Lower key stage 2 – years 3-4

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

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

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

Lower Key Stage 2

Working scientifically

Lower Key Stage 2 programme of study (statutory requirements)	Notes and guidance (non-statutory
• 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,	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.

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.	They should learn how to use new equipment, such as data loggers, appropriately. They should collect data from their own observations and measurements, using notes, simple tables and standard units, and help to make decisions about how to record and analyse this data. With help, pupils should look for changes, patterns, similarities and differences in their data in order to draw simple conclusions and answer questions. With support, they should identify new questions arising from the data, making predictions for new values within or beyond the data they have collected and finding ways of improving what they have already done. They should also recognise when and how secondary sources might help them to answer questions that cannot be answered through practical investigations. Pupils should use relevant scientific language to discuss their ideas and communicate their findings in ways that are appropriate for different audiences. These opportunities for working scientifically should be provided across years 3 and 4 so that the expectations in the programme of study can be met by the end of year 4. Pupils are not expected to cover each aspect for every area of study.

Year 3: Plants

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • identify and describe the functions of different parts of flowering plants: roots, stem, leaves and flowers • explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant • investigate the way in which water is transported within plants • explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.	Pupils should be introduced to the relationship between structure and function: the idea that every part has a job to do. They should explore questions that focus on the role of the roots and stem in nutrition and support, leaves for nutrition and flowers for reproduction. Note: Pupils can be introduced to the idea that plants can make their own food, but at this stage they do not need to understand how this happens. **Note:** Pupils can be introduced to the idea that plants can make their own food, but at this stage they do not need to understand how this happens.	• How does the amount of water/light/soil affect the height/number of leaves of a plant? • How is seed germination affected by seed size / temperature / moisture / soil? • How does the amount of space for roots affect the size of a plant? • What affects the speed that water rises up a plant stem? Pupils might work scientifically by: comparing the effect of different factors on plant growth, for example the amount of light, the amount of fertiliser; discovering how seeds are formed by observing the different stages of plant life cycles over a period of time; looking for patterns in the structure of fruits that relate to how the seeds are dispersed. They might observe how water is transported in plants, for example by putting cut, white carnations into coloured water and observing how water travels up the stem to the flowers.
Other teaching ideas 1. Growing cress seeds to illustrate phototropism (growing towards the light) 2. Observational drawing of plants root systems 3. Looking at root vegetables 4. Sorting and grouping plants or pictures of plants according to those whose leaves we eat and those we do not		

5. Design a poster to show what plants need to grow
6. Split the stem of a carnation upwards and put each half in a different food colouring
7. Diagram of the transportation of water and nutrients through the plant

Key information

Plants need warmth, light and water for healthy growth.

Plants grown without light often germinate quickly or grow tall but they are not strong plants.

The plant is held in the soil by the root. The roots of different species of plant can be very different. Plants of the same species have roots which are similar.

Plants take up water from the soil through their roots.

When plants are pulled up, they cannot get water and the stems and leaves droop (wilt).

When the roots are put in water, the stems and leaves become upright again.
Seeds need space to grow away from the parent plant. Plants produce lots of seeds, only a few of them find suitable places and grow into new plants. They are adapted to be dispersed in several ways:

- seeds blown away by the wind have parachutes e.g. dandelion or wings (sycamore);
- seeds that stick to animal coats have tiny hooks on the outside which can be seen with a lens e.g. burdock;
- seeds used by animals for food, e.g. nuts are buried as a food store
- seeds eaten by birds are encased in brightly coloured fleshy fruit. The seeds inside have a hard outer covering so they can pass through the gut and still grow into new plants e.g. berries and rosehips.
- some seeds have an outer casing which dry and bursts open, flinging the seeds away. e.g. broom pods

Seeds need light, water and space (to get air and sunshine) in order to grow after they have germinated.

Some plants grow from pieces of root or underground stem left in the soil when it is dug.

Plants will eventually cover (colonise) an area.

