SCIENCE PROGRESSION: Disciplinary and Substantive knowledge

Disciplinary knowledge (working scientifically)					
Enquiry types					
	KS1	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Asking relevant questions and using different types of scientific enquiries to answer them	• Ask simple questions and recognising that they can be answered in different ways • Understand what a scientific question is. • Know how a scientific question could be answered • Use simple secondary sources to find some answers	• Begin to raise questions of their own about the world around them. • Begin to suggest what type of enquiry will be the best to answer their question.	• Begin to raise questions of their own about the world around them. • Begin to suggest what type of enquiry will be the best to answer their question.	• Begin to independently ask questions of scientific phenomena to investigate. • Choose the type of scientific investigation appropriate to the question	• Independently, choose questions to investigate. • Choose and justify their choice of scientific investigation they will use to answer the question. •

Knowledge of Scientific methods					
	KS1	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Setting up simple practical enquiries, comparative and fair tests	• Use set variables in practical work. • Understand that one variable needs to change. • Understand they need to measure or observe what happens.	• Decide what they need to observe to find answers to a question. • Begin to decide what variables they might test and which should stay the same. • With support, decide what methods and equipment may be needed, to complete their observations. • With support, understand if their chosen methods would be a 'fair' test. •	• Decide, through class discussion, what variables should be kept the same and what should be changed each time. • Think about what they can use to measure their observations accurately (inc. data loggers and thermometers) • Plan how they will record the results they measure clearly. •	• Decide and begin to explain the variables that will need to be controlled to answer the question. • Begin to explain if this will produce a fair test. • Decide what to observe and record, over what period of time and what equipment they will need to use and explain how they will use it. • Begin to think if tests should be repeated for fairness.	• Independently decide what variables will be controlled in the investigation and explain which change and which stay the same. • Be able to explain how they have produced a fair test- Explanations should include how they decided the time over which to observe, the equipment chosen and how it will be used accurately (what units and level of accuracy) and explain why tests should be repeated and how many times.

Knowledge of apparatus and techniques					
Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers	• Observe closely, using simple equipment. • Use simple equipment to make measurements. • Observe changes over time. • Perform simple tests, measuring and recording data appropriately in a simple way.	• Record observations accurately using equipment they are familiar with.(including data loggers, keys, scales and thermometers)	• Show increasing independence in making careful and accurate observations, using equipment they are familiar with.	• Make accurate and precise measurements using the correct standard units, from the equipment chosen.	• Make accurate and precise measurements using the correct standard units, from the equipment chosen, understanding the need for accuracy and the same tolerances between different measurements.
Knowledge of data analysis and presentation					
Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions	• Gather and record data to help in answer questions. • Understand what data is. • Know what a table is and how to place data into it. • Know data in a table can be clearer when displayed as a simple graph.	• Given choices, decide on ways that data can be classified or sorted, into groups in different ways. • Use simple models, keys and diagrams to assist their decisions	• Decide on ways that data can be classified or sorted, into groups in different ways.	• Begin to develop their own keys and diagrams that enable them to sort and classify data.	• Develop their own keys and diagrams that enable them to sort and classify data. Begin to explain their choices.

Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables		• Record their measurements clearly as a table • Use other methods to record measurements with support including labelled diagrams, bar charts and tables	• With guidance, decide and use appropriate ways to record their observations clearly including labelled diagrams, bar charts and tables.	• Begin to make independent choices to use a variety of different methods to record increasingly complex observations and data. Ensure they are collected in a clear and useable format.	• Make independent choices to use a variety of different methods to record increasingly complex observations and data. Ensure they are collected in a clear and useable format. • Be able to explain the format they have chosen.
Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions		• Begin to make decisions about how to present my findings to others in the most appropriate way (with guidance) using written, graphical or spoken methods.	• Make decisions, using methods well known to them, how to present my findings to others in the most appropriate way using written, graphical or spoken methods.	• With increasing independence, choose methods to present their findings that are appropriate to the question they are answering and the audience. • Use appropriate scientific language and vocabulary when presenting their findings.	• Independently, choose a variety of methods to present their findings that are appropriate to the question they are answering and the audience. • Use precise and concise scientific language when presenting their findings.

