

# National Curriculum 2017-18

## Science Objectives



“Evolving Scientists”

# 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 new curriculum 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

## Guidelines

### **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.

### **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.

### **Scientific 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.

## Progression and Expectations for each Phase

<p>Key Stage 1</p>	<p>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.</p> <p>‘Working scientifically’ is described separately in the programme of study, but must <b>always</b> 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.</p> <p>Pupils should read and spell scientific vocabulary at a level consistent with their increasing word reading and spelling knowledge at key stage 1.</p>
<p>Lower Key Stage 2</p>	<p>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.</p> <p>‘Working scientifically’ is described separately at the beginning of the programme of study, but must <b>always</b> 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.</p> <p>Pupils should read and spell scientific vocabulary correctly and with confidence, using their growing word reading and spelling knowledge.</p>
<p>Upper Key Stage 2</p>	<p>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.</p> <p>‘Working and thinking scientifically’ is described separately at the beginning of the programme of study, but must <b>always</b> be taught through and clearly related to substantive science content in the programme of study. Throughout the notes and</p>

	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.
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## Curriculum Coverage

The Programmes of Study for science are set out year-by-year for Key Stages 1 and 2. However, we are only required to only teach the relevant Programme of Study by the end of 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, we can introduce content during an earlier key stage if appropriate.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Biology	Plants	Plants	Plants	Animals including humans	Animals including humans	Animals including humans
	Animals including humans	Animals including humans	Animals including humans	Living things and their habitats	Living things and their habitats	Living things and their habitats
	Seasonal change (Across the Year)	Living things and their habitats				Evolution and inheritance
Chemistry	Everyday materials	Uses of everyday materials	Rocks	States of matter	Properties and changes of materials	
Physics	Forces (Pushes and Pulls)	Electricity (Appropriate Level for KS 1)	Light	Sound	Forces	Light
	Light	Sound	Forces and magnets	Electricity	Earth and Space	Electricity

## Key Stage 1 Objectives

Working Scientifically Key Stage 1						
<p>The principal focus is to enable pupils to <b>experience and observe</b> 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. 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.</p> <p>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:</p>						
	1	2	3	4	5	6
To ask simple questions and recognise that they can be answered in different ways						
To observe closely, using simple equipment						
To perform simple tests						
To identify and classify						
To use their observations and ideas to suggest answers to questions						
To gather and record data to help in answering questions						

Biology – Life Processes and Living Things						
	1	2	3	4	5	6
<b>Plants Year 1</b>						
To identify and name a variety of common plants, including garden plants, wild plants and trees, and those classified as deciduous and evergreen						
To identify and describe the basic structure of a variety of common flowering plants, including roots, stem/trunk, leaves and flowers.						
<b>Plants Year 2</b>						
To observe and describe how seeds and bulbs grow into mature plants						
To find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.						
<b>Animals, including Humans Year 1</b>						
To identify and name a variety of common animals that are birds, fish, amphibians, reptiles, mammals and invertebrates						
To identify and name a variety of common animals that are carnivores, herbivores and omnivores						

To describe and compare the structure of a variety of common animals (birds, fish, amphibians, reptiles, mammals and invertebrates, and including pets						
To identify, name, draw and label the basic parts of the human and body and say which part of the body is associated with each sense						
<b>Animals, including Humans Year 2</b>						
To notice that animals, including humans, have offspring which grow into adults.						
To find out about and describe the basic needs of animals, including humans, for survival (water, food and air)						
To describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.						
<b>Seasonal Changes Year 1</b>						
To observe changes across the four seasons						
To observe and describe weather associated with the seasons and how day length varies						
<b>All living things and their habitats Year 2</b>						
To explore and compare the differences between things that are living, dead, and things that have never been alive						
To 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						
To identify and name a variety of plants and animals in their habitats, including micro-habitats						
To 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.						

<b>Chemistry – Materials and their Properties</b>						
	1	2	3	4	5	6
<b>Everyday Materials Year 1</b>						
To distinguish between an object and the material from which it is made						
To identify and name a variety of everyday materials, including wood, plastic, glass, metal, water and rock						
To describe the simple physical properties of a variety of everyday materials						
To compare and group together a variety of everyday materials on the basis of their simple physical properties						
To find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching						

<b>Everyday Materials Year 2</b>						
To identify and compare the uses of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard						
To compare how things move on different surfaces.						

