water and coloured filters (they do not need to explain why these phenomena occur).

Electricity**Statutory requirements**

Pupils should be taught to:

- associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit
- compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches
- use recognised symbols when representing a simple circuit in a diagram.

Notes and guidance (non-statutory)

Building on their work in year 4, pupils should construct simple series circuits, to help them to answer questions about what happens when they try different components, for example, switches, bulbs, buzzers and motors. They should learn how to represent a simple circuit in a diagram using recognised symbols.

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.