St Cecilia's R. C. High School

Key Stage 1 and 2

Key Substantive Knowledge Carried Forward (subject knowledge)

	Living things and their habitats	Animals, including humans	Evolution and inheritance	Properties and changes of materials	Light	Electricity	Earth and space	Forces
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 know that some materials will dissolve in liquid to form 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 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.	
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 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 explain that objects are seen because they give out or reflect light into the eye we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used compare variations in how components function, use recognised symbols when representing a simple circuit in a diagram.		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.

Key Disciplinary Knowledge Carried Forward (methods/framework to establish knowledge)

- 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
- 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

Mapping Substantive Knowledge and Concepts Through Our Science Curriculum

KS3

Forces	Speed	Gravity	Contact forces	Pressure
Electromagnets	Voltage and resistance	Current	Electromagnets	Magnetism
Energy	Energy costs	Energy transfer	Work	Heating and cooling
Waves	Sound	Light	Wave effects	Wave properties
Matter	Particle model	Separating mixtures	Periodic table	Elements
Reactions	Metals and non-metals	Acids and alkalis	Chemical energy	Types of reaction
Earth	Earth structure	Universe	Climate	Earth resources
Organisms	Movement	Cells	Breathing	Digestion
Ecosystem	Interdependence	Plant reproduction	Respiration	Photosynthesis
Genes	Variation	Human reproduction	Evolution	Inheritance

KS4

K in biology:

• life processes depend on molecules whose structure is related to their function
• the fundamental units of living organisms are cells, which may be part of highly adapted structures including tissues, organs and organ systems, enabling living processes to be performed effectively
• living organisms may form populations of single species, communities of many species and ecosystems, interacting with each other, with the environment and with humans in many different ways
• living organisms are interdependent and show adaptations to their environment
• life on Earth is dependent on photosynthesis in which green plants and algae trap light from the Sun to fix carbon dioxide and combine it with hydrogen from water to make organic compounds and oxygen
• organic compounds are used as fuels in cellular respiration to allow the other chemical reactions necessary for life
• the chemicals in ecosystems are continually cycling through the natural world
• the characteristics of a living organism are influenced by its genome and its interaction with the environment
• evolution occurs by a process of natural selection and accounts both for biodiversity and how organisms are all related to varying degrees.

Key ideas in chemistry:

• matter is composed of tiny particles called atoms and there are about 100 different naturally occurring types of atoms called elements
• elements show periodic relationships in their chemical and physical properties
• these periodic properties can be explained in terms of the atomic structure of the elements
• atoms bond by either transferring electrons from one atom to another or by sharing electrons
• the shapes of molecules (groups of atoms bonded together) and the way giant structures are arranged is of great importance in terms of the way they behave
• there are barriers to reaction so reactions occur at different rates
• chemical reactions take place in only three different ways:
• proton transfer
• electron transfer
• electron sharing

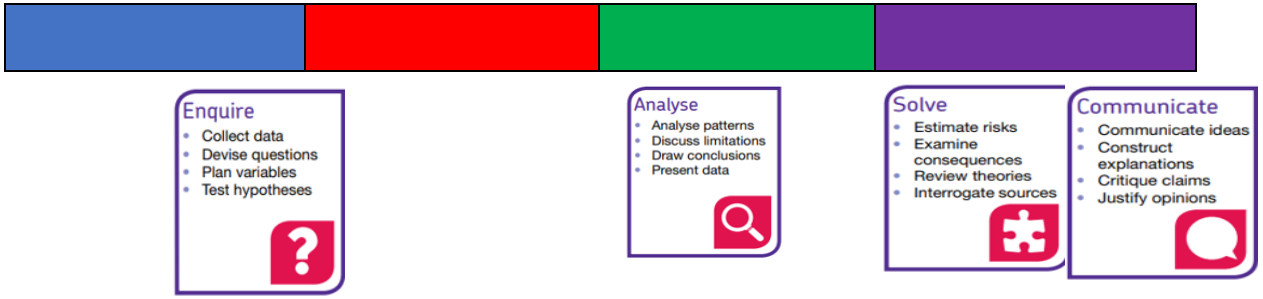
• energy is conserved in chemical reactions so can therefore be neither created or destroyed

Key ideas in physics:

• the use of models, as in the particle model of matter or the wave models of light and of sound
• the concept of cause and effect in explaining such links as those between force and acceleration, or between changes in atomic nuclei and radioactive emissions
• the phenomena of 'action at a distance' and the related concept of the field as the key to analysing electrical, magnetic, and gravitational effects
• that differences, for example between pressures or temperatures or electrical potentials, are the drivers of change
• that proportionality, for example between weight and mass of an object or between force and extension in a spring, is an important aspect of many models in science
• that physical laws and models are expressed in mathematical form.

Mapping Disciplinary Knowledge Through Our Science Curriculum

Disciplinary KS3



Disciplinary KS4

	Methods to answer scientific questions	Apparatus and techniques, including measurement	Analysis, presentation and evaluation of scientific data to draw valid conclusions	Development of scientific knowledge over time and its implications
KS3	• Select, plan and carry out the most appropriate types of **scientific enquiries** to test predictions. • Identify independent, dependent and control **variables**. • Apply **sampling** techniques.	• Use **appropriate** techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety.	• Pay attention to **objectivity** and concern for accuracy, precision, repeatability, reproducibility. • **Explain data** in relation to predictions and hypotheses.	• Understand that scientific **theories** are modified to take account of new evidence. • Understand importance of publishing results and **peer review**.
KS4	2.1 hypotheses 2.2 planning/variables 2.5 sampling technique 2.7 evaluate methods	2.3 technique, select apparatus 2.4 use apparatus 2.6 record	3.1 present 3.2 translate 3.3 maths 3.4 distributions 3.5 interpret 3,6 explain 3.7 objectivity	1.1 methods theories 1.2 models 1.3 limitations ethics 1.4 applications 1.5 application risk 1.6 peer review

Scientific vocabulary, quantities, units, symbols and nomenclature

WS 4.1 Use scientific vocabulary, terminology and definitions.

WS 4.2 Recognise the importance of scientific quantities and understand how they are determined.

WS 4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.

WS 4.4 Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano).

WS 4.5 Interconvert units.

WS 4.6 Use an appropriate number of significant figures in calculation.

