PROGRESSION IN SCIENCE 2014 CURRICULUM

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Year 1 – Progression, Background Knowledge and Vocabulary

Working scientifically
● Children 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. ● 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. Children are not expected to cover each aspect for every area of study.
Plants
● Children 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*). ● Children 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. Children 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
● Children 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. Children should become familiar with the common names of some fish, amphibians, reptiles, birds and mammals, including those that are kept as pets. ● Children 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. ● Children 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
● Children 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*. Children 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. ● Children 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
● Children should observe and talk about changes in the weather and the season. Children should observe and talk about changes in the weather and the season. ● **Note:** Children should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses. ● Children 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.

Overview of Progression in Year 1

Working scientifically

In Key Stages 1 and 2, children will progressively develop their knowledge and experience of scientific methods and skills. The foundations for this are laid in Year 1, building on children's earlier explorations of the world around them in the Early Years Foundation Stage. Children will begin to learn how to work scientifically by applying basic methods and skills to the topics they study. The concept of working scientifically is introduced in a very natural way, as children make observations and ask questions about what they observe. They may begin to use some simple scientific equipment to help them observe closely, learn how to conduct simple tests and start to record the data gathered using simple tables and lists. They will use the results of their tests and their observations to help them work out the answers to their questions. Children will learn how to identify different members of a class of objects and how to differentiate and classify objects – skills they will go on to develop in Year 2, where there will also be a greater emphasis on recording their results.

Plants

Children will learn the names and features of a range of common plants, including trees and flowering plants. Ideally they will have the opportunity for hands-on experience and observation of plants which they are helping to grow themselves. They will become familiar with, and will compare, the different parts of plants, including trunk/stem, branches, leaves, roots, flowers, petals, seeds, bulbs and fruit. Children will practise working scientifically when they make close observations of plants, draw and label the different parts of plants, and record how plants change over time. They will build on this work when they continue their study of plants and differences between living, non-living and dead things, in Year 2.

Animals, including humans

Children will practise working scientifically as they study animals in the local environment, including different types of birds and mammals, and a range of other animals such as fish, amphibians and reptiles. They will also learn about pet animals. Through practical experience they will find out about how to care for animals, and they will learn the names of a wide range of animals. They will compare and contrast different types of animals, grouping them in different ways (e.g. carnivores, herbivores and omnivores). Children will learn about the main parts of the human body, and draw and label pictures of different body parts. They will focus on the senses, the body parts associated with each, and do a range of practical experiments and explorations using their senses. This work will be extended in Year 2 when they continue their study of animals and habitats.

Everyday materials

Children will explore a range of different materials, learning the names of them and identifying the key properties of each. They will practise working scientifically when they take part in simple experiments and tests to identify and compare the properties of materials, and find out how some materials can change shape when squashed, bent, stretched etc. They will build on this work in Year 2, when they learn more about the uses of everyday materials.

Seasonal changes

Children will learn about the weather and how it changes with the seasons. They will make some direct observations of the changing day length throughout the year and work scientifically to observe and record seasonal changes in plants and the environment around them. They could also think about what seasonal changes mean for animals. Their work on the Sun will help support their understanding of Light which is introduced in Year 3.

Background Knowledge for Year 1

In Year 1, the science curriculum builds on the hands-on observational work and exploration of the world around them, which children began in the Early Years Foundation Stage. The concepts of scientific skills and methods, and what it means to work scientifically, are gradually introduced in the context of the topics children work on during the year, and children are encouraged to consider changes that happen over time. This means that new scientific concepts can be introduced in an intuitive way. Many of the concepts introduced in Year 1 will be reinforced in Year 2 in order to make sure that children are really secure in their understanding before they move into Key Stage 2.

Introducing the idea of a simple test

The concept of a fair test is formally introduced during Years 3 and 4, but the observations and mini-experiments children undertake in Key Stage 1 will help them prepare for this. It's therefore important to make sure that the children's observations and tests in Year 1 fulfil the criteria for a fair test as much as possible, and that they are encouraged to start making choices about the best ways to carry out their scientific enquiries. It's helpful to be very clear with children about the reasons for their observations and mini-experiments: we do these things because they help us to find out the answers to our questions. Emphasise this by starting with a very clear question, such as *What do we want to find out about X?* This leads on to a further question: *What can we do to find this out?* For example, if the answer to the first question is, *We want to know what happens if plants don't have any water,* the answer to the second question might be: *We can take two plants and give one plenty of water, but keep the other one dry*. Children can be invited to add their own ideas about the best ways of finding the answers to their questions and the equipment that could be used. In the context of simple tests like this, children can also be introduced to the importance of observing, and of recording their observations. Children can record results and observations by taking photos, drawing and labelling pictures, keeping a pictorial diary of a process, or creating a simple chart with numbers, words or symbols. It may be helpful to explain that unless we keep a record, we could easily forget what happened – and records also help us to compare our results at different times or in different tests.

Introducing the concept of identifying and classifying things

For Year 1 children, it may be easiest to talk in terms of sorting and grouping things in different ways, asking how things are the same and different. For example, they can observe a range of mini beasts and sort and group them according to size, body shape, number of legs and so on. Or, they might produce a visual calendar of the seasons, grouping together the pictures that represent each season. It's helpful for children to work in groups to do these activities so that they get the opportunity to talk about the process and explain their reasons for putting items in different groups, thereby consolidating their understanding. This is particularly interesting when classifying objects which might belong in more than one group.