The numbers and types of species in an area changes over the years

Most flowers have: sepals; petals; stamens (anthers and filaments) and carpels (stigma, style and ovary)

Flowers of the same species have common characteristics: the same number, shape and arrangement of sepals, petals, stamens and carpels, e.g. sweet pea, vetch and clover, daffodil, jonquil and narcissus .

A 'control' in a science experiment is one which is set up under 'normal' conditions - in this case, given all the requirements for growth - so that it can be compared to the others.

Plants can be grouped for identification according to the shape, pattern and arrangement of leaves and flowers.

Plants of the same species, growing in different places, often produce plants of a different size and shape to suit local conditions. This is called adaptation, e.g. bluebells grow taller in the shade than in the sun.

Different plants grow in different habitats.

All plants need different amounts of light and water to grow and produce flowers and seeds. Some plants grow best in certain kinds of soil. All species of plants have specific requirements.

Year 3: Animals, including humans

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat • identify that humans and some animals have skeletons and muscles for support, protection and movement.	Pupils should continue to learn about the importance of nutrition (including a balanced diet) and should be introduced to the main body parts associated with the skeleton and muscles, finding out how different parts of the body have special functions.	• Do people with longer legs jump further/higher? • Do people with longer arms throw farther? • Which has stronger bones: chicken or fish, lamb or cow? • How many bones are there in a human body? • How many muscles are there in a human body? • Which is the longest bone in the body • Do people with large hands have big large feet? Pupils might work scientifically by: identifying and grouping animals with and without skeletons and observing and comparing their movement; exploring ideas about what would happen if humans did not have skeletons. They might compare and contrast the diets of different animals (including their pets) and decide ways of grouping them according to what they eat. They might research different food groups and how they keep us healthy and design meals based on what they find out.

Other teaching ideas

1. School cook to talk to children about planning school meals and a balanced diet
2. Cooking using healthy food and recipes
3. Collage of proteins, fats, carbohydrate, vitamin foods etc.
4. Collage of which part of plant a fruit or vegetable comes from
5. Sorting and grouping food packets
6. Ask children where their bones and muscles are
7. Make a paper model of a human skeleton
8. Make a jointed puppet using cardboard and split pins
9. Discussion about location and function of joints e.g. hinge, ball and socket and how they function
10. Sing 'Dem bones'
11. Measuring length of some bones in the human body e.g. femur, tarsels, humerus etc.

Key information

Our bodies need a variety of foods for activity (energy), growth and health:

- Foods for growth include meat, fish and nuts.
- Foods for activity include bread, potatoes, pasta and fatty foods.
- Foods for health include fruit, vegetables and foods rich in fibre, e.g. wholemeal cereals.

Some of the food we eat comes from animals and some directly from plants. Cheese, butter, yoghurt, and cream all come from milk. Most of the milk we use comes from cows. When we use milk to make cheese or butter, parts of it are thrown away. Cows get their food from grass. A food chain shows where our food comes from. Nearly all food chains start with green plants that need the sun in order to grow.

Some food we eat comes directly from plants and some from animals that eat plants. Flour comes from wheat. Whole-meal flour is made from the whole grain and it is healthier because it has the bran in it. Many foods are made from wheat - cereals, spaghetti, bread etc. It is also an ingredient of cakes, biscuits etc. Grain from wheat and other cereals form the staple diet of people from many countries. Wheat, corn (maize) and rice are all grains from plants that need the sun in order to grow. A food chain shows where our food comes from.

- We need to eat:
  - a variety of food;
  - the right amount of food; to stay strong and healthy.

Moving and Growing

Our bodies need a variety of foods for activity, growth and health. Some foods for growth include meat, fish, nuts. Some foods for activity (energy) include bread, potatoes, pasta and fatty foods. Some foods for health include fruit and vegetables, and foods rich in fibre, e.g. wholemeal cereals. We need to eat: - a variety of food; and the right amount of food; to stay strong and healthy.

When we exercise we use up energy to move our muscles, so:

- we have to breathe faster
- our heart has to beat faster.

Energetic exercise makes us hot so our skin gets redder and we sweat (perspire). This helps to cool us down. When we stop exercising our body returns to normal after a while.