<b>Physics – Physical Processes</b>						
	1	2	3	4	5	6
<b>Light Year 1</b>						
To observe and name a variety of sources of light, including electric lights, flames and the Sun						
To associate shadows with a light source being blocked by something						
<b>Forces year 1</b>						
To notice push and pull forces in the world we live						
<b>Sound Year 2</b>						
To observe and name a variety of sources of sound, noticing that we hear with our ears						
To recognise that sounds get fainter as the distance from the sound source increases.						
<b>Electricity Year 2</b>						
To identify common appliances that use electricity						
To construct a simple series electrical circuit						

## Key Stage 1 Notes and Guidance (non-statutory)

<b>Working scientifically</b>
<ul style="list-style-type: none"><li>• 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 (e.g. 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.</li><li>• 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.</li></ul>
<b>Biology – Life Processes and Living Things</b>
<b>Plants Year 1</b>
<ul style="list-style-type: none"><li>• 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.</li><li>• They should become familiar with common names of flowers, examples of deciduous and evergreen trees, and plant structures (trees: trunk, roots, branches, leaves, flowers (blossom), fruit; garden and wild plants: flower, petals, stem, leaves, roots, fruit, bulb and seed).</li><li>• 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 and 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 how different plants change over time.</li></ul>
<b>Plants Year 2</b>
<ul style="list-style-type: none"><li>• Pupils should use the local environment throughout the year to observe how plants grow (including seeds, bulbs, fruit and vegetables, deciduous and evergreen bushes and trees). Pupils should be introduced to the requirements of plants for growth and survival, as well as the process of reproduction and growth in plants. Note: Seeds and bulbs need water to grow but do not need light; seeds and bulbs have a store of food inside them.</li><li>• 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.</li></ul>
<b>Animals including humans Year 1</b>
<ul style="list-style-type: none"><li>• 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 birds, fish, amphibians, reptiles, mammals and invertebrates, including pets.</li><li>• 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.</li><li>• 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.</li></ul>



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### **Animals including humans Year 2**

- 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. 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.

### **Seasonal Change Year 1**

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

### **All living things and their habitats Year 2**

- 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 such as: '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); describing the conditions in different habitats and micro-habitats (under log, on stony path, under bushes); finding out how the conditions affect the number and type(s) of plants and animals that live there.

## **Chemistry – Materials and their Properties**

### **Everyday materials year 1**

- 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. 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 find out about people who have developed useful new materials, for example, John Dunlop, Charles Macintosh or John McAdam.
- Pupils might work scientifically by: performing simple tests to explore questions such as: 'What is the best material for an umbrella? ... for lining a dog basket? ... for curtains? ... for a bookshelf? ... for a gymnast's leotard?'

### **Uses of everyday materials year 2**

- 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; tables can be made from plastic, wood, metal, but not normally from paper).
- 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. Pupils should be encouraged to think about unusual and creative uses for everyday materials. They could ask questions about the movement of objects such as toy cars on different surfaces; comparing them, by measuring how far they go; ordering their findings and recording their observations and measurements, for example by constructing tables and charts, and drawing on their results to answer their questions.

### **Physics – Physical Processes**

#### **Light Year 1**

- Pupils should explore materials to raise questions that will help them to understand the differences between materials that are transparent, translucent and opaque (though these words do not need to be used at this stage). They should observe shadows being formed in everyday contexts, such as when they play outside or shine torches indoors. 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 exploring shiny things and grouping them according to whether they shine in the dark or not. They can go on a shadow hunt and think about what is similar about the places where shadows are found (that is, that there is a light source and something is blocking it).

#### **Sound year 2**

- Linked with work in music, pupils should explore various ways of making sounds, for example using a range of musical instruments to make louder and softer and higher and lower sounds.
- Pupils might work scientifically by: comparing different sound sources and looking for patterns; carrying out tests to find the best places to locate fire bells in school.

## Lower Key Stage 2 Objectives

Working Scientifically Lower Key Stage 2						
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 <b>exploring, talking about, testing and developing ideas</b> about everyday phenomena and the relationships between living things and familiar environments, and by beginning to develop their ideas about functions, relationships and interactions.						
To ask relevant questions and use different types of scientific enquiries to answer them	1	2	3	4	5	6
To set up simple practical enquiries, comparative and fair tests making systematic and careful observations where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers						
To gather, record, classify and present data in a variety of ways						
To record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables						
To report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions						
To use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions						
To identify differences, similarities or changes related to simple scientific ideas and processes using straightforward scientific evidence to answer questions or to support their findings.						

