The Royal School

Wolverhampton

Curriculum 2024

SCIENCE

(July 2024 edit)

Curriculum 2024 Science

Science curriculum intent

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, our pupils will be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, our pupils will be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They will be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

In particular we aim to ensure that all pupils:

- Develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics.
- Develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them.
- Are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Science curriculum implementation

In science we teach three lessons per week at KS3, six (eight lessons in Triple Science) per week at KS4 and five lessons per week at KS5. Our curriculum is structured in learning cycles. Each cycle lasts for 7 weeks and includes at least one assessment followed by a review where re-teaching or stretch and challenge opportunities, tailored to the needs of the pupils can take place. There are 5 learning cycles per year.

Each lesson follows The Royal lesson structure below:

- Date and learning question.
- Review questions as bell work and answers to be self-assessed or peer assessed.
- Homework set at start of lesson.
- The learning journey shared including lesson objectives and success criteria.
- Challenge tasks set every lesson.
- Review learning objectives at end of lesson.

Our curriculum is implemented in many ways including taught lessons, investigative and experimental science, group work, presentations and out of class experiences which emphasise the importance of STEM, women in science, local industry and university undergraduate opportunities.

Science curriculum impact

The impact of our curriculum can be evaluated in many ways using both quantitative and qualitiative information indicating how ready pupils are for the next stage in their learning whether that be transition between key stages or leaving for universities, apprenticeships or work at the end of year 13.

This includes an assessment of

- The number of pupils achieving the national average (and often higher!) at the end of their key stage indicating their readiness to move forward with the next stage of their learning journey.
- The number of pupils in Key Stage 3 who opt to study Triple Science at GCSE.
- The number of pupils in Key Stage 4 who opt to study A-level sciences.
- The number of pupils participating in science activities within the department, including enrichment activities during P6, school open days, options evenings and revision sessions.

Further information that can be used to assess the impact of the curriculum includes:

- The number of pupils gaining places at their first choice universities to study the sciences.
- The number of pupils gaining entry into a scientific career route including apprenticeships and employment.

As an essential rule within science we should be looking to:

1. Inspire and enthuse
2. Engage
3. Embed
4. Excel

As pupils progress through school they should consistently engage with an inspiring curriculum, build around practical experiences. They will have repeated exposure to curriculum content so that practise of key skills and knowledge embeds learning. They will then develop a personal desire to excel withinin the subject in greater detail, choose A-level or BTEC pathways and identify career progression within science or STEM subjects.

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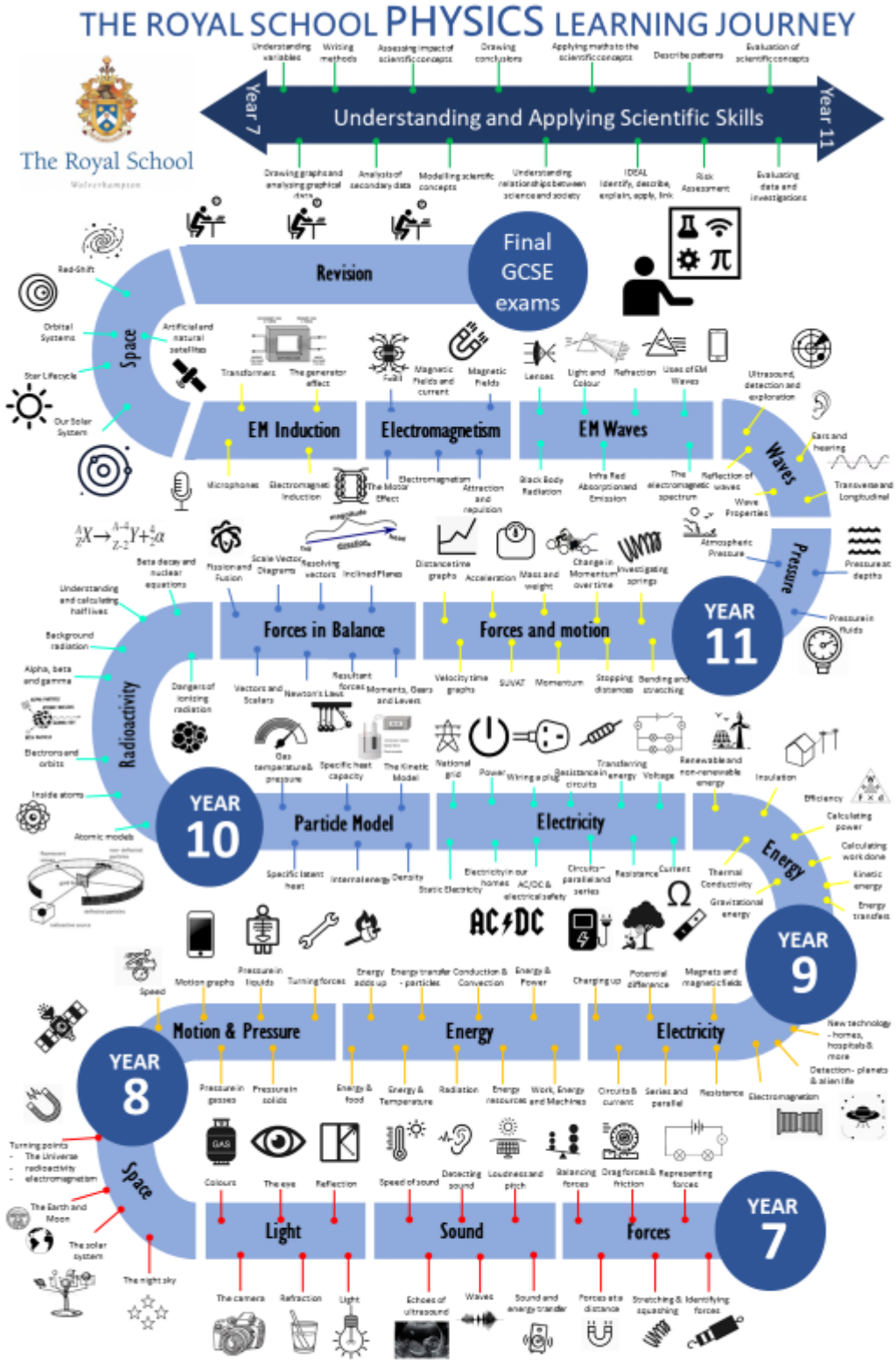
Physics Learning Journey



CROSS-CURRICULAR LINKS

Isotopes	Chemistry	Energy	Chemistry
Electricity	Engineering	Calculations	Mathematics
Pressure	Chemistry	Radiation dangers	Biology
Atomic models	Chemistry	Detecting light & sound	Biology

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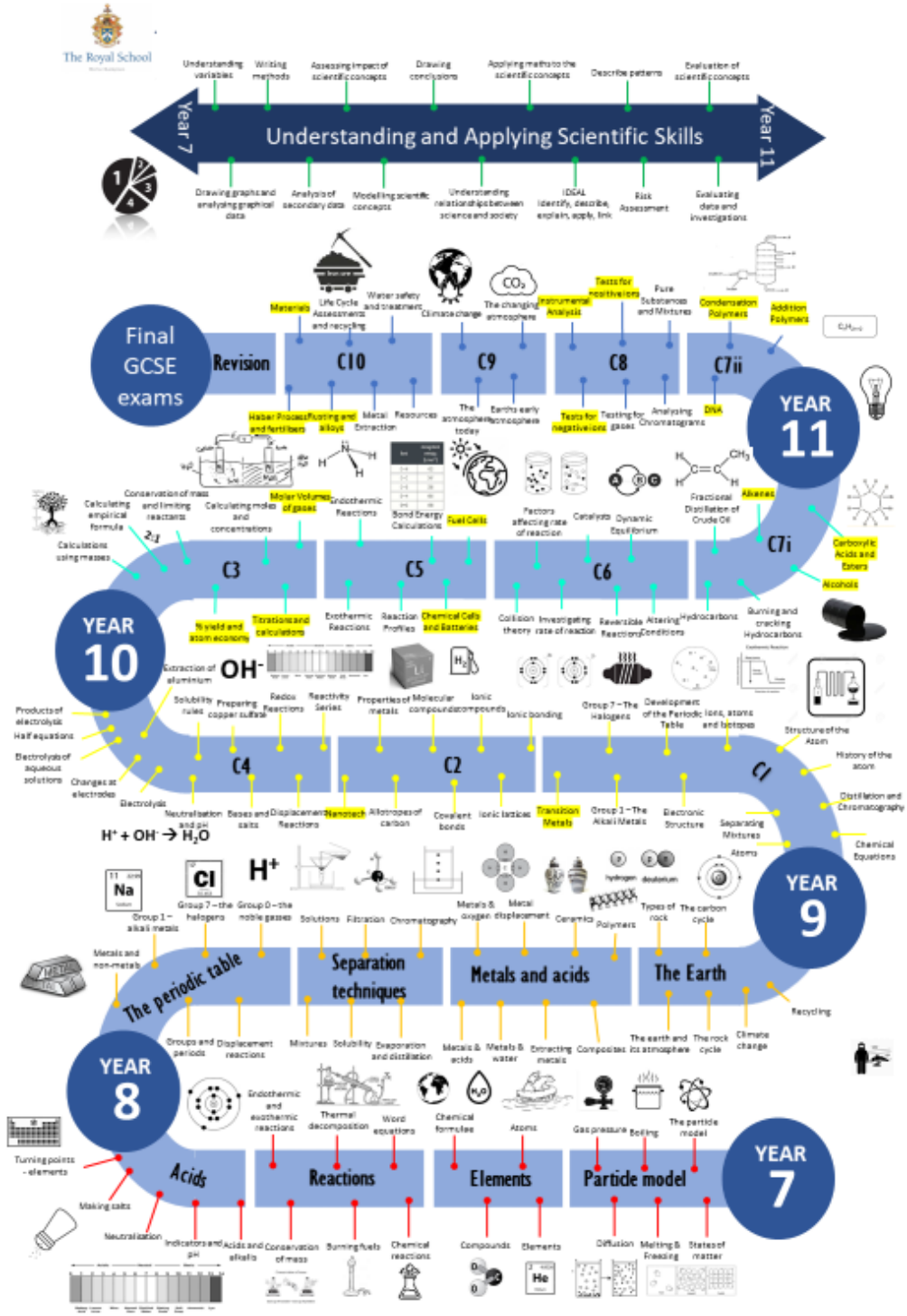
Chemistry Learning Journey

THE ROYAL SCHOOL CHEMISTRY LEARNING JOURNEY



CROSS-CURRICULAR LINKS

Movement	Biology	Isotopes	Physics
Calculating mass	Mathematics	Balancing equations	Biology
The Earth	Geography	Climate change	Biology
Atomic models	Physics	Materials	Art & Design

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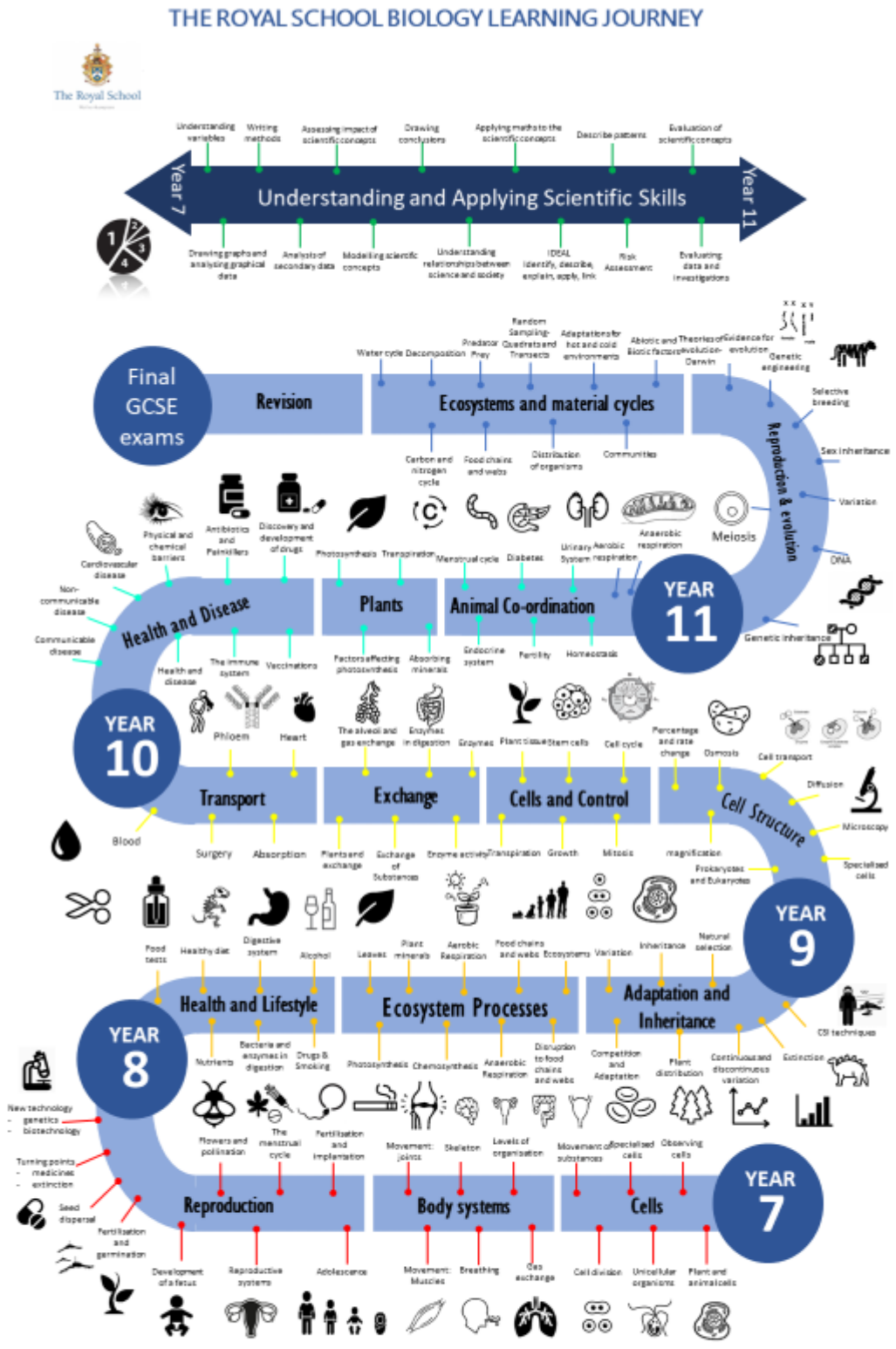
Biology Learning Journey



CROSS-CURRICULAR LINKS

Body systems	PE	Health and disease	History
Reproduction	PSHE	Data analysis	Mathematics
Health & Lifestyle	PSHE	Photosynthesis	Chemistry
C, N and H_2O cycle	Geography	Diffusion & Osmosis	Chemistry

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Key stage 1-2 Science provision

Year Group	Knowledge	Skills	Trackable development from previous year.	What this will look like in books	Opportunities to include Maths MGS objectives
Year 6	• describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals • give reasons for classifying plants and animals based on specific characteristics. • identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood • recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function • describe the ways in which nutrients and water are	• planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	• Students select the most appropriate way to present their results and which graphical representation should be used. • Investigations are planned independently and factors such as variables are considered by students. These factors are fluently explained in written methods and evaluations. • Classwork tests and applies known scientific theories and	• Written up, and structured investigations and experiments. Starting the year scaffolded and becoming independently constructed through the year. Using correct language and structure: Aim, Hypothesis, Method, Reliability, Observations, Evaluations. • Range of ways to present data: scientific observations, bar graphs drawn independently, line graphs drawn independently, pie charts, with support. • Photo and QR code evidence for practical	• Calculate and interpret the mean as an average. • Solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate • Calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm3) and cubic

	transported within animals, including humans. • recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago • recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents • identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution. • recognise that light appears to travel in straight lines • use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye • explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes • use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	• using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.	students are able to reference this in their work • Students report and present their findings. • An increasingly sophisticated range of scientific analysis and equipment is used, including dissection.	investigations, such as: heart dissection. • Balanced arguments which use scientific findings to support points. • Posters to represent understanding of being healthy. • Food chains and webs drawn independently. • Biography of Charles Darwin. • Stop frame animations made to model the circulatory system. • Stop frame animations to show understanding of animal adaptations. • Models to represent observations such as making blood. Recorded with photos and detailed drawings, with annotations, of observations. • Investigation into ice melting and the impact of global warming. • Genetic / inheritance investigations to look at eye, hair and skin colour.	metres (m3), and extending to other units [for example, mm3 and km3]. • Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

	• associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches • use recognised symbols when representing a simple circuit in a diagram. •				
Year 5	• describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird • describe the life process of reproduction in some plants and animals. • describe the changes as humans develop to old age. • compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets • know that some materials will dissolve in liquid to form a solution, and describe how	• Beginning to plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • beginning to take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels,	• Increasingly sophisticated language is used in science work, including controlling variables and reference to previous research. • Bar and line graphs are used to show results • Conclusions and evaluations lead to further research • Other scientific studies are referenced in work.	• Write up scientific investigations, with a clear focus on conclusion, evaluation and fair tests. • Mummification process – experiment write up. • Experiment looking at friction of different materials. • Investigation on surface area and buoyancy. • Venn Diagram – comparing everyday materials by properties. • Investigating solubility looking at different substances in water.	• Convert between different units of metric measure (for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre) • Understand and use approximate equivalences between metric units and common

	to recover a substance from a solution • use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating • give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic • demonstrate that dissolving, mixing and changes of state are reversible changes • explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda. • describe the movement of the Earth, and other planets, relative to the Sun in the solar system • describe the movement of the Moon relative to the Earth	classification keys, tables, scatter graphs, bar and line graphs • using test results to make predictions to set up further comparative and fair tests • Beginning to report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments.		• Separation – filtering, sieving and discussed evaporation. • Scientific Workshop – Periodic table, solubility, pH levels and chromatography. • Building basic electrical circuits. • Magnets – Scream machine. • Conductivity/Thermal - • Evaporation – Science labs (no tumble dryers in Tudor period – how to dry clothes) • Air resistance –Space topic • Humans develop change old age -Life expectancy during Tudor period (poor diet)	imperial units such as inches, pounds and pints • Estimate volume [for example, using 1 cm3 blocks to build cuboids (including cubes)] and capacity [for example, using water] • Solve comparison, sum and difference problems using information presented in a line graph • Complete, read and interpret information in tables, including timetables. • Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles • Draw given angles, and

	• describe the Sun, Earth and Moon as approximately spherical bodies • use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky. • explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object • identify the effects of air resistance, water resistance and friction, that act between moving surfaces • recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. •				measure them in degrees (o)
Year 4	• recognise that living things can be grouped in a variety of ways (Blue Abyss) • explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment (Blue Abyss) • recognise that environments can change and that this can sometimes pose dangers to living things. (Blue Abyss)	• Asking increasingly sophisticated and relevant questions and using different types of scientific enquiries to answer them • Independently setting up simple practical enquiries, comparative and fair tests	• Experiments are independently planned and carried out using a scientific structure. • A range of scientific equipment is used independently, with the limitations of	• Stick pictures of animals and plants in table, according to how they have been grouped. • Group living things by using a classification key. • Explain about problem of plastic pollution in the ocean and the Amazon rainforest	vert between different s of measure [for mple, kilometre to metre; r to minute] asure and calculate the imeter of a rectilinear re (including squares) in timetres and metres rpret and present rete and continuous data g appropriate graphical thods, including bar charts time graphs.

	• describe the simple functions of the basic parts of the digestive system in humans (Burps, Bottoms and Bile) • identify the different types of teeth in humans and their simple functions (Burps, Bottoms and Bile) • construct and interpret a variety of food chains, identifying producers, predators and prey compare • group materials together, according to whether they are solids, liquids or gases (Blue Abyss) • observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) (Misty Mountain Sierra) • identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. (Misty Mountain Sierra) • identify how sounds are made, associating some of them with something vibrating (Playlist)	• 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 • Independently, or with peer support, recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables • Independently reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions • Independently using results to draw simple conclusions, make	such equipment being evaluated • Results are used to draw conclusions and make recommendations • Data is recorded in increasingly sophisticated graphical notations.	being cut down for farming: make a poster • Make a 3D model of the human digestive system. • Label the different types of teeth. • Make food chains in book and a poster. • Photos in book of materials grouped together by solid, liquid or gas. • Carry out investigation with ice cubes, to see how quickly they melt. • Carry out investigation on evaporation and condensation. Use puddles in playground if it has rained. Write up investigation with photos. • Listen to sounds made by string instruments. Carry out investigation. • Look at how pitch is changed on string instruments. • Look at how hard strings are plucked affects volume.	ve comparison, sum and erence problems using rmation presented in bar rts, pictograms, tables other graphs. ve problems involving verting from hours to utes; minutes to seconds; rs to months; weeks to s.

	• recognise that vibrations from sounds travel through a medium to the ear (Playlist) • find patterns between the pitch of a sound and features of the object that produced it (Playlist) • find patterns between the volume of a sound and the strength of the vibrations that produced it (Playlist) • recognise that sounds get fainter as the distance from the sound source increases. (Playlist) • identify common appliances that run on electricity (Road Trip USA) • construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers (Road Trip USA) • identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery (Road Trip USA) • recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit (Road Trip USA)	predictions for new values, suggest improvements and raise further questions • identifying and recording differences, similarities or changes related to simple scientific ideas and processes • Independently using straightforward scientific evidence to answer questions or to support their findings.		• See how far someone has to be to stop hearing a quiet voice. • Take photos of appliances which run on electricity. • Make electrical circuits and take photos of them. Write down how circuits were made. • Make a circuit without a complete loop. • Use a switch in a circuit. • Complete gap in circuit with various insulators and conductors.	

	• recognise some common conductors and insulators, and associate metals with being good conductors. (Road Trip USA)				
Year 3	• identify and describe the functions of different parts of flowering plants: roots, stem/trunk, 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. • 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	• Beginning to ask relevant questions and using different types of scientific enquiries to answer them. • With adult support, setting up simple practical enquiries, comparative and fair tests. • In supported groups, 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	• Experiments and tests are recorded scientifically • A greater range of scientific equipment is used • Scientific language is learned and applied to written and oral work. • Conclusions based on gathered evidence are drawn and recorded to evaluate an experiment.	• Conducting experiments with magnets, comparing the types of them and identifying the north and south pole. • Experimenting with different material types and sorting them into magnet or not magnetic. • Creating a magnet and using it to identify directions. • Building a model flower and annotating its parts and requirements for life. • Creating our own fossils using bread and sweets. Using this to describe and evaluate the experiment and how fossils are formed. • Creating a Shadow stick to investigate why shadows change throughout the day. • Drawing reflections seen in different types of mirrors.	asure, compare, add and tract: lengths cm/mm); mass (kg/g); npare durations of events example to calculate the e taken by particular nts or tasks]. mate and read time with easing accuracy to the rest minute; record and npare time in terms of onds, minutes and hours; vocabulary such as ock, a.m./p.m., morning, rnoon, noon and night ntify horizontal and tical lines and pairs of pendicular and parallel s ve one-step and two-step stions [for example, 'How ny more?' and 'How many er?'] using information sented in scaled bar rts and pictograms and es.

	• 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 an opaque object • find patterns in the way that the size of shadows change. • 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	language, drawings, labelled diagrams, keys, bar charts, and tables. • reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions • using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions • identifying differences, similarities or changes related to simple scientific ideas and processes • using straightforward scientific evidence to answer questions or to support their findings.		• Making predictions and then creating a periscope to record the path that light travels through it.	

	each other, depending on which poles are facing.				
Year 2	• explore and compare the differences between things that are living, dead, and things that have never been alive • identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other • identify and name a variety of plants and animals in their habitats, including microhabitats • describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food. • observe and describe how seeds and bulbs grow into mature plants • find out and describe how plants need water, light and a suitable temperature to grow and stay healthy • notice that animals, including humans, have offspring which grow into adults. • find out about and describe the basic needs of animals,	• Independently asking simple questions and recognising that they can be answered in different ways • observing closely, using simple equipment independently • performing simple tests and recording the results. • identifying and classifying • Independently using their observations and ideas to suggest answers to questions • gathering and recording data to help in answering questions.	• Use technical language independently • Independently write and compare observations • With support, create a food chain or web. • Independently carry out simple experiments and log the results.	• Classification table • Food chains • Identification of habitats and animals which match them • Life cycle diagram • Experiment table of plant growth • Flow diagram of growth in humans • Pictograph and bar chart for 'bounce' experiment. • Investigating floating and sinking in bounce.	• Compare and order lengths, mass, volume/capacity and record the results using >, < and = • Interpret and construct simple pictograms, tally charts, block diagrams and simple tables • Ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity • Ask and answer questions about totalling and comparing categorical data.

	including humans, for survival (water, food and air) • describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene • identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses • find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.				
Year 1	• Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees • Identify and describe the basic structure of a variety of common flowering plants, including trees. • Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals • Identify a variety of animals as carnivores, herbivores and omnivores • Describe and compare the structure of a variety of common animals – fish,	• With support, asking simple questions and recognising that they can be answered in different ways • observing closely, beginning to use simple equipment • performing simple tests with adult support. • identifying and classifying • using their observations and ideas to suggest answers to questions	• Pupils are beginning to ask simple questions and record simple experiments • Ways of sorting and grouping are used • Technical language is introduced and applied.	• Sorting by features (heroes and villains) • Investigating senses and recording results • Identify, name and label basic body parts. • Perform simple tests and record results. • Seasonal sorting and observing and sorting by changes (Bright lights, big city) and also linked to recount topic in Autumn 1. • Investigating and exploring properties of everyday materials (Moon Zoom)	• Compare, describe and solve practical problems for: • lengths and heights [for example, long/short, longer/shorter, tall/short, double/half] • mass/weight [for example, heavy/light, heavier than, lighter than] • capacity and volume [for

	amphibians, repitiles, birds, mammals. • Identify, name, draw and label the basic parts of the human body. • Distinguish between an abject and the material from which it is made • Identify and name a variety of everyday materials, including wood, plastic, glass, metal, water and rock. • Describe the simple physical properties of a variety of everyday materials • Compare and group together a variety of everyday materials on the basis of their physical properties. • Observe changes across the four seasons • Observe and describe the weather associated with the seasons.	• gathering and recording data to help in answering questions, with adult support.		• Grouping materials – man made and natural, recyclable and non-recyclable Moon Zoom) • Gather and record simple data – tables, pictograms (Moon Zoom) • Observe how plants and animals change over time. Identify and name a variety of common plants. (Dinosaur Planet) • Identify and name a variety of common animals. Group and sort them by what they eat. Simple food chains. (Paws, claws and whiskers) • Identify and describe plants and their structure. Look at real plants and label plants.	example, full/empty, more than, less than, half, half full, quarter] • time [for example, quicker, slower, earlier, later] • Measure and begin to record the following: o lengths and heights o mass/weigh o capacity and volume o time (hours, minutes, seconds)
EYFS	• ELG 14 – children know about similarities and differences in relation to places, objects, materials and living things. They make observations of animals and plants and explain why some things occur, and talk about changes. • Children know and match animals and their babies. • Animals and their habitats	• Children know about similarities and differences in relation to places, objects, materials and living things. • They talk about features of their own immediate environment and how environments vary.	N/a	• Photographic evidence of sorting and classifying or minibeasts. • Photographs of mobile planetarium visit. • Examples of cutting and ordering planets. • Cutting and sticking of life cycle pictures. • Photographic evidence/written chick	

	• Difference between day and night • Nocturnal and diurnal animals • Body parts and labelling • Lifecycles of a butterfly, hen and frog • Comparison of our environment – Wolverhampton and Africa • Visit from a mobile planetarium • The Solar System – ordering the planets and naming some of their physical features. • Identifying the moon, stars, sun, planets and asteroids. • Virtual walk around the International Space Station.	• They make observations of animals and plants and explain why some things occur. • Children talk about change.		diaries detailing egg hatching experience in school. • Observations on 2Simple of verbal discussions about similarities and differences between day and night and nocturnal/diurnal animals • Picture sorting activities.	

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Key Stage 3 Science Curriculum Mapping

Aims: The national curriculum for science aims to ensure that all pupils:

Develop a deeper understanding of a range of scientific ideas in the subject disciplines of biology, chemistry and physics.

Pupils should begin to see the connections between these subject areas and become aware of some of the big ideas underpinning scientific knowledge and understanding. Examples of these big ideas are the links between structure and function in living organisms, the particulate model as the key to understanding the properties and interactions of matter in all its forms, and the resources and means of transfer of energy as key determinants of all of these interactions.

They should be encouraged to relate scientific explanations to phenomena in the world around them and start to use modelling and abstract ideas to develop and evaluate explanations. Pupils should understand that science is about working objectively, modifying explanations to take account of new evidence and ideas and subjecting results to peer review. Pupils should decide on the appropriate type of scientific enquiry to undertake to answer their own questions and develop a deeper understanding of factors to be taken into account when collecting, recording and processing data. They should evaluate their results and identify further questions arising from them.

‘Working scientifically’ is described separately below, but must always be taught through and clearly related to substantive science content in the programme of study. Department colleagues should feel free to choose examples that serve a variety of purposes, from showing how scientific ideas have developed historically to reflecting modern developments in science. Pupils should develop their use of scientific vocabulary, including the use of scientific nomenclature and units and mathematical representations.

Key stage 3 science is mapped into ‘Big Themes’ against NC statements and guidance. An example of a Year 7 theme is below.

All KS3 mapping can be found in the relevant section of the science Teams SOW Channel, including 2024 updates, which should reflect our drive to develop pupils’ experimental and investigative skills. This is designed to maintain science as an exciting and engaging part of a pupil’s academic week, foster a lifelong love of science, and provide a strong foundation for the study of science throughout GCSE and A-level.

Big Idea 8: Organisms						
AQA & NC Topic	**Mastery goal**	**Syllabus statement**	**Learning outcomes**	**Activate reference**	**Kerboodle resources**	**Keywords**
8.1 Movement	**Know**	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 movement when one contracts and the other relaxes.		**B1 2.1 Levels of organisation - Activate 1 - Page 26** **B1 2.4 Skeleton - Activate 1 - Page 32** **B1 2.5 Movement: joints - Activate 1 - Page 34** **B1 2.6 Movement: muscles - Activate 1 - Page 36**	B1 2.1 Activity: Organising a body B1 2.1 Information sheet: Organising a body B1 2.1 Teacher and technician: Organising a body B1 2.1 Animation: Organisation in multicellular organisms B1 2.1 Interactive screen: Cells, tissues, or organs? B1 2.4 Activity 1: Build your own skeleton B1 2.4 Activity 2: Build your own skeleton B1 2.4 Teacher and technician: Build your own skeleton B1 2.4 Activity: Question-led lesson B1 2.4 Teacher notes: Question-led lesson B1 2.4 Interactive screen: Name those bones! B1 2.5 Practical: Forces for lifting B1 2.5 Support: Forces for lifting B1 2.5 Teacher and technician: Forces for lifting B1 2.5 Interactive screen: The role of joints in movement B1 2.5 WebQuest: Hip replacements B1 2.5 WebQuest Writing frame B1 2.6 Practical: Investigating muscle fatigue B1 2.6 Access: Investigating muscle fatigue B1 2.6 Teacher and technician: Investigating muscle fatigue B1 2.6 Interactive screen: Revisiting antagonistic muscles	multi-cellular cell tissue organ organ system circulatory system respiratory system reproductive system digestive system muscular skeletal system immune system bone skeleton bone marrow biomechanics joint cartilage ligament newtons tendon antagonistic muscle pair
	Apply	Explain how a physical property of part of the skeleton relates to its function. Explain why some organs contain muscle tissue. Explain how antagonistic muscles produce movement around a joint. Use a diagram to predict the result of a muscle contraction or relaxation.	Describe the structure and function of joints. Interpret observations in a chicken wing to describe how the muscles work together to cause movement. Use a diagram to predict the result of a muscle contraction or relaxation.			
	Extend	Predict the consequences of damage to a joint, bone or muscle. Suggest factors that affect the force exerted by different muscles. Consider the benefits and risks of a technology for improving human movement.	Predict the consequences of damage to a bone. Interpret observations in a chicken wing to explain how the muscles work together to cause movement.			