Vocabulary to introduce in Year 1

Working scientifically: changes over time, comparing, contrasting, criteria, data/results, describing, equipment, grouping, identify, name, observations, patterns, record, sorting, test.

Plants: branches, bud, bulb, deciduous tree, evergreen tree, flowers, fruit, garden/flowering plants, leaves, petals, roots, seed, stem, trunk, wild plants.

Animals, including humans: amphibians, arms, birds, body parts, carnivores, ears, elbows, environment, eyes, face, fish, habitat, hair, head, hearing, herbivores, knees, legs, mammals, mouth, neck, omnivores, pets, reptiles, seeing, senses, smells, sounds, taste, teeth, touch.

Everyday materials: absorbent/not absorbent, bending, bendy/not bendy, gas, glass, hard/soft, liquid, metal, plastic, property, rock, rough/smooth, shiny/dull, solid, squashing, stretching, stretchy/stiff, twisting, water, waterproof/not waterproof, wood.

Seasonal changes: autumn, dark, day length, days, hours, light, months, moon, movement, shadow, spring, summer, sun, winter

Year 2 – Progression, Background Knowledge and Vocabulary

Working scientifically

● Children 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. Children are not expected to cover each aspect for every area of study.

Living things and their habitats

● Children 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. Children 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. Children 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.
● Children 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

● Children should use the local environment throughout the year to observe how different plants grow. Children 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.
● Children 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

● Children 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 children 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.
● Children 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.

Use of everyday materials

● Children 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. Children might find out about people who have developed useful new materials, for example John Dunlop, Charles Macintosh or John McAdam.
● Children 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.

Overview of Progression in Year 2

Working scientifically

Children will build on the scientific methods and skills they began to learn in Year 1, as they continue to make observations of the world around them, and ask questions about what they observe. They will extend their use of simple scientific equipment, beginning to use measuring tools such as egg timers, tape measures and scales, and they will develop their data handling skills, recording data in various simple formats such as tables and lists. They will begin to think for themselves about the best way to find the answer to a scientific question, and they will become more experienced at sorting, grouping and classifying objects. This will provide children with a good foundation for the more detailed investigations, tests and data-collection which they will begin to take part in from Year 3.

Living things and their habitats

Children will begin to learn about the characteristics and life processes shared by all living things, and will think about the main differences between things that are alive, that are dead, and that have never been alive. They will show their ability to work scientifically by classifying things according to whether they are alive, dead or non-living. With help, they will learn how to explain their reasons for placing things in different categories. They will continue to build on this logical categorisation of objects in their work in Year 3. Children will begin to understand what is meant by 'habitat' and 'micro-habitat', and will study a range of different plants and animals in their local area. They will also be encouraged to compare animals in a range of habitats to see how living things depend on each other, learning about simple food chains as part of this work. They will demonstrate that they can work scientifically by recording their observations, comparing how different animals are suited to life in their habitats, and drawing and labelling a simple food chain.

Plants

Children will build on their observations and categorisation of different types and features of plants from Year 1. They will look at how plants grow, beginning with seeds and bulbs, and find out about the conditions plants need in order to grow and stay healthy. They will conduct simple comparative experiments and tests to demonstrate this, and will record their results with increasing accuracy. Children's findings in Year 2 will prepare them for a more detailed study of the conditions needed for plant growth, in Year 3.

Animals, including humans

Children will find out what humans and other animals need in order to grow and to survive. They will find out about animal life cycles, but with an emphasis on how animals grow and change as they age, rather than on reproduction. They will begin to learn about the important factors which help humans stay healthy, including exercise, a balanced diet, and hygiene. Children will work scientifically by observing animals and humans at first hand or using secondary sources, and by thinking of good questions about how animals grow and survive, and suggesting possible ways of finding out the answers to their questions.

Uses of everyday materials

Children will build on the work begun in Year 1, by learning about the different uses of specific materials such as metal, wood, plastic, glass etc. They will help to design tests and experiments to show some of the basic properties of different materials and how they can be used. They may also find out about scientists and inventors of new materials, and why their discoveries were so useful. They will work scientifically by observing, identifying and classifying the uses of different materials, both in and around the school and elsewhere in the world around them. They will continue to explore properties of materials in their work on Forces in Year 3.

Background Knowledge for Year 2

In Year 2, children will continue to gain practical experience of making observations and carrying out simple tests to find out the answers to their questions about the world around them. During this year in particular, they begin to approach their learning in terms of the data cycle, drawing on their mathematical skills to consider how best to gather, record, present and interpret their data.

Gathering and recording data

In Year 2, children will build on the work done with simple scientific tests in Year 1. Children will continue to sort and group objects, compare features, and explore changes over time, but their observations will become more detailed, using a growing range of equipment, such as magnifying glasses, tape measures, weighing scales, and so on. They will undertake simple tests to answer a more diverse range of scientific questions, and so the gathering and recording of accurate data will become more important.

