KS3 Science PROGRESSION MAP

Overview: Science education provides the foundations for understanding the world. Science changes our lives and is vital to the world's future prosperity. Through science education, students learn to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They are encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes. Students are taught about Working Scientifically through a range of practical investigations that are always clearly related to the science content in the programme of study. Students develop key practical skills such as use of microscopes, safe handling of chemicals and basic equipment to carry out simple chemical reactions and measurements of time, distance and forces in different contexts.

Themes within subject	Year 5	Year 6	Year7	Year 8	Year 9	End of KS4
Subject Knowledge overview	During their time in Year 6, pupils will have studied the following areas: • Plants • Animal Life Cycles • Solar System • Properties of Materials	During their time in Year 6, pupils will have studied the following areas: • Animals groups • Circulation • Digestion • Variation • Evolution • Light	During their time in Y7, pupils will have studied the following areas: • Particle Theory • Separating Mixtures • Cells • Energy Transfer	During their time in Y8, pupils will have studied the following areas: • Digestion • Breathing • Respiration • Periodic Table • Elements • Sound	David Thompson (QE school) will have completed the final 2 columns by June 28th) During their time in Y9, pupils will study the following areas:	• The following topics studied at KS3 will provide the foundation from which to build at KS4: • Infection and Response (Disease and defence)

	• Separating Materials • Forces • Sound • Electricity	• Electricity	• Energy Costs • Genes Variation • Movement • Acids and Alkalis • Gravity • Speed • Universe • Current • Voltage and Resistance • Light • Earth – Rock Cycle • Metals and Non-Metals • Plant reproduction • Human Reproduction	• Energy - Work • Evolution • Inheritance • Types of Reaction • Chemical Energy • Heating and Cooling • Photosynthesis • Magnetism • Electromagnets • Contact Forces • Climate • Earth Resources	• Properties of waves • Pressure • Cells (structure and types and transport) • Organisation (Tissues, Organs, Systems etc..) • Energy (Stores, changes, transfer, resources) • Electricity (Current, pot difference & resistance, Uses and national grid). • Atomic structure (history and arrangement) • Periodic Table (groups and history) • Bonding, Structure and properties	• Bioenergetics (Photosynthesis, respiration) • Homeostasis and response (Nervous system, hormones) • Inheritance, variation and evolution (Reproduction, genetics, classification). • Ecology (Adaption, factors, organisation & biodiversity). • Quantitative chemistry (Chemical measurements, moles etc.) • Chemical changes (Reactivity of metals, reactions of acids & Electrolysis

						• Energy changes • Rates of reaction and equilibrium • Organic chemistry (Carbon compounds as fuels and feedstock) • Chemical analysis • Chemistry of the atmosphere (Composition, history and pollution) • Using resources (water, LCA & recycling) • Particle Model of matter • Atomic structure (linked to radiation) • Forces • Waves

						• Magnets and electromagnetism.
Skills Planning	**Understand that there are different types of scientific *enquiry*** eg observing over time; identifying and *classifying* through observation; pattern seeking; Research; *comparative* or *fair testing*. **Plan a test based on a scientific prediction** **Recognise and control variables** **Understand that sometimes taking several**	**Choose the best type of enquiry to test a prediction, and say why** **Name the variable being changed and the variable being measured.** **Make decisions to ensure that their results will be as trustable as possible** – understand the idea of degree of trust. **Identify when they may have made errors.**	In addition to prior learning, pupils will know the following: a)**Identify the most important variables.** **b)Select the Independent and dependent variables.** c)Pick the best method of measuring the dependent variable from a selection. d)Agree as a group how to control the control variables. **e)Use an observation to**	In addition to prior learning, pupils will know the following: **a)Decide how to vary the independent variable between planned values.** **b)Decide how to measure the dependent variable.** **c)List all the variables that could affect the dependent variable.** **d)Select important control variables.** **e)Identify how to control each control variable independently.**	WS 2.1 Use scientific theories and explanations to develop hypotheses WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select	WS 2.1 Use scientific theories and explanations to develop hypotheses WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select

	measurements and averaging can make results more *accurate*.	**Explain which *variables* need to be controlled.** Take repeat readings when necessary. Choose and use equipment with *precision* to 2 decimal place)	**generate questions.** **f)Identify an independent variable from the general question.** **g)Select a dependent variable from a provided range.** **h)Start to ask questions using the terminology 'How does changing the independent variable affect the dependent variable?'**	f)List variables you cannot control. --- **g)Identify an observation that could be recorded or measured over time.** **h)Write a question in the format 'How does... change over time?'** **Identifying a dependent variable.** **i)Identify an independent variable.** **j)Write a question linking variables in the form 'How does... affect...?'**	those appropriate to the experiment.	those appropriate to the experiment.

				k)Identify two variables which may show a correlation. l) Write a question in the form 'Is there a correlation between…		
Skills Obtaining Evidence	Make observations linked to answering the questions. Identify hazards.	Pupils will be able to : Make a range of relevant observations. Be able to compare not only based on physical properties but also on knowledge gained through previous enquiry	**a) Identify and record key features of an observation.** **b)Use a hypothesis given to suggest a prediction.** **c)Follow an experiment from a set of instructions with regard to safety instructions.** Devise experiments to test from a hypothesis.	a**)Write a scientific description of the observation, using key words.** **b)Suggest a hypothesis for the observation.** c)Suggest an experiment to test the hypothesis. **d)Predict what will happen if hypothesis is correct.** **e)Decide whether the conclusion**	WS 2.4 Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.5 Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative.	WS 2.4 Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.5 Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative.