8.2 Cells	**Know**	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.		**B1 1.1 Observing cells - Activate 1 - Page 14** **B1 1.2 Plant and animal cells - Activate 1 - Page 16** **B1 1.3 Specialised cells - Activate 1 - Page 18** **B1 1.4 Movement of substances - Activate 1 - Page 20** **B1 1.5 Unicellular organisms - Activate 1 - Page 22**	B1 1.1 Practical: Discovering the microscope B1 1.1 Support: Discovering the microscope B1 1.1 Teacher and technician: Discovering the microscope B1 1.1 Interactive screen: What's in a name? B1 1.1 WebQuest: Development of the microscope B1 1.1 WebQuest writing frame B1 1.2 Practical: Making an onion slide B1 1.2 Support: Making an onion slide B1 1.2 Teacher and technician: Making an onion slide B1 1.2 Interactive screen: Parts of a cell B1 1.2 Skills interactive: Microscopes and cells B1 1.3a Activity: Building a cell B1 1.3b Activity: Speed dating B1 1.3 Activity: Specialised cells B1 1.3 Teacher and technician: Specialised cells B1 1.3 Activity: Question-led lesson B1 1.3 Teacher notes: Question-led lesson B1 1.4 Practical: Observing diffusion B1 1.4 Support: Observing diffusion B1 1.4 Teacher and technician: Observing diffusion B1 1.4 Interactive screen: Wanted or not B1 1.4 Animation: Diffusion in cells B1 1.5 Practical: Observing amoeba and euglena B1 1.5 Support: Observing amoeba and euglena B1 1.5 Teacher and technician: Observing amoeba and euglena B1 1.5 Interactive screen: Spot the difference	organisms microscope observe nucleus cell membrane cytoplasm mitochondria respiration cell wall vacuole chloroplast specialised cell nerve cell red blood cell sperm cell leaf cell root hair cell structural adaptations diffusion concentration uni-cellular amoeba euglena flagellum
	Apply	Explain why multi-cellular organisms need organ systems to keep their cells alive. Suggest what kind of tissue or organism a cell is part of, based on its features. Explain how to use a microscope to identify and compare different types of cells. Explain how uni-cellular organisms are adapted to carry out functions that in multi-cellular organisms are done by different types of cell.	Explain why multi-cellular organisms need organ systems to keep their cells alive. Explain how uni-cellular organisms are adapted to carry out functions that, in multi-cellular organisms, are done by different types of cell.			
	Extend	Make deductions about how medical treatments work based on cells, tissues, organs and systems. Suggest how damage to, or failure of, an organ would affect other body systems. Deduce general patterns about how the structure of different cells is related to their function. Find out how recreational drugs might affect different body systems.				

Working scientifically

Through the content across all three disciplines, pupils should be taught to:

Scientific attitudes

Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility

Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review

Evaluate risks.

Science Experimental skills and investigations

Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience

Make predictions using scientific knowledge and understanding

Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate

Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety

Make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements

Apply sampling techniques.

Analysis and evaluation

Apply mathematical concepts and calculate results

Present observations and data using appropriate methods, including tables and graphs

Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions

Present reasoned explanations, including explaining data in relation to predictions and hypotheses

Evaluate data, showing awareness of potential sources of random and systematic error

Identify further questions arising from their results.

Measurement

Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature

Use and derive simple equations and carry out appropriate calculations

Undertake basic data analysis including simple statistical techniques.

KS3 Science – Curriculum Map 2024

	BIOLOGY	Approximate hours	CHEMISTRY	Approximate hours	PHYSICS	Approximate hours
YEAR 7	Cells	15	Introduction and safety	7	Forces	10
	Reproduction	15	Elements, Mixtures & Compounds	13	Waves	13
			Separation, Solutions & Change	10	Space	7
Year 7 overview	In Year 7 Biology pupils will discover what plants and animals are made of. They will also meet study tiny organisms that can only be seen under a microscope. They will explore how movement is vital to cell functioning. Finally, they will discover how new plants and animals are created through the process of reproduction.		Pupils will consider 'What is stuff made of?' Everything is made up of chemicals – the food we eat, the plastic in our phone… and us! But what are these chemicals like inside, and why do they behave the way they do? In Year 7 Chemistry pupils will learn about the atoms that make up everything on Earth… and beyond. They will explore how chemical reactions make vital materials, and transfer energy for almost everything we do.		In Year 7 Physics pupils will learn about how we see, and how light and sound waves behave. They will learn about the place of the Earth in the Universe. They will also learn about the forces that keep us from falling through the floor and allow astronauts to stand on the Moon.	
YEAR 8	Processes & Organisms	15	Acids & Alkalis	14	Energy & Speed	12
	Ecosystems	15	Reactivity	7	Electricity & Magnetism	12
			Fuels & Environment	10	Pressure & Moments	6
Year 8 overview	In Year 8 pupils will compare the effect of healthy and unhealthy lifestyles on their body. They will look at why organisms		Pupils will ask the big question 'Where do we get the materials we need?' They will learn about the structure of the Earth, and		Pupils will recognise that it is hard to imagine a world without electricity. In Year 8 they will discover how circuits work and how	

	need energy to function effectively. They will explore how different structures work together to keep an organism alive. Finally they will investigate the differences that exist between organisms, and why this is important for their survival.	the rocks of its crust. They will discover how we separate mixtures, and use chemical reactions, to obtain the materials we need from the Earth and its atmosphere. Pupils will also explore patterns in chemical reactions. They will identify patterns in the properties of elements and learn how to use the Periodic Table to predict properties.	the electricity in our houses is generated. They will learn why it is important to insulate a house and what they pay for when they pay their electricity bill. They will also learn how to use a graph to tell a story, and how forces explain gas and air pressure.

Each topic has planned an opportunity for:

- A mid-topic assessment and review.
- An end-of-topic assessment and review.
- Multiple practical (AO3) investigative experiences.
- Numeracy and data-handling skills.
- Literacy and scientific language skills development.

	BIOLOGY	Learning cycle	CHEMISTRY	Learning cycle	PHYSICS	Learning cycle
YEAR 7	Cells	1, 2 & part 3	Introduction and safety	1	Forces	1 & 2
	Reproduction	Part 3, 4 & 5	Atoms and Particles	2 & 3	Waves	3 & 4
			Separation, Solutions & Change	4 & 5	Space	5
YEAR 8	Processes & Organisms	1, 2 & part 3	Acids & Alkalis	1 & 2	Energy & Speed	1 & 2
	Ecosystems	Part 3, 4 & 5	Reactivity	3	Electricity & Magnetism	3 & 4
			Fuels & Environment	4 & 5	Pressure & Moments	5

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BIOLOGY Curriculum Map – 2024 pathway for GCSE and A-level

	Year 9	Year 10	Year 11	Year 12	Year 13
Learning Cycle 1	B1 Cell structure.	B8 Photosynthesis.	B18 Biodiversity & Ecosystems (inc. Trophic Levels, Food Efficiency – Triple only)	Cell structure. Cells and replication Monomers & Polymers. Carbohydrates, lipids & proteins	Respiration & Photosynthesis. Stimuli and response. Nervous coordination.
Learning Cycle 2	B2 Cell division, stem cells & chromosomes. B3 Principles of organisation and the digestive system	B9 Respiration. YEAR 10 BIOLOGY PAPER 1 MOCK EXAMINATION PREPARATION	B13 Cell division and reproduction. (inc. sexual V asexual, DNA, cloning – triple only)	Transport across membranes. Cell recognition and the immune system. Enzymes. Nucleic acids. ATP, water & ions.	Energy & Ecosystems. Nutrient cycles. Skeletal muscles. Homeostasis. AQA PAPER 1 MOCK
Learning Cycle 3	B4 Animal tissues, organs and organ systems. B7 Non-communicable diseases.	YEAR 10 MOCK EXAMS Homeostasis. B10 The nervous system.	B14 Variation and evolution. (inc. cloning – triple only) B15 Genetics & Evolution	Surface area to volume ratio. Gas exchange. Digestion and absorption	Inheritance. Populations. DNA, bases and protein changes.

		(inc. brain, eye – triple only)	(inc. Theories of Evolution – Triple only)	DNA, genes and chromosomes. Protein synthesis.	Gene expression.
Learning Cycle 4	B4 Plant tissues, organs and organ systems. B5 Communicable diseases. (inc. culturing microorganisms – triple only)	Homeostasis. B11 Hormones. (inc. body temperature, water balance – triple only) Plant hormones. (Triple) B12 Homeostasis in Action The kidney (Triple)	Tidy up loose ends / recap. Revision AQA PAPER 2 FULL MOCK EXAM Further past paper work and practical review	Digestion and absorption. Mass transport in animals. Genetic diversity. Diversity and adaptation.	Evolution leading to speciation. Populations in ecosystems. Using genome projects. Gene technologies and gene function. MOCK PAPER 2
Learning Cycle 5	B5 Communicable diseases. Plant diseases. (Triple) B6 Preventing and Treating Disease Monoclonal antibodies. (Triple)	B16 Adaptations, Interdependence & Competition. B17 Organisation of an ecosystem.	Revision. Alternative Timetable lessons. Practical review. A-level bridging.	Mass transport in plants. Statistical analysis. Species & taxonomy. Biodiversity Year 12 review, end of year assessment and year 13 preparation. AQA AS MOCK PAPER 1 & PAPER 2	Exam revision and intervention. MOCK PAPER 2 (and also in Spring) MOCK PAPER 3

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Chemistry Curriculum Map 2024-25 Pathway for GCSE and A-level

	Year 9 T= Triple Science D = Double/Combined Science	Year 10	Year 11	Year 12 TEACHER 1 /TEACHER 2 Teacher with 3 lessons		Year 13 TEACHER /TEACHER 2 Teacher with 3 lessons	
Learning Cycle 1	**Atomic structure (T&D)**	**Chemical changes continued (T&D)** Req Prac 1 – Making Copper Sulfate Req Prac 2 - Titrations **Electrolysis (Triple)** Req Prac 3 - Electrolysis **Chemical calculations (Double award)**	**Polymers (Triple)** **Chemical analysis (D&T)** Triple award to cover Tests for Ions and Instrumental analysis Req Prac 6 - Chromatography Req Prac 7 – Identifying Ions **– TRIPLE ONLY**	**Amount of substance** RP 1 Make up a volumetric solution and carry out a simple acid–base titration	**Atomic structure**	**Acids, bases and buffers** RP 9 Investigate how pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base	**Nomenclature and isomerism** **Compounds containing the carbonyl group** RP 10a Preparation of a pure organic liquid

Learning Cycle 2	**The periodic table (T&D)** **Transition Metals (Triple)**	**Rates of reactions and equilibrium (T&D)** Req Prac 5 – Rates Investigation	**Our atmosphere (T&D)** AQA PAPER 1 FULL MOCK EXAM	**Bonding** **Periodicity**	**Group 2 and Group 7** **Oxidation, reduction and redox reactions** RP 4 Carry out simple test-tube reactions to identify: • cations – Group 2, NH_4^+ • anions – Group 7 (halide ions), OH^-, CO_3^{2-}, SO_4^{2-}	**Kinetics** RP 7 Measuring the rate of reaction: • by an initial rate method • by a continuous monitoring method	**Aromatic chemistry** PAG 10b Preparation of a pure organic solid and test of its purity **Amines** **Polymerisation** **Amino acids, proteins and DNA**
						AQA PAPER 1 and 2 MOCK	
Learning Cycle 3	**Structure and bonding (T&D)** ONLY States of Matter, Ions and Ionic Bonding for double award **Bulk Properties (Triple)**	**Energy changes (T&D)** Req Prac 4 – Temp Changes	**The Earth's resources (T&D)** Req Prac 8 – Water analysis – **TRIPLE ONLY** **Using our resources (Triple)**	**Energetics** PAG 2 Measurement of an enthalpy change	**Introduction to organic chemistry Alkanes** **Halogenoalkanes** PAG 5 Distillation of a product from a reaction	**Thermodynamics**	**Organic synthesis and analysis** **Structure determination Chromatography** PAG 12 Separation of species by thin-layer

							chromatography
Learning Cycle 4	**Structure and bonding Continued (Double)** Covalent Bonding, Metallic **Calculations (Triple)**	**Electrolysis (Double)** **Chemical Cells and Mid-point review (Triple)**	**Revision** AQA PAPER 2 FULL MOCK EXAM	**Kinetics** PAG 3 Investigation of how the rate of a reaction changes with temperature **Equilibria**	**Alkenes** **Alcohols** **Organic analysis** PAG 6 Tests for alcohol, aldehyde, alkene and carboxylic acid	**Electrode potential and electrochemical cells** PAG 8 Measuring the EMF of an electrochemical cell **Redox titrations**	**The transition elements** **Reactions of inorganic compounds in solutions** PAG 11 Carry out simple test-tube reactions to identify transition metal ions in aqueous solution
Learning Cycle 5	**Chemical changes (T&D)** Part 1 – Reactivity Series and Redox End of Year assessments	**Crude oil and fuels (D&T)** **Alkenes, Alcohols, Carboxylic Acids and Esters (Triple)** YEAR 10 AQA ASSESSMENT	**Revision and external examination**	Revision and Consolidation AQA AS MOCK PAPER 1 & PAPER 2 **Equilibrium constant Kp** **Period 3**		MOCK PAPER 1 **Revision and external examination** MOCK PAPER 2 MOCK PAPER 3	

SUBJECT Curriculum Map – Physics 2024-2025 GCSE and A-level

	Year 9	Year 10	Year 11	Year 12 3 lessons (EHU)	Year 12 2 lessons (PM)	Year 13 3 lessons (EHU1)	Year 13 3 lessons (EHU2)
Learning Cycle 1	***Energy*** (Stores, Conservation, Work, Power & SHC) **Required Prac: SHC**	***Atoms & Radiation*** Atomic Structure, Isotopes, Radioactivity, Half Life	***Waves*** Transverse & Longi, properties, EM waves and uses Req Prac: Measuring Waves	***Basics & Bridging*** ***Waves*** Req Prac: Stationary Waves	***Basics & Bridging*** ***Mechanics***	***Circular Motion*** ***SHM*** Req Prac: Pendulums and mass spring	***Thermal Physics*** Req Prac: Gas Laws
Learning Cycle 2	***Energy*** Energy transfer through heating, insulation, Resources and demands. EOM LC1 Assessment	***Atoms & Radiation*** Irradiation and Contamination ***Triple Only: Background Radiation, Fission and Fusion*** EOM LC2 Assessment	***Waves*** Refraction ***Triple Only: Lenses, Light & Colour, Sound, waves for detection, reflection, Black body Radiation*** Req Prac: Infra-Red Radiation Req Prac (Triple only) Reflection **EOM Assessment** **Christmas Mocks**	***Waves*** Req Prac: Interference ***Particles*** ***Christmas Mocks***	***Mechanics*** Req Prac: Freefall by g	***Gravitational Fields***	***Nuclear*** Req Prac: Inverse Square Law

Learning Cycle 3	***Electricity*** Circuits, symbols, components, IV curves, Ohms Law Series & Parallel. Req Prac: Resistance Req Prac: IV Curves	***Forces*** Vectors & Scalars, weight, Vector diagrams and resolution, Newton's Laws Required Prac: F=ma	***Electromagnetism*** Magnetic field, electromagnetism, motor effect, F=BIl **Triple Only: Loudspeakers, Induction, Transformers** Spring Mocks	***Particles***	***Mechanics***	***Electric Fields*** Req Prac: Capacitance	***Astrophysics (Option Module)***
Learning Cycle 4	***Electricity*** AC/DC, Domestic Electricity, Power, Electrical Distribution National Grid ***Triple Only: Static Electricity*** EOM LC2 Assessment	***Motion*** Speed, distance and time. Velocity and Acceleration. Motion graphs.	***Mop Up & Revision for <u>combined</u>*** ***Triple: Electromagnetism*** ***Triple Only: <u>Space:</u>*** Solar System, Stars, Orbits	***Electricity*** Required Prac: Resistivity, Internal Resistance	***Materials*** Req Prac: Youngs Modulus	***Magnetic Fields & Induction*** Req Prac: F=BIl Req Prac: Mag Flux Linkage	***Practical Skills***
Learning Cycle 5	***Particle Model*** Kinetic Model, Density, Changing State, Internal Energy Specific Latent Heat, Gas Laws ***Triple Only: P vs V*** **EOY Assessment & Review** Req Prac: Density	***Forces and Motion*** Weight and terminal velocity. Forces and Braking. Momentum. Forces and elasticity. ***Triple Only: Moments, Pressure in fluids*** Req Prac: Hookes Law		***Practical Skills*** ***End of Year Assesment.*** ***Pre-year 13 Learning***	***Practical Skills*** ***End of Year Assesment.*** ***Pre-year 13 Learning***	***Revision for Final Exams***	***Revision for Final Exams***

Combined Science: Where a particular learning cycle contains a significant amount of triple only content (mostly paper 2) use some time to build deeper understanding of the content. Furthermore, the opportunity to advance to the next module should be taken to ensure revision time at the end of the course can be as comprehensive as possible.