Bones make parts of our body, e.g. legs and spine, rigid so we can stand up. Joints between bones allow movement. Some parts of our body, e.g. back, have many small bones with sliding joints so we can bend in a curve. Some joints, e.g. elbow and knee, are hinge joints and move only backwards and forwards. Some joints, e.g. shoulder and hip, are ball and socket joints and move all the way round. The longest bone in the body is the thigh bone.

Every time we move our bodies we are using our muscles. Muscles can contract and relax. When muscles contract they pull bones together. Some parts of our bodies have big muscles e.g. calf muscles in our legs, biceps in our arms. Muscles are attached to bones.

People start their life when they are born. People change in some ways as they grow up and as they grow old.

They need to be looked after when they are young and sometimes when they are old or ill. At the end of their life, people die. A life cycle diagram is a way of showing this. When people are grown up they can have babies and the life cycle starts again.

Some of the food we eat comes from animals and some directly from plants. Cheese, butter, yoghurt, and cream all come from milk. Most of the milk we use comes from cows. When we use milk to make cheese or butter, parts of it are thrown away. Cows get their food from grass. A food chain shows where our food comes from. Nearly all food chains start with green plants that need the sun in order to grow.

Some food we eat comes directly from plants and some from animals that eat plants. Flour comes from wheat. Whole-meal flour is made from the whole grain and it is healthier because it has the bran in it. Many foods are made from wheat - cereals, spaghetti, bread etc. It is also an ingredient of cakes, biscuits etc. Grain from wheat and other cereals form the staple diet of people from many countries. Wheat, corn (maize) and rice are all grains from plants that need the sun in order to grow. A food chain shows where our food comes from.

Year 3 : Rocks

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • compare and group together different kinds of rocks on the basis of their appearance and simple physical properties • describe in simple terms how fossils are formed when things that have lived are trapped within rock • recognise that soils are made from rocks and organic matter.	Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.	• How does the size of particles affect the flow rate of water through a funnel? • Which soil is best for seed germination? • Which is the hardest rock? Pupils might work scientifically by: observing rocks and exploring how and why they might have changed over time; using a hand lens or microscope to help them to identify and classify rocks according to whether they have grains or crystals, and whether they have fossils in them. Pupils might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed. Pupils could explore different soils and identify similarities and differences between them and investigate what happens when rocks are rubbed together. They can raise and answer questions about the way soils are formed.
Other teaching ideas 1. Examining rocks and soils with lenses and microscopes 2. Discussing, sorting and grouping rocks 3. Taking rubbings of different rocks 4. Putting different rocks into water to see how the water level changes 5. Shaking different soils in a transparent screw top plastic container and leaving them to stand will reveal the contents in layers		
Key information • Soil comes from the ground when rocks are worn away (eroded).		

- Soil is made up of different sized particles.
- Clay particles feel silky when dry because they are very fine. When wet, they feel sticky and can be rolled into a ball.
- Sand particles feel gritty because they are larger. When wet they cannot be rolled into a ball.
- The chalk in soils comes from fossil shells deposited millions of years ago. The particles are very fine but do not become sticky when wet.
- Water drains through some soils quicker than others.
- Because clay particles are very fine there are few air spaces and the water cannot drain through easily. Clay soil gets water-logged in wet weather. When it dries out the clay sticks together forming a hard layer.
- Sand particles are larger with bigger air spaces so the water drains through easily.
- Stones in soil provide bigger air spaces and improve drainage.

Year 3: Light

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • recognise that they need light in order to see things and that dark is the absence of light • notice that light is reflected from surfaces • recognise that light from the sun can be dangerous and that there are ways to protect their eyes • recognise that shadows are formed when the light from a light source is blocked by a solid object • find patterns in the way that the size of shadows change.	Pupils should explore what happens when light reflects off a mirror or other reflective surfaces, including playing mirror games to help them to answer questions about how light behaves. They should think about why it is important to protect their eyes from bright lights. They should look for, and measure, shadows, and find out how they are formed and what might cause the shadows to change. **Note:** Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses.	• How does distance of a shadow causing object from a screen affect the size of the shadow? • How does distance from the light source affect the size of the shadow? • How does the colour of a filter affect the colour of white/blue/red/green/yellow light? • How do overlapping shadows affect the darkness of the shadow? Pupils might work scientifically by: looking for patterns in what happens to shadows when the light source moves or the distance between the light source and the object changes.