			d)Identify features of an investigation which are hazardous. **e)Identify ways of reducing the hazard.** f)Use student Hazcards to identify and manage risks. **g)Select an appropriate**	**of the experiment agrees with prediction.** f)State whether or not the hypothesis is correct. **g)Identify features of an investigation which are hazardous.** **h)Determine the nature of identified hazards.** **i)Suggest the likelihood of that happening.** **j)Identify ways of reducing the hazard based on its nature and likelihood** **k)Identify ways of reducing the risk.**	WS 2.6 Make and record observations and measurements using a range of apparatus and methods	WS 2.6 Make and record observations and measurements using a range of apparatus and methods

			range for variables from a selection provided. **h)Collect three sets of data,** repeating if anomalies are identified. i)Choose the best table from a range of tables provided to record in. **j)Use equipment with accuracy appropriate to the data being collected.** **k)Carry out the method carefully and consistently.**	l)Weigh up the benefits and risks of an application of science to make a decision. m)Explain why they made this decision. **n)Choose a suitable range for the independent and dependent variable.** **o)Gather sufficient data for the investigation and repeat if appropriate.** p)Prepare a table with space to record all measurements. q)Apply sampling techniques if appropriate. **r)Check that the measuring**		

				instrument can measure the complete range of the independent variable. s)Check you can detect differences in the dependent variable. **t)Use the measuring instrument correctly.** .		
Skills Presenting Evidence	**Choose a recording method that helps them *analyse***	Choose the best recording method and say why – eg scientific diagrams, keys, tables, scatter graphs, line graphs.. Use their scientific knowledge to draw conclusions. (identifying patterns)	**a)Use line and scatter graphs for continuous data and bar charts for discontinuous data.** **b)Use branching diagrams to sort groups.** **c)Use Venn diagrams for classification.**	**a)See if repeated measurements are close.** b)Remove outliers. **c)Calculate a mean from a set of data.** **d)Decide the type of chart or graph to draw based on its purpose or type of data**.	WS 3.1 Presenting observations and other data using appropriate methods. WS 3.2 Translating data from one form to another. WS 3.3 Carrying out and represent mathematical and statistical analysis	WS 3.1 Presenting observations and other data using appropriate methods. WS 3.2 Translating data from one form to another. WS 3.3 Carrying out and represent

		eg develop keys, analyse data mathematically.	**d)Label the x axis with the name of the independent variable and the y axis with the dependent variable.** **e)Write unit labels on the axes.** f)Draw a straight line of best fit through the points.	e)Decide which numbers to start and finish with on each axis. f)Mark out an equal scale showing what each square of graph paper represents. g)Draw a straight line or a curve of best fit through the points.		mathematical and statistical analysis
Skills Considering Evidence	Start to *systematically* analyse and compare their data **Use their scientific knowledge to draw *conclusions (identifying patterns)***	Systematically analyse and compare their data. discuss any data which does not fit the rest of the set. Recognise when further tests are necessary and. Suggest improvements	**a)Describe a general pattern shown by their graph/results, discuss any data which does not fit the rest of the set** **b)Be able to use data to show that livings things that are grouped**	**a)Read values from a line graph.** **b)Spot a data point that does not fit the pattern.** **c)Identify a general pattern in results comparing the independent and dependent variables.**	WS 3.4 Representing distributions of results and make estimations of uncertainty. WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic	WS 3.4 Representing distributions of results and make estimations of uncertainty. WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic

	Say whether they applied fair testing effectively	Understand that scientists' conclusions help their ideas to change over time.	**together have more things in common than with things in other groups** **c)Be able to answer their question,** describing causal relationships or changes over time. **d)Provide oral or written explanations for their findings using relevant vocabulary** **e)Explain their degree of trust in their results e.g. precision in taking measurements**, variables that may not have been controlled, and	**d)Answer original question using evidence from data.** **e)Identify anomalous results.** f)Use ideas from the real world to support or dispute findings. **g)Make relevant remarks on findings using accurate scientific vocabulary.**	or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. WS 3.6 Presenting reasoned explanations including relating data to hypotheses WS 3.7 Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error	or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. WS 3.6 Presenting reasoned explanations including relating data to hypotheses WS 3.7 Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error

			accuracy of results f**)Understand why we need to repeat results for reliability** g)Be able to talk about their degree of trust in research sources they have used	**h)Use simple diagrams to enhance explanations.** i)Link findings to prior learning .		
Themes within subject	Year 5	Year 6	Year7	Year 8	Year 9	End of KS4
Organisms	**Identify changes for humans as they age, using a timeline.** **Draw a *life-cycle* diagram for a human. Understand *puberty* prepares our bodies for being adult (reproduction)**	**Know difference *vertebrates* and *invertebrates*** **Know the 5 vertebrate groups** Know some common invertebrate groups, eg insects	**The parts of the human skeleton work as a system for support, protection, movement and the production of new blood cells.** **Antagonistic pairs of muscles create**	**The body needs a balanced diet with carbohydrates, lipids, proteins, vitamins, minerals, dietary fibre and water, for its cells' energy, growth and maintenance.**	**Compare the structure of plant/animal (Eukaryotic) cells with bacterial cells (prokaryotic)** Demonstrate an understanding of the scale and size of cells and be able to make order of	**Explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants.** **Describe the non-specific defence systems of the human**