Lesson orders and accompanying resources can be found on Teams within the Science POS/SOW folder.

SUBJECT Curriculum Map – BTEC Applied Science from 2020 onwards

	Year 12 Teacher A	Year 12 Teacher B	Year 12 Teacher C	Year 13 Teacher A	Year 13 Teacher B	Year 13 Teacher C
Learning Cycle 1	***Unit 1: Principles and applications of science 1*** ***Physics - Waves in communication*** ***Working with waves*** Wave features – periodic time, speed, wavelength, frequency, amplitude, oscillation Graphical representation of waves Transverse and longitudinal waves Displacement, coherence, path difference, phase difference, superposition Diffraction gratings – emission spectra, identifying gases Wave speed equations Stationary waves resonance, musical instruments LC1 assessment	***Unit 1: Principles and applications of science 1*** ***Biology - Structure and functions of cells and tissues*** ***Cell structure and function*** Cell theory, ultrastructure and function of organelles, electron micrographs and light microscopes, similarities and differences of plant and animal cells, bacterial cell walls and reactions with antibiotics, magnification ***Cell specialisation*** Palisade mesophyll cells, sperm and egg cells, root hair cells, white blood cells, red blood cells LC1 assessment	***Unit 1: Principles and applications of science 1*** ***Chemistry - Periodicity and properties of elements*** ***Structure and bonding in applications in science*** Electronic structure of atoms Ionic bonding Covalent bonding Metallic bonding Intermolecular forces Chemical reactions LC1 assessment	***Unit 3: Science Investigation Skills*** ***A Planning a scientific investigation*** Developing a hypothesis Selection of appropriate equipment, techniques and standard procedures Health and safety Variables Method for data collection and analysis ***B Data collection, processing and analysis / interpretation*** Collection of quantitative/qualitative data Processing data – standard deviation, formulae, units, standard form, percentage error, tables and graphs LC1 assessment	***Unit 3: Science Investigation Skills*** ***D Enzymes in action*** Protein structure – peptide linkage, active sites, denaturation Enzymes as biological catalysts in chemical reactions – collision theory, formation of enzyme-substrate complex, specificity of enzymes, lowering of activation energy, changing substrate concentration, importance of measuring initial rates of reaction Factors that can effect enzyme activity – temperature, pH, substrate and enzyme concentration LC1 assessment	***Unit 3: Science Investigation Skills*** ***E Diffusion of molecules*** Factors affecting the rate of diffusion – concentration gradient, shape and size of molecules, temperature, distance, surface area Arrangement and movement of molecules – random movement of molecules in liquids and gases, diffusion along a concentration gradient until dynamic equilibrium is reached LC1 assessment
Learning Cycle 2	***Waves in communication*** Principles of fibre optics – refractive index, total	***Tissue structure and function***	***Production and uses of substances in***	***Drawing conclusions and evaluation***	***F Plants and their environment*** Factors that can affect plant growth and/or	***G Energy content of fuels*** Different types of fuels – petrol, paraffin, food,

	internal reflection, critical angles Applications of fibre optics in medicine Applications of fibre optics in communication – analogue and digital, broadband Properties of electromagnetic waves – speed, frequency Inverse square law – intensity of a wave Applications of electromagnetic waves – satellite communication, mobile phones, bluetooth, infrared, wi-fi LC2 assessment Unit 1 mock preparation and assessment	Epithelial tissue, endothelial tissue, muscular tissue, nervous tissue LC2 assessment Unit 1 mock preparation and assessment	***relation to properties*** Periodic table – periods, groups, layout and electronic arrangement of elements using s, p, d notation Physical properties of elements – first ionisation energy, trends in groups and periods, electron affinity, ionic radius, electronegativity, melting and boiling points, electrical and thermal conductivity, thermal, malleability, ductility Chemical properties of elements – products and reactivity of elements, reactivity series, oxidation and reduction, displacement reactions, uses and applications of substances LC2 assessment Unit 1 mock preparation and assessment	Interpretation/analysis of data – trends/patterns, primary and secondary data, making valid conclusions, interpretation of statistical tests Evaluation – improvements, anomalous data, sources of error, reliability, strengths and weaknesses ***H Electrical circuits*** Use of electrical symbols to design circuits – battery, ammeter, voltmeter, bulbs, resistors, diodes Electrical power and energy equations Energy usage – different domestic appliances, fuse sizes, power ratings LC2 assessment Unit 3 mock preparation and assessment	distribution – human effects, soil pH and aeration, light intensity, temperature, water, mineral ions Sampling techniques – random sampling, ecological sampling investigating abiotic factors e.g. transects, quadrats, point frames Sampling sizes – samples sizes selected with regards to practical constraints, need to collect sufficient data to make valid conclusions LC2 assessment Unit 3 mock preparation and assessment	cooking oil, methanol, ethanol, propan-1-ol, butan-1-ol, pentan-1-ol, wax temperature Hazards associated with fuels – flammability, toxicity, risk of explosion, harmful effects, pollution Units of energy – joules, calories Specific heat cpapacity Heat energy released from fuels in kJ/mol LC2 assessment Unit 3 mock preparation and assessment
Learning Cycle 3	Unit 1 external assessment preparation and external assessment ***Unit 2: Practical scientific***	Unit 1 external assessment preparation and external assessment ***Unit 2: Practical scientific***	Unit 1 external assessment preparation and external assessment ***Unit 2: Practical scientific***	Unit 3 external assessment preparation and external assessment ***Unit 8: Physiology of human body systems***	Unit 3 external assessment preparation and external assessment ***Unit 8: Physiology of human body systems***	Unit 3 external assessment preparation and external assessment ***Unit 8: Physiology of human body systems***

	procedures and techniques ***Undertake calorimetry to study cooling curves*** Obtain data using different equipment to construct cooling curves Determine the rate of cooling of substances using cooling curves Unit 2 Practical observations	***procedures and techniques*** ***Undertake chromatographic techniques to identify components in mixtures*** Use chromatographic techniques to produce chromatograms Explain the use of chromatographic techniques to separate mixtures Unit 2 Practical observations	***procedures and techniques*** ***Undertake titration and colorimetry to determine the concentration of solutions*** Prepare and standardise solutions Investigate the concentration of unknown solutions Unit 2 Practical observations	***Understand the impact of disorders of the musculoskeletal system and their associated corrective treatments*** Structure of the musculoskeletal system Unit 8 Practical / presentation observation	***Explore the physiology of the digestive system and the use of corrective treatments for dietary-related diseases*** Structure of the digestive system Unit 8 Practical / presentation observation	***Understand the impact of disorders on the physiology of the lymphatic system and the associated corrective treatments*** Structure of the lymphatic system Unit 8 Practical / presentation observation
Learning Cycle 4	***Undertake calorimetry to study cooling curves continued*** Analyse the rate of cooling of substances from your data using cooling curves to draw conclusions Evaluate the accuracy of practical work in calorimetry in relation to the analysis of the cooling curve	***Undertake chromatographic techniques to identify components in mixtures continued*** Analyse own chromatograms and relate the factors that affect the separation of mixtures to the quality of results obtained Evaluate the chromatographic	***Undertake titration and colorimetry to determine the concentration of solutions continued*** Demonstrate skilful application of procedures and techniques in titration and colorimetry to accurately determine the concentration of solutions	***Understand the impact of disorders of the musculoskeletal system and their associated corrective treatments continued*** Function of the musculoskeletal system Health matters and treatments related to	***Explore the physiology of the digestive system and the use of corrective treatments for dietary-related diseases continued*** Function of the digestive system Health matters and treatments related to the digestive system	***Understand the impact of disorders on the physiology of the lymphatic system and the associated corrective treatments continued*** Function of the lymphatic system

	Unit 2 practice assignment and feedback Unit 2 assignment - internally assessed and verified	techniques used in relation to outcomes and suggest improvements Unit 2 practice assignment and feedback Unit 2 assignment - internally assessed and verified	Evaluate the accuracy of procedures and techniques used in titration and colorimetry in relation to outcomes and suggest improvements Unit 2 practice assignment and feedback Unit 2 assignment - internally assessed and verified	the musculoskeletal system Unit 8 practice assignment and feedback Unit 8 assignment - internally assessed and verified	Unit 8 practice assignment and feedback Unit 8 assignment - internally assessed and verified	Health matters and treatments related to the lymphatic system Unit 8 practice assignment and feedback Unit 8 assignment - internally assessed and verified
Learning Cycle 5	***Review personal development of scientific skills for laboratory work (shared across three teachers)*** Final Unit 2 assignment - internally assessed and verified Unit 1 external assessment attempt 2 preparation and external assessment 2 ***Year 13 learning introduction and preparation***	***Review personal development of scientific skills for laboratory work (shared across three teachers)*** Final Unit 2 assignment - internally assessed and verified Unit 1 external assessment attempt 2 preparation and external assessment 2 ***Year 13 learning introduction and preparation***	***Review personal development of scientific skills for laboratory work (shared across three teachers)*** Final Unit 2 assignment - internally assessed and verified Unit 1 external assessment attempt 2 preparation and external assessment 2 ***Year 13 learning introduction and preparation***	Unit 3 external assessment attempt 2 preparation and external assessment 2	Unit 3 external assessment attempt 2 preparation and external assessment 2	Unit 3 external assessment attempt 2 preparation and external assessment 2

Science Learning Cycle SOW Overview

General – an overview for each unit can be found at the front of each individual scheme of work. Below is a basic reflection of each scheme of work. Specifics can be found via Teams and in consultation with the Head of Science and Subject Leads.

Intent of this SOW (Rationale for this sequence of learning/lessons)	Implementation of this SOW (The pedagogies/teaching strategies that will be utilised to deliver the objectives and outcomes)	Impact of this SOW (How the assessment for this SOW demonstrates progression of knowledge, understanding and skills)
The available schemes are specific to biology, chemistry or physics and represent a two year route through KS3 science, a three year route through GCSE and a final two years of study at A-level or BTEC. This provides pupils with a seven year programme to develop an enquiring mind, with an emphasis on practical science skills, data analysis & presentation, assimilation of core knowledge and regular opportunities to apply understanding to both familiar and unfamiliar key concepts. All schemes represent one unit of study and can individually be found within the department Teams group and within the teaching file of each member of the department.	All schemes of work, for all units, will contain a mix of theory and practical science. Pupils will have opportunities to experience hands-on work where appropriate and work in small groups alongside their peers to support learning. Teaching of each unit will be supported by the Kerboodle suite, and for GCSE, by My GCSE Science. Each class will have a Class Teams group available, so that work can be filed for later retrieval. Class work and homework will support the consolidation and retrieval of knowledge (AO1 skills) and time throughout the year will be devoted to application of knowledge (AO2 skills) and investigative skills, the study of data and formulation of conclusions and evaluations (AO3 skills).	At the start of KS3 all pupils will complete GL Assessments. This baseline assessment will help to formulate a target for the year and develop a flight-plan for the journey through five or seven years of science study. Each unit of study will be assessed and recorded, with intervention introduced as necessary if the pupil is below the expected level of performance. Practical skills will be continually developed at KS3 and monitored, assessed and refined throughout GCSE and A-level or BTEC as part of the required practical element of the course. At agreed points within the school year each year group will complete full year assessments to gauge their understanding and weaknesses of the taught curriculum. Final intervention for the year will then be introduced to close gaps. A review of each taught unit will also be undertaken by each teacher so that the unit content can be amended to address misconceptions, time management issues and any other concern which may have arisen during the series of lessons delivered.
Context/prior knowledge (link to previous Key Stages/Topics)	Common misconceptions	Keywords

Science is interconnected by its very nature. Pupils in KS2 will have studied discrete topics and undertaken some investigations before commencing KS3 science. The curriculum is spiral in its construction, with pupils experiencing general themes and topics in greater depth as they progress through the seven year curriculum. Examples include cells and organisation in biology, the study of forces in physics and continued teaching of atoms, elements and compounds in chemistry. Pupils will draw information from a variety of units as they progress through the course in order to explain key scientific principles. Pupils will link and develop scientific method throughout their journey and recall key scientific numeracy or literacy in greater depth with time. To ensure that numeracy and literacy improves consistently through the years, regular links will be firmed with mathematics and English departments. This will ensure that these key skills are taught with the same emphasis, direction and importance across all three departments.	Misconceptions are highlighted within each unit as they are specific to the unit being taught. Examples include the confusion of mitosis and meiosis in biology, the difference between atoms, sub-atomic particles and charge in chemistry or renewable and non-renewable energy types in physics. These will be compiled by each teacher and shared amongst colleagues within the department. Further misconceptions will be discovered through summative assessment episodes, which are naturally more high-stakes in their nature. Under pressure a pupil will make errors which have been fully embedded over time but may not have been spotted by formative assessment. These will be fed back into each unit and discussed within the department so that each scheme addresses the error and remodels the lesson.	Each unit is delivered with a prescribed glossary of key words, terms and phrases which can be made available to pupils via the Kerboodle platform. These key words are not just unit or topic specific, but are often transferable between lessons and even subjects. The key objective of the teacher is to embed the use of scientific literacy into every lesson and ensure that pupils can use the language of science without fear or embarrassment and with increased fluency and confidence.

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Science Learning Cycle SOW LESSON BY LESSON

Please note that the framework for each unit can be found in the department Teams directory. This will form part of the overview for each unit alongside the Kerboodle scheme, detailing the differentiated objectives, curriculum content, resources and lesson outline. Accompanying this will be relevant lesson resources, self-assessment checklists and assessments – which are tiered for foundation or higher (except for A-level) and available at GCSE for both the Triple Science route and the Combined Science: Trilogy pathway.

An example can be found below – for GCSE biology unit 4.

LC/ Lesson	Learning question(s)	Lesson Objectives/ outcomes	Resources	Teaching and Learning activities (including assessment opportunities)	Homework	Cross curricular links Lit/Num/ICT/ Cit/AG&T
LC1/1						
LC1/2						
LC1/3						
LC1/4						
LC1/5						
LC1/6						
LC1/7						
LC1/8						

LC/ Lesson	Learning question(s)	Lesson Objectives/ outcomes	Resources	Teaching and Learning activities (including assessment opportunities)	Homework	Cross curricular links Lit/Num/ICT/ Cit/AG&T
LC3/1	What is the structure of blood and what are the functions of each component?	Describe the functions of blood. Explain the adaptations of blood cells.	Blood slides and microscope. Images.	Discussion of role of blood. Links to mitochondria and respiration. Use of microscopes to view blood. Tabulate blood structure and function. Make wider links to respiration and immunology.	Evaluate a model of the blood.	DIAMETER OF RED BLOOD CELL.
LC3/2	What are the three blood vessels? How does their structure relate to their function?	Recognise images of three blood vessels. Explain significance of their structure. Explain a double circulatory system.	Diagrams of blood vessels. Bunsen tubing and tap.	Diagram of circulatory system. Pupils follow the journey of blood. What happens to the blood along the journey and what does it gain and lose? Think about how this happens, where and why. Relate this to the structure of each vessel.	Compare human circulation with fish circulation and explain the differences.	HEARTRATE MATHS CALCULATIONS. COMPARATIVE WRITING.
LC3/3	What is the structure and function of the heart? What is coronary heart disease?	Describe the structure of the heart and relate to its function. Explain how problems arise in coronary arteries and how this can be treated with stents and statins.	Heart dissection. Stent video.	Structure of the heart diagram – to label and add blood vessels. Explain role of valves. Heart dissection. Identify coronary arteries and explain function. Link to diet, LDL cholesterol. Explain CVD and atheroma & lack of oxygen to tissue. Compare use of stents and statins in treatment of CVD.	Exam questions on stents and statins.	COMPARING STENTS AND STATINS EVALUATION. DATA ANALYSIS.
LC3/4	How is heart-rate controlled? How do we help the heart to function correctly?	Describe the role of pacemaker cells. Describe how pacemakers work. Explain and evaluate pacemakers, artificial valves, artificial hearts and transplants.	Videos of pacemakers, valves, hearts and transplants.	Locate pacemaker cells in the heart and describe function. Look at the ways the heart can fail and how scientists have solved these problems. Show clips of pacemakers, valves transplants etc. Compare effectiveness and evaluate pros and cons of each treatment. Relate to exam question for data analysis.	A3 display sheet on different aspects of the heart from work today and previous.	EVALUATION OF PROCEDURES. DATA ANALYSIS EXERCISE.