Knowledge of how science uses evidence to develop explanations					
Identifying differences, similarities or changes related to simple scientific ideas and processes	• Make simple Identifications and classifications of objects • Sorting and compare objects according to simple criteria such as similarities and differences. • Identify patterns	• Begin to notice, with prompts, any similarities, differences and patterns in the recorded observations. Join in discussions about how these relate to the substantive knowledge learnt. •	• Describe similarities, differences and patterns in the recorded observations and begin to relate these to the substantive knowledge learned and scientific models.	• Describe patterns in the recorded observations and begin to communicate how these relate to the substantive knowledge learned and scientific models	• Independently, describe patterns in the recorded observations and communicate how these relate to the substantive knowledge learned and abstract scientific models
Using straightforward scientific evidence to answer questions or to support their findings.		Begin to answer my questions using my recorded observations to start to justify an answer in simple terms	Answer the question, using clear evidence from the recorded observations to help justify an answer	• Begin to explain and communicate clearly the answers to the question that is clearly based on the observations gathered and recorded.	• Explain and communicate clearly the answers to the question that is clearly based on the observations gathered and recorded. • Relate my answer to scienfic conventions and be able to suggest where 'rogue' results may have affected the answer found from observation.

Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions	• Use their observations and ideas to suggest answers to question. • Separate scientific evidence from non-relevant information • Know what conclusions are used for • Know what a scientific conclusion should include	• Begin to use my findings to answer the question in the form of a simple conclusion (scaffolded). • With support, make suggestions about improving the methods used, further investigations, new predictions or new questions that have been raised.	• Draw simple conclusions to answer the question. Begin to use my findings to make suggestions about improving the methods used, further investigations, make new predictions or raise further questions to investigate.	• Begin to draw more detailed scientific conclusions that is clearly based on the observations collected. • Be able to make suggestions about improving the methods used, further investigations, new predictions or new questions that have been raised	• Draw more detailed scientific conclusions that is clearly based on the observations collected. • Be able to make suggestions about each area - improving the methods used, further investigations, new predictions or new questions that have been raised

Substantive knowledge					
Scientific domains					
	KS1	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Plants	**Yr 1** - A seed contains a miniature plant that can develop into a fully grown plant. - A bulb has underground vertical shoots which already has modified leaves - Seeds and bulbs need water to grow but most do not need light (germination) - Seeds and bulbs have food stores inside them to help the plant start to grow. - To survive plants, need to get water, light, and avoid being eaten - A seed produces roots to allow water to get into the plant. - A seed produces shoots to produce leaves to collect the sunlight. - A basic plant structure can include leaves, flowers (blossom), petals, fruit, roots, bulb, seed, trunk, branches, stem Yr 2	- Plants do not eat food so have to make their own. - This food provides then with energy, and materials to grow - To make the food (sugar) plants need water from the ground, carbon dioxide from the air and light from the sun. - The water is taken up through the roots from the soil - The carbon dioxide is taken in through the leaves - As well as food, plants also make oxygen which is given out back into the air through the leaves	- Flowering plants reproduce by the process of pollination - Pollination leads to the formation of a seed which can grow into a new plant - Flowering plants have evolved specific parts to carry out pollination and seed growth - Those parts are stamen where pollen is produced, stigma where pollen is collected, and the ovaries which contains the eggs that become a seed when the pollen travels down the stigma and meets the egg - Flowers have petals also are a range of colours, patterns, and smells to attract insects - Plants and flowers look different because they pollinate in different ways. - There are two types of pollination Insect and wind - Insect pollinated flowers are usually bright		