Year 7

Physics

Concept	Forces	Electromagnets	Energy	Waves
Unit Titles	**1.1 Introduction to Forces**	**2.1 Potential difference and resistance**	**3.1 Energy Costs**	**4.1 Sound**
	1.2 Gravity	**2.2 Current**	**3.2 Energy transfer**	**4.2 Light**
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	How forces affect the movement of an object	The relationship between current and potential difference in series and parallel circuits	How electricity is generated and how it is used in the home.	The properties of longitudinal and transvers waves
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	If the overall, resultant force on an object is non-zero, its motion changes. Mass and weight are different but related. Weight depends upon mass but also on gravitational field strength. Every object exerts a gravitational force on every other object.	In a series circuit, voltage is shared between each component where current is the same. In a parallel circuit, voltage is the same across each loop. Current divides between loops Current is a movement of electrons An electromagnet uses the principle that a current through a wire causes a magnetic field	Domestic electricity usage is based on the amount of energy transferred. Electricity is generated by a combination of resources which each have advantages and disadvantage. Calculate the cost of home energy usage. Describe how work gets done using an energy model.	Sound consists of vibrations which travel as a longitudinal wave through substances. When a light ray meets a different medium, some of it is absorbed and some reflected. For a mirror, the angle of incidence equals the angle of reflection. The ray model can describe the formation of an image in a mirror

	Gravity holds planets and moons in orbit around larger bodies.			and how objects appear different colours.
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Use Newton meter Distance time graphs investigate variables on the speed of a toy car rolling down a slope Investigate how pressure from your foot onto the ground varies with different footwear	Set up and use correctly electrical components Compare the voltage drop across resistors Compare and explain current flows in different parts of a parallel circuit	Compare the running costs of light bulbs Explain the energy transfers in a series of everyday items	Use ray boxes correctly Measure angles of incidence and reflection
Examples of Reading Opportunity	Reading of class text book.	Reading of class text book.	Reading of class text book.	Reading of class text book.
Examples of Key Tier 2 Vocabulary	Distance	Parallel series	Resource Calculate	travel
Examples of Key Tier 3 Vocabulary	Speed Weight Mass Orbit Newton	Current Potential difference Ohm	Efficiency transfer	Incidence Reflection
Examples of Numeracy	Using speed, weight and pressure equations	Calculating current, potential difference and resistance.	Calculating the cost of electricity used	Measuring angles

Year 8

Physics

Concept	Forces	Electromagnets	Energy	Waves
Unit Titles	1.3 Contact forces	2.3 Magnetism	3.3 Energy costs	4.3 Wave effects
	1.4 Pressure	2.4 Electromagnets	3.4 Heating and cooling	4.4 Wave properties
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	The effect of forces on the motion of an object	State what determines the strength of an electromagnet and describe uses of them.	Describe how energy is transferred	What ultrasound is and how we use it. What damage electromagnetic radiation does to the human body

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	If the overall, resultant force on an object is non-zero, its motion changes Mass and weight are different but related. Mass and weight are different but related. Every object exerts a gravitational force on every other object. Gravity holds planets and moons in orbit around larger bodies. Gravity holds planets and moons in orbit around larger bodies. When the resultant force on an object is zero, it is in equilibrium and does not move, or remains at constant speed in a straight line. One effect of a force is to change an object's form, causing it to be stretched or compressed.	We can describe how jobs get done using an energy model where energy is transferred from one store at the start to another at the end. When energy is transferred, the total is conserved, but some energy is dissipated, reducing the useful energy When energy is transferred, the total is conserved, but some energy is dissipated, reducing the useful energy Magnetic materials, electromagnets and the Earth create magnetic fields which can be described by drawing field lines to show the strength and direction.	Work is done and energy transferred when a force moves an object. Machines and levers make work easier by reducing the force needed. Machines and levers make work easier by reducing the force needed. The thermal energy of an object depends upon its mass, temperature and what it's made of. When there is a temperature difference, energy transfers from the hotter to the cooler object. When there is a temperature difference, energy transfers from the hotter to the cooler object. Thermal energy is transferred through different pathways, by particles in conduction and	When a wave travels through a substance, particles move to and from. Energy is transferred in the direction of movement of the wave. Energy is transferred in the direction of movement of the wave. Waves of higher amplitude or higher frequency transfer more energy. A physical model of a transverse wave demonstrates it moves from place to place, while the material it travels through does not, and describes the properties of speed, wavelength and reflection.

			convection, and by radiation.	
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Using newton meters Investigate factors that affect the size of frictional or drag forces Investigate how pressure from your foot onto the ground varies with different footwear	Students build and test electromagnets. Students investigate the properties of magnets	Students complete experiments to calculate work done. Results are recorded and then used in calculations. Students complete various experiments to investigate conduction convection and radiation. Results are recorded and then analysed.	
Examples of Reading Opportunity	Text books	Reading of class text book.	Reading of class text book.	Reading of class text book.

Examples of Key Tier 2 Vocabulary	investigate	Transfer strength	Between	High Low
Examples of Key Tier 3 Vocabulary	Friction Gravity Resultant	electromagnet	Conservation Insulation	Reflect Frequency
Examples of Numeracy	Calculating resultant forces. Calculating speed Drawing distance-time graphs	Calculating resistance	Calculating efficiency	Calculating the speed of sound

Year 9

Physics

Concept	Forces	Electro magnets	Energy		Waves
Unit Title			**6.1 Energy**	6.4 Atomic structure	
Comprising of (use spec subtitle main sections, not subsections, indicate chem only or subsections that are chem only – see AN exmample)			6.1.1 Energy changes in a system, and the ways energy is stored before and after such changes 6.1.2 Conservation and dissipation of energy 6.1.3 National and global energy resources	6.4.1 Atoms and isotopes 6.4.2 Atoms and nuclear radiation	
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)			Students should be able to calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level. **6.1.2 Conservation and dissipation of energy** Students should be able to describe with examples where there are energy transfers in a closed system, that there is no net change to the total energy. **6.1.3 National and global energy resources** Students should be able to: • describe the main energy sources available • distinguish between energy resources that are renewable and energy resources that are non-renewable • compare ways that different energy resources are used, the uses to include transport, electricity generation and heating • understand why some energy resources are more reliable than others	Students should be able to explain the concept of half-life and how it is related to the random nature of radioactive decay	