Biology – Life Processes and Living Things						
	1	2	3	4	5	6
<b>Plants Year 3</b>						
To identify and describe the functions of different parts of flowering plants: roots, stem, leaves and flowers						
To 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						
To investigate the way in which water is transported within plants						
To explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.						
<b>Animals, including humans Year 3</b>						
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						
To identify that humans and some animals have skeletons and muscles for support, protection and movement.						

<b>Animals, including humans Year 4</b>						
To describe the simple functions of the basic parts of the digestive system in humans						
To identify the different types of teeth in humans and their simple functions						
To construct and interpret a variety of food chains, identifying producers, predators and prey.						
<b>All living things Year 4</b>						
To identify and name a variety of living things (plants and animals) in the local and wider environment, using classification keys to assign them to groups						
To recognise that environments can change and that this can sometimes pose dangers to living things.						

<b>Chemistry – Materials and their Properties</b>						
	1	2	3	4	5	6
<b>Rocks Year 3</b>						
To compare and group together different kinds of rocks on the basis of their appearance and simple physical properties To describe in simple terms how fossils are formed when things that have lived are trapped within rock To recognise that soils are made from rocks and organic matter.						
<b>States of matter Year 4</b>						
To compare and group materials together, according to whether they are solids, liquids or gases						
To 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)						
To identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.						

<b>Physics – Physical Processes</b>						
	1	2	3	4	5	6
<b>Light Year 3</b>						
To notice that light is reflected from surfaces						
To find patterns that determines the size of shadows.						

<b>Forces and magnets year 3</b>						
To notice that some forces need contact between two objects, but magnetic forces can act at a distance						
To observe how magnets attract or repel each other and attract some materials and not others						
To 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						
To describe magnets as having two poles						
To predict whether two magnets will attract or repel each other, depending on which poles are facing.						
<b>Sound Year 4</b>						
To identify how sounds are made, associating some of them with something vibrating						
To find patterns between the pitch of a sound and features of the object that produced it						
To find patterns between the volume of a sound and the strength of the vibrations that produced it.						
<b>Electricity Year 4</b>						
To identify common appliances that run on electricity						
To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers						
To 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						
To recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit						
To recognise some common conductors and insulators, and associate metals with being good conductors.						

## Lower Key Stage 2 Notes and Guidance (non-statutory)

<b>Working scientifically</b>
<ul style="list-style-type: none"><li>• 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 patterns 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. 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.</li><li>• 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.</li></ul>
<b>Biology – Life Processes and Living Things</b>
<b>Plants Year 3</b>
<ul style="list-style-type: none"><li>• 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.</li><li>• 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.</li></ul>
<b>Animals including Humans Year 3</b>
<ul style="list-style-type: none"><li>• Pupils should continue to learn about the importance of nutrition (including a balanced diet) 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.</li><li>• 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.</li></ul>
<b>Animals including Humans Year 4</b>
<ul style="list-style-type: none"><li>• Pupils should be introduced to the main body parts associated with the digestive system, such as mouth, tongue, teeth, oesophagus, stomach and intestine and explore questions that help them to understand their special functions.</li></ul>

- 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.

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## All Living Things Year 4

- 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; and how the habitat changes throughout the year. Pupils should 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 are more difficult to classify, but 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 such as 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: exploring local small invertebrates and using guides or keys to identify them; 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.

## Chemistry – Materials and their Properties

### Rocks Year 3

- Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.
- 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. They can raise and answer questions about the way soils are formed.

### States of matter Year 4

- 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. 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, such as when iron melts or when oxygen condenses, using and applying what they have learnt in mathematics. They might observe and record evaporation over a period of time, such as a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting.

## Physics – Physical Processes

### Light Year 3

- 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.
- 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 Year 3**

- 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: 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, such as 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.

### **Sound Year 4**

- 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 data (for example, blowing across the top of bottles, changing the length and thickness of elastic bands). 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 Year 4**

- Pupils should construct simple series circuits, trying different components, such as 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 Objectives

Working Scientifically Upper Key Stage 2						
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.						
To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary	1	2	3	4	5	6
To take measurements, using a range of scientific equipment, with increasing accuracy and precision						
To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, and bar and line graphs						
To use test results to make predictions to set up further comparative and fair tests						
To use simple models to describe scientific ideas						
To report and presenting findings from enquiries, including conclusions, causal relationships and explanations of results, in oral and written forms such as displays and other presentations						
To identify scientific evidence that has been used to support or refute ideas or arguments.						