As in Year 1, it's important to be clear about the reasons why children are making their observations – what question are they trying to answer, and what is the best way of finding the answer? Children's data recording could take many different forms, including detailed observational drawings, graphs and charts which help them to collect and compare data in words, numbers or pictorial symbols. Children should also be encouraged to start looking for patterns in their results – for example, plants that are regularly watered grow better. As well as recording their own observations, children will also begin to record information from secondary sources – for example, copying a simple life-cycle diagram, finding out about a particular unfamiliar habitat, or drawing pictures to represent a simple food chain.

Introducing simple scientific language

In Year 2, children will consolidate their understanding and use of the proper scientific words introduced in Year 1 to describe what they do and what they observe. They will also build their scientific vocabulary. In addition to reading these words, children should also be encouraged to spell them correctly in their written work.

If these words are introduced in the appropriate context and used consistently, children will quickly pick them up and will enjoy trying out their new scientific vocabulary!

Vocabulary to introduce in Year 2

Living things and their habitats: adaptation, alive, carnivore, characteristics, conditions, consumer, dead, excrete, feed, food chain, grow, habitat, heat, herbivore, life processes, light, living/non-living, micro-habitat, move, ocean, omnivore, pond, producer, rainforest, reproduce, respire, respond to stimuli, seashore, sound, touch, woodland.

Plants (as for Year 1, plus): germination, insect pollination, nutrients, pollination, seed dispersal, wind pollination.

Animals, including humans: adult, baby, bacteria, balanced diet, carbohydrates, child, circulation, dairy, exercise, fats, fibre, fitness, food groups, germs, growth, healthy, heart rate, infection, life cycle, minerals, nutrition, protein, teenager, toddler, unhealthy, vitamins.

Uses of everyday materials (as for Year 1, plus): characteristics, classification, man-made, natural, properties.

Year 3 – Progression, Background Knowledge and Vocabulary

Working scientifically

● Children 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. 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, children 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. Children should use relevant scientific language to discuss their ideas and communicate their findings in ways that are appropriate for different audiences.
● These opportunities 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. Children are not expected to cover each aspect for every area of study.

Plants

● Children 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:** Children 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.
● Children 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

● Children 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.
● Children 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

● Children should explore different kinds of rocks and soils, including those in the local environment.
● Children 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. Children might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed. Children 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

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

● Children 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).
● Children 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, 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.

Overview of Progression in Year 3

Working scientifically

Children will broaden their scientific knowledge, as well as develop the understanding of scientific methods and skills which they began to acquire in Key Stage 1. Children will continue to be encouraged to ask their own scientific questions about the world around them, and, with support, will make decisions about how best to find answers, through observations, sorting objects in different ways, carrying out simple tests and experiments, and research using secondary sources. In particular during this year, children will begin to learn how to construct a fair test. They will also build on the work done in Year 2 on data collection, using an increasingly sophisticated range of equipment to help them, including data loggers. Emphasis will be placed on recording their data using standard units and in a wider range of formats, including notes, charts, graphs and tables. They will begin to learn how to analyse their data, looking for patterns, similarities and differences in order to reach simple conclusions. They will extend this learning as they move into Year 4, beginning to use their data to help them identify new questions for research.

Plants

Building on the work done in Year 2, children will learn more about the parts of a plant, and find out about the specific functions of those different parts (in particular, the role of flowers in a plant's life cycle and the importance of the root system and stem for transporting water and providing support). They will find out more about the things plants need in order to live and grow healthily, and will compare the needs of different plants. They will work scientifically by devising and carrying out simple fair tests to identify the impact of different factors (such as light, water, fertiliser etc.) on plant growth. They will also do simple experiments to demonstrate how water travels within plants.

Animals, including humans

Children will continue the work done in Year 2 on the importance of nutrition for animals' health, by looking at the different food groups and finding out about the contribution that each group makes. They will have opportunities to compare and contrast the needs of different animals (including humans). This work will be extended during Year 4 as children learn about the digestive system and in Year 6 as they learn about the circulatory system. Finally they will explore the role of the skeleton and muscles in some animals for support, protection and movement. Children will work scientifically to group animals in different ways (i.e. whether or not they have skeletons) and compare the ways in which animals move.

Rocks

Children will devise different ways of grouping and sorting rocks according to their characteristics, and will make direct close observation of the structure of rocks and soils using tools such as hand lenses and microscopes. They will learn about how fossils occur, which will link with their work on Evolution in Year 6. Children will work scientifically by conducting their own observations of rocks in the local environment, and will use secondary sources to find out more about fossils and learn about how rocks might change over time.

Light

Children will find out how light makes it possible for us to see things. They will learn about shadows and conduct simple experiments to show how the size of a shadow is affected by the distance between the object casting the shadow and the light source.

Forces and magnets

Children will begin to compare magnetic forces (which can operate at a distance, without direct contact) with other forces, where direct contact is needed. They will learn that magnets have two opposite poles. They will conduct experiments to show how magnets attract or repel each other, depending on which poles are facing, and this will enable them to make accurate predictions of the behaviour of magnets. They will work scientifically by devising a fair test to find out the

Background Knowledge for Year 3

Children will have used simple scientific tests in their work at Key Stage 1, but in Year 3 this is extended so that children will explicitly encounter the concept of a fair test. In order that they can make sense of this, and use the principle to design their own simple investigations, it's important that children both understand the criteria for a fair test, and have experience of applying these to real situations. Children should also be encouraged to play a more active role in asking scientific questions and choosing the appropriate type of enquiry to find the answers.