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)			**6.1.1 Energy changes in a system, and the ways energy is stored before and after such changes** Energy changes in a system, and the ways energy is stored before and after such changes Throughout this section on Energy students should be able to calculate the changes in energy involved when a system is changed by: • heating • work done by forces • work done when a current flows T• use calculations to show on a common scale how the overall energy in a system is redistributed when the system is changed kinetic energy = 0.5 × mass × s peed Conservation and dissipation of energy National and global energy resources The changes involved in the way energy is stored when a system changes. Calculations to include work done by forces and when a current flows kinetic energy, gravitational potential energy The distribution of energy in a system The specific heat capacity of a substance Describe the main energy resources available for use on Earth Working critically with primary and secondary evidence: What is the best type of insulation to use in the home?	The basic structure of an atom is a positively charged nucleus composed of both protons and neutrons surrounded by negatively charged electrons. All atoms of a particular element have the same number of protons. The number of protons in an atom of an element is called its atomic number. The total number of protons and neutrons in an atom is called its mass number Students should be able to relate differences between isotopes to differences in conventional representations of their identities, charges and masses. Students should be able to describe the difference between the plum pudding model of the atom and the nuclear model of the atom. Activity is the rate at which a source of unstable nuclei decays. Required knowledge of the properties of alpha particles, beta particles and gamma rays is limited to their penetration through materials, their range in air and ionising power. Nuclear equations are used to represent radioactive decay Students should be able to determine the half-life of a radioactive isotope from given information.	
Separate Science Key Substantive Knowledge				Background radiation is around us all of the time. It comes from: • natural sources such as rocks and cosmic rays from space • man-made sources such as the fallout from nuclear weapons testing and nuclear accidents. The level of background radiation and radiation dose may be affected by occupation and/or location. Radiation dose is measured in sieverts (Sv) 1000 millisieverts (mSv) = 1 sievert (Sv) Nuclear radiations are used in medicine for the: • exploration of internal organs • control or destruction of unwanted tissue. Nuclear fission is the splitting of a large and unstable nucleus (eg uranium or plutonium).	

				Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. In this process some of the mass may be converted into the energy of radiation	
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)			Plan and carry out an investigation to find out which type of insulation will reduce heat loss the most.		
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down)			Required practical activity 14: an investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.		
Examples of Reading Opportunity			Reading of class text book.	Reading of class text book.	
Examples of Key Tier 2 Vocabulary			Transfer Specific	Release Absorb	
Examples of Key Tier 3 Vocabulary			Conservation Capacity	Absorbtion Emit	
Examples of Numeracy			Pupils need to be able to calculate work done and energy transferred. They need to be able to use and re-arrange the equations for potential and kinetic energy.	Pupils need to be able to calculate the half life of a substance. Pupils need to be able to complete radioactive decay equations.	

Year 10

Physics

Concept	Forces	Electromagnets	Energy	Waves
Unit Title	6.5 Forces	6.2 Electricity	6.3 Particle model of matter	
Comprising Of (use spec subtitle main sections, not subsections, indicate chem only or subsection chem only-see AN example)	6.5.1 Forces and their interactions 6.5.2 Work done and energy transfer 6.5.3 Forces and elasticity 6.5.4 Forces and motion	6.2.1Current, potential difference and resistance 6.2.2 Series and parallel circuits 6.2.3 Domestic uses and safety	6.3.1 Changes of state and the particle model 6.3.2 Internal energy and energy transfers 6.3.3 Particle model and pressure	
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	**6.5.1 Forces and their interactions** Students should be able to describe the interaction between pairs of objects which produce a force on each object. The forces to be represented as vectors. Students should be able to: • describe examples of the forces acting on an isolated object or system **6.5.4 Forces and motion** Students should be able to draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs, translating information between graphical and numerical form.	**6.2.1Current, potential difference and resistance** Students should be able to draw and interpret circuit diagrams Students should be able to explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes. Students should be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties.	Students should be able to describe how, when substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. Students should be able to distinguish between specific heat capacity and specific latent heat. Students should be able to: • explain how the motion of the molecules in a gas is related to both its temperature and its pressure • explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.	

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	**6.5.1 Forces and their interactions** Scalar quantities have magnitude only. Vector quantities have magnitude and an associated direction. contact forces – the objects are physically touching • non-contact forces – the objects are physically separated Weight is the force acting on an object due to gravity. The force of gravity close to the Earth is due to the gravitational field around the Earth. The weight of an object depends on the gravitational field strength at the point where the object is. The weight of an object can be calculated using the equation: weight = mass × gravitational field strength use free body diagrams to describe qualitatively examples where several forces lead to a resultant force on an object, including balanced forces when the resultant force is zero. **6.5.2 Work done and energy transfer** When a force causes an object to move through a distance work is done on the object. So a force does work on an object when the force causes a displacement of the object. **6.5.3 Forces and elasticity** Students should be able to: • give examples of the forces involved in stretching, bending or compressing an object • explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only • describe the difference between elastic deformation and inelastic deformation caused by stretching forces. force = spring constant × extension **6.5.4 Forces and motion** Distance is how far an object moves. Distance does not involve direction. Distance is a scalar quantity Students should be able to make measurements of distance and time	6.2.1 Current, potential difference and resistance Circuit diagrams use standard symbols. Students should be able to draw and interpret circuit diagrams Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: charge f low = current × time The current (I) through a component depends on both the resistance (R) of the component and the potential difference (V) across the component. The greater the resistance of the component the smaller the current for a given potential difference (pd) across the component. Current, potential difference or resistance can be calculated using the equation: potential difference = current × resistance Students should be able to explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes. Students should be able to: WS 1.2, 1.4 • explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component • draw an appropriate circuit diagram using correct circuit symbols.	The density of a material is defined by the equation: density = mass volume The particle model can be used to explain • the different states of matter • differences in density. If the temperature of the system increases: The increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system. The following equation applies: change in thermal energy = mass × specific heat capacity × temperature change The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius. The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature. energy for a change of state = mass × specific latent heat 6.3.3 The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules	

	and then calculate speeds of objects. For an object moving at constant speed the distance travelled in a specific time can be calculated using the equation: distance travelled = speed × time If an object moves along a straight line, the distance travelled can be represented by a distance–time graph. The speed of an object can be calculated from the gradient of its distance–time graph. The acceleration of an object can be calculated from the gradient of a velocity–time graph.			
Separate Science Key Substantive Knowledge	A force or a system of forces may cause an object to rotate.. The turning effect of a force is called the moment of the force. The size of the moment is defined by the equation: momentt of a force = force × distance If an object is balanced, the total clockwise moment about a pivot equals the total anticlockwise moment about that pivot. A simple lever and a simple gear system can both be used to transmit the rotational effects of forces When a force acts on an object that is moving, or able to move, a change in momentum occurs. The equations F = m × a and a = combine to give the equation F = where mΔv = change in momentum ie force equals the rate of change of momentum		A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container (or any surface). Students should be able to use the particle model to explain how increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure. For a fixed mass of gas held at a constant temperature: pressure × volume = constant p V = constant pressure, p, in pascals, Pa volume, V, in metres cubed, m3	
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Experiment- calculating the speed of an object Experiment finding the centre of mass of regular and irregular shaped objects	Build circuits to complete experiments looking at potential difference, current and resistance, including thermistors and LDR's		

Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down)	Required practical activity 18: investigate the relationship between force and extension for a spring.	Required practical activity 15: use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include: • the length of a wire at constant temperature • combinations of resistors in series and parallel.	Required practical activity 17: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers.	
Examples of Reading Opportunity	Reading of class text book.	Reading of class text book.	Reading of class text book.	
Examples of Key Tier 2 Vocabulary	Balanced	Potential Resistance	Dense	
Examples of Key Tier 3 Vocabulary	Moment Equalibrium	Ammeter Diode	Displacement	
Examples of Numeracy	Students should be able to calculate the size of a force, or its distance from a pivot, acting on an object that is balanced. The equations $F = m \times a$ and $a =$ combine to give the equation $F =$ where $m\Delta v$ = change in momentum ie force equals the rate of change of momentum	Students need to apply and re-arrange equations for potential difference, charge, current and resistance	Pupils need to calculate ther density of regular shaped and irregular shaped objects. They ned to analyse information to determine whether an object will sink or swim.	

Year 11

Physics

Concept	Forces	Electromagnets	Energy	waves
Unit Title		6.7 Magnetism and electromagnetism		6.6 Waves
Comprising Of (use spec subtitle main sections, not subsections, indicate chem only or subsection chem only-see AN example)		**6.7.1** Permanent and induced magnetism, magnetic forces and fields **6.7.2** The motor effect		**6.6.1** Waves in air, fluids and solids **6.6.2** Electromagnetic waves
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)		**6.7.1 Permanent and induced magnetism,** magnetic forces and fields Students should be able to: • describe how to plot the magnetic field pattern of a magnet using a compass • draw the magnetic field pattern of a bar magnet showing how strength and direction change from one point to another • explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic. Students should be able to: • describe how the magnetic effect of a current can be demonstrated • draw the magnetic field pattern for a straight wire carrying a current and for a solenoid (showing the direction of the field) • explain how a solenoid arrangement can increase the magnetic effect of the current **6.7.2 The motor effec**t Students should be able to recall the factors that affect the size of the force on the conductor.		**6.6.1 Waves in air, fluids and solids** Students should be able to describe the difference between longitudinal and transverse waves. Students should be able to describe wave motion in terms of their amplitude, wavelength, frequency and period

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)		**6.7.1 Permanent and induced magnetism,** magnetic forces and fields The poles of a magnet are the places where the magnetic forces are strongest. When two magnets are brought close together they exert a force on each other. Two like poles repel each other. Two unlike poles attract each other. Attraction and repulsion between two magnetic poles are examples of non-contact force. A permanent magnet produces its own magnetic field. An induced magnet is a material that becomes a magnet when it is placed in a magnetic field. Induced magnetism always causes a force of attraction. When removed from the magnetic field an induced magnet loses most/all of its magnetism quickly. Students should be able to describe: • the attraction and repulsion between unlike and like poles for permanent magnets • the difference between permanent and induced magnets. The region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt and nickel) is called the magnetic field. The force between a magnet and a magnetic material is always one of attraction. The strength of the magnetic field depends on the distance from the magnet. The field is strongest at the poles of the magnet. The direction of the magnetic field at any point is given by the direction of the force that would act on another north pole placed at that point. The direction of a magnetic field line is from the north (seeking) pole of a magnet to the south(seeking) pole of the magnet. A magnetic compass contains a small bar magnet. The Earth has a magnetic field. The compass needle points in the direction of the Earth's magnetic field. When a current flows through a conducting wire a magnetic field is produced around the wire. The strength of the magnetic field depends on the current through the wire and the distance from the wire. Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. The magnetic field inside a solenoid is strong and uniform. The magnetic field around a solenoid has a similar shape to that of a bar magnet. Adding an iron core increases the strength of the magnetic field of a solenoid. An electromagnet is a solenoid with an iron core. **6.7.2 The motor effect** When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the		**6.6.1 Waves in air, fluids and solids** Waves may be either transverse or longitudinal. The ripples on a water surface are an example of a transverse wave. Longitudinal waves show areas of compression and rarefaction. Sound waves travelling through air are longitudinal. The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position. The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave. The frequency of a wave is the number of waves passing a point each second. period = 1/ frequency wave s peed = f requency × wavelength **6.6.2 Electromagnetic waves** Electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber. Electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air. The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency. Going from long to short wavelength (or from low to high frequency) the groups are: radio, microwave, infrared, visible light (red to violet), ultraviolet, Xrays and gamma rays. Electromagnetic waves have many practical applications. For example: • radio waves – television and radio • microwaves – satellite communications, cooking food • infrared – electrical heaters, cooking food, infrared cameras • visible light – fibre optic communications • ultraviolet – energy efficient lamps, sun tanning • X-rays and gamma rays – medical imaging and treatments.

		conductor exert a force on each other. This is called the motor effect.		
Separate Science Key Substantive Knowledge		If an electrical conductor moves relative to a magnetic field or if there is a change in the magnetic field around a conductor, a potential difference is induced across the ends of the conductor. If the conductor is part of a complete circuit, a current is induced in the conductor. This is called the generator effect. The generator effect is used in an alternator to generate ac and in a dynamo to generate dc. Microphones use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits. A basic transformer consists of a primary coil and a secondary coil wound on an iron core.		Sound waves can travel through solids causing vibrations in the solid. Within the ear, sound waves cause the ear drum and other parts to vibrate which causes the sensation of sound. The conversion of sound waves to vibrations of solids works over a limited frequency range. This restricts the limits of human hearing. Ultrasound waves have a frequency higher than the upper limit of hearing for humans. Ultrasound waves are partially reflected when they meet a boundary between two different media. The time taken for the reflections to reach a detector can be used to determine how far away such a boundary is. This allows ultrasound waves to be used for both medical and industrial imaging. Seismic waves are produced by earthquakes. P-waves are longitudinal, seismic waves. P-waves travel at different speeds through solids and liquids. S-waves are transverse, seismic waves. S-waves cannot travel through a liquid. P-waves and S-waves provide evidence for the structure and size of the Earth's core. Echo sounding, using high frequency sound waves is used to detect objects in deep water and measure water depth.
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)				
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down to see)				Required practical activity 20: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements. Required practical activity 21: investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.
Examples of Reading Opportunity		Reading of class text book.		Reading of class text book.
Examples of Key Tier 2 Vocabulary		Conductor Resistance		Vibrate Continuous
Examples of Key Tier 3 Vocabulary		Alternator generator		Seismic