Biology – Life Processes and Living Things						
	1	2	3	4	5	6
<b>All living things Year 5</b>						
To explain the differences in the life cycles of a mammal, an amphibian, an insect and a bird						
To describe the life process of reproduction in some plants and animals.						
<b>All living things Year 6</b>						
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						
To give reasons for classifying plants and animals based on specific characteristics.						
<b>Animals including humans Year 5</b>						
To describe the changes as humans develop from birth to old age.						

<b>Animals including humans Year 6</b>						
To identify and name the main parts of the human circulatory system, and explain the functions of the heart, blood vessels and blood						
To recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function						
To describe the ways in which nutrients and water are transported within animals, including humans.						
<b>Evolution and inheritance Year 6</b>						
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						
To recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents						
To identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.						

<b>Chemistry – Materials and their Properties</b>						
	1	2	3	4	5	6
<b>Properties and changes of materials Year 5</b>						
To compare and group together everyday materials based on evidence from comparative and fair tests, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets						
To understand that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution						
To use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating						
To give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic						
To demonstrate that dissolving, mixing and changes of state are reversible changes						
To 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						

Physics – Physical Processes						
	1	2	3	4	5	6
<b>Earth and space Year 5</b>						
To describe the movement of the Earth, and other planets, relative to the Sun in the solar system						
To describe the movement of the Moon relative to the Earth						
To describe the Sun, Earth and Moon as approximately spherical bodies						
To use the idea of the Earth's rotation to explain day and night.						
<b>Forces Year 5</b>						
To explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object						
To identify the effects of air resistance, water resistance and friction, that act between moving surfaces						
To understand that force and motion can be transferred through						
<b>Light Year 6</b>						
To understand that light appears to travel in straight lines						
To 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						
To 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						
To use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them, and to predict the size of shadows when the position of the light source changes.						
<b>Electricity Year 6</b>						
To associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit						
To 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						
To use recognised symbols when representing a simple circuit in a diagram.						

## Upper Key Stage 2 Notes and Guidance (non-statutory)

<b>Working scientifically</b>
<ul style="list-style-type: none"><li>• 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; 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. 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.</li></ul>
<b>Biology – Life Processes and Living Things</b>
<b>All living things Year 5</b>
<ul style="list-style-type: none"><li>• 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 such as David Attenborough and Jane Goodall.</li><li>• Pupils should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals.</li><li>• 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.</li></ul>
<b>All living things Year 6</b>
<ul style="list-style-type: none"><li>• 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 of broad groupings and how these subdivide. Through direct observations where possible, they should classify animals into vertebrates (reptiles, fish, amphibians, birds and mammals) and commonly found invertebrates (e.g. insects, spiders, snails, worms). They should discuss reasons why living things are placed in one group and not another.</li><li>• Pupils might find out about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.</li><li>• Pupils might work scientifically by: devising classification systems and keys to identify some animals and plants in the immediate environment. They could research animals and plants in other habitats and decide where they belong in the classification system.</li></ul>
<b>Animals, including humans Year 5</b>
<ul style="list-style-type: none"><li>• Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty.</li><li>• Pupils could work scientifically by comparing data about the gestation periods of humans and other animals or by finding out and recording the length and mass of a baby as it grows.</li></ul>

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### **Animals including humans Year 6**

- 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 Year 6**

- 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 Alfred Wallace and Charles Darwin developed their ideas on evolution. Note: At this stage, pupils are not expected to understand how genes and chromosomes work.
- Pupils might work scientifically by: observing and raising questions about local animals and how they are adapted to their environment; comparing how some living things are adapted to survive in extreme conditions, for example cactuses, penguins and camels. They might analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.

## **Chemistry – Materials and their Properties**

### **Properties and changes of materials Year 5**

- 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, such as 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. 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 such as '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.



## Physics – Physical Processes

### Forces year 5

- Pupils should explore falling objects and raise questions about the effects of air resistance. 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. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists such as 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 artefacts that use simple levers, pulleys, gears and/or springs and explore their effects.

### Earth and space Year 5

- 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.
- 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.

### Light Year 6

- Pupils should explore the way that light behaves, including light sources, reflection and refraction. They should talk about what happens and make predictions. They should experience a range of examples of interesting aspects of light such as rainbows, colours on soap bubbles, objects looking bent in water and white light being split by prisms.
- 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.

### Electricity Year 6

- 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, such as 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.