	List changes boys and girls go through at puberty Hormones control these changes which can be physical or emotional**.** **Know other animals age at different rates. Draw a life cycle diagram for another mammal (M), an amphibian (A), a reptile (R), an insect (I), a bird (B).** identify **differences** between these groups eg M only ones that start as babies inside mothers, are fed milk by their mothers, or A and	, spiders, annelids,molluscs) **Be able to put example animals into the right group (Linnaeus' system-)Carl Linnaeus-** Know at least five of the kingdoms **Know what microorganisms are and how they can be grouped (Bacteria, viruses)** **Know that some microorgasims can be used for good. i.e. pencillium)** **Identify *heart,lungs***	**movement when one contracts and the other relaxes.** Use a diagram to predict the result of a muscle contraction or relaxation. **Multicellular organisms are composed of cells which are organised into tissues, organs and systems to carry out life processes.** **There are many types of cell. Each has a different structure or feature so it can do a specific job.** **Both plant and animal cells have**	**Organs of the digestive system are adapted to break large food molecules into small ones which can travel in the blood to cells and are used for life processes.** Describe the role of diffusion in movement between cells. Explain the role of bacteria in the digestive system Iron is a mineral important for red blood cells. Calcium is a mineral needed for strong teeth and bones. Vitamins and minerals are needed in small amounts to keep the body healthy.	magnitude calculations, including the use of standard form. **Explain how the main sub-cellular structures, including the nucleus, cell membranes, mitochondria, chloroplasts in plant cells and plasmids in bacterial cells are related to their functions.** **Explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism.** (e.g. Nerve, muscle, root hair etc).	**body against pathogens** **Explain the role of the immune system in the defence against disease** Explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population Explain the use of antibiotics and other medicines in treating disease. Describe the process of discovery and development of potential new medicines, including

	I have thousands of eggs. Vocab: *reproduce* **Draw a *life-cycle* for a plant.** **Know the process of reproduction in plants** **.** **Know the process of reproduction in animals.** Understand difference between *asexual* and *sexual reproduction* in plants	***blood vessels, veins, arteries*** ***Investigate pulse-rate*** **Know the *function* of each, including carrying *nutrients* and water; oxygen is breathed into the lungs and absorbed by the blood.** *Link to PE* **Describe one way that diet, exercise, *drugs* can affect the body positively and one way negatively.** Link this to *lifestyles*	**a cell membrane, nucleus, cytoplasm and mitochondria.** **Plant cells also have a cell wall, chloroplasts and usually a permanent vacuole.** Use a light microscope to observe and draw cells. Explain why multi-cellular organisms need organ systems to keep their cells alive.	Describe possible health effects of unbalanced diets from data provided. Calculate food requirements for a healthy diet, using information provided. **In gas exchange, oxygen and carbon dioxide move between alveoli and the blood.** **Oxygen is transported to cells for aerobic respiration and carbon dioxide, a waste product of respiration, is removed from the body.** **Breathing occurs through the**	Explain the importance of cell differentiation Understand how microscopy techniques have developed over time Explain how electron microscopy has increased understanding of sub-cellular structures. **Explain how different factors affect the rate of diffusion** Explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for	preclinical and clinical testing. **Describe Photosynthesis as a balanced equation and link energy changes to it.** **E**xplain the effects of temperature, light intensity, carbon dioxide, concentration, and the amount of chlorophyll on the rate of photosynthesis. State the uses of glucose from Photosynthesis **Describe cellular respiration in muscles and in plants and using an equation.**

				action of muscles in the ribcage and diaphragm. **The amount of oxygen required by body cells determines the rate of breathing.** Explain how exercise, smoking and asthma affect the gas exchange system. Explain how the parts of the gas exchange system are adapted to their function.	exchanging materials. **Describe the process of Osmosis** **Describe active transport** **Explain the differences between the three processes.** **Describe the main parts of an organ system (including tissues etc).** **Explain using the main parts of the digestive system how food is digested** (including the role and a description of how enzymes are involved, and the role of bile).	Describe and explain the body's response to exercise **Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.** **Describe what homeostasis is and what it controls** **Explain how the structure of the nervous system is adapted to its functions** **Describe the principles of hormonal**

					Describe the structure and functioning of the human heart and lungs, including how lungs are adapted for gaseous exchange. **State and describe the functions of each of these blood components.** Evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant **Describe the relationship between health and disease and**	**coordination and control by the human endocrine system** Describe how control of blood glucose concentration occurs. Describe the roles of hormones in human reproduction, including the menstrual cycle. Evaluate the different hormonal and non-hormonal methods of contraception. Explain the use of hormones in modern reproductive technologies to treat infertility

					the interactions between different types of disease. Discuss the human and financial cost of these noncommunicable diseases to an individual, a local community, a nation or globally **Explain the effect of lifestyle factors including diet, alcohol and smoking on the incidence of non-communicable diseases** at local, national and global levels Describe cancer as the result of changes in cells that lead to uncontrolled	Explain the roles of thyroxine and adrenaline in the body **Classification of organisms using the Linnaeus & three-domain systems.**

					growth and division **Explain how the structures of plant tissues are related to their functions**	
Electro magnets	**Identify things at home and school that run on *electricity*** **Identify the following things in a circuit: *Cell, wire, bulb, switch, buzzer, lamp*.** **Know a circuit with everything in a single loop is a *series* circuit.** **Know there must be a complete loop for**	**Use the circuit *symbols* for bulb, switch, cell, battery, motor, buzzer and wire.** Draw accurately a simple circuit diagram. **Know that in a series circuit more cells make lights brighter or buzzer sound louder.** **Know that more cells provide greater voltage, so more energy**	**Model voltage as an electrical push from the battery, or the amount of energy per unit of charge transferred through the electrical pathway.** **In a series circuit, voltage is shared between each component.** **In a parallel circuit, voltage is the same across each loop.**	**An electromagnet uses the principle that a current through a wire causes a magnetic field. Its strength depends on the current, the core and the number of coils in the solenoid.** **The magnetic field of an electromagnet decreases in strength with distance.**	**Identify and draw electrical components (**diodes, resistors, LED's, fuses, thermistors etc…) **Describe current and calculate it.** **Describe the relationship between current, potential difference and resistance in an equation and be able to make any one of these subject of the equation.**	**Describe the difference between permanent and induced magnets.** Describe how to plot the magnetic field pattern of a magnet using a compass **Draw the magnetic field pattern of a bar magnet showing how strength and direction change**