LC3/5	What is the structure and function of the lungs? How are they adapted for gas exchange?	Describe the structures of the lungs and alveoli. Describe the process of ventilation. Explain why adaptations of the alveoli lead to efficient gas exchange.	Lung dissection. Model of the lung (gas bell jar).	Compare gas composition of inhaled and exhaled air. Complete diagram of the gross structure of the lungs and relate the structure of alveoli to Fick's Law and rate of diffusion from earlier unit. Lung dissection to identify structures. List the order of ventilation for inhalation. Pupils work out process for exhalation. Use bell jar to demonstrate. Evaluate the use of bell jar as a model.	Exam question. Write up of dissection with images. Evaluation of bell jar exercise.	PERCENTAGES OF GAS IN AIR.
LC3/6	What is the structure and function of different plant tissues?	State the functions of different plant tissues. Explain how these structures relate to their functions. Suggest functions for unknown plant structures.	Leaves, slides and microscope. Make model of leaf using different papers.	Link back to animal tissues and organs. Work through different tissues and organs including xylem / phloem / epidermis / mesophyll and meristem. Look at cross-section of leaf. View leaf under microscope. Look at variety of tissues and suggest function of each.	Variety of exercises available relating to plant tissues.	CALCULATION OF STOMATA NUMBER PER CM3 OF LEAF.
LC3/7	How do plants transport substances around their body? What are transpiration and translocation?	Explain the structures and functions of xylem and phloem. Suggest why transport is crucial to plants. Explain how rate of transport can be measured.	Celery, dye, scalpel etc.	Discuss substances needed by plants and those it might need to remove. Link water to xylem and photosynthesis. Discuss direction of flow and transpiration stream. Link sugar to phloem and photosynthesis. Discuss direction(s) of flow and translocation. Show movement with celery and dye.	Write-up of practical work.	MEASURE FLOW RATE FROM CELERY PRACTICAL

LC3/8	What is transpiration? How do stomata and guard cells support transpiration?	State the function of stomata and guard cells. Calculate mean number of stomata. Link stomata number to environment of plants.	Leaves, nail varnish or tape, slides, microscope. Images of stomata and guard cells.	Examine images of stomata and guard cells under EM microscope. Discuss function and link to earlier lesson. Discuss gas exchange in leaf based on earlier lesson then add info on water vapour movement and evaporation. Show how number of stomata can be linked to environment and water loss. Perform epidermal peel and count stomata under microscope.	Maths-based exam question on stomata.	MATHS LINK TO STOMATA NUMBER
LC3/9	What are the factors that affect the rate of transpiration? How can we investigate the effect of these factors?	Describe the use of a potometer. Make predictions and design suitable investigations. Evaluate the potometer and investigations.	Potometer, fan, lamp, Plant.	Discuss washing on a line and the conditions where this dries fastest. Compare this to plants losing water. Introduce the potometer and suggest how different factors might be investigated to measure transpiration. Make predictions and investigate. Discuss wilting and xerophytes.	Write-up of investigation.	MATHS DATA ON RATE OF TRANSPIRATION.

This plan is then followed by the end of unit assessment, red pen improvement tasks, misconception unpicking and intervention work.

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Science Assessment Calendar – 2024 pathway for KS3, GCSE and A-level

	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Learning Cycle 1	Science baseline Cells	Electricity Energy	Science baseline B1 Cell structure Atomic structure Energy (work, power, SHC)	B8 Photosynthesis Chemical changes Electrolysis (Triple) Chemical calculations Atoms and radiation (isotopes and half-life)	B18 Biodiversity & ecosystems Polymers and DNA (Triple) Chemical analysis Waves (Types and EM)	Initial review assessment Cells Monomer / polymer Atomic structure Amount of substance Waves Mechanics	Respiration & photosynthesis Nervous control Kinetics and Kp Period 3 Carbonyl Chemistry Circular motion SHM Thermal physics
Learning Cycle 2	Body systems Reproduction	Motion / pressure Health	B2 Cell division, stem cells and chromosomes B3 Organisation and the digestive system Periodic table. Transition metals (Triple) Energy (transfer, resources and demands)	B9 Respiration Rates of reaction Equilibrium Atoms and radiation (irradiation and contamination) YEAR 10 MOCK EXAMINATIONS	Full paper 1 mock exams B13 Cell division and reproduction Our Atmosphere Waves (refraction, light & sound)	Membranes / enzymes Bonding Groups 2 & 7 Redox Waves Mechanics Particles	Full paper 1 mock exams Energy & ecosystems Muscles Homeostasis Acids/bases/buffers Aromatics and Bio-chemistry Gravitational fields Nuclear physics
Learning Cycle 3	Particles Elements, atoms Reactions	Year 8 exams Ecosystems Adaptation	B4 Animal tissues, organs and systems B7 Non-communicable diseases Structure and bonding (triple) Structure and bonding Ions (double)	B10 Nervous system Energy changes Forces	B14 Variation & evolution B15 Genetics & evolution Earth's resources Using our resources Electromagnetism	Mid-year assessment Immunology Energetics Particles Mechanics	Inheritance Gene expression Thermodynamics Organic synthesis and analysis Electric fields Astrophysics

			Bulk properties (Triple) Electricity (circuits)				
Learning Cycle 4	Year 7 exams Acids and alkalis Forces	Periodic table Separation tech.	B4 Plant tissues, organs and systems Structure and bonding covalent (double) Calculations 1 (Triple) Electricity (domestic & national grid)	B11 Hormones B12 Homeostasis in action Electrolysis Chemical cells Mid-point review Motion	Full paper 2 mock exams Review Review Review	Gas exchange / protein synthesis Kinetics Equilibria Electricity Materials	Full paper 2 & 3 mock exams Evolution Gene technology Transition elements Inorganic compounds Electrochemical cells Magnetic fields & induction Practical skills
Learning Cycle 5	Progress tests Sound & light Space	Progress tests Year 8 Options Metals and acids The Earth	Progress tests B5 Communicable disease B6 Preventing and treating disease Chemical changes Particle model	End of year assessment B16 Adaptations and competition B17 Organisation of ecosystems Crude oil & fuels Alkenes, alcohols, acids & esters Forces & Motion	GCSE/BTEC exams	End of year assessment Mass transport / ecology Organic chemistry Alkenes, alcohols, organic analysis Practical skills Pre-year 13 knowledge	A level/BTEC exams

NB. The assessments and mark scheme for each learning cycle will be placed in the science assessment folder in the science Teams.

Throughout each learning cycle, several units will be taught. Each of these units will conclude with a unit assessment. These unit assessments will follow the curriculum maps for biology, chemistry and physics, as set out in the pages above.

Biology – green
Chemistry – red
Physics – blue

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KS3 Assessment Criteria

Pupils in years 7, 8 and 9 will be assessed on their knowledge, understanding and skills of the curriculum. GCSE grades will be used in years 10 and 11.

KS3	WB – Working below end of year expectations	WT – Working towards end of year expectations	WAT – Working at end of year expectations (SECURING)	WA – Working above end of year expectations (MASTERING)
General science skills	I can use simple practical scientific techniques to investigate a prediction, produce results and can say whether the results support or refute the prediction. I have a basic understanding of the key ideas of Science and can use this with some success to explain my observations. I am able to spot simple patterns in data and recognise obvious anomalies. I am able to recall important scientific facts such as key practical equipment, units for measurements, common chemical symbols or parts of cells.	I am able to use a range of scientific techniques with confidence and am able to select an appropriate technique to produce useful data. I am critical of the data I produce and am able to explain whether or not a set of data or an investigative strategy will produce reliable data. I am able to suggest improvements to produce better quality data. I am able to describe with confidence whether results support or refute a simple prediction and take into account anomalous results. I am able to explain my observations using key scientific ideas and make a judgement about the extent to which	I am able to use a range of scientific techniques with confidence and make judgements about the best technique to produce the best quality data. I am critical of an investigative strategy and can recognise how to amend a strategy to produce reliable data. I am able to consider issues of accuracy and precision in my analysis of data. I am able to describe with confidence the extent to which results support a prediction. I am able to explain observations using more complex scientific ideas and incorporate ideas from more than one source into more complex models. I am able to predict outcomes in a variety of	I am able to use a range of scientific techniques with confidence and make judgements about the best technique to be used to produce the best quality data. I will be highly critical of the data that an investigative strategy is likely to produce and will amend my strategy accordingly to ultimately produce reliable data. I am able to consider issues of accuracy and precision in my choices of technique and my analysis of data. I am able to describe with confidence the extent to which results support a prediction, and evaluate the success of

		data supports a conclusion. I am able to recall scientific ideas and apply these in new situations. I am beginning to be able to generalise and use simple models to explain ideas and observations.	unfamiliar situations, using models to justify my ideas.	an investigation. I am able to explain observations using more complex scientific ideas, analyse similarities and differences in data from different sources and use competing ideas to develop complex models. I am able to apply complex ideas in a variety of unfamiliar situations and suggest and justify outcomes.

KS3	WB – Working below end of year expectations	WT – Working towards end of year expectations	WAT – Working at end of year expectations (SECURING)	WA – Working above end of year expectations (MASTERING)
Scientific enquiry	I can pose a question which can be investigated. I can follow instructions to reduce the risk from hazards in an investigation. I am aware of experimental error, know that variables need to be controlled and can suggest reasons for differences in repeat readings. I can analyse data to identify a simple pattern, identifying the variables involved, and can calculate a simple mean or estimate values of data between known values. I can draw simple conclusions from a data set. I am are able to present data in a table and, with guidance, produce a chart or graph. I can communicate my key ideas in an understandable way using accurate scientific vocabulary. I am able to identify evidence	I can write an investigation question about how one variable can affect another. I can identify hazards in an investigation and take steps to reduce risk. I can recognise ways to reduce measurement errors and understand how the size of error in an investigation affects the strength of evidence. I can use a set of data to identify the relationship between two variables, can identify anomalous results and select appropriate data for calculating a mean. I can describe the pattern in a data set and explain it using scientific knowledge. I am able to present data in a table with correctly labelled headings with units. I can draw graphs with an accurate line of best fit.	I can pose a question to investigate the correlation between one variable and another. I can identify strategies which enable a question to be safely investigated in a school laboratory. I can apply strategies to reduce experimental error and can explain how random and systematic errors affect data. I can confidently identify patterns in data and use these to describe the relationships between variables. I can consider anomalies in my analysis of the results and show some ability to be able to carry out more complex analysis such as calculating gradient of a sloping line. I can draw conclusions from primary and secondary data, justifying whether some data can be judged as	I can explain whether a given question can be investigated scientifically and which type of enquiry to use. I can justify the decisions taken and strategies used to mitigate risks in an investigation. I can use strategies which avoid experimental error and can identify potential sources of random and systematic error. I am competent in undertaking a full analysis of data including more complex statistical analysis and taking full account of anomalies. I can use data from more than one source, fully justifying decisions about the significance of results in

	which supports a claim made. I can identify a fact, idea, data or conclusion which supports an opinion. I can identify a consequence of a scientific development. I can recognise that evidence can disagree with a theory.	I can communicate my ideas coherently and using scientific vocabulary in a way that makes it clear the meaning is understood. I am able to comment on whether evidence is scientifically accurate and relevant to a claim made. I can identify the most important piece of evidence to support a claim as well as one or two supporting pieces of evidence. I can recognise consequences of scientific developments for economies, society and the environment. I can recognise that when evidence disagrees with a theory then the evidence needs to be tested or the theory needs to be amended or abandoned.	anomalous, and describe the extent to which a data set supports a conclusion. I can justify my chosen method of chart or graph for displaying results and recognise when to use zero or non-zero starting points for axes. I can communicate complex ideas coherently making full use of scientific vocabulary and taking account of audience. I am able to describe the reasoning which links the evidence to a claim made. I can give a justified opinion but acknowledge other opinions or interpretations of the evidence. I can evaluate the merits of scientific developments based on their economic, social and environmental impacts. I can recognise that evidence which disagrees with a theory needs to be evaluated to decide whether the evidence or	supporting a conclusion. I can identify further questions arising from the investigation. I can justify all aspects of the chart or graph used for displaying results and can explain my choice of a straight line or curved line of best fit. I am able to communicate complex ideas coherently and succinctly using scientific vocabulary appropriate to the particular audience for the report. I am able to comment on whether the reasoning for a claim made follows logically from the evidence. I can recognise, and take account of, contrasting interpretations of evidence. I can critique a claim made. I can justify an opinion about the merit of a scientific development and make

			the theory is refuted.	choices which maximise benefit and minimise harm. I can explain how evidence challenges theories and refutes them or makes them more robust.

NB. The assessment criteria matrix for individual themes within science can be found below.

3.1 Forces – Working Below

3.1.1 Pupils know that mass and weight are different but related. They know that every object exerts a gravitational force on every other and that gravity keeps planets and moons in orbit.

3.1.2 Pupils know that an object with no resultant force will be stationary or moving at a constant speed in a straight line. They can describe the object as being in equilibrium. They understand that unbalanced forces can stretch or compress an object or cause an object to speed up, slow down or change direction. They understand that frictional and drag forces act against the forward motion of an object. Pupils can describe the effects of force on a spring.

3.1.3 Pupils can describe how pressure acts in all directions in a fluid and increases with depth. They recognise why some solid objects float and others sink.

3.1.4 Pupils know that the speed of an object depends on the time taken to cover a distance and know that a straight line on a distance-time graph represents a constant speed.

3.1 Forces – Working Towards

3.1.1 Pupils know that weight depends on the mass of an object and also on gravitational field strength. They are able to explain the difference between mass and weight and why the weight of an object will be different on different planets. They can use the formula W = mg to calculate weight.

3.1.2 Pupils can use simple force diagrams to explain how the shape or motion of an object will change. They can draw a simple force diagram using a description of the forces on an object or of the changes taking place to an object's size, shape or motion. They describe an object with no resultant force as being in equilibrium. They can describe everyday situations where frictional and drag forces act against the forward motion of an object. They can describe the effects of force on a spring up to and beyond its elastic limit.

3.1.3 Pupils can describe how pressure acts in all directions in a fluid and increases with depth. They can explain why some solid objects float and others sink in terms of weight and upthrust.

3.1.4 Pupils can calculate the speed of objects and can recognise a range of types of motion on a distance-time graph.

3.1 Forces – Working At

3.1.1 Pupils know that weight depends on the mass of an object and also on gravitational field strength. They are able to explain the difference between mass and weight and can use data about the mass of planets to calculate the weight of an object on different planets.

3.1.2 Pupils can use more complicated force diagrams to explain how the shape or motion of an object will change. They can draw a more complicated force diagram using a description of the forces on an object or of the changes taking place to an object's size, shape or motion. They can apply their understanding of frictional and drag forces to a range of scenarios involving moving and falling objects. They can describe the effects of force on a spring up to and beyond its elastic limit and use data from graphs to identify the elastic limit of an object.

3.1.3 Pupils can describe how pressure acts in all directions in a fluid and increases with depth. They can calculate the pressure exerted on a fluid and explain why some solid objects float and others sink in terms of weight and upthrust. They can apply this understanding to unfamiliar scenarios such as one solid scratching the surface of another.

3.1.4 Pupils can calculate the speed of objects, describe acceleration, and can recognise the full range of types of motion on a distance-time graph.

3.1 Forces – Working Above

3.1.1 Pupils can confidently manipulate the equation W = mg to calculate any of the variables. They can suggest implications of mass and weight for a space mission and can identify the relationship between the orbit speed/period and orbit distance for natural and artificial satellites.

3.1.2 Pupils are confident in creating and interpreting force diagrams for objects in a range of scenarios. They can apply their understanding of frictional and drag forces to a range of scenarios involving moving and falling objects. They recognise the impact of these forces in transport and sports scenarios and can explain how these forces need to be harnessed or minimised. They can use ideas of proportionality in describing the effects of forces on springs and deformation of objects. They recognise the importance of an objects ability to deform.