Introducing the concept of a fair test

Children must understand that for a fair test, just one factor (also called a 'variable') is changed at a time, while other factors are kept the same. They should recognise that if more than one factor is changed at a time, a straightforward conclusion cannot be reached. In order to really grasp this, children should have lots of practical experiences. For example, as part of the 'Plants' programme of study, they could do lots of investigations into the effects of different variables on plant growth. They could then be asked to think about what might happen if more than one variable were changed at a time. For example, if three plants were given different amounts of water, but in addition one were kept in a dark cupboard, it would be impossible to tell whether the plant looked sickly because of the lack of light or because of the amount of water it was getting.

Deciding what type of enquiry will be best to answer a question

In Year 3, children should be encouraged to contribute their ideas about the best sort of enquiry to use to answer a scientific question. It would be helpful to focus their attention on the differences between questions that can be answered by direct observation or testing, and those where you would need to rely on a secondary source. So, for example, if children were learning about different food groups and wanted to find out about how each food group affected human health, it obviously wouldn't be a good idea to design an experiment in which they stopped eating a particular food group and waited to observe the effects! Instead they would need to use secondary sources such as books, websites, films etc., to find out about this. Conversely, if they wanted to find out how the size of a shadow changes when the distance between the light source and the object casting the shadow is changed, it would make sense to carry out a simple test or experiment.

Vocabulary and concepts to introduce in Year 3

Plants (as for previous years, plus): absorb, competition for resources, function, minerals, optimum conditions, plant life cycle, plant tissues, pores (stomata), reproduction, seed formation, structure, support, well-aerated soil, well-drained soil.

Animals, including humans (as for previous years, plus): ankle, arteries, backbone, ball and socket joints, bone, brain, branching blood vessels, capillaries, cardio-vascular system, cartilage, collar bone (clavicle), contract, endoskeleton, exoskeleton, extensor, fibula, finger, fixed joints, flexor, foot, hand, heart, hinge joints, humerus, involuntary muscles, joints, knee cap (patella), ligaments, moveable joints, movement, muscles, opposing pairs, pelvis, protection, shoulder blades (scapula), skeletal and muscular systems, radius, relax, ribs, skeletons, skull, sliding joints, spinal cord, sternum, support, thigh bone (femur), tibia, toe, ulna, veins, vertebrates, voluntary muscles, wrist.

Rocks: crystalline, crystals, erosion, fossils, grains, layers (strata), molten magma, particles, permeability, permeable, physical properties, soils.

Light: absorb, bright, dim, emit, light beam, light sources, light spectrum, opaque, rays, reflect, reflection, speed of light, sunlight, torch, translucent, transparent.

Forces and magnets: air resistance, attract, compress, direction of force, faster, floating, flying, forcemeter, forces, friction, gravity, magnetic, magnetic field, magnetic forces, Newton meter, Newtons (N), non-magnetic, north pole, poles, pull, push, repel, sinking, sliding, slower, south pole, speed, streamlined, stretch, twist, water resistance.

Year 4 – Progression, Background Knowledge and Vocabulary

Working scientifically

● Children 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.
● 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, children 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. Children 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. Children are not expected to cover each aspect for every area of study.

Living things and their habitats

● Children 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. Children should explore possible ways of grouping a wide selection of living things. Children 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 and non-flowering plants.
● Children 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.
● Children 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

● Children should be introduced to the main body parts associated with the digestive system and explore questions that help them to understand their special functions.
● Children 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

● Children 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). Children 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.
● Children might work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream. 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

● Children 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.
● Children 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

● Children 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. Children should draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols; these are introduced in Year 6.
● **Note**: Children might use the terms current and voltage, but these should not be introduced or defined formally at this stage. Children should be taught about precautions for working safely with electricity.
● Children might work scientifically by: observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors, and that some materials can be used to connect across a gap in a circuit.

Overview of Progression in Year 4

Working scientifically

Children's work in Year 4 develops and extends their grasp of scientific skills and methods introduced in Year 3. Children will continue to ask their own scientific questions, and they will become increasingly independent in thinking of effective ways to answer them. Children will learn more about devising and carrying out fair tests, and about recording and analysing their data. They will learn how to look for patterns in data, including changes, similarities and differences, and with support they will learn how to explain these clearly, drawing appropriate conclusions (including considering ways of improving investigations, identifying new questions to be answered, and devising new tests to find the answers). Children will become more independent and confident using secondary sources for research, including using simple keys, and they will begin to distinguish between times when secondary sources provide the best way of finding answers, and times when first-hand observations and tests are more appropriate. Children will also become more confident and proficient in communicating their results to others, through oral presentations as well as written reports, charts, graphs, etc.