Examples of Numeracy				

Year 7

Chemistry

Concept	Matter	Reactions	Earth
Unit Titles	Particle Model	Metals and Non-Metals	Earth structure
	Separating Mixtures	Acids and Alkalis	Universe
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	How states of matter derive from changes of state and energy changes of particles. How pure substances are different to mixtures.	How metals have different reactivities and will react with oxygen to produce acids and alkalis whose pH determines their reactions with other metals	How sedimentary, igneous, and metamorphic rocks can be inter converted over millions of years through weathering and erosion.
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	Properties of solids, liquids and gases can be described in terms of particles in motion. Changes of temperature or state can be described in terms of particles gaining or losing energy. A pure substance consists of only one type of element or compound and has a fixed melting and boiling point. Mixtures may be separated due to differences in their physical properties.	Metals and non-metals react with oxygen to form oxides which are either bases or acids. Metals can be arranged as a reactivity series in order of how readily they react with other substances. Some metals react with acids to produce salts and hydrogen. The pH of a solution depends on the strength of the acid: strong acids have lower pH values than weak acids.	Sedimentary, igneous and metamorphic rocks can be inter converted over millions of years through weathering and erosion, heat and pressure, and melting and cooling. The solar system can be modelled as planets rotating on tilted axes while orbiting the Sun, moons orbiting planets and sunlight spreading out and being reflected. This explains day and year length, seasons and the visibility of objects from Earth. Our solar system is a tiny part of a galaxy, one of many billions in the Universe.

	The method chosen to separate a mixture depends on which physical properties of the individual substances are different.	Mixing an acid and alkali produces a chemical reaction, neutralisation, forming a chemical called a salt and water.	Light takes minutes to reach Earth from the Sun, four years from our nearest star and billions of years from other galaxies.
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Relate the features of the particle model to the properties of materials in different states Devise ways to separate mixtures, based on their properties Be able to boil water and write a method and draw a graph as well as investigate the variables Investigate variables with diffusion of skittles ' States of matter selection of S, L and G to look at Heating Iron and Sulphur Mixture and being able to show the difference between compounds and mixtures aswell as be able to draw particle diagrams Investigate variables to see which substances can dissolve in water so students are being introduced to solutions, soluble, insoluble etc Investigate variables selection of different solutes being able to write a method as well as be able to calculate a mean and draw a graph Filtering Salt sandy water and then heating it until evaporation and write a method Distillation whole class experiment being able to write a method Chromatography experiment being able to write a method Also mention ethical issues	Use experimental results to suggest an order of reactivity of various metals Devise an enquiry to compare how well indigestion remedies work Selection of metals and nonmetals to look at seeing if they conduct electricity or not with placemats Burning various metals such as Iron, Copper, Potassium and Magnesium to see its flame Metals reacting with Acids testing for Hydrogen gas with a splint and being able to write a method Metals reacting with water demonstration and allowing students to react magnesium and calcium in water Chemical reactions stations of different chemicals and students writing observations down Selection of Acids and Alkalis to look at and use indicator such as universal indicator red and blue litmus paper Demonstration of different strength acids and pupils write down their observation Investigation of variables Selection of grounded antacids added in small spatula amounts in to the HCl beaker	Using chocolate to show sedimentary, metamorphic and igneous rocks Demonstration of acids and rocks pupils to write down their observations Pupils to write down their observations using hot and cold salol to test crystal size (size of igneous rocks) Pupils to create a poster presentation on the planets and explain their findings to the rest of the class

	around the usage of chromatography in various scenarios such as drug testing, pregnancy test and covid test	Making CuSO4 crystals and being able to write a method and risk assessment	
Examples of Reading Opportunity		Textbooks PowerPoints Etymology	
Examples of Key Tier 2 Vocabulary	Vibrate Space Movement	Reaction Neutral Hazard	Axis Tilt Equator
Examples of Key Tier 3 Vocabulary	Particle Diffusion Density Condense Solvent Mixture	Metals Non-metals Displacement pH indicators Base	Igneous Metamorphic Sedimentary Galaxy Satellite
Examples of Numeracy		PH scale values and its meaning in terms of Hydrogen potential	

Year 8

Chemistry

Concept	Matter	Reactions	Earth
Unit Titles	Periodic Table	Chemical Energy	Climate
	Elements	Types of Reaction	Earth resources
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	Explain patterns in the periodic table and how atoms produce molecules and compounds that are often different	Chemical reactions (including combustion and thermal decomposition) involve energy changes where mass is always conserved	How natural processes and human activities affect how resources are obtained, used and disposed of and the impact of such on the future of our earth.

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	The elements in a group all react in a similar way and sometimes show a pattern in reactivity. As you go down a group and across a period the elements show patterns in physical properties. Most substances are not pure elements, but compounds or mixtures containing atoms of different elements. They have different properties to the elements they contain.	During chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic. Combustion is a reaction with oxygen in which energy is transferred to the surroundings as heat and light. Thermal decomposition is a reaction where a single reactant is broken down into simpler products by heating. Chemical changes can be described by a model where atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved.	Carbon is recycled through natural processes in the atmosphere, ecosystems, oceans and the Earth's crust (such as photosynthesis and respiration) as well as human activities (burning fuels). Greenhouse gases reduce the amount of energy lost from the Earth through radiation and therefore the temperature has been rising as the concentration of those gases has risen. Scientists have evidence that global warming caused by human activity is causing changes in climate. There is only a certain quantity of any resource on Earth, so the faster it is extracted, the sooner it will run out. Recycling reduces the need to extract resources. Most metals are found combined with other elements, as a compound, in ores. The more reactive a metal, the more difficult it is to separate it from its compound. Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals.
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Sort elements using chemical data and relate this to their position in the periodic table Compare the properties of elements with the properties of a compound formed from them Identifying the difference between elements and compounds by heating iron and sulphur Investigation of variables by testing different polymer bags strength Pupils to write down their observations for Group 1 elements and testing the metal ions in the flame and writing the observations Pupils to write down their observations for the displacement of halogens	Investigate a phenomenon that relies on an exothermic or endothermic reaction Investigate changes in mass for chemical and physical processes Investigation of variables by adding Sodium Hydroxide in 5cm^3 intervals in the beaker to test the exothermic reaction that is taking place. Also being able to write a conclusion with the findings in their results and draw a graph Testing different exothermic and endothermic reactions and be able to sketch reaction profiles Investigation of variables by testing NaOH and HCl and recording the temperature every 30 seconds. Pupils to write down their observations for sodium bicarbonate to citric acid and adding KI and lead nitrate Investigation of variables by heating different fuels and testing the temperature rise that is taking place. Also being able to	Heating Iron Oxide with Carbon to extract Carbon and write word equation for displacement reduction reaction that is occurring Ethical issues surrounding recycling which is to include whole class debate