	electricity to flow. **Know most metals are good *conductors*. Name some insulators eg wood, plastic.** **Know an open switch stops the electricity and a closed switch lets it flow.**	Use a voltmeter to measure voltage. **Know an open switch stops the bulb or buzzer working and a closed switch lets it work** **Understand that an open switch stops the electrical *energy* flowing to the bulb or buzzer** Identify a parallel circuit. Know that resistance can have an effect on the component in a circuit.	**Components with resistance reduce the current flowin**g and shift energy to the surroundings Calculate resistance using the formula: resistance (Ω) = potential difference (V) ÷ current (A). **Current is a movement of electrons and is the same everywhere in a series circuit.** **Current divides between loops in a parallel circuit, combines when loops meet, lights up bulbs and makes components work.**	**Magnetic materials**, electromagnets and the Earth **create magnetic fields which can be described by drawing field line**s to show the strength and direction. **The stronger the magnet**, and the smaller the distance from it**, the greater the force a magnetic object in the field experiences.** **Two 'like' magnetic poles repel and two 'unlike' magnetic poles attrac**t. Field lines flow from the north-seeking pole to the	**Explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes.** **Describe the effect on current, potential difference and resistance of placing components in series or in parallel.** Explain the differences between AC and DC and state the standard values in a main AC supply. Describe the setup of a standard 3 pin plug and explain the dangers	**from one point to another** Describe how the magnetic effect of a current can be demonstrated Draw the magnetic field pattern for a straight wire carrying a current and for a solenoid (showing the direction of the field) **Describe Fleming's Left hand rule** Recall the factors that affect the size of the force on the conductor **Describe the basic concepts behind an electric motor**.

			Around a charged object, the electric field affects other charged objects, causing them to be attracted or repelled. Themagnetic field strength decreases with distance Two similarly charged objects repel, two differently charged objects attract	south-seeking pole.	associated with incorrectly wiring the plug. **Explain how the power transfer in any circuit device is related to the potential difference across it and the current through it, and to the energy changes over time** Describe how different domestic appliances transfer energy from batteries or ac mains to the kinetic energy of electric motors or the energy of heating devices **Explain how the power of a circuit device is related to the**	

					potential difference across it and the current through it or the energy transferred over a given time. Describe what the national grid is and explain why it is an efficient way to transfer electricity.	
Energy		No prior knowledge	**We pay for our domestic electricity usage based on the amount of energy transferred.** **Electricity is generated by a combination of resources** which each have advantages and disadvantages.	**Work is done and energy transferred when a force moves an object.** **The bigger the force or distance, the greater the work.** **Machines make work easier by reducing the force needed.**	**Compare the starting with final conditions of a system. Describe increases and decreases in amounts of energy (movement, temperature, chemical composition)** **Use physical processes and**	The following skills developed at KS3 will provide the foundation from which to build at KS4: **Describe the specific latent heat of a material and calculate it.** **Interpret heating and cooling graphs**

			Calculate the cost of home energy usage, using the formula: cost = power (kW) x time (hours) x price (per kWh) **Food labels list the energy content of food in kilojoules (kJ)**. Link to calories in food labelling **We can describe how jobs get done using an energy model where energy is transferred from one store at the start to another at the end.** **When energy is transferred, the total is conserved,** but some energy is	Levers and pulleys make work easier by increasing the distance moved, and wheels reduce friction. **When there is a temperature difference, energy transfers from the hotter to the cooler object.** **Thermal energy is transferred through different pathways, by particles in conduction and convection, and by radiation** The thermal energy of an object depends upon its mass, temperature and what it's made of.	**mechanisms to explain steps that bring about changes.** **Calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level.** **Calculate the amount of energy stored in or released from a system** (using specific heat capacity) **Define power and calculate it using an equations**	**that include changes of state.** Distinguish between specific heat capacity and specific latent heat **Explain how the motion of the molecules in a gas is related to both its temperature and its pressure**

			dissipated, reducing the useful energy.	Insulators can reduce energy transfers.	State examples that illustrate the definition of power Describe, with examples, how in all system changes energy is dissipated, so that it is stored in less useful ways and explain ways of reducing unwanted energy transfers **Calculate efficiency.** **Compare ways that different energy resources are used, the uses to include transport, electricity generation and heating and link the process to reliability, environmental**	

					impact and sustainability.	
Ecosystems		Organisms best suited to their environment are more likely to survive long enough to reproduce. Competition exists for resources and mates.	**Organisms in a food web (decomposers, producers and consumers) depend on each other for nutrients.** So, a change in one population leads to changes in others. **The population of a species is affected by the number of its predators and prey, disease, pollution and competition between individual**s for limited resources such as water and nutrients.	**Respiration is a series of chemical reactions, in cells, that breaks down glucose to provide energ**y and form new molecules. **Most living things use aerobic respiration but switch to anaerobic respiration**, which provides less energy, when oxygen is unavailable. Yeast fermentation is used in brewing and breadmaking.		**Describe different levels of organisation in an ecosystem from individual organisms to the whole ecosystem** **Describe the importance of interdependence and competition in a community.** Explain how a change in an abiotic factor would affect a given community given appropriate data or context. Explain how a change in a biotic factor might affect