Living things and their habitats

Children will continue to observe and identify plants and animals in the local environment, and will learn how to classify animals into vertebrates and invertebrates using classification keys. They will also learn to group plants into different categories, such as flowering and non-flowering plants. As part of their study of the local environment, children will learn about how animal and plant habitats are affected by changes in the environment (both human and natural) throughout the year.

Animals, including humans

Building on their work in Year 3, children will find out more about the human digestive system, identifying the parts of the body involved and the functions performed by each part. They will focus in particular on teeth, and will learn about the roles and functions of the different types of teeth, making observations to compare the teeth of herbivores, carnivores and omnivores and discussing possible reasons for the differences. They construct and interpret a variety of food chains, identifying producers, predators and prey.

States of matter

Children will learn how to group materials according to whether they are solids, liquids or gases. They will work scientifically when they do simple experiments with water to show its different properties in solid, liquid and gaseous form. They will also look at how different materials change when heated or cooled (i.e. chocolate and butter). They will learn about the role of evaporation and condensation in the water cycle, and will do simple experiments to identify the effect of temperature on the rate of evaporation. This links to Year 5, when they will study the properties of everyday materials and the concept of reversible change.

Sound

Children will learn about how sounds are made, and through simple tests and experiments (including with musical instruments) they will notice the link between vibration and sound. They will conduct tests to explore how different factors can change pitch and volume.

Electricity

Children will learn to make a simple electrical circuit using different components, including bulbs, buzzers, motors and switches. They will record their circuits pictorially (building on this in Year 6 when they learn the conventional circuit symbols). Children will conduct observations to work out the effects of adding a switch to a circuit, and will find out how to arrange a circuit in order for a bulb to light. They will learn about conductors and insulators, and in particular that metals tend to be good conductors. They will do some simple tests to show whether different materials can fill a gap in an electrical circuit.

Background Knowledge for Year 4

Children will gather data from a wider range of observations and tests, and continue to use more sophisticated data-gathering tools and standard units of measure. They will begin to bring their own ideas to the analysis of their data, looking for patterns and changes, and learn how to use ideas gleaned from the data analysis to identify new questions for research.

Analysing data

From experience, children will begin to recognise that whenever you do an experiment or test, you will end up with some data. They will see that some experiments produce relatively small amounts of data, whereas some experiments produce lots. Children will need guidance to understand how, as scientists, to work with this more complex data. Of course, data itself can't answer a question directly – we need to add human insights to analyse it and find out what it might mean. Children will need support to think about how best to record their data to make that analysis easier. As part of their work on habitats, children might make direct observations of the local environment across a long period, such as a month or a year. They will end up with lots of data, which might show (for example) which minibeasts they found in particular habitats on each occasion. Plotting information on a bar chart will show the frequency of particular minibeasts during each month, and should make it easier to spot any patterns emerging which would suggest further questions that they could research. Children could also think about whether the patterns they observe are clear. This will eventually lead to a more statistical approach to experimentation, for example repeating experiments to find out whether the initial results are sound. Although not required at this stage, it's helpful for children to begin to think about the reliability of data, and if they think results are believable.

Identifying new questions from data

In Year 4, children will be encouraged to identify further questions arising from the data they have collected, which might be answered by further research. They should recognise that most scientific discoveries have resulted from scientists taking this approach to their work. Although it's satisfying to create a neat bar graph of your results, this is arguably a waste of time unless you are asking what the results mean and how you can find out more. So, for example, observations of the environment might show lots of butterflies during June and July, but very few in November. Encourage the children to ask why this might be. The best way to research this would probably be through secondary sources giving information about butterflies' life cycle and the conditions they need in order to thrive. Sometimes, experiments give answers which you really were not expecting, or which don't seem to make sense. It's important for children to think about this – figuring out why your experiment might have given a nonsense result is an important part of scientific thinking.

Vocabulary and concepts to introduce in Year 4

Living things and their habitats (as for Year 2, plus): classification keys, differences, human effects on the environment (population, development, deforestation, pollution), invertebrates (snails and slugs, worms, spiders, insects), organism, plant groups (trees, grasses, flowering plants, non-flowering plants), similarities, variation characteristics, vertebrates (fish, amphibians, reptiles, birds, mammals).

Animals, including humans (as for previous years, plus): absorption of food into blood stream, canines, cavities, chemical breakdown by enzymes, chewing, churning in stomach, dentine, digestion, digestive system, enamel, faeces, fluoride toothpaste, gastric juice, gums, incisors, intestine, molars, nerves, oesophagus, plaque, premolars, pulp cavity, predators, prey, producers, reabsorption of water from waste, saliva, swallowing, tooth decay.

States of matter: boiling, condensation, degrees Celsius (°C), energy transfer solid, evaporation, fixed shape and volume, forces of attraction, freezing, gaseous, liquid, melting, particles, rate of evaporation, solidifying, temperature, thermometer, vibrate, water cycle.

Sound: echo, frequency of vibration, pitch (higher, lower), reflection of sound, sound insulation, sound wave, tuning fork, vacuum, vibration, volume (louder, softer).

Electricity: battery, bulbs, buzzers, cell, closed circuit, conductor, crocodile clips, electrical appliances, insulator, motors, open circuit, simple series circuit, switches, wires.

Year 5 – Progression, Background Knowledge and Vocabulary

Working scientifically

● Children 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.
● 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. Children are not expected to cover each aspect for every area of study.