		write a conclusion with the findings in their results and draw a graph Investigation of variables by heating different carbonates and testing the time it takes for limewater to turn cloudy. Also being able to write a conclusion with the findings in their results Burning Magnesium in the crucible and testing maths skills in calculating the difference between the different times of heating	
Examples of Reading Opportunity			
Examples of Key Tier 2 Vocabulary	Particle Matter	Heat Reaction	Earth Recycle Mining
Examples of Key Tier 3 Vocabulary	Periodic table Physical properties Chemical properties Groups Elements Atom Compound	Catalysts Exothermic Endothermic Chemical Bond Reactants Products Conserved	Renewable Non Renewable Finite
Examples of Numeracy			

Year 9

Chemistry

Concept	Matter		Reactions	Earth
Unit Title	**C1 and C2 Atomic structure and the periodic table**	**C3 Bonding, structure, and properties of matter**		
Comprising of (use spec subtitle main sections, not subsections, indicate chem only or subsections that are chem only – see AN exmample)	**C1.1 Atoms** **C 1.2 Chemical equations** **C1.3 separating Mixtures** **C1.4 FD and Chromatography** **C1.5 History of the atom** **C1.6 Structure of the atom** **C1.7 Ions** **C1.8 Electronic Structures** **C2.1 Development of Periodic Table** **C2.2 Group 0 Noble Gases** **C2.3 Group 1 Metals** **C2.4 Group 7 Halogens** **C2.5 Explaining trends**	**C3 .1 States of matter** **C3.2 Atoms into ions** **C3.3 ionic Bonding** **C3.4 giant Ionic Structures** **C3.5 Covalent Bonding** **C3.6 Structures of simple molecules** **C3.7 Giant covalent Structures** **C3.8 Fullerenes and Graphene** **C3.9 Bonding In metals** **C3.10 Giant Metallic Structures** **C3.11 Nanoparticles (GCSE CHEM ONLY)** **C3.12 Applications of nanoparticles**		
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	End Of Unit 1 Be able to identify Protons Electrons and Neutrons in an atom and be able to identify the number of PEN in atoms and ions End Of Unit 2 Be able to know the key names of G1, G7 and G0 elements and the history of the periodic table	End of Unit 3 Students should be able to identify key components from Ionic, Covalent, Giant Covalent and Metallic Bonding and see the differences between them		

Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	4.1.1.1 **C1.1 Atoms** **C 1.2 Chemical equations** Students know that Elements are made up of one type of atom Compounds are made up of 2 or more elements chemically combined Mixtures consists of 2 or more compounds and is not chemically combined 4.1.1.2 **C1.7 Ions** How we go from Atoms to Ions for non-metals and metals due to the movement of electrons to get a full outer shell 4.1.1.3 **C1.5 History of the atom** Describe the difference between the plum-pudding model of the atom and the nuclear model of the atom. Describe why the new evidence from the scattering experiment led to a change in the atomic model. 4.1.1.4 **C 1.2 Chemical equations** Chemical reactions can be represented by word equations or equations using symbols and formulae. Looking at charges of subatomic particles **C1.3 Separating Mixtures** **C1.4 FD and Chromatography** Suggest suitable separation and purification techniques for mixtures when given appropriate information eg chromatography and Distillation **C1.6 Structure of the atom** Students should be able to calculate the relative atomic mass of an element given the percentage abundance of its isotopes. **C1.7 Ions** **C1.8 Electronic Structures** Students should be able to represent the electronic structures of the first	**C3 .1 States of matter** Students should be able to: predict the states of substances at different temperatures given appropriate data · explain the different temperatures at which changes of state occur in terms of energy transfers and types of bonding **C3.2 Atoms into ions** **C3.3 Ionic Bonding** Students should be able to recall that Ionic is the transfer of electrons between metals and non-metals. How the electrons are transferred to achieve a full outer shell **C3.4 giant Ionic Structures** Students should be familiar with the structure of sodium chloride Ionic compounds have high Mpt due to the strong electrostatic forces of attraction between oppositely charged ions Ionic compounds in solid form do not conduct electricity as ions are not free to move but they do carry a charge when molten or in solution **C3.5 Covalent Bonding** Students should be able to define that Covalent Bonding is the sharing of electrons between non-metals. How the electrons share to achieve a full outer shell. Students should be able to draw dot and cross diagrams **C3.6 Structures of simple molecules** Students know the limitations of using dot cross ball and stick and 2D 3D diagrams **C3.9 Bonding In metals** Students recognise that the Metallic bond is the presence of positive ions surrounded by a sea of delocalised electrons **C3.7 Giant covalent Structures** Students know the differences that in Simple covalent molecules and graphite they have weak intermolecular forces which break upon heating, and this gives them a low Mpt and Bpt. They have covalent bonds between atoms. Students should be able to recognise giant covalent structures and that Giant covalent structures have high Mpt due to strong covalent bonds between their atoms Diamond – Only Covalent bonds Graphite – Covalent Bonds and Intermolecular forces Fullerene, Buckminster Fullerene, Graphene Students need to be Familiarised with Displayed, Molecular Formulae and Dot and Cross diagrams **C3.9 Bonding In metals** Metals can conduct electricity as they have delocalised electrons and can carry a charge How are alloys different to regular metals in terms of their structure eg comparing steel and copper **C3.11 Nanoparticles (GCSE CHEM ONLY)** **C3.12 Applications of nanoparticles** Carrying out mathematical analysis on Nanoparticles and researching Nanoscience projects		