			Insects are needed to pollinate food crops. Explain effects of environmental changes and toxic materials on a species' population. **Combine food chains to form a food web.** **Plants have adaptations to disperse seeds using wind, water or animals.** **Plants reproduce sexually to produce seeds, which are formed following fertilisation in the ovary.**	**Plants and algae do not eat, but use energy from light, together with carbon dioxide and water to make glucose (food) through photosynthesis**. Plants and algae either use the glucose as an energy source, to build new tissue, or store it for later use. **Plants have specially-adapted organs that allow them to obtain resources needed for photosynthesis.**		a given community given appropriate data or context Describe and give examples of extremophiles. Understand that photosynthetic organisms are the producers of biomass for life on Earth Recall that many different materials cycle through the abiotic and biotic components of an ecosystem Explain the importance of the carbon and water cycles to living organisms **Explain how biodiversity can**

			Flowers contain the plant's reproductive organs. Pollen can be carried by the wind, pollinating insects or other animals. Describe the main steps that take place when a plant reproduces successfully. Identify parts of the flower and link their structure to their function. Suggest how a plant carried out seed dispersal based on the features of its fruit or seed. Explain why seed dispersal is important to survival of the	Iodine is used to test for the presence of starch. Explain why other organisms are dependent on photosynthesis. Sketch a line graph to show how the rate of photosynthesis is affected by changing conditions. Use a word equation to describe photosynthesis in plants and algae.		**be affected.** Include waste management, land use, deforestation and global warming Describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity

			parent plant and its offspring.			
Genes		**Know that living things produce offspring of the same kind.** **Know offspring are similar to but not identical to parents (*variation*).** **Understand that variation has meant living things have changed over time.** **Understand that variation means that animals become more or less able to survive where they live.**	**There is variation between individuals of the same species.** **Some variation is inherited, some is caused by the environment and some is a combination.** **Variation between individuals is important for the survival of a species**, helping it to avoid extinction in an always changing environment.	**Natural selection is a theory that explains how species evolve and why extinction occurs.** Variation is the driver for Natural Selection. **Biodiversity is vital to maintaining populations. Within a species variation helps against environment changes, avoiding extinction.** Within an ecosystem, having	**Describe how the process of Mitosis takes place.** **Describe the function of stem cells in embryos, in adult animals and in the meristems in plants**	**Understand difference between asexual and sexual reproduction involving Mitosis and Meiosis.** **Describe Meiosis** **Describe the structure of DNA and define genome** **Explain the key ideas behind genetic inheritance.** Explain (using specific examples) how inherited disorders occur. Describe how Sex determination

		Understand/**Know that animals and plants that are able to survive are *adapted* to suit their environment.** Know that the process of *adaptation* leads to *evolution* **Know that fossils tell us about living things from millions of years ago.**	Plot bar charts or line graphs to show discontinuous or continuous variation data. Explain how variation helps a particular species ina changing environment. Explain how characteristics of a species are adapted to particular environmental conditions. **The menstrual cycle prepares the female for pregnancy and stops if the egg is fertilised by a sperm**. **The developing foetus relies on the mother to provide it with**	many different species ensures resources are available for other populations, like humans. Use evidence to explain why a species has become extinct or adapted to changing conditions. Evaluate whether evidence for a species changing over time supports natural selection. Explain how a lack of biodiversity can affect an ecosystem. **Inherited characteristics are the result of genetic information, in**		takes place using chromosomes. Describe simply how the genome and its interaction with the environment influence the development of the phenotype of an organism **Describe evolution (by natural selection)** Explain the impact of selective breeding of food plants and domesticated animals. Describe genetic engineering Describe the evidence for evolution including

			oxygen and nutrients, to remove waste and protect it against harmful substances. The menstrual cycle lasts approximately 28 days. If an egg is fertilised it settles into the uterus lining. Explain whether substances are passed from the mother to the foetus or not. Use a diagram to show stages in development of a foetus from the production of sex cells to birth. Describe causes of low fertility	**the form of sections of DNA called genes, being transferred from parents to offspring during reproduction.** **Chromosomes are long pieces of DNA which contain many genes. Gametes, carrying half the total number of chromosomes of each parent, combine during fertilisation.** **The DNA of every individual is different, except for identical twins.** There is more than one version of each gene eg different blood groups.		fossils and antibiotic resistance in bacteria Describe how a fossil is formed and link this to how different organisms have changed Describe factors which may contribute to the extinction of a species Describe and explain how resistant bacteria are formed (using MRSA)

			in male and female reproductive systems. Identify key events on a diagram of the menstrual cycle.	Explain how a change in the DNA (mutation) may affect an organism and its future offspring. Explain why offspring from the same parents look similar but are not usually identical.		
Matter	**Understand meaning of *hardness, solubility, transparency, conductivity (thermal* and *electric*), and *magnetic*.** **Group materials by these properties**. **Understand meaning of *dissolving* and *solution*** – know		**Properties of solids, liquids and gases can be described in terms of particles** in motion but with differences in the arrangement and movement of these same particles: **closely spaced and vibrating (solid), in random motion but in contact (liquid), or in**	**The elements in a group all react in a similar way and sometimes show a pattern in reactivity.** **As you go down a group and across a period the elements show patterns in physical properties.** **Metals are generally found on the left side**	Suggest suitable separation and purification techniques for mixtures when given appropriate information. **Describe why the new evidence from the scattering experiment led to a change in the atomic model** **Describe the difference**	**Calculating the relative formula mass of a substance** **Describing the amount of a substance in moles (HT).** Calculate the masses of substances shown in a balanced symbol equation Calculate the masses of

	that some materials are soluble in water and some not . **Know methods of separating materials – *filtering, sieving* and evaporating.** **Know a property and associated use of metals, wood and plastic.** Give evidence for these properties of materials		**random motion and widely spaced (gas).** Observations where substances change temperature or state. When objects change state they gain or lose energy. A substance is a solid below its melting point, a liquid above it, and a gas above its boiling point. Changes of state related to energy and density with ice as an anomaly. Particles in fluids move randomly due to Brownian motion.	**of the table, non-metals on the right.** Group 1 contains reactive metals called alkali metals. Group 7 contains non-metals called halogens. Group 0 contains unreactive gases called noble gases. **Most substances are not pure elements, but compounds or mixtures containing atoms of different elements**. **Compounds and mixtures have different properties to the elements they contain.**	**between the plum pudding model of the atom and the nuclear model of the atom.** **Describe the nuclear model to describe atoms,** including the properties of the subatomic particles. **Calculate the numbers of protons, neutrons and electrons in an atom or ion, given its atomic number and mass number.** **Relate size and scale of atoms to objects in the physical world.**	reactants and products from the balanced symbol equation and the mass of a given reactant or product. Balance an equation given the masses of reactants and products Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution. Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution.