Living things and their habitats

● Children should study and raise questions about their local environment throughout the year. They should observe life-cycle changes in a variety of living things 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.
● Children should find out about different types of reproduction in plants and animals.
● Children 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

● Children should draw a timeline to indicate stages in the growth of humans, and learn about puberty.
● Children could work scientifically by comparing the gestation periods of other animals with humans.

Properties and changes of materials

● Children 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. Children 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.
● **Note**: At this stage, it is sufficient for children 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.
● Children might work scientifically by: carrying out tests to answer questions, for example, 'Which materials would be the most effective for making a warm jacket?' 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, and discuss the creative use of new materials such as polymers and super-thin materials.

Earth and space

● Children should be introduced to a model of the Sun and Earth that enables them to explain day and night. Children should learn that the Sun is a star at the centre of our solar system and that it has eight planets. They should understand that a moon is a celestial body that orbits a planet.
● **Note**: Children should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.
● Children should find out about the way that ideas about the solar system have developed, and understand the geocentric and heliocentric models by considering the work of scientists such as Ptolemy, Alhazen and Copernicus.
● Children 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 and so on.

Forces

● Children 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 fall. They should experience forces that make things begin to move, get faster or slow down. Children should explore the effects of friction on movement and find out how it slows or stops moving objects. Children should explore the effects of levers, pulleys and simple machines on movement. Children might find out how scientists helped to develop the theory of gravitation.
● Children 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.

Overview of Progression in Year 5

Working scientifically

Children will revisit the ideas and methods introduced in Years 3 and 4, including the concepts of comparative and fair tests. They will use a wider range of methods to record their results and data with increasing accuracy, including labelled scientific diagrams and models, as well as tables, bar graphs and line graphs. With support, they will distinguish between fact and opinion. They will continue to learn about how scientific ideas have developed over time, finding out about the work of influential scientists. Children will become more independent in designing their own enquiries and experiments and will outline the key variables when designing a fair test, considering how to effectively control them. They will also become more confident in using the results of their experiments to make predictions and suggest further research questions. They will report their findings orally and in writing, and learn how to use relevant scientific language and illustrations to communicate ideas. This continues in Year 6 as children become more independent scientific thinkers.

Living things and their habitats

Children will build on their Year 2 and 4 work, studying the life cycles of animals (mammals, amphibians, insects and birds) and plants in greater depth (focusing on birth, growth, development, reproduction and death in animals, and growth, reproduction and death in plants). They will make observations of plant and animal reproduction by growing plants, or rearing and caring for baby animals, and will work scientifically when they make observations of animal and plant life cycles in the local environment. They will extend this by finding out about the work of naturalists and animal behaviourists, making comparisons and beginning to think about possible reasons for similarities and differences.

Animals, including humans

Developing from their work on life cycles in Year 2, children will learn about changes in humans as they develop from birth to death. They will draw timelines to indicate stages in the growth and development of humans and learn about changes experienced in puberty.

Properties and changes of materials

This links with Year 3 and 4 work on magnetism and electricity and the states of matter. Children conduct tests to identify the properties of everyday materials (hardness, solubility, conductivity and magnetism) and experiment with different materials to find out about reversible changes (melting, dissolving and evaporating). They learn how to recover substances from solution, through evaporation, and explore ways of separating mixtures into solids and liquids by filtering and sieving. Children will experiment with heating, cooling, dissolving and mixing different substances to understand the concepts of reversible change and changes of state. This will enable them to draw connections to irreversible or hard to reverse changes (burning, rusting or other chemical reactions). With support, they will observe the effect of burning, or the irreversible chemical changes involved in cooking. Children will find out about scientists who helped to create new materials with advantageous properties through chemical change, and learn how these materials can be used.

Earth and space

Children will learn about the solar system and the way that the Earth moves relative to the Sun, and the Moon relative to the Earth. They will create and use simple models of the solar system and use these to demonstrate why we experience day and night on Earth. They will find out about different time zones and understand why it isn't the same time all over Earth simultaneously. They will also learn about how our heliocentric (Sun-centred) model of the solar system differs from the geocentric (Earth-centred) model used in the past.

Forces

Building on their Year 3 work on forces and magnets, children learn about the effects of gravity and drag forces, such as friction and air and water resistance. They will find out how and why drag forces slow moving objects down, devising experiments to show air resistance, or look at how friction works to slow down a wheeled vehicle when a brake is applied. Children will learn how levers, pulleys, gears and springs work, and how they transfer force and motion. They will look at the work of scientists such as Galileo and Isaac Newton.

Background Knowledge for Year 5

Children will have the opportunity to consolidate their understanding of the scientific ideas and methods introduced in previous years (i.e. the concept of a fair test). Their observations and measurements will be increasingly accurate, and they will become more skilled and independent in analysing data. They will be able to use the results of their experiments to design new enquiries and predict possible outcomes. Children will be expected to take more responsibility for the planning of investigations, including considering which variable to change and which to control, and be able to justify their choices. They will need to begin to focus on the differences between fact and opinion in a scientific context, and look at how scientific ideas have developed and changed over time.