	- All flowering plants make seeds (reproduction) that can grow (germinate) into new plants - Plants need water, light and a suitable temperature to grow and stay healthy - Some plants die after it has produced its seed and sometimes the plant lives for many generations producing seeds each year		coloured and strong scents - Wind pollinated flowers have less colourful petals and much less scent - Plants have evolved many different ways to disperse their seeds - Seed dispersal increases the chances of seeds germinating and growing into a mature plant -A seed contains a miniature, undeveloped version of the plant -They contain a food store for the first stage of growth -They are surrounded with a protective coat.		
Animals including humans	Yr 1 - Animals are groups of organisms that need to consume food to survive. -Food provides energy and the building blocks of growth. -There are many different groups of animals including fish, amphibians, reptiles, birds and mammals. -They have different structures, and they eat different types of foods.	-All vertebrates have internal skeletons that protect vital organs. Invertebrates have exoskeletons that protect vital organs. -Skeletons support the weight of land animals. -Stronger bones can support a greater mass. -Bones are connected at joints. -Muscles connect to bones and move them when they contract.	-Animals need a variety of foods to help them grow and survive. -The main food groups are: Meat, dairy and pulses provide protein for muscles. Grains and root vegetables provide carbohydrates for energy. Fat for insulation and energy. Fruit and vegetables for minerals, vitamins and	-All animals need oxygen to survive. -Air is breathed into the lungs where the oxygen in the air is passed into the blood. -Every part of animals' bodies need oxygen, especially muscles. -Muscles need a supply of oxygen and sugar (glucose) to make them work, they are supplied by the blood.	

	- The structure of a variety of common animals varies - Mammals have hair/fur and give birth to live young, fish can breathe underwater using gills, birds have feathers, beaks and wings. - Females lay eggs. -Most birds can fly -Reptiles are air breathing and have scaly skin and lays eggs - Amphibians have smooth skin and live on land and in water. -Some eat other animals (carnivores), and others only eat vegetables (herbivores), and some like to eat both plants and meat (omnivores) -Animals must move to get their food -They will move in different ways to get their food -Animals that eat other animals are called predators -Animals that are eaten by other animals are called prey -Animals feeding relationships can be illustrated in a food chain	-Stronger bones can anchor stronger muscles.	fibre. These are essential to keep our bodies working well and protect us from illnesses. - Different animals require different foods to survive. - Animals get their food from plants and other animals. This can be shown in a food chain. -A food chain begins with a producer. This is often a green plant because plants can make their own food. -A living thing that eats other plants is called a consumer. -Humans require a balanced diet to remain healthy but healthy diets vary depending upon the type of activity that humans do. -Humans have 2 sets of teeth in their lifetimes -Humans have three main types of teeth- incisors, canines and molars. Incisors help to bite off and chew pieces of food. Canines are used for tearing and ripping food. Molars help to crush and grind food. -The nutrients in food have to get to every part	-The heart is a vital organ pumps blood through the blood vessels. -Blood Vessels are the tubes that blood flows through. -The blood circulates around the body in a way that ensures all muscles in the body get a supply of oxygen and sugar. -The heart pumps blood to every muscle in the body. The circulatory route must allow the blood to collect oxygen from the lungs, sugar from the intestines and visit muscles. -The blood then returns to the heart where it is pumped again. -Exercise helps the heart to work more efficiently. -Eating a healthy diet helps to keep the blood vessels from getting blocked. -Avoiding smoking and alcohol puts less stress on the whole system and keeps it healthier. -Describe the changes as humans develop to old age.	

	-The five sense organs are the eyes (for seeing), nose (for smelling), ears (for hearing), tongue (for tasting), and skin (for touching or feeling). - Animals have senses to help them survive -Animals have developed a range of ways to find prey or avoid being eaten -Animals have developed a range of ways to find prey or avoid being eaten Yr2 -Things that are living, move, feed, grow, reproduce and use their senses - Animals grow until they reach maturity and then don't grow any larger - Animals reproduce when they reach maturity (adulthood) -All animals eventually, die -Different animals live to different ages -Different animals reach different sizes before they are able to reproduce -Different animals reproduce at different ages		of the body. The blood transports them. -The role of digestion is to get the nutrients in food to dissolve in the blood, if it doesn't dissolve it can't enter the blood and be transported.		

	-Animals, including humans, have offspring which grow into adults -Exercise, eating the right amounts of different types of food and hygiene are important to maintain good health and wellbeing -Habitats are places where animals and plants live -Animals live in habitats in which they are suited. -Different kinds of animals and plants depend on each other within habitat. -Animals get their food from plants and other animals. This can be shown in a food chain. -A food chain begins with a producer. This is often a green plant because plants can make their own food. -A living this that eats other plants is called a consumer.				
Living things and their habitats Yr5 and 6 Evolution and inheritance	Yr 1 -There is variation in all living things -Animals and plants live in a variety of different places called habitats		-Living things can be divided into groups based upon their characteristics -Classification keys help group, identify and name living things	-The Earth is very old. -Life first appeared on Earth around 3.8 billion years ago. -Over millions of years life became more	-Evolution is the change of physical form in a population over a long-time span