			A pure substance consists of only one type of element or compound and has a fixed melting and boiling point. **Mixtures may be separated due to differences in their physical properties**. **The method chosen to separate a mixture depends on which physical properties of the individual substances are different.** Explain how substances dissolve using the particle model.	The symbols of hydrogen, oxygen, nitrogen, carbon, hydrogen, iron, zinc, copper, sulfur, aluminium, iodine, bromine, chlorine, sodium, potassium and magnesium.	**Calculate the relative atomic mass of an element given the percentage abundance of its isotopes.** **Draw the electronic structures of the first twenty elements of the periodic table in both forms.** **Explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number.** **Describe the key steps in the development of the periodic**	**Link the Idea of a mixture to explain what a formulation is.** Describe how to identify a pure substance. **Explain how chromatography works** **Suggest how chromatographic methods can be used for distinguishing pure substances from impure substances and interpret chromatograms to determine Rf values.** **Describe how to identify common gases** (Carbon dioxide, hydrogen, oxygen and Chlorine)

			Use the solubility curve of a solute to explain observations about solutions. Diffusion occurs due to different concentrations of substances. Use evidence from chromatography to identify unknown substances in mixtures. Air, fruit juice, sea water and milk are mixtures.		**table.** In terms of ordering elements and key ideas used by Mendeleev **Explain the differences between metals and non-metals on the basis of their characteristic physical and chemical properties**. This links to Group 0, Group 1, Group 7 and Bonding, structure and the properties of matter. Explain how the atomic structure of metals and non-metals relates to their position in the periodic table	**Describe and calculate density (**explain different densities linked to the particle model). **Describe electron arrangements may change depending on absorption or emission of EM radiation.** *Common ideas on the structure of atoms is also covered in the Chemistry content.* **Describe the properties of alpha particles, beta particles and gamma rays is limited to their**

					Describe the structure of a metal **Link the states of substances at different temperatures to their structure or types of bonding involved**	**penetration through materials, their range in air and ionising power** Explain uses of radiation linked to properties **Write equations to represent radioactive decay** **Explain the concept of half-life and how it is related to the random nature of radioactive decay** Compare the hazards associated with contamination and irradiation. Describe the precautions that

						must be taken to protect against any hazard that the radioactive source used in the process of irradiation may present.
Reactions	**Know the difference between *reversible* and *irreversible* changes** Know dissolving, *mixing* and changes of state are reversible. **Know that irreversible changes can make a new material** Know burning and action of *acid* on *bicarbonate of soda* are irreversible.		**Metals and non-metals react with oxygen to form oxide**s which are either bases or acids. **Metals can be arranged as a reactivity series in order of how readily they react with other substances.** **Some metals react with acids to produce salts and hydrogen.**	**During a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy)**. If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic	**Name compounds of these elements from given formulae or symbol equations** Write word equations for the reactions in this specification Write formulae and balanced chemical equations for the reactions in this specification. (Including Ionic equations HT)	**State the law of conservation of mass and link to equations and masses involved in reactions.** Explain any observed changes in mass in non-enclosed systems during a chemical reaction **Describe reactions of metals with oxygen as either oxidation or reduction.**

			Iron, nickel and cobalt are magnetic elements. Mercury is a metal that is liquid at room temperature. Bromine is a non-metal that is liquid at room temperature **Describe an oxidation, displacement, or metal/acid reaction with a word equation.** Use particle diagrams to represent oxidation, displacement and metal-acid reactions. **The pH of a solution depends on the strength of the acid:**	**Combustion is a reaction with oxygen in which energy is transferred to the surroundings as heat and light.** **Thermal decomposition is a reaction where a single reactant is broken down into simpler products by heating.** **Chemical changes can be described by a model where atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved**.	Predict possible reactions and probable reactivity of elements from their positions in the periodic table. Explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number. **Explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons.** Students should be able to draw dot and cross diagrams for ionic compounds	**Describe the reactivity series in terms of metals reacting with water/acid or experimental results.** Link these ideas to the ability of these metals to form ions **Evaluate specific metal extraction processes when given appropriate information** **Explain in terms of gain or loss of electrons, why metals and acids are redox reactions.** **Use the names of the acids and the substance used**

			strong acids have lower pH values than weak acids. **Mixing an acid and alkali produces a chemical reaction, neutralisation, forming a chemical called a salt and water.** **Acids have a pH below 7, neutral solutions have a pH of 7, alkalis have a pH above 7.** Acids and alkalis can be corrosive or irritant and require safe handling. Hydrochloric, sulfuric and nitric acid are strong acids. Acetic and	Predict the products of the combustion or thermal decomposition of a given reactant and show the reaction as a word equation. Explain observations about mass in a chemical or physical change.	Students should be able to work out the charge on the ions of metals and non-metals **Represent Ionic and covalent compounds using diagrams and models** (dot and cross diagrams, limitations of models and formulas from structures) **Describe the structure of a metal** **Identify state symbols in chemical equations for the reactions in this specification.** **Explain the properties of**	**to neutralise it, to deduce the name of the salt.** **Describe how to make pure, dry samples of named soluble salts from information provided** **In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water.** **Explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of**

			citric acid are weak acids.		**substances from their structure and bonding involved.** Melting point, conductivity of electricity	**the degree of ionisation) in relation to acids** **Describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH** **Explain what electrolysis is and describe how an aqueous substance or a molten substance are electrolysed.** Explain the key features behind the electrolysis and extraction of Aluminium.