Fact and opinion

Most children will be familiar with the concepts of fact and opinion and how these differ, both from their work in literacy and also from everyday experience. At this stage, they can begin applying these concepts to their scientific thinking. This is helpful because it encourages children to think more rigorously about the quality of scientific evidence. They can be encouraged to think about how we know that a particular statement, for example 'pulse and breathing rate increase when you exercise,' is a fact rather than an opinion. They will begin to see that experimental data, when analysed correctly, can help to prove a particular assertion or idea as fact. They may know from their own experience that they get out of breath when running, but in order to prove that a high breathing rate is directly linked to exercise they would need to construct a fair test to find out if this happens to everyone.

Understanding how scientific ideas develop over time

Thinking about fact and opinion is helpful in the context of learning about how scientific ideas have developed over time. Children will need to understand that science is an on-going process – scientists build on work done by people in the past in order to understand the world more fully. Some concepts are difficult to prove as fact, and so theories are developed based on what is known or can be tested. Scientists of the future will develop the work being done now, and no doubt some ideas we believe are true will be proven false or only partly accurate. Children will think about this when they learn about the geocentric model of the solar system and understand how, for centuries, people believed that the Earth was at the centre of the universe. It wasn't until the work of Nicolaus Copernicus in the 16th century that the heliocentric model of the solar system began to be accepted. Children will need to understand that before the 16th century, scientists believed the geocentric model to be true because it seemed to explain some of the phenomena they observed (for example, the way that gravity causes objects to fall towards the Earth). As time went on, scientists noticed discrepancies that couldn't be explained by this model, so they had to alter their theories.

Vocabulary and concepts to introduce in Year 5

Living things and their habitats and Animals, including humans (as for previous years, plus): anther, asexual reproduction animal behaviourist, birth, bud, carpel, chromosomes, cross-pollination, death, egg cell (ovum), embryo, fallopian tubes, female gamete, fertilization, filament, gestation, growth, hormones, life cycles, male gamete, menstrual cycle, microorganisms, naturalist, ovaries, ovary, ovulation, penis, petals, placenta, puberty, sepals, sexual reproduction, sperm, stamens, stigma, style, testes, uterus, vagina, vertebrates (reptiles, fish, amphibians, birds, mammals), zygote

Properties and changes of materials: buoyancy, burning, change of state, chemical changes, chemical reaction, density, dissolving, elasticity, electrical conductivity, evaporating, filtering, filtrate, gas, hardness, irreversible or hard-to-reverse change, liquid, melting, magnetism, polymer, residue, reversible change, rusting (oxidisation), sieving, solid, solubility, solute, solution, solvent, stiffness, strength, suspension, thermal conductivity, toughness

Earth and space: asteroids, axis, celestial body, comets, Earth, Earth's rotation, elliptical orbit, gravitational force, heliocentric model of the solar system, galaxy, geocentric model, hemisphere, Jupiter, light year, Mars, Mercury, meteors, moon, Neptune, phases of the moon, Saturn, shadow clock, shooting stars, Sun, sundial, time zones, Uranus, Venus

Forces (as for Year 3, plus): drag forces, gears, levers, pulleys, springs, transference of force and motion

Year 6 – Progression, Background Knowledge and Vocabulary

Working scientifically

● Children 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.
● 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.

Living things and their habitats

● Children 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 and vertebrates. They should discuss reasons why living things are placed in one group and not another.
● Children might find out about the significance of the work of scientists such as Carl Linnaeus.
● Children 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

● Children should build on their learning from Years 3 and 4 about the main body parts and internal organs to explore and answer questions that help them to understand how the circulatory system enables the body to function.
● Children should learn how to keep their bodies healthy and how their bodies might be damaged.
● Children 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

● Building on what they learned about fossils in the topic on rocks in Year 3, children 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. Children 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, children are not expected to understand how genes and chromosomes work.
● Children 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

● Children 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.
● Children 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

● Building on their work in Year 4, children 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**: Children are expected to learn only about series circuits, not parallel circuits. Children should be taught to take the necessary precautions for working safely with electricity.
● Children 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.

Overview of Progression in Year 6

Working scientifically

Building on the concepts, ideas and methods in Year 5, children will have opportunities to become still more independent in devising fair and comparative tests and experiments, controlling variables and thinking about how to make sure their results are reliable. They will use a range of scientific and everyday equipment to take accurate measurements, and learn how to record and explain their data clearly using a range of formats (introduced in Year 5). They will learn how to use and create their own classification keys when grouping plants and animals. Children will be learning to think critically and evaluate the evidence they get from their own tests and experiments, and from research using secondary sources. They will explain their results and findings in terms of causal relationships (i.e. focusing on likely reasons for the phenomena they observe, and the links between cause and effect). They will also begin to be more confident in identifying the specific scientific evidence that is used to support a particular idea or argument. They will be able to make links between different areas of their learning, and get to grips with more abstract concepts.

Living things and their habitats

Extending the work in Year 4 on classification, children learn about classifying living things into five 'kingdoms' and animals into vertebrates (reptiles, fish, amphibians, birds and mammals) and invertebrates, using direct observation and explaining their choices. They use classification keys to help with (and to demonstrate) the decision-making process involved.