	-Animals and plants have adapted to survive in different habitats -Wild plants such as ferns, daisies, nettles and dandelions grow randomly. -Garden plants such as roses, tulips, poppies, daffodils are planted intentionally. -Plants have specific adaptations for survival- they need to get water, light, and avoid being eaten -Animals and plants have adapted ways of surviving the changing seasons -Trees can be either evergreen or deciduous.		-Animals can be classified as vertebrates or invertebrates -In any habitat there are food chains and webs where nutrients are passed from one organism to another -If the population of one organism in the chain or web is affected, it affects the others -Lifecycles vary in time depending on the species of animal -All animal life cycles begin with growth and development followed by reproduction. -Metamorphosis is a process where animals undergo an abrupt and obvious change in the structure of their body and their behaviour. -Environmental change affects different habitats and organisms differently -Human activity significantly affects the environment	complex through the process of evolution -There are many sources of evidence for evolution -Fossils are one of the main sources of evidence for evolution. -Scientists use fossils along with other pieces of evidence to work out how organisms have evolved -Fossils form when dead organisms are rapidly buried or leave an imprint and are turned to stone over a long period of time. -All living (and extinct) organisms are classified into groups based upon their physical features. -Within each of these broad groups, organisms are classified into small subgroups. -Bacteria are a group of organisms	-Natural selection is the process which controls that change. -In any population there is variation and competition for resources -Organisms can have features which make them better adapted and more likely to survive. -They produce offspring that inherit the same successful features. -Those not well adapted will go extinct. -This is known as the Theory of Evolution by Natural Selection and was developed by Charles Darwin in 1859
Materials	Yr 1 -There are many different materials that have different observable properties	-Materials can be divided into solids, liquids and gases. -Solids hold their shape unless forced to change.	-A substance is an object with the same properties throughout. -A mixture is when more than one substance is	-All matter, including gas, has mass. -Sometimes, mixed substances react to make a new substance. These	

	-Materials that have similar properties are grouped into metals, rocks, fabrics, wood, plastic and ceramics (including glass). Yr 2 -Materials can be changed by physical force (twisting, bending, squashing and stretching). -The properties of a material determine whether they are suitable for a purpose.	-Liquids flow easily but stay in their container because of gravity. -The more viscous a liquid the less runny it is. -Gases move everywhere and are not held in containers by gravity. -Heating causes solids to melt into liquids and liquids to evaporate to gases. -Cooling causes gases to condense to liquids and liquids to freeze to solids. -Different substances change state at different temperatures but the temperatures at which given substances changes state is always the same. -The temperature at which a substance melts from a solid to a liquid is the same at which it freezes from a liquid to a solid. -The temperature at which a substance boils from a liquid to a gas is the same at which it condenses from a gas to a liquid. -Liquids evaporate slowly, even below their boiling temperatures. -The water cycle is the process by which water is	present in the same container -When a substance is added to a liquid and disappears it is called dissolving -A mixture of a substance that has dissolved in a liquid is called a solution -Not every substance can dissolve in water -Mixtures can be separated if the substances have different properties -There are different techniques for separating mixtures :Filtration, sieving, evaporation, floating	changes are usually irreversible. -Heating can sometimes cause materials to change permanently. -Indicators that something new has been made are the properties of the material are different	

		continuously transferred between the surface of the earth and the atmosphere. -A rock is a solid material made up of minerals forming part of the surface of the Earth -Rocks are exposed on the surface but are also under the surface. -Some rocks, called ores contain metals -Rocks can be sedimentary, igneous or These types have different properties to each other -Soil is made up of small broken-down pieces of rock of different sizes called silt or clay. -Soil also contains humus			
Electricity			-Lots of devices are powered by electricity -Electricity comes from a source There are two main sources- batteries and mains -A battery pushes electricity to the device. -To be able to push electricity the battery must be connected to the device using wires This is called a circuit		-Current is the flow of electricity around a circuit. -The power supply in a circuit pushes the current round the circuit -The voltage of the power supply is a measure of this push -Voltage is measure in volts -Batteries have a limited store of energy and when