						Represent the key reaction in electrolysis using half equations **Describe reactions in terms of gain or loss of energy .** Endothermic and Exothermic Link reactions and a use to energy changes. Represent these reactions using reaction profile diagrams Explain bond breaking and making in terms of energy change **Describe the meaning of the rate of a reaction**.

						Represent the rate of reaction as an equation and draw and interpret graphs representing the rate during a reaction. **Describe and Explain how the rates of reaction can be changed using temperature , pressure concentration and surface area.** Use collision theory in the explanation **Describe and explain how catalysts affect the rate of reaction and link to energy level diagrams and activation energy**.

						Link the ideas of Exothermic and Endothermic (energy changes) to reversible reactions, **Explain what dynamic equilibrium is and link the position of equilibrium to changes in conditions** (pressure, temperature and concentration HT).
Earth	**Know we live on a *planet*.** **Know planets orbit a *star*, in our case the sun.**		**Sedimentary, igneous and metamorphic rocks can be inter converted over millions of years through**	**Carbon is recycled through natural processes in the atmosphere, ecosystems, oceans and the**		**Describe what crude oil, a hydrocarbon and an alkane are.**

	Remember they must not look directly at the sun even with dark glasses. **Know there are 8 planets in our *solar system,* and name them** **Know planets may have moons *orbiting* them.** **Know the Earth, Moon and Sun are roughly *spherical*.** **Know we have day and night because the earth turns.** **Know the sun does not move – it just seems to because the earth is *rotating***		**weathering and erosion, heat and pressure, and melting and cooling**. **The three rock layers inside Earth are the crust, the mantle and the core** Construct a labelled diagram to identify the processes of the rock cycle. **The solar system = planets rotating on tilted axes while orbiting the Sun, moons orbiting planets.** **The rotation explains day length**, and **orbit explains year length.** The **tilt**	**Earth's crust** (such as photosynthesis and respiration) as well as human activities (burning fuels). **Greenhouse gases reduce the amount of energy lost from the Earth** through radiation and therefore the **temperature has been rising as the concentration of those gases has risen.** Scientists have evidence that**t global warming caused by human activity is causing changes in climate.**		Name and draw the structure of an alkane **Describe how crude oil forms.** **Describe how to separate crude oil into Useful substances and link their properties to the structure of the alkanes present.** (boiling points, viscosity, flammability). **Explain the need for cracking and describe the process of it.** Represent the process as an equation and Identify one of the products as alkenes.

	Katherine Johnson**, Dorothy Vaughan, and Mary Jackson, three mathematicians who worked as computers (then a job description) at NASA, during the **space race. Scientists have different ideas about the Solar System as more evidence has been gained.		**explains the season**s. Reflected light explains visibility of objects in the solar system from Earth.. Our solar system is a tiny part of a galaxy, one of many billions in the Universe. **A light year is a measure of distance** Light takes minutes to reach Earth from the Sun, four years from our nearest star and billions of years from other galaxies. Describe the appearance of planets or moons from diagrams showing their position in relation	Methane and carbon dioxide are greenhouse gases. Earth's atmosphere contains around 78 % nitrogen, 21 % oxygen, <1 % carbon dioxide, plus small amounts of other gases. **There is only a certain quantity of any resource on Earth, so the faster it is extracted, the sooner it will run out**. Recycling reduces the need to extract resources. **Most metals are found combined with other elements, as a compound, in**		Describe a use and test for alkenes. Represent the composition of the earth's atmosphere using ratios, fractions and percentages. **Describe the formation of the Earth's early atmosphere.** **D**escribe the processes that have taken place to change the composition (linked to water, carbon dioxide and oxygen) **Describe how methane and Carbon dioxide cause the green effect in terms of changes of wavelength.**

			to the Earth and Sun. Explain why places on the Earth experience different daylight hours and amounts of sunlight during the year.	**ores**. **The more reactive a metal, the more difficult it is to separate it from its compound.** Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals. Justify the choice of extraction method for a metal, given data about reactivity.		Describe the effects of global warming Describe Carbon footprint Evaluate the quality of evidence in a report about global climate change given appropriate information Describe uncertainties in the evidence base **Describe the common how the common atmospheric pollutants are produced and their effects**. (Carbon monoxide, sulphur dioxide, nitrogen oxides and soot).

