



- The ability to think independently and raise questions about working scientifically and the knowledge and skills that it brings.
- Confidence and competence in the full range of practical skills, taking the initiative in, for example, planning and carrying out scientific investigations.
- Excellent scientific knowledge and understanding which is demonstrated in written and verbal explanations, solving challenging problems and reporting scientific findings.
- High levels of originality, imagination or innovation in the application of skills.
- The ability to undertake practical work in a variety of contexts, including fieldwork.
- A passion for science and its application in past, present and future technologies.



To work scientifically

Biology

To understand plants

To understand animals and humans

To investigate living things

To understand evolution and inheritance

Chemistry

To investigate materials

Physics

To understand movement, forces and magnets

To understand the Earth's movement in space

To investigate light and seeing

To investigate sound and hearing

To understand electrical circuits

Working scientifically

Lower Key Stage 2 programme of study (statutory requirements)	Notes and guidance (non-statutory)
<ul style="list-style-type: none">• 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.	<p>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.</p> <p>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.</p> <p>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.</p>

Year 4: All living things

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
<p>Pupils should be taught to:</p> <ul style="list-style-type: none"> 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. 	<p>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.</p> <p>Note: Plants can be grouped into categories such as flowering plants (including grasses) and non-flowering plants, such as ferns and mosses.</p> <p>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.</p>	<ul style="list-style-type: none"> Are mini beasts affected by bright light? Compare two habitats: Which has most trees/plants/minibeasts? In minibeasts which number of legs is most common? What affects the numbers of different plants in different parts of the school grounds ? Which tree has most birds on it? <p>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.</p>

Year 4: Animals, including humans

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
<p>Pupils should be taught to:</p> <ul style="list-style-type: none"> • describe the simple functions of the basic parts of the digestive system in humans • identify the different types of teeth in humans and their simple functions • construct and interpret a variety of food chains, identifying producers, predators and prey. 	<p>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.</p>	<ul style="list-style-type: none"> • Which is the best toothpaste to clean shoe polish from a tile? • How clean are our teeth at different times during the day (Use disclosing tablets) <p>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 <i>discuss</i> their ideas about the digestive system and compare them with models or images.</p>

Year 4: States of matter

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
<p>Pupils should be taught to:</p> <ul style="list-style-type: none"> • 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. 	<p>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.</p> <p>Note: Teachers should avoid using materials where heating is associated with chemical change, for example, through baking or burning.</p>	<ul style="list-style-type: none"> • How does the temperature of water affect the time for salt/sugar to dissolve? • How does the amount of salt/sugar affect the time for water to evaporate? • How does the type of filtering agent alter the cleanliness of water? • What affects the time for sand particles to flow in an egg-timer? • What happens when water is added to sand, salt and sugar, instant coffee, flour, and milk powder, custard powder, corn flour and icing sugar, plaster of paris, powder paint and dye. • Does the temperature of the water affect how much solid will dissolve in it? <p>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.</p>

Year 4: Sound

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
<p>Pupils should be taught to:</p> <ul style="list-style-type: none"> identify how sounds are made, associating some of them with something vibrating recognise that vibrations from sounds travel through a medium to the ear find patterns between the pitch of a sound and features of the object that produced it find patterns between the volume of a sound and the strength of the vibrations that produced it recognise that sounds get fainter as the distance from the sound source increases. 	<p>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.</p>	<ul style="list-style-type: none"> How is the volume of a bell affected by the surface it is on? What material conducts sound the best? What material is the most effective sound insulator? How can you amplify sound ie make an alarm clock sound loud, shout a message across the playground? Make the best drum from a container. Does the length of material affect the pitch eg straw, string, wooden and metal ruler? How can you make the best string telephone? <p>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.</p>

Year 4: Electricity

Year 4 programme of study (statutory requirements)	Notes and guidance (non-statutory)	Working Scientifically ideas
<p>Pupils should be taught to:</p> <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 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 	<p>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.</p>	<ul style="list-style-type: none"> How is brightness of the bulb affect by number of batteries/length of wire/thickness of wire/type of wire? Which materials conduct electricity the best? <p>How can we stop Burglar Bill from coming into the classroom? Find the best conductors and insulators. How does the number of batteries affect the brightness of a bulb?</p> <ul style="list-style-type: none"> How does the number of bulbs affect the brightness of a bulb? <p>Pupils might work scientifically by: observing</p>

<p>opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit</p> <ul style="list-style-type: none">• recognise some common conductors and insulators, and associate metals with being good conductors.	<p>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.</p>	<p>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.</p>
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