			-More batteries added to a circuit provides a bigger push on the electricity This will make the device work harder -Some materials are conductors -Other materials are insulators -A switch opens and closes a circuit		this is gone, they can no longer push the current -Current is the flow of electricity through a conductor -When current passes through a device it makes it work -Increasing the voltage (the number of cells in the battery) increases the current. -All parts of a circuit offer resistance to electrical current -Resistance is the slowing down of electrical current -The more devices added into a circuit the greater the resistance
Forces and magnets	Yr2 -Objects can be in various ways -The pushing or pulling of an object can affect its motion. -Pushing or pulling can do three things, slow down, speed up or change the direction of an object. -The larger the push/pull the bigger the effect on motion	-Magnets exert attractive forces on some metals -Each end of a magnet is called a pole, opposite poles are called north and south. -Magnets exert attractive forces on each other when the poles facing each other are north and south (opposites). -Magnets exert repulsive forces on each other when the poles facing each other are the same. -The strength of magnetic forces is affected by:		-When objects move through air and water, they a forces push back called water resistance and air resistance. -The harder it is to push the material out of the way the greater the resistance. -Gases weigh less than liquids and so water resistance is greater than air resistance. -Friction is a force stopping motion caused by two surfaces rubbing against each other.	

		The strength of the magnet. The distance between the magnet and the object. The material the object is made from.		-No surfaces are perfectly smooth; they can interlock when placed on top of each other. -Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move. -The use of levers can reduce the force needed to move things. -The object you are lifting is called the load, and the force you apply to make the object move is called the effort. -The use of pulleys can reduce the force needed to move things	
Light and sound		-Light comes from a source. -We need light to see things, even shiny things. -Light from the sun can be dangerous and that there are ways to protect their eyes -If an object is transparent light will go through it and can see through it. -If an object is opaque, it will block the light and no light will get through.. -The closer to the light source an opaque object			-When light is emitted from a light source, it travels in straight lines until it hits an object -Shadows form when light hits an opaque object. The area behind the object is in darkness because light can only travel in straight lines. -Shadows have the same shape as the objects that cast them. -When light hits a transparent object, it goes through it in a straight line so we can

		is, the bigger the shadow will be because the object blocks more of the light. -If an object is reflective, light will bounce back off it and we will see reflections of objects. -If the material is translucent, it will allow light through, but we won't be able to see through it.			see a clear image through it. -When light hits a translucent material, it goes through it but is scattered, this means light can pass through, but we can't see an image through it. -When light hits a mirrored surface, it reflects off it in straight lines, so we can see an image in the reflective material. -Shiny surfaces are better reflectors and rough surfaces scatter light more. -Animals see objects when light is reflected off the object and enters the eye through the pupil. -The pupil changes its size to allow enough light into the eye. -Sounds can be produced in a variety of ways. -Sounds have the properties of pitch and volume. -When a sound is produced it spreads out from its source in all directions -Sound is caused by vibration

					-When objects vibrate it makes the objects in contact with it also vibrate including the air. -The vibration travels through the air and makes other objects it is in contact with vibrate including your ear drum. -Pitch and volume are caused by how the material vibrates -How fast an object vibrates is called the frequency of vibration. Higher the frequency, higher the pitch -Volume is caused by how big each vibration and called the amplitude of vibration. -Sounds get fainter as the distance from the sound source increases.
Earth and space	-There are four seasons, -Each season is about three months long - Different things happen in each season to plants , animals and the weather			-A Solar system is a collection of planets, which orbita star. -There are many stars in space, therefore a huge number of solar systems -Our solar system consists of 8 planets, some have orbiting moons. -The Moon appears to change shape. We call these the phases of the moon.	

				-The Moon doesn't emit -Our solar system can be represented with a model but it isn't possible to draw it to scale. -The planets and moons are rotating -The time it takes one planet to rotate is called a day. On Earth this is 24 hours -The time it takes a planet to complete one orbit is called a year. On Earth this is 356.25 days -The solar system is with a massive collection of stars called gaalaxy -The Milky way is one of billions of galaxies in the Universe. -Stars produce vast amounts of light and heat. -Asteroids are lumps of rock that orbit a star -Comets are objects that are made of Ice, which melts when they get closer to the sun leaving a tail. -Gravity is force of attraction between two objects with mass -Gravity works over distance but gets weaker as distance increases	