	twenty elements of the periodic table in both forms. **C2.1 Development of Periodic Table** 4.1.2.1 – 4.1.2.6 Explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number. The early periodic tables were incomplete, and some elements were placed in inappropriate groups. To know that the early periodic table was arranged by atomic weight. Why John Newland came up with the law of Octaves and understand what Mendeleev discovered and why he left gaps in his periodic table **C2.1 Development of Periodic Table** Most elements are metals. Metals are found to the left of the periodic table. Non-metals are found towards the right **C2.2 Group 0 Noble Gases** The noble gases have eight electrons in their outer energy level, except for helium, which has only two electrons. **C2.3 Group 1 Metals** In Group 1, the reactivity of the element's increases going down the group. **C2.4 Group 7 Halogens** In Group 7, the reactivity of the element's decreases going down the group. A more reactive halogen can displace a less reactive halogen from an aqueous solution The transition elements are metals with similar properties which are	Carrying out quantitative analysis converting units		

	different from those of the elements in Group 1.			
Separate Science Key Substantive Knowledge				
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Students to write a detailed method for the chromatography practical and calculating an Rf value Students to write a detailed method for the distillation practical using scientific key terms Students to test their observational skills by writing down what happens in the reaction of Group 1 Alkali metals Students to write their observation by reacting calcium and magnesium in water and linking it to the electronic structure as to why magnesium is unreactive, but Calcium is reactive Students to test their observational skills by writing down what happens during the displacement of halogen reactions.	Students to write a detailed method on the production of Salt crystals using scientific key words		
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down)				
Examples of Reading Opportunity				

Examples of Key Tier 2 Vocabulary	Pattern Trend	Properties,		
Examples of Key Tier 3 Vocabulary	Configuration, sub-atomic particles, ions, isotopes, halogens, alkali metals, periodic table	Ionic, covalent, diamond, giant, simple, particle model. Graphite, allotropes.		
Examples of Numeracy				

Year 10

Chemistry

Concept	Matter	Reactions				Earth
Unit Title		**Quantitative Chemistry**	**Chemical Changes**	**Energy Changes**	**The rate and extent of chemical change**	
Comprising of (use spec subtitle main sections, not subsections, indicate chem only or subsections that are chem only – see AN example)		**C4.1 relative Masses and Moles** **C4.2 Equations and calculations** **C4.3 From masses to Balanced equations** **C4.4 Percentage Yield (GCSE CHEMISTRY ONLY)** **C4.5 Atom Economy (GCSE CHEMISTRY ONLY)** **C4.6 Expressing Concentrations** **C4.7 Titrations (GCSE CHEMISTRY ONLY)** **C4.8 Titration calculations (GCSE CHEMISTRY ONLY)** **C4.8 Volume of Gases (GCSE CHEMISTRY ONLY)**	**C5.1 The Reactivity Series** **C5.2 Displacement Reactions** **C5.3 Extracting metals** **C5.4 Salts from metals** **C5.5 Salts from Insoluble Bases** **C5.6 Making More salts** **C5.7 neutralisation and pH scale** **C5.8 Strong and weak acids** **C6.1 Introduction to electrolysis** **C6.2 Changes at the electrode** **C6.3 Extraction of aluminium** **C6.4 Electrolysis of aqueous solutions**	**C7.1 Exothermic and endothermic** **C7.2 Using energy transfers from reactions** **C7.3 Reaction profiles** **C7.4 Bond Energy Calculations** **C7.5 Chemical Cells and Batteries (GCSE CHEMISTRY ONLY)** **C7.6 Fuel Cells (GCSE CHEMISTRY ONLY)**	**C8.1 Rates of Reaction** **C8.2 Collision theory and Surface Area** **C8.3 Effect of temperature** **C8.4 Effect of Concentration and Pressure** **C8.5 Effects of catalysts** **C8.6 reversible reactions** **C8.7 Energy and reversible reactions** **C8.8 Dynamic Equilibrium** **C8.9 Altering Conditions**	
Composite Knowledge/End Point		Students be able to do Chemical measurements, conservation of mass and the quantitative interpretation of chemical equations Use of amount of substance in relation to masses of pure substances Yield and atom economy of chemical reactions (chemistry only)	How metals react in water, acids What are bases and insoluble bases How Neutralisation occurs and testing the	Definition of Exothermic and Endothermic reactions and identifying physical chemical changes	Rate of Reaction interpretation of graphical data. Being able to calculate rate of reaction using a tangent	