3.1.3 Pupils can describe how pressure acts in all directions in a fluid and increases with depth. They can calculate the pressure exerted on a fluid and explain why some solid objects float and others sink in terms of weight and upthrust. They can confidently apply their understanding to a range of scenarios such as hydraulics or helicopter blade abrasion and recognise how variables can be manipulated to make an object float or sink.

3.1.4 Pupils can calculate the speed and acceleration of objects and produce distance-time graphs to describe motion. They recognise the significance of relative motion; that an observer's perception of an object's motion is relative to the observer's motion.

3.2 Electromagnets – Working Below

3.2.2 Pupils recognise that objects can become electrically charged. They recognise that charged objects can affect each other when they are brought close together. They recognise that static charges can move and this creates a spark.

3.2.1 Pupils recognise voltage as an electrical push from a battery. They can explain that a voltage is needed for an electric circuit to work and that resistance is a feature of circuits which reduces the current flowing.

3.2.3 Pupils recognise that currents can create magnetic fields and that these can be used in a solenoid. They can describe why the magnetic field can be turned on and off.

3.2.4 Pupils know that permanent magnets have a magnetic field around them which can attract and repel other objects. They know that permanent magnets have a north-seeking pole and a south-seeking pole. They recognise that the Earth behaves like a permanent magnet with a north pole and south pole.

3.2 Electromagnets – Working Towards

3.2.2 Pupils can explain static charge as a movement of electrons and how objects become positively or negatively charged. They can predict how charged objects will affect each other. They recognise that a current is created when charges move; the size of a current depends on the amount of charge moved in a given time.

3.2.1 Pupils recognise voltage as an electrical push from a battery. They can describe how voltage is different across components in series and parallel circuits and recognise how resistance affects current and energy transfer in circuits.

3.2.3 Pupils recognise that currents can create magnetic fields and that the strength of the magnetic field varies with size of current and distance from the conductor. They can describe how the magnetic field around a solenoid can be varied.

3.2.4 Pupils can explain why other magnets or objects are attracted or repelled by a permanent magnet. They know that the magnetic field around objects is composed of field lines and that these field lines flow from the north-seeking pole to the south-seeking pole. They can describe how a permanent magnet is used as a compass.

3.2 Electromagnets – Working At

3.2.2 Pupils can explain static charge and how objects become positively or negatively charged in terms of movement of electrons. They can predict and explain how charged objects will affect each other. They can describe simple uses and dangers of static charge. They can describe a model of current as electrons moving from the negative to the positive terminal of a battery through a circuit.

3.2.1 Pupils recognise voltage (potential difference) as the amount of energy transferred per unit of charge through a circuit. They can use ideas of energy to explain how voltage and resistance affect the way components work. They recognise how resistance can be calculated from a voltage-current graph.

3.2.3 Pupils recognise the relationship between current and magnetic field strength in a conductor. They can describe how the magnetic field in a solenoid can be varied and describe a range of applications.

3.2.4 Pupils can use ideas of field lines around permanent magnets to explain why other magnets or objects are attracted or repelled. They can explain why a suspended permanent magnet works as a compass.

3.2 Electromagnets – Working Above

3.2.2 Pupils can explain static charge and how objects become positively or negatively charged in terms of movement of electrons. They can apply their ideas to a range of scenarios where static electricity is useful or dangerous. They demonstrate a secure understanding of current as a flow of charge across a potential difference.

3.2.1 Pupils recognise potential difference as the amount of energy transferred per unit of charge through a circuit. They can confidently describe the relationship between potential difference, resistance and current and can predict voltage-current graphs for a range of components.

3.2.3 Pupils can confidently explain how the magnetic field strength around a solenoid can be varied and evaluate the design of devices using electromagnets.

3.2.4 Pupils can predict the pattern of field lines around objects which are attracting or repelling. They can deduce the properties of the Earth’s magnetic field from its interaction with the magnet in a compass.

3.3 Energy – Working Below

3.3.1 Pupils know that energy is needed to be able to carry out tasks. They understand that we pay for domestic electricity in our homes based on the amount of energy we use.

3.3.2 Pupils can describe simple energy transfers and recognise that an energy transfer can be useful or waste.

3.3.3 Pupils know that work is done when a force is used to move an object. They recognise that energy is used to do work.

3.3.4 Pupils know that the temperature of an object changes when it is heated or cooled and depends on the amount of thermal energy it has. They know that thermal energy moves from areas of high temperature to areas of low temperature.

3.3 Energy – Working Towards

3.3.1 Pupils can compare the amounts of energy in different foods or used by different activities or devices. They can recognise how diagrams can show energy use.

3.3.2 Pupils can describe energy transfers where input energy is transferred as more than one type of energy. They can identify the waste energy and explain why it is waste.

3.3.3 Pupils can calculate work done for simple scenarios. They recognise how simple machines can make jobs easier by reducing the force needed.

3.3.4 Pupils can describe the relationship between temperature and thermal energy. They know that thermal energy moves from high temperature to low temperature. They can describe conduction and convection and recognise that all hot objects radiate heat.

3.3 Energy – Working At

3.3.1 Pupils can compare the advantages and disadvantages of different foods, activities or devices based on energy use. They can interpret Sankey diagrams.

3.3.2 Pupils can describe a range of complex energy transfers and can use data to calculate efficiency. They can describe why energy is always dissipated in energy transfers and offer suggestions for how energy can be conserved.

3.3.3 Pupils can calculate work done for more complex scenarios. They can use calculations to explain how simple machines can be used to make work easier. They understand why the energy used should be the same as the work done and can explain why this isn't usually the case.

3.3.4 Pupils can describe the relationship between temperature, mass and thermal energy within an object. They can explain how heat moves by conduction, convection and radiation and how insulation prevents heat loss. They recognise that the rate of movement of thermal energy depends on the temperature gradient.

3.3 Energy – Working Above

3.3.1 Pupils can justify options for foods, activities or devices in a range of scenarios where energy needs to be considered. They can construct accurate Sankey diagrams.

3.3.2 Pupils can analyse energy transfers and evaluate the efficiency of an energy transfer system.

3.3.3 Pupils can evaluate the use of a machine by considering issues of forces needed and the efficiency of energy transfers.

3.3.4 Pupils can explain the relationship between temperature, mass and thermal energy within an object. They can use a detailed understanding of conduction, convection and radiation to explain how heat is lost or retained and the rate of heat loss in a range of scenarios.

3.4 Waves – Working Below

3.4.1 Pupils know that sound travels as a wave through gases, liquids and solids. They can recognise that louder sounds have bigger sound waves and the waves of higher pitched sounds are closer together. They know that sound travels much more slowly than light and cannot travel at all through a vacuum. They know that humans cannot hear all sounds and that the range of sounds we can hear is called our hearing range.

3.4.2 Pupils know that light travels in straight lines and can describe the path of light in a ray diagram. They recognise that a reflection is created in a mirror because light rays are reflected. They know that all light can pass through a transparent object, that most light can pass through a translucent object and that no light can pass through an opaque object. They observe that light changes direction when it passes into a material with a different density and that lenses can be used to deliberately alter the path of light.

3.4.3 Pupils know that loud sounds can damage hearing and bright light can damage eyesight. They know that microphones convert sound into electrical signals and loud speakers convert electrical signals to sound.

3.4.4 Pupils recognise how waves can be shown by a model such as a slinky spring.

3.4 Waves – Working Towards

3.4.1 Pupils know that a sound wave is a longitudinal wave and travels more quickly through solids than liquids or gases and not at all through a vacuum. They know that hard, smooth surfaces reflect sound well and soft, rough surfaces absorb sound. They recognise how sound waves are represented as transverse waves on an oscilloscope and can identify the amplitude and wavelength of a wave. They recognise a relationship between frequency and wavelength. They can describe the sound wave produced by sounds which are loud/quiet and high-pitched/low-pitched. They can use their understanding of the speed of sound and light to describe what happens during thunderstorms or at firework displays. They know factors which can affect the hearing range of humans.

3.4.2 Pupils recognise that light is reflected by a mirror and that, for a plane mirror, the angle of reflection is equal to the angle of incidence. They recognise the pattern of light rays for concave and convex mirrors. They can describe an object as transparent, translucent or opaque based on its effect on light rays. They recognise that light bends towards the normal when it passes into a more dense medium and bends away from the normal when it passes into a less dense medium. They understand that lenses are used to alter the path of light and that eyes have a lens to focus light on the retina.

3.4.3 Pupils can recognise that loud sounds damage hearing and bright light damages eyesight because their wave has lots of energy. They know that audio equipment converts between varying sound and a changing electrical signal.

3.4.4 Pupils recognise the features of waves in a model such as a slinky spring. They recognise that energy moves from place to place while the material it travels through does not.

3.4 Waves – Working At

3.4.1 Pupils can explain why sound travels more quickly through denser materials and not at all through a vacuum and can be reflected or absorbed by different surfaces. They recognise how sound waves are represented as transverse waves on an oscilloscope and can work out the amplitude and frequency of a sound from a diagram or oscilloscope picture. They can use their understanding of the speed of sound and light to explain what happens during thunderstorms or at firework displays. They

3.4.2 Pupils recognise that light is reflected by a mirror and can draw a ray diagram for a plane mirror, including the normal, the angle of incidence and the angle of reflection. They can apply their understanding of reflection to explain convex and concave mirrors and understand that these mirrors still obey the law of reflection. They can identify an object as transparent, translucent or opaque based on its effect on light rays. They can explain how and why light changes direction when it passes into a more or less dense medium. They understand how lenses are used to alter the path of light in situations including the eye.

3.4.3 Pupils can explain, in terms of energy, how loud sounds damage hearing and bright light damages eyesight. They can describe the relationship between the sound received by or produced by a piece of audio equipment and the electrical signal.

3.4.4 Pupils explain the behaviour of different waves using a model such as a slinky spring, recognising the difference between transverse and longitudinal waves.

3.4 Waves – Working Above

3.4.1 Pupils can apply their understanding of sound waves to explain how materials can be chosen to control the passage of sound waves. They recognise how sound waves are represented as transverse waves on an oscilloscope and can work out the amplitude and frequency of a sound from a diagram or oscilloscope picture. They can explain, in terms of energy and frequency of vibrations, why sounds of different volume and pitch appear as they do on an oscilloscope.

3.4.2 Pupils can apply their understanding of the laws of reflection to explain the patterns of incident and reflected light rays for plane, convex and concave mirrors and to explain why matt surfaces are poor reflectors. They can identify an object as transparent, translucent or opaque based on its effect on light rays. They can explain how and why light changes direction when it passes into a more or less dense medium. They can explain how lenses are used to alter the path of light in situations including the eye and can select the lens needed in glasses or contact lenses for a short-sighted and long-sighted person.

3.4.3 Pupils can evaluate the likelihood that various scenarios might cause damage to hearing and eyesight. They can explain the relationship between the sounds received by or produced by a piece of audio equipment and the electrical signal.

3.4.4 Pupils can use models to explain the behaviour of materials in a range of situations where they are transmitting waves.

3.5 Matter – Working Below

3.5.1 Pupils are able to describe the differences between the motion and arrangement of particles in solids, liquids and gases and recognise the arrangements in particle diagrams. They know some differences in the properties of solids, liquids and gases. They understand that substances can change state when heated or cooled.

3.5.2 Pupils know that a pure substance consists of only one type of element or compound. They are familiar with simple techniques including dissolving, filtering and evaporating. They can carry out one-step techniques to separate simple mixtures. They recognise that mixtures are substances which can be separated into two or more substances.

3.5.3 Pupils know that the Periodic table shows all the known elements grouped according to their properties.

3.5.4 Pupils know that elements react and bond to form compounds. They can identify a substance as a compound from its formula.

3.5 Matter – Working Towards

3.5.1 Pupils can relate the arrangement of particles in solids, liquids and gases to the basic properties of solids, liquids and gases. They can describe broadly how changes to the arrangement and motion of their particles can cause substances to change state.

3.5.2 Pupils know that a pure substance consists of only one type of element or compound and has a fixed melting and boiling point. They are familiar with a range of separating techniques including dissolving, filtering, evaporating, distillation and chromatography. They can select and carry out one-step techniques to separate simple mixtures. They can explain why certain techniques are able to separate certain types of simple mixtures.

3.5.3 Pupils can identify groups and periods in the Periodic table. They can identify the position of groups 1, 7 and 0 and they know that the elements in each of these groups have similar properties. They know that metals are generally found to the left of the Periodic table and non-metals to the right.

3.5.4 Pupils can identify the numbers of atoms of different elements in a molecule from its formula.

3.5 Matter – Working At

3.5.1 Pupils can explain states of matter and changes in state in terms of energy and particles and can recognise melting and boiling point on a cooling curve. They can use particle diagrams to describe more complex scenarios such as dissolving and diffusion.

3.5.2 Pupils can describe what constitutes a pure substance and can explain why they have a fixed melting and boiling point. Pupils can select, organise and carry out a multi-step technique to separate a more complex mixture. They are able to explain what is happening to particles in separating techniques including dissolving, filtering, evaporating, distillation and chromatography.

3.5.3 Pupils are familiar with the arrangement of elements in the Periodic table into groups and periods. They can explain why the elements in groups 1, 7 and 0 are grouped together and can identify trends in the properties of the elements in a group.

3.5.4 Pupils can identify the name of a compound from the different elements in its formula.

3.5 Matter – Working Above

3.5.1 Pupils have a secure grasp of the relationship between the kinetic energy of particles and the properties of solids, liquids and gases. They are able to describe complex scenarios such as gas pressure and density and can explain the shape of a cooling curve at a substances melting and boiling point.

3.5.2 Pupils can explain why mixtures of substances can have different melting and boiling points while those of pure substances are fixed. Pupils can select, organise and carry out a multi-step technique to separate complex mixtures including a mixture of solutes with different solubility and can use data such as cooling and solubility curves to explain the outcome of separating techniques.

3.5.3 Pupils are familiar with the arrangement of elements in the Periodic table into groups and periods. They can explain why the elements in groups 1, 7 and 0 are grouped together, can identify trends in the properties of the elements in a group and can predict the physical and chemical properties of an unfamiliar Group 1 or 7 elements.

3.5.4 Pupils can identify patterns in the formulae of compounds and use these to predict the formulae of unknown compounds.

3.6 Reactions – Working Below

3.6.1 Pupils know that metals and non-metals react with oxygen to form oxides.

3.6.2 Pupils can identify a substance as an acid, base or neutral from its pH number using Universal Indictor solution. They know that strong acids have a low pH and strong bases have a high pH.

3.6.3 Pupils know that, in a chemical reaction, bonds are broken and new bonds are formed to make products. They know it takes energy to break bonds.

3.6.4 Pupils know that, when substances burn, they are reacting with oxygen and this is called combustion. They know that the combustion of fossil fuels produces carbon dioxide which contributes to Global Warming. They know that thermal decomposition is a reaction where a single reactant breaks down into simpler products by heating.

3.6 Reactions – Working Towards

3.6.1 Pupils know that elements can be metals or non-metals and react with oxygen to form oxides. They can describe oxidation and name the oxide formed. They know that metals form oxides which are bases while those of non-metals are acidic.

3.6.2 Pupils know that metals react with acids to form a salt and hydrogen gas. They can identify the name of the salt that will be formed and can represent the reactions in word equations. They recognise that the reactivity of metals affects the rate of its reaction with an acid and can use information about its reactions to place an unfamiliar metal into the reactivity series. They know how Universal Indicator and the pH scale can be used to distinguish between acids, bases and neutral substances. They can describe how to make a neutral solution from an acid and a base and know that this is called neutralisation.

3.6.3 Pupils can describe how bonds are broken and new bonds formed during a chemical reaction. They know that it takes energy to break bonds and that energy is produced when bonds are formed. They know that a reaction is exothermic when it produces more energy than it uses and endothermic when more energy is used.

3.6.4 Pupils know that, when substances burn, they are reacting with oxygen and this is called oxidation. They know that the combustion of fossil fuels produces carbon dioxide which contributes to Global Warming. They know that thermal decomposition is a reaction where a single reactant breaks down into simpler products by heating. They can describe the products of the combustion of fossil fuels and describe how the combustion of fossil fuels contributes to Global Warming. They are able to describe thermal decomposition and represent the reaction as a word equation. They understand that masses will change during reactions but the total mass is conserved.

3.6 Reactions – Working At

3.6.1 Pupils can explain what happens in an oxidation reaction and use word equations to describe oxidation reactions. They can identify an element as a metal or a non-metal from the pH of its oxide and from its physical properties. They can describe how a metal's position in the reactivity series will affect its reactions with acids which they can represent as word equations.