						State examples of natural products that are supplemented or replaced by agricultural and synthetic products **Distinguish between finite and renewable resources given appropriate information.** **Distinguish between potable water and pure water** **Describe the differences in treatment of ground water and salty water** Give reasons for the steps used to produce potable water

						Describe how wastewater is treated **Explain why there is the need for alternative methods of extracting resources and describe these methods** (Phytomining and bioleaching HT). **Link the key ideas of Recycling to Life cycle assessments.**
Forces	**Know *unsupported* objects fall because of *gravity* between earth and the object.**		**Mass and weight are different but related. Mass is a property of the object; weight depends upon mass but also on**	**When the resultant force on an object in motion is zero, it is in equilibrium and remains at**	**Pressure acts in a fluid in all directions. It increases with depth due to the increased weight of fluid, and**	**Describe the difference between Scalar and Vector quantities.**

	Identify forces and their effects: *Air resistance, water resistance,* friction **Know air resistance, water resistance and friction act between moving surfaces in contact** **Know *levers* and *pulleys* make lifting easier.** **Know some objects require large forces to make them move**; gears, pulley and levers can reduce the force needed to make things move		**gravitational field strength.** **Every object exerts a gravitational force on every other object.** The force increases with mass and decreases with distance. Gravity holds planets and moons in orbit around larger bodies. **g on Earth = 10 N/kg.** On the moon it is 1.6 N/kg **weight = mass x gravitational force** **When the resultant force on a stationary object is zero, it is in equilibrium**	**constant speed in a straight line.** One effect of a force is to change an object's form, causing it to be stretched or compressed. In some materials, the change is proportional to the force applied	**results in an upthrust.** **Objects sink or float depending on whether the weight of the object is bigger or smaller than the upthrust.** Different stresses on a solid object can be used to explain observations where objects scratch, sink into or break surfaces. Moment as a turning force	**Describe a forces as either contact or non-contact** **Describe the link between Weight and centre of mass** **Calculate the resultant of two forces that act in a straight line** **Draw and interpret vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction (scale drawings only).**

			and does not move. **One effect of a force is to change an object's form, causing it to be stretched.** **Sketch the forces acting on an object, and label their size and direction.**			**Calculate work done (**including converting between units). State forces involved in stretching, bending or compressing an object Calculate the force of a spring based on its spring constant and extension. Describe the difference between elastic deformation and inelastic deformation caused by stretching forces Calculate work done in stretching (or compressing) a spring

Waves (Sound and Light)	**Know sounds are made by something *vibrating*** **Know that sounds travel through something to get to our ears** **Know the *pitch* of the sound depends on the thing producing it.** **Know the faster the vibration the higher the pitch** **Know the *volume* of a sound depends on the strength of the vibration producing it.**	**Know that light travels in straight lines** **Understand that this explains why shadows have the shapes they do.** **Understand that we (**including animals) **see a light because it sends light to our eyes** **Understand that we see other objects because light hits them and they reflect it to our eyes** (unless they are black)**.**	**Sound consists of vibrations which travel as a longitudinal wave through substances.** **The denser the medium, the faster sound travels.** **The greater the amplitude of the waveform, the louder the sound.** **The greater the frequency (and therefore the shorter the wavelength), the higher the pitch.** Sound does not travel through a	Not studied at Year 8 but addressed through regular quizzing, low stakes regular practise and homework	When a wave travels through a substance, particles transfer the energy. Energy is transferred in the direction of movement of the wave. Waves of higher amplitude or higher frequency transfer more energy. A physical model of a transverse wave demonstrates it moves from place to place, while the material it travels through does not, and describes the	**Describe transverse or longitudinal waves in terms of compression and rarefaction.** **Describe wave motion in terms of their amplitude, wavelength, frequency and period.** **Describe the term Period relating to a wave and calculator it, and wave speed.** **Describe the electromagnetic spectrum and the waves within it in terms of**

	Know that sounds get fainter the further away they are	Non shiny surfaces scatter the light so we don't see the beam **How a simple optical instrument works (periscope)**	vacuum. The speed of sound in air is 330 m/s, a million times slower than light. **When a light ray meets a different medium, some of it is absorbed and some reflected.** **For a mirror, the angle of incidence equals the angle of reflection.** The ray model can describe the formation of an image in a mirror and how objects appear different colours. **When light enters a denser medium it bends towards the normal; when it**		properties of speed, wavelength and reflection.	**speed, wavelength and energy.** **Describe the properties of all electromagnetic waves.** State the uses of electromagnetic waves linked to their properties.

			enters a less dense medium it bends away from the normal. Refraction through lenses and prisms can be described using a ray diagram as a model. White light can be split to form the spectrum. Some light is absorbed and some is reflected for us to see colours. **We see when light is focused through a lens onto the retina in the eye** / film in a camera resulting in a chemical change.			

Forces- Speed		**Identify forces and their effects: *Air resistance, water resistance,* friction** **Know air resistance, water resistance and friction act between moving surfaces in contact**	**If the overall, resultant force on an object is non-zero, its motion changes and it slows down, speeds up or changes direction.** **A straight line on a distance-time graph shows constant speed,** a curving line shows acceleration. **The higher the speed of an object, the shorter the time taken for a journey.** **Illustrate a journey with changing speed on a distance-time graph, and**			**Describe the difference between distance and displacement.** Describe a displacement in terms of both the magnitude and direction. Calculate average speed for non-uniform motion **Describe the meaning of the term Velocity and explain why it is a vector quantity.** **Draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs,**

			label changes in motion. Describe how the speed of an object varies when measured by observers who are not moving, or moving relative to the object. **Use the formula: speed = distance (m)/time (s**) or distance-time graphs, to calculate speed. Calculate speeds of objects approaching and passing each other.			**translating information between graphical and numerical form.** **Describe and calculate acceleration and calculate from acceleration from the gradient of a velocity–time graph.** Draw velocity–time graphs from measurements and interpret lines and slopes to determine acceleration Use the equation that applies to uniform acceleration.

						State and apply Newtons first law **State and apply Newtons second law** **State and apply Newtons third law** **State and describe stopping distance and the factors which affect it.** Explain methods used to measure human reaction times and recall typical results **Define Momentum (HT) as an equation** Describe and explain examples

						of momentum in an event, such as a collision
Themes within subject	Year 5	Year 6	Year7	Year 8	Year9	End of KS4

The end unit of Year 6 will consist of Interdependence

Reference documents other than National Curriculum:	AQA GCSE Science Syllabus WAT KS1/2 Progress Map