Animals, including humans

Building on their work in Years 3 and 4 on human digestion, circulation, muscles and skeleton, children will learn about the human circulatory system (identifying the functions of the heart, blood vessels and blood) and look at how diet, exercise, drugs and lifestyle impact on health. They will compare and contrast the needs of different animals (including humans), and find out about how nutrients and water are transported within our (and animals') bodies. They work scientifically to make drawings and models to show ideas about the circulatory system, and compare these with images from secondary sources. They may also conduct experiments and tests to show the effect of different activities on pulse and breathing rate, suggesting reasons for their findings. They will have an opportunity to learn about scientists whose work has contributed to our understanding of the circulatory system, including Harvey and Galen.

Evolution and inheritance

Children will be introduced to the idea that characteristics are passed from parent to child, in plants and animals, including humans. They build on their fossil work from Year 3, and look at how plants and animals on Earth adapt to their environment, gradually change over time, and how living things evolve. They learn that offspring are not identical to their parents, and that this variation can give rise to characteristics that help or hinder animals' chances of survival, leading over long periods of time to evolutionary change. Children may also start to learn about Charles Darwin's work and its contribution to our understanding of evolution.

Light

Extending their work in Year 3, children do practical experiments and make observations of the way light travels, looking at different effects of light in phenomena such as rainbows, rays of light split by prisms, objects appearing bent in water, etc. They look at how light appears to travel in straight lines, and understand that we can see objects because they reflect light into our eyes. They know that shadows are the same shape as the object that cast them and experiment with shadows by placing objects at different distances from a light source.

Electricity

To develop their work from Year 4, children construct simple electrical series circuits using a range of components (switches, buzzers, motors etc). They can name the parts of a circuit and draw diagrams using recognised symbols. They experiment by adding cells to a circuit, or using cells with a higher voltage, to make a lamp shine brighter, or a buzzer buzz louder.

Background Knowledge for Year 6

Year 6 gives children further opportunities to consolidate their understanding of the scientific concepts and methods introduced in Key Stage 2, making links between the areas of their learning to take a 'bigger picture' view of interrelationships, systems and processes. By Year 6, children will be able to draw on their existing knowledge to process more abstract ideas, and begin to appreciate the wider implications of scientific concepts outside their immediate experience. During this year they will also refine the way they report their findings from experiments and tests they have undertaken – in both oral and written reports they will need to understand how to create clear explanations involving causal relationships. They will also build on the work done on fact and opinion in Year 5 in order to identify the specific scientific evidence that has been used to support a particular theory or idea, explaining it in their own words or using simple models.

Explanations involving causal relationships

In Year 6, children will be building on their previous work on data analysis. When explaining the results of an experiment or reporting their research into a topic, they will need to begin to draw out the causal relationships. It's not always enough to show that a particular phenomenon has occurred – children will also need to show an understanding of why this has happened, what caused it and what it means. There are plenty of opportunities for this kind of approach in the programme of study for Year 6. For example, in 'Forces', children will look at how motion can be transferred using mechanical devices like pulleys and levers. They could draw diagrams or make models that show how a lever allows a small movement (pressing down on the 'handle' end of the lever) to be transferred into a much more powerful movement at the other end of the lever. In 'Evolution and inheritance', children's explanations will need to include the causal relationship between the small-scale adaptations that happen on an individual level as offspring differ from their parents, and the evolutionary change that can eventually result from this.

How scientific evidence can support or refute an idea

When children are familiar with the idea that scientific ideas develop over time, and with the differences between fact and opinion in a scientific context, they will be able to understand more clearly how scientific evidence can be used to support or refute a particular idea. This is an important concept for all of us to understand, whether we go on to develop a scientific career or not. Children can begin to learn to make, and justify, their own judgements about whether a piece of evidence put forward in support of an argument is valid or not. This skill will help them in later life too, when they want to work out whether a particular argument or theory they hear about in the media is scientifically plausible or not.

Vocabulary and concepts to introduce in Year 6

Living things and their habitats (as for previous years, plus): *classification, classification keys, dichotomous/binary keys, five kingdoms (bacteria, protists, animals, plants, fungi), genetic variation, invertebrates, vertebrates (reptiles, fish, amphibians, birds, mammals)*

Animals, including humans (as for previous years plus): *adrenaline, aerobic respiration, alveoli, aorta, arteries, atrium, blood, blood vessels, bronchi, bronchioles, capillaries, carotid artery, circulatory system, clotting, deoxygenated, diaphragm, gills, haemoglobin, heart, heart rate, intercostal muscles, lungs, oxygenated, plasma, platelets, pulmonary artery, pulmonary vein, pulse, red blood cells, veins, ventricles, white blood cells, wind pipe (trachea)*

Evolution and inheritance: *adaptation, chromosomes, competition, DNA, environmental conditions, environmental variations, evolution, evolutionary change, features, fossil records, genes, genetic variation, inheritance, natural selection, palaeontologist, survival of the fittest, variation over time*

Light (as for Year 3, plus): *absorption, lenses, light source, optics, periscope, prism, rainbow, reflection, refraction, spectrum, transmission*

Electricity (as for Year 4, plus): *circuits, circuit diagrams, components, series circuit, voltage*