3.6.2 Pupils can describe neutralisation in terms of relative strength of acid and base, and pH. They can name the products formed from a reaction between an acid and a base and represent neutralisation as a word equation.

3.6.3 Pupils can use the idea of bond energy to describe why a reaction is exothermic or endothermic. They can identify a reaction as exothermic or endothermic from primary data and justify uses for such reactions.

3.6.4 Pupils are able to describe combustion and thermal decomposition using word equations and particle diagrams. They can describe how to identify the products of these reactions and can use data about masses to calculate the mass of a remaining reactant or product.

3.6 Reactions – Working Above

3.6.1 Pupils can represent oxidation reactions as word and chemical equations. They can link the pH of oxides and their other physical and chemical properties to their uses and occurrences in real-world scenarios such as toothpaste and acid rain. They can use a metal's position in the reactivity series to predict its reactions with acids and show these in word and symbol equations.

3.6.2 Pupils can explain what happens in a neutralisation reaction. They can confidently identify all the products from a range of neutralisation reactions and represent them as word and symbol equations.

3.6.3 Pupils can use data for bond energies to predict whether a reaction will be exothermic or endothermic. They can identify exothermic and endothermic reactions from energy level diagrams.

3.6.4 Pupils are able to explain combustion and thermal decomposition in the context of the law of conservation of mass and using particle diagrams and symbol equations. They can explain the significance of the combustion of fossil fuels and the production of cement for the Earth's climate.

3.7 Earth – Working Below

3.7.1 Pupils know that the Earth's internal structure is layered and includes the crust, the mantle and the core. They know there are three types of rock – igneous, sedimentary and metamorphic – and that, once formed, these rocks are subject to weathering and erosion.

3.7.2 Pupils know that our solar system consists of a star and orbiting planets, some of which have moons orbiting them. They know that day and night is caused by the rotation of the Earth on its axis. They know we can see some other planets and the Moon because they reflect the Sun's light and that their changing position affects how they appear from Earth. They know we can explore the Solar System with telescopes, probes and landers and that there are other solar systems but they are too far away to travel to.

3.7.3 Pupils know that the Earth's atmosphere is mostly nitrogen, about one fifth oxygen and a tiny amount of carbon dioxide. They know that carbon dioxide enters and leaves the atmosphere by processes including photosynthesis, respiration and combustion. They know that human activities are causing the amount of carbon dioxide to increase.

3.7.4 Pupils know that some resources such as fossil fuels, metals and minerals need to be extracted and there is only a certain quantity of these resources on the Earth. They know that some metals can be found in their pure form and others need to be extracted from ores. They understand that recycling some materials reduces the need to extract them from the ground.

3.7 Earth – Working Towards

3.7.1 Pupils can describe the processes which form igneous and sedimentary rocks and how they are linked in a rock cycle which includes metamorphic rocks. They can identify weathering processes as physical, chemical or biological and can link the processes forming sedimentary rocks to the occurrence of fossils.

3.7.2 Pupils can describe the objects which make up our solar system. They can explain how the rotation of the Earth causes day and night and they understand that its orbit around the Sun tilted axis creates seasonal differences in temperature or daylight. They can explain the changing shape of the Moon. They can describe the various ways that we can explore the Universe and understand how our exploration is affected by its scale.

3.7.3 Pupils know the composition of Earth's atmosphere and understand how carbon is recycled. They can describe how human activities affect the carbon cycle and are increasing the amount of carbon dioxide in the atmosphere. They can describe how Global Warming can impact climate and the consequences of that climate change.

3.7.4 Pupils know that resources extracted from the Earth are a finite resource and can describe why this is a problem. They know that the least reactive metals can be found in their pure form and more reactive metals need to be extracted from ores, which are often metal oxides. They know that some metals can be displaced by carbon while the most reactive need to be extracted by electrolysis. They understand there are advantages and disadvantages from recycling some metals.

3.7 Earth – Working At

3.7.1 Pupils can confidently describe the processes in the rock cycle and link them to the formation of fossils and igneous rocks with crystals of different sizes. They can explain why sedimentary rocks are formed in the crust and igneous rocks from material from the mantle. They can begin to predict the characteristics of the rocks formed from the conditions present.

3.7.2 Pupils can explain how the motion of the Earth causes day and night, seasonal variations and differences in the observations of the Moon and planets. They can link the conditions on the planets in our Solar System with their position and describe how objects are kept in orbit by gravity. They can describe the importance and limitations of the search for exoplanets.

3.7.3 Pupils can describe the evidence and explain the processes causing climate change. They can use a diagram to explain how carbon is recycled naturally and how human activities impact this natural recycling. They understand that there are differing interpretations of the evidence and the impacts. They can describe some strategies for limiting or mitigating the impacts of global warming.

3.7.4 Pupils know that metals are extracted from their ores using a method dependent on their reactivity. They can describe the reduction of iron oxide in a blast furnace and the reduction of aluminium oxide using electrolysis. They can represent the reactions as word equations. They are able to describe a range of arguments for and against the recycling of metals.

3.7 Earth – Working Above

3.7.1 Pupils can link the processes in the rock cycle with the characteristics of the rocks formed. They can explain how processes within the Earth drive the rock cycle. They can predict how different conditions will affect the types and characteristics of the rocks formed.

3.7.2 Pupils can use their knowledge of the motion of objects in the Solar System to predict observations and conditions at different places on the Earth and on other planets. They can explain how objects are kept in orbit by gravity and why the orbits of the planets are different. They can explain how we explore the Universe and how our understanding, now and in the past, is limited by technology and understanding.

3.7.3 Pupils can evaluate the claims that human activity is causing global warming and climate change. They can evaluate different strategies for limiting or mitigating the impacts of global warming.

3.7.4 Pupils are able to explain the method required to extract a metal from its ore. They can describe the processes and reactions involved in the reduction of iron oxide and aluminium oxide and produce symbol equations and half equations. They can suggest how human behaviour is influenced by the availability of these natural resources and use data to evaluate recycling strategies.

3.8 Organisms – Working Below

3.8.1 Pupils know that the skeleton provides support and allows us to move. They know that muscles are used to make bones move at joints.

3.8.2 Pupils know that all living things are made of cells and that these cells are microscopic. They can identify the main parts of typical plant and animal cells. They know that there are different types of cell which carry out different jobs. They know that organs are made of cells working together to carry out a particular job.

3.8.3 Pupils know that, in the lungs, oxygen from the air passes into the blood stream and carbon dioxide from the blood passes out into the lungs and is breathed out. They know the oxygen is needed by cells in our body to make energy and that carbon dioxide is a waste product produced. They understand that we need more energy when we exercise so we breathe in more oxygen.

3.8.4 Pupils know that the body needs a balanced diet containing protein, fats, carbohydrate, vitamins, minerals, fibre and water. They know that the food we eat needs to be broken down by digestion and carried by the blood to be used for cells' energy, growth and repair.

3.8 Organisms – Working Towards

3.8.1 Pupils can explain how different parts of the skeleton are used for support, protection and movement. They recognise that pairs of muscles are required to make bones move at joints and they know that the ends of bones are protected by cartilage and attached to muscles by tendons.

3.8.2 Pupils can describe the function of different parts of typical plant and animal cells. They know there are many different types of cell which have features that enable them to carry out specific tasks. They can explain how to use a microscope to look at cells. They understand the organisation of cells into tissues, organs and organ systems and they can describe how organ systems are needed to carry out the functions which keep a multi-cellular organism alive.

3.8.3 Pupils know the basic structure of the lungs and that, in the alveoli, oxygen from the air passes into the blood stream and carbon dioxide from the blood passes out into the air. They can describe how the ribs and diaphragm move during breathing. They know oxygen is needed by cells in our body to make energy by respiration and that carbon dioxide is a waste product produced. They can investigate the effects of exercise on breathing and can describe how exercise, smoking and asthma affect breathing.

3.8.4 Pupils know that a balanced diet is needed for a healthy body and contains protein, fats, carbohydrate, vitamins, minerals, fibre and water. They understand that various factors might affect the food needed and the health problems caused by malnourishment and over-eating. They know what a deficiency disease is and can give an example. They know that the food we eat is broken down by physical and chemical digestion and can name the parts of the digestive system. They know that digested food passes into the blood stream in the small intestine and is carried by the blood to be used for cells' energy, growth and repair.

3.8 Organisms – Working At

3.8.1 Pupils can explain how the structure of different parts of the skeleton are used for support, protection and movement. They know that bone marrow is a tissue found inside bones which produces new blood cells. They can explain the process by which antagonistic pairs of muscles cause joints to move and describe the limitations of some muscles in exerting forces.

3.8.2 Pupils can explain the structure and function of different parts of typical plant and animal cells. They know how the features of specialised cells enable them to carry out specific tasks. They can describe the limitations of using a microscope to look at cells. They can explain the organisation of cells into organ systems and the specific roles of all the main organ systems. They know that unicellular organisms are adapted to carry out functions that in multi-cellular organisms are done by different types of cell.

3.8.3 Pupils can describe how the different parts of the breathing system are involved in breathing and gas exchange. They can describe how the ribs and diaphragm move during breathing and how this creates pressure changes which makes air move in and out of the lungs. They can explain how the structure of alveoli helps gas exchange. They can link the body's demand for energy with respiration rate and with breathing and they are aware that breathing becomes deeper as well as quicker during exercise. They understand what is meant by oxygen debt and can explain why our breathing rate remains high for a period of time after exercise.

3.8.4 Pupils can describe a balanced diet and explain why it is needed for a healthy body. They understand that various factors might affect the food needed and can describe the health problems caused by a poor diet. They know what a deficiency disease is and can describe the causes and symptoms of scurvy, rickets and kwashiorkor. They can describe how the food is broken down by physical and chemical digestion at each stage of the digestive system including the role of the liver and large intestine. They understand that chemical digestion using enzymes is needed to break down food into small molecules and they can explain how the small intestine is adapted to absorb the digested food.

3.8 Organisms – Working Above

3.8.1 Pupils can explain how the skeleton provides support, protection and movement. They know that bone marrow is a tissue found inside bones which produces new blood cells. They can explain the process and limitations of using antagonistic pairs of muscles to cause joints to move and exert force. They can consider the benefits and risks of technology used to improve human movement.

3.8.2 Pupils can explain how the different parts of typical plant and animal cells are adapted to carry out their functions. They can explain how specialised cells are adapted to carry out specific tasks. They can describe the limitations of using a microscope to look at cells. They can explain the organisation of cells into organ systems and explain how the structure and features of all the main organ systems enable them to carry out their specific roles. They can describe how the structure of unicellular organisms enables them to carry out all the life functions.

3.8.3 Pupils can describe the process of breathing in terms of pressure and gas exchange in terms of diffusion. They can use their understanding to evaluate a model of the breathing mechanism. They recognise the importance of the lungs for respiration and can describe and explain various factors which might affect the efficiency of the lungs. They can explain oxygen debt and factors affecting recovery rate.

3.8.4 Pupils can identify the nutrients needed for a healthy diet and describe a healthy diet. They recognise factors which might affect dietary needs and can design a suitable diet. They are able to make deductions from medical symptoms to identify problems with the diet or digestive system. They are able to describe the adaptations of the digestive system and the physical and chemical processes at each stage.

3.9 Ecosystems – Working Below

3.9.1 Pupils know that energy passes along a food chain and that food chains are linked to make food webs. They know the Sun provides the light energy at the start of almost all food chains and that this is used by green plants, which are producers, to make food. Consumers eat other organisms to get their energy.

3.9.2 Pupils know that most plants reproduce sexually and that flowers contain the reproductive organs. They can label a diagram of the main parts of a flower and they know that the flower produces pollen and will produce seeds. They know that a flower can be pollinated by insects or by the wind.

3.9.3 Pupils know that all living things get their energy from glucose in a process called respiration. They know that most organisms also need oxygen but yeast does not and we can make use of it in baking and brewing.

3.9.4 Pupils know that plants produce their own food by photosynthesis. They know that plants need to take in water and carbon dioxide and that they use light energy from the Sun and the chlorophyll in their leaves to make sugar and oxygen. The oxygen is given out and the sugar is used for energy and to build new tissue. They can explain why photosynthesis doesn't happen at night and is reduced on a cloudy day.

3.9 Ecosystems – Working Towards

3.9.1 Pupils can describe how energy passes along a food chain and that food chains are linked to make food webs. They know that green plants are producers and make their own food by photosynthesis. Consumers eat other organisms to get their energy and can be classed as herbivores, omnivores and carnivores and also as predators and prey. They recognise that a population of prey animals will need to be larger than the population of predators and they can describe how changes in populations might affect food chains. They represent populations in a food chain as a pyramid of numbers.

3.9.2 Pupils know that plants reproduce sexually and this involves male sex cells called pollen, produced in the anthers, and female sex cells called ovules, produced in the ovary. They can explain the process of pollination including the role of insects or the wind and describing the parts of the flower involved. They understand that seeds are formed from the ovules and that the ovary becomes a fruit. They can describe the importance of seed dispersal and the methods used to disperse the seeds including the fruit being eaten by animals, the fruit being dispersed by the wind and the fruit being catapulted away from the plant.

3.9.3 Pupils know that aerobic respiration is used by most living things to produce energy from glucose and oxygen. They know the word equation for aerobic respiration. They know that some organisms can respire anaerobically and that this reaction produces lactic acid in the muscles of animals. Anaerobic respiration by yeast is used in brewing to make alcohol and baking to make bread rise.

3.9.4 Pupils can use a word equation to describe photosynthesis and can explain that this is how plants produce their own food. They know that plants take in water through their roots and carbon dioxide through pores in their leaves called stomata. They know that sunlight is absorbed by the leaves and chlorophyll is contained in the chloroplasts. They understand that the sugar that is made is used for energy, for building new tissue or is stored in the leaves as starch. They can explain that the oxygen is released into the air through the stomata. They can describe how to test a leaf for starch and that the presence of starch is evidence of photosynthesis. They can describe how sunlight, availability of water and amount of carbon dioxide can affect the rate of photosynthesis.

3.9 Ecosystems – Working At

3.9.1 Pupils can explain how energy passes along food chains and through food webs. They understand that organisms occupy different trophic levels and how energy is lost at each trophic level. They can explain how the population of organisms at each trophic level can affect a food web and can describe a range of reasons why populations change. They can describe how toxic substances accumulate in food chains and the implications for top predators. They recognise the limitations of representing food chains as pyramids of numbers and know how to produce a pyramid of biomass.

3.9.2 Pupils have a secure understanding of the structure of flowers and the process of pollination. They can describe fertilisation including the growth of the pollen tube. They can explain the formation of seeds and fruit and can describe how the characteristics of seeds and fruit are influenced by the method of seed dispersal. They can suggest how plant breeders might be able to intervene to improve the likelihood of fertilisation.

3.9.3 Pupils know that aerobic respiration takes place in the mitochondria in the cells of most living things to produce energy from glucose and oxygen. They know the word and balanced symbol equation for aerobic respiration. They know that some organisms can respire anaerobically and that this reaction produces lactic acid in the muscles of animals and can describe the usefulness and limitations of anaerobic respiration in animals. They can describe and write word equations for fermentation used in brewing and baking.

3.9.4 Pupils can use a word equation and symbol equation to describe photosynthesis. They can describe how water is taken in by the roots and transported to the leaves and they can describe how the gases are exchanged via the stomata in leaves. They recognise adaptations in the plant which enable them to effectively absorb sunlight, to absorb water and to exchange gases. They can explain the importance of the guard cells in stomata. They can describe how to test a leaf for starch and explain why sugars are stored as starch in the leaves. They can describe how various factors including light intensity and temperature might affect the rate of photosynthesis and justify conditions used in a commercial greenhouse to promote photosynthesis.

3.9. Ecosystems – Working Above

3.9.1 Pupils can explain how energy passes along food chains and through food webs and how energy losses at each trophic level limit the length of food chains. They can explain a number of factors which can affect the population of an organism and the implications for other organisms in the food web. They understand the risks of bioaccumulation for humans and other top predators and can explain issues with human food supplies in terms of insect pollinators. They understand how legislation is used to mitigate problems. They can evaluate a proposal for introducing an unfamiliar species into a food web.