Other teaching ideas

1. Exploring how shadows of stationary objects change through the day (or the seasons)
2. Discussing where the sun first appears and where it goes during the day
3. Discussing where the sun disappears and where it goes during the night
4. How does the apparent movement of the sun compare with our model of the solar system?
5. Where do colours go at night - a speculative discussion
6. What kind of lights make sharp shadows?
7. Sorting and grouping materials into opaque, shiny and transparent
8. Make a shadow clock in the playground
9. Using shadows of children's heads to draw silhouettes
10. Using a torch, some objects and a screen to create silhouettes and then drawing around them
11. Make a collage of objects that are opaque or shiny or transparent
12. Observational drawings of the same object in different kinds of light

Key information

- Light travels in straight lines.

- Light passes through some materials and not others.
  Light passes through transparent materials.
- Light passes through translucent materials but you cannot see objects through it.
- No light passes through opaque materials.
- Shadows are made when the light cannot pass through an object.
- Transparent objects like glass bottles will not be able to make good shadows.
- The size of a shadow will change with the distance of the light and object from the screen.
- When you put an opaque object in the path of a beam of light, a shadow is made.
- Light cannot shine through an opaque object. Opaque objects cast clear, dark shadows. The Sun is a light source. The person is opaque.
- As the Sun appears to move through the sky the position of the shadow changes.
- Transparent materials let all light through; we can see clearly through these materials.
- Translucent materials let some light through; we can only see light through these materials but no shapes.
- Opaque materials let no light through; we cannot see through these materials at all.
- Light travels in straight lines.
- Light can pass round corners if it is reflected using mirrors.

Year 3: Forces and magnets

Year 3 programme of study (statutory requirements)	Notes and guidance (non-statutory	Working Scientifically ideas
Pupils should be taught to: • compare how things move on different surfaces • notice that some forces need contact between two objects, but magnetic forces can act at a distance • observe how magnets attract or repel each other and attract some materials and not others • compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials • describe magnets as having two poles • predict whether two magnets will attract or repel each other, depending on which poles are facing.	Pupils should observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe).	• How well does magnetism pass through or attract different materials? • Which magnet is strongest? • Are bigger magnets stronger? • Are all metal objects attracted to a magnet? Pupils might work scientifically by: comparing how different things move and grouping them; raising questions and carrying out tests to find out how far things move on different surfaces and gathering and recording data to find answers their questions; exploring the strengths of different magnets and finding a fair way to compare them; sorting materials into those that are magnetic and those that are not; looking for patterns in the way that magnets behave in relation to each other and what might affect this, for example, the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets.
Other teaching ideas 1. Children have magnets and they search for magnetic materials 2. Discuss what magnetic materials do near magnets 3. Will magnets attract magnetic materials through paper, fabric etc? 4. Which part of a bar magnet attracts magnetic materials		

5. Children have two bar magnets and explore how they interact
6. Discuss what bar magnets do near other bar magnets
7. Make a fishing game with magnets
8. Make a maze game. The object has to follow the path/maze on a board with a magnet pulling the object from underneath

Key information

- Pushes and pulls are examples of forces.
- Forces act in particular directions.
- When a force is applied it will make an object start moving, stop moving, change shape or change direction.
- The greater the force, the greater the movement or change in shape.
- The greater the mass the bigger the push or pull needed to move it.
- The greater the mass, the greater the force needed to pull the mass. The steeper the incline, the greater the force required to pull the object up the ramp The greater the mass/incline the more the elastic band will stretch. This can be measured with a ruler.
- Forces are measured in newtons.
- Magnets attract certain metals. Like ends of magnets repel each other. Unlike ends attract.