3.9.2 Pupils can use their understanding of the structure of flowers and the process of pollination to evaluate methods used by plant breeders to improve fertilisation rates or to develop an argument why some plant structures found naturally are more successful than others. They can describe the various processes for seed dispersal in the wild and link this to the ability of different plants to spread and colonise new areas. They can suggest how plant breeders might be able to use their knowledge of pollination and fertilisation to carry out selective breeding.

3.9.3 Pupils can describe aerobic respiration in the mitochondria in the cells of living things referring to the diffusion of substances into and out of the cell. They know that some organisms can respire anaerobically and can evaluate the usefulness of anaerobic respiration as a life process in animals. They know the balanced symbol equations for aerobic respiration, anaerobic respiration in animals and fermentation in yeast.

3.9.4 Pupils can use a word equation and symbol equation to describe photosynthesis. They can describe the processes of transpiration and gas exchange in the leaves and recognise the mechanisms which regulate these in plants. They can explain how plants are adapted for photosynthesis. They can explain limiting factors for the rate of photosynthesis and show these as graphs. They can explain how the glucose produced is stored and how minerals are needed to build the glucose into new tissues.

3.10 Genes – Working Below

3.10.1 Pupils know that differences between members of the same species are called variation. They know that variation is inherited or caused by the environment or a combination of the two. They can investigate variation between members of a species and plot results as bar charts or line graphs.

3.10.2 Pupils know that animal and plant species have evolved and many species have become extinct. They understand that evidence for different species is found in fossils. They know that an ecosystem is a biological community and that a healthy ecosystem has many different species living in it.

3.10.3 Pupils know the main parts of the male and female human reproductive systems. They know that the menstrual cycle prepares the woman for pregnancy and that an egg is released from an ovary once a month approximately. They know that fertilization happens if the egg joins with a sperm and that this might lead to pregnancy. They understand that the developing foetus depends on the mother to provide the oxygen and nutrients it needs and to remove its waste.

3.10.4 Pupils know that inherited characteristics are the result of genetic material carried on chromosomes in the nucleus of cells. They understand that parents pass on information to their offspring as genes during reproduction. They know that half of an offspring's genes are inherited from each parent in the parents' gametes.

3.10 Genes – Working Towards

3.10.1 Pupils can describe what is meant by variation and how variation is caused. They can identify discontinuous and continuous variation and plot results of an investigation as bar charts or line graphs. They recognise how the characteristics of a species are adapted to a particular environment and how variation can affect survival.

3.10.2 Pupils know that natural selection is a theory which explains how species have changed over time. They recognise how fossils provide evidence for evolution and how evolution can be caused by natural selection. They understand that species have become extinct or evolved because of changing conditions in ecosystems. They know that populations in an ecosystem depend on each other and the possible effects of a lack of biodiversity.

3.10.3 Pupils know that the menstrual cycle repeats approximately every 28 days, preparing a woman's body for pregnancy by building up the blood supply in the lining of the uterus and releasing an unfertilised egg from the ovary. They can describe the journey of the egg from the ovary and the path that sperm will take to fertilise the egg. They understand that the fertilised egg cell will multiply and develop into an embryo which will need to implant in the uterus lining for a pregnancy to continue. They can explain how, during the pregnancy, the growing foetus is dependent on its mother for protection, provided by the amniotic fluid, and for the supply of food and nutrients and the removal of waste through the placenta. They can explain that the gestation period for a human baby is around nine months during which the baby needs to develop enough to be born.

3.10.4 Pupils know that offspring inherit characteristics from their parents as sections of DNA, called genes, during reproduction. They recognise that half of an offspring's genes are inherited from each parent so offspring from the same parents look similar but are not usually identical. They understand that genes are arranged into chromosomes which are found in the nucleus of most cells.

3.10 Genes – Working At

3.10.1 Pupils can explain how characteristics of a species might be adapted to a particular environment. They can explain the causes of variation and recognise that variation can influence an individual's and a species' chances of survival in a changing environment.

3.10.2 Pupils understand how fossils provide evidence for evolution but that the evidence is limited. They can describe how variation and changes in environmental conditions can lead to natural selection and how this provides a mechanism for evolution. They understand how different species in an ecosystem depend on each other and recognise the importance of biodiversity for the maintenance of healthy populations.

3.10.3 Pupils can describe the key stages in the human menstrual cycle and understand how it prepares a woman's body for pregnancy. They can use their understanding of the path of sperm and egg to deduce where the egg is most likely to be fertilised and when a woman is most likely to become pregnant. They can apply their understanding of fertilisation to be able to explain how different contraception methods work. They can describe how the mother provides for the developing foetus and the effects that smoking, or the mother drinking too much alcohol or taking drugs might have on the foetus.

3.10.4 Pupils understand how offspring inherit characteristics from their parents and why each gamete carries only half the number of genes. They can apply this understanding to explain why offspring from the same parents are similar but not usually identical except in the case of identical twins. They know there is more than one version of each gene and can show with diagrams how the combination of inherited genes affects an offspring's characteristics. They can describe how a mutation might affect an organism and its offspring.

3.10 Genes –Working Above

3.10.1 Pupils can explain how variation occurs in species and how a species can become adapted to a particular environment. They can use ideas of variation to explain why one species may adapt better than another to an environmental change.

3.10.2 Pupils can evaluate the strength of fossil evidence for evolution. They can explain how natural selection provides a mechanism for evolution. They can discuss how populations of organisms depend on each other and recognise the benefits for humans of biodiversity in ecosystems. They can evaluate schemes for preserving plant and animal material for future generations.

3.10.3 Pupils can explain the key stages in the human menstrual cycle. They can apply their understanding of fertilisation to explain why pregnancy is more or less likely at different times and to explain reasons why some couples might find it difficult to conceive a baby. They can justify their ideas about the effectiveness of different contraception methods. They can explain how the mother provides for the developing foetus and the effects that smoking, or the mother drinking too much alcohol or taking drugs might have on the foetus. They can give reasons why a baby might be born premature and suggest the problems that might arise.

3.10.4 Pupils can use their detailed understanding of genetic inheritance to be able to explain why offspring do or do not inherit certain features from their parents. They can explain how a mutation can be beneficial or harmful. They can suggest benefits of knowing all the genes in the human genome and suggest arguments for and against genetic modification.

GCSE Grading – AQA

To achieve grades 8 and 8-8 candidates will be able to:

- demonstrate relevant and comprehensive knowledge and understanding and apply these correctly to both familiar and unfamiliar contexts using accurate scientific terminology
- use a range of mathematical skills to perform complex scientific calculations
- critically analyse qualitative and quantitative data to draw logical, well-evidenced conclusions
- critically evaluate and refine methodologies, and judge the validity of scientific conclusions

To achieve grades 5 and 5-5 candidates will be able to:

- demonstrate mostly accurate and appropriate knowledge and understanding and apply these mostly correctly to familiar and unfamiliar contexts, using mostly accurate scientific terminology
- use appropriate mathematical skills to perform multi-step calculations
- analyse qualitative and quantitative data to draw plausible conclusions supported by some evidence
- evaluate methodologies to suggest improvements to experimental methods, and comment on scientific conclusions

To achieve grades 2 and 2-2 candidates will be able to:

- demonstrate some relevant scientific knowledge and understanding using limited scientific terminology
- perform basic calculations
- draw simple conclusions from qualitative or quantitative data
- make basic comments relating to experimental methods

GCSE Grading – Individual grade points

Grade 1

Pupils recall some key words and their meanings. They can describe simple similarities and differences in the phenomena they observe. They can answer basic recall questions in familiar contexts. Pupils can recall some practical activities carried out and select some appropriate pieces of equipment for a task. They can identify a hypothesis and a conclusion. They can recall and use a small number of basic formulae. Pupils can identify simple patterns from a graph or data table.

Grade 2

Pupils apply skills (including suitable communication, mathematical and technological skills), knowledge and understanding in basic contexts. They show some understanding of the nature of science and its applications. They can explain straightforward models of phenomena, events and processes. They can use a select range of skills and techniques, answer scientific questions with a good range of vocabulary, and solve straightforward problems and tests. Pupils also begin to recognise simple interrelationships between science and society. Pupils can recall practical experiments they carried out and select appropriate equipment for a specific task. They have a basic understanding of hypotheses, evidence, theories and explanations. They can recall that models may be used in science but may not link this to specific examples. They can use basic skills to test hypotheses and answer scientific questions. They can recall and use some basic formulae. Pupils recognise and describe simple patterns and begin to link in scientific explanations for these.

Grade 3

Pupils can occasionally communicate scientific knowledge and understanding from the course of study. For example, facts, definitions, and explanations. They occasionally use scientific and technical knowledge, terminology, and conventions appropriately to show understanding of the nature of science and its applications. Pupils can occasionally apply appropriate communication, mathematical, and technical skills in a range of practical contexts. This includes making links between hypotheses, evidence, theories, and explanations. They understand models are used in science to explain phenomena. They can occasionally apply their understanding to connect theory with particular contexts. They can usually make sense of connections within data. They can recall and use the majority of simple formulae. Pupils can occasionally analyse information and ideas to interpret and evaluate. They can usually make judgements and draw conclusions from a range of quantitative and qualitative data and information. They can occasionally understand basic limitations of evidence and develop ideas to improve experimental procedures.

Grade 4

Pupils recall, select and communicate secure knowledge and understanding of a relatively wide range of concepts in science. Pupils demonstrate sound knowledge and understanding, which can be applied to a range of scientific processes. They use scientific and technical knowledge, terminology and conventions appropriately most of the time, showing an understanding of scale in terms of time, size and space. They can apply appropriate skills, including communication, mathematical and technological skills. Pupils can apply knowledge and reasoning to carry out a range of practical tasks (PAGs). They recognise, understand and apply links between hypotheses, evidence, theories and explanations, in most cases. They use models to explain phenomena, events and processes in most cases. Using appropriate methods, sources of information and data, they apply their skills to answer scientific questions, solve problems and test hypotheses. Pupils can recall and apply the majority of scientific equations. They can use the majority of complex formulae, rearrange and use the majority of simple formulae. Pupils often analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand some of the limitations of evidence and develop arguments with some supporting explanations. They can draw the majority of the conclusions consistent with the available evidence.

Grade 5

Pupils recall, select and communicate secure knowledge and understanding of science. Pupils demonstrate extensive knowledge and understanding, which can be applied to various scientific processes. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical and technological skills. Pupils can apply knowledge and reasoning to carry out a range of practical tasks, (PAGs). They recognise, understand and apply links between hypotheses, evidence, theories, and explanations. They use models to explain phenomena, events and processes. Using appropriate methods, sources of information and data, they apply their skills to answer scientific questions, solve problems and test hypotheses. Pupils can recall and apply the majority of scientific equations. They can use complex formulae and rearrange and use simple formulae. Pupils analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand some of the limitations of evidence and develop arguments with supporting explanations. They draw conclusions consistent with the available evidence.

Grade 6

Pupils recall, select and communicate accurate knowledge and detailed understanding of science. They demonstrate a broad understanding of the nature of science, its laws, its applications, and the influence of society on science and science on society. They understand how relationships between scientific advances and their ethical implications have benefits and risks associated with them. They use scientific and technical knowledge, terminology and conventions appropriately and consistently, showing a good understanding of scale in terms of time, size and space. They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding effectively in a range of practical and other contexts. They are able to link the relationships between hypotheses, evidence, theories and explanations and make effective use of models to explain phenomena, events and processes. They use a range of appropriate methods, sources of information and data regularly, applying relevant skills to address scientific questions, solve problems and test hypotheses. Pupils can correctly recall and use the majority of formulae for calculations. They can rearrange the majority of these formulae when required. Pupils analyse, interpret and accurately evaluate a wide range of quantitative and qualitative data and information. They evaluate information to develop arguments and explanations taking account of the limitations of the available evidence. They make reasoned judgments and draw evidence-based conclusions. Pupils can apply higher level mathematical skills to analyse the majority of the evidence provided.

Grade 7

Pupils recall, select and communicate precise knowledge and a detailed understanding of science and its applications. Pupils can recall and explain the effects and risks of scientific developments and their applications on society, industry, the economy and the environment. They demonstrate a clear understanding of why and how scientific applications, technologies and techniques change over time, and the need for regulation and monitoring. They use terminology and conventions appropriately and consistently. They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding effectively to a wide range of practical contexts, and to explain applications of science. They apply a comprehensive understanding of practical methods, processes and protocols to plan and justify a range of appropriate methods to solve practical problems. They apply appropriate skills, including mathematical, technical and observational skills, knowledge and understanding in a wide range of practical contexts. They follow procedures and protocols consistently, evaluating and managing risk and working accurately and safely. Pupils can correctly use the full range of complex formulae for calculations. They can recall all the formulae needed for calculations. Pupils analyse and interpret critically a broad range of quantitative and qualitative information. They reflect on the limitations of the methods, procedures and protocols they have used and the data they have collected, and can evaluate information systematically to develop reports and findings. They make reasoned judgments consistent with the evidence to develop substantiated conclusions. Pupils can apply higher level mathematical skills to analyse evidence provided.

Grade 8

Pupils are able to communicate precise knowledge and detailed understanding of the full range of concepts from biology, chemistry and physics. Pupils will be able to answer questions/tasks using their applied knowledge in written, numerical, theoretical, practical, ethical, social, economic and environmental scenarios. Pupils should be able to relate scientific advances to the ethical implications of the scientific advances, and be able to analyse and evaluate the associated risks and benefits. Pupils should select appropriate, scientific, technical knowledge, and associated terminology and conventions to demonstrate a consistently detailed understanding of scale, (size, time and space). Pupils are able to adapt, modify and enhance experimental procedures with justifications. They are also able to apply and demonstrate appropriate skills (communication/mathematical/ technological). Pupils should also be able to apply these skills to other scenarios. Pupils can recall and manipulate both simple and complex mathematical formulae. Pupils should be able to formulate and test hypotheses and link this to evidence, theories and explanations, alongside using models to explain phenomena, events and processes. Emphasis should be placed upon the pupil's ability to use and synthesise skills such as interpreting, evaluating, problem solving, judging, drawing conclusions and modifying/improving experimental procedures. Pupils are able to critically evaluate quantitative and qualitative data and develop arguments and explanations, taking into account limitations of the available evidence. Pupils can comprehensively apply higher level mathematical skills to analyse evidence provided.

Grade 9

Pupils apply principles and abstract concepts in familiar contexts and in contexts outside those experienced during lessons. They are able to link together appropriate facts, principles and concepts from all areas of the specification. They can devise and plan experimental and investigative activities, selecting appropriate techniques and demonstrating safe and skilful practical techniques. They make observations and measurements with precision and record these methodically. They can explain significant trends and patterns shown by complex data presented in tabular or graphical form. They are able to translate successfully data that is presented as prose, diagrams, tables or graphs from one form to another. Pupils can recall and manipulate both simple and complex mathematical formulae. They are able to interpret, explain and critically and systematically evaluate any statements and conclusions they make. They can also carry out all of the calculations and use complex mathematical techniques to analyse data and explain scientific phenomena. Pupils can comprehensively apply higher level mathematical skills to analyse evidence provided.

The Royal School Wolverhampton

Science Department

Year 11 Reproduction review

My score for this assessment: _____ My grade for this assessment: _____

My target for this assessment: _____

Assessing my performance – please tick the relevant boxes:

Question	Score	Strengths	Areas to improve
1. Genetics key words	/5		
2. Pedigree chart and inheritance	/4		
3. Division, chromosomes and gender	/7		
4. Data analysis and embryo screening	/8		
5. DNA and alleles	/6		

I am: Working below target / Working towards target / On target / Working beyond my target

Teacher Feedback:

Progress! Well done guys – lots of really good scores, which shows a good understanding of this material. Lots of grade 5's. This is proving that many of you really do have the potential for higher tier work. Genetic crosses are going well and use of key words is strong.

T Please check reading of graphs and data analysis. Also, please review the cystic fibrosis (recessive needing two faulty alleles) and polydactyly (dominant, needing only 1 faulty allele) genetic diseases.

Make sure you can write pros and cons of genetic screening.

Pupil red pen response:

Questions I completed well – including why this was the case:
Questions I need to develop further – including how I will do this:
Questions to support your development – please complete in your book: • What are the major differences between mitosis and meiosis? • Can you draw a diagram to prove the inheritance of gender is 50:50? • Why is polydactyly going to appear in the phenotype of a child if one parent is homozygous dominant? • Looking ahead: • **What was the work of Charles Darwin, what was his theory, and how does this explain evolution of different species of organism?**

Signed (Student): _____ Date: _____