(big idea that should be answered at the end of a unit)		Using concentrations of solutions in mol/dm3 (chemistry only) Use of amount of substance in relation to volumes of gases (chemistry only) Reactions of acids - Titrations (chemistry only)	different strengths of acid How Ionic compounds can conduct electricity in molten and aqueous conditions How to write half equations and oxidation and reduction occurs	Drawing reaction profile curves for both exothermic and endothermic reactions labelling Ea, energy change, reactants and products and labelling the axes Bond Energy Calculations Chemical Cells and Batteries (chemistry only)	Collision Theory: Surface Area, Temperature, Concentration, Pressure and Catalysts Reversible Reactions and Dynamic Equilibrium interpreting data	
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)		**C4.1 relative Masses and Moles** Calculating Mr by doing Ar multiplied by number of atoms and then for more complex formulae with brackets In a balanced chemical equation, the sum of the relative formula masses of the reactants in the quantities shown equals the sum of the relative formula masses of the products in the quantities shown. **C4.2 Equations and calculations** Calculating the conservation of mass and seeing how LHS = RHS unless gas enters or escapes. Some reactions may appear to involve a change in mass but this can usually be explained because a reactant or product is a gas, and its mass has not been taken into account. For example: when a metal reacts with oxygen the mass of the oxide produced is greater than the mass of the metal or in thermal decompositions of metal carbonates carbon dioxide is produced and escapes into the atmosphere leaving the metal oxide as the only solid product. **C4.2 Equations and calculations** Calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant or product. **C4.3 From masses to Balanced equations** Balancing equations – Ensuring you balance the complex ions first if present followed by exciting elements and then C, H, O. The law of conservation of mass states that no atoms are lost or made during a chemical reaction, so the mass of the products equals the mass of the reactants.| **C4.3 From masses to Balanced equations** Be able to explain the effect of a limiting quantity of a reactant on the number of products it is possible to obtain in terms of amounts in moles or masses in grams. Calculating limiting reagents and ensuring you calculate which is limiting and excess by calculating moles and then calculating unknown mass **C4.6 Expressing Concentrations** Calculating Concentration = Moles/Volume and being able to convert units accordingly into m3 and dm3 and cm3. Many chemical reactions take place in solutions. The concentration of a solution can be	**C5.1 The Reactivity Series** Reacting Group 1 metals with Water and seeing that they form metal hydroxide and water **C5.2 Displacement Reactions** Displacement reaction is when more reactive metal pushes out the least reactive metal in the compound **C5.3 Extracting metals** Reduction of metals with carbon below in the reactivity series and seeing how metals are extracted from their ores deep underground **C5.4 Salts from metals** Metal Acid reactions and learning the name of the Acids and then knowing what salts are formed with HCl H2SO4 and HNO3 **C5.5 Salts from Insoluble Bases** Metal oxides form Salt and Water Metal Carbonates form Salt,	**C7.1 Exothermic and endothermic** **C7.2 Using energy transfers from reactions** Identifying that exothermic reactions release heat to the surroundings and endothermic reactions absorb heat from the surroundings. Physical change can return to their original state and is reversible and chemical change cannot return to their original state **C7.3 Reaction profiles** Exothermic reactions rise in temperature this causes heat energy to rise which means the products release heat to surroundings causing product to have less energy Endothermic reactions decrease in temperature which means products will absorb the heat from the surroundings, so products have more	**C8.1 Rates of Reaction** Atoms are colliding into one another all the time however they will only cause a reaction if they have energy greater or equal to Ea Rate of reaction=Amount of reactant used, or Product formed/Time taken Calculating rate of reaction from a graph when it is only a straight-line simple triangle and calculating rate of reaction from a graph when it is a curved line and this where a tangent must be drawn at the desired time or mass and then drawing a triangle to calculate the gradient **C8.2 Collision theory and Surface Area** Knowing how increasing SA means more particles are in contact with the surface which means more particles have energy greater or equal to Ea which means more frequent and successful collisions **C8.3 Effect of temperature** Knowing how increasing temperature means more particles have high KE to	

		measured in mass per given volume of solution, eg grams per dm3 (g/dm3	Water and Carbon Dioxide. Explain reduction and oxidation in terms of loss or gain of oxygen. **C5.6 Making More salts** Forming Copper sulphate crystals and ensuring a write up is completed, **C5.7 neutralisation and pH scale** How Acids and Alkalis form Salt and Water and knowing how pH changes upon addition of acid **C5.8 Strong and weak acids** Seeing the clear difference between strong and weak acids. Strong acids undergo full dissociation and Partial Acids undergo partial dissociation. Concentrated Acids have a lot of Acid Particles and weak acids have less Acid particles **C6.1 Introduction to electrolysis** Throughout 4.4.3: Higher Tier students should be able to write half equations for the reactions occurring at the electrodes during electrolysis and may be required to complete and balance supplied half equations. **C6.2 Changes at the electrode** **C6.4 Electrolysis of aqueous solutions**	than reactants. Students then use this knowledge to draw reaction profiles **C7.4 Bond Energy Calculations** Using Reactants – Products to calculate bond energy and knowing the difference between the units for bond energy and degrees Celsius	move which means more particles have energy greater or equal to Ea which means more frequent and successful collisions **C8.4 Effect of Concentration and Pressure** Knowing how increasing concentration means more particles in each volume which means more particles have energy greater or equal to Ea which means more frequent and successful collisions Knowing how increasing pressure means more particles are squeezed closer in each volume which means more particles have energy greater or equal to Ea which means more frequent and successful collisions **C8.5 Effects of catalysts** How catalysts lower Ea by providing an alternative pathway for the reaction to occur . Students then be able to know that catalysts speed up the rate of reactions but does not get used up in the process **C8.6 reversible reactions** **C8.7 Energy and reversible reactions** Knowing how to identify reversible reactions by looking at the symbol. Then be able to write symbol equations for the more common reversible reactions **C8.8 Dynamic Equilibrium** Students be able to define Le Chatelier's principle is that when a system undergoes a change in concentration, temp, pressure the system will counteract the change by shifting the equilibrium	

			Be able to predict the products of the electrolysis of aqueous solutions containing a single ionic compound. **C6.3 Extraction of aluminium** Be able to know how Aluminium is extracted from Aluminium Oxide and the half equations involving Aluminium and Oxygen		position in the opposite direction Dynamic equilibrium is that in a closed system nothing can enter or exit, and equilibrium is maintained **C8.9 Altering Conditions** Be able to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. Be able to interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium.	
Substantiative Knowledge SEPARATES SCIENCE		**C4.4 Percentage Yield (GCSE CHEMISTRY ONLY)** Calculate the percentage yield of a product from the actual yield of a reaction. Using % yield = actual / theoretical multiplied by 100. The reaction may not go to completion because it is reversible · some of the product may be lost when it is separated from the reaction mixture · some of the reactants may react in ways different to the expected reaction **C4.5 Atom Economy (GCSE CHEMISTRY ONLY)** Explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy. Calculate the atom economy of a reaction to form a desired product from the balanced equation. % Atom Economy = Desired Mr of Product/ Total Mr of Reactants **C4.8 Volume of Gases (GCSE CHEMISTRY ONLY)** Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass. Equal amounts in moles of gases occupy the same volume under the same conditions of temperature and pressure. **C4.7 Titrations (GCSE CHEMISTRY ONLY)** **C4.8 Titration calculations (GCSE CHEMISTRY ONLY)** Titrations ensuring knowledge on endpoint and how to write a method on the practical and using concentration equation and using ratios to calculate unknown concentration		**C7.5 Chemical Cells and Batteries (GCSE CHEMISTRY ONLY)** **C7.6 Fuel Cells (GCSE CHEMISTRY ONLY)** Knowing how a chemical cell battery works and seeing what is produced at the anode and cathode Be able to interpret data in terms of the relative reactivity of different metals and to evaluate the use of cells. Be able to evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries. (HT only) Be able to write the half equations for the electrode reactions in the hydrogen fuel cell.		

Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)		Students to write a detailed method on conservation of mass and do simple calculations to calculate conservation of mass Students to use Weighing scale apparatus to measure the amount of product so that the calculation of Mr can be made GCSE CHEMSITRY ONLY Reaction between Copper chloride and Sodium carbonate and filtering the relevant mixture allowing it to dry and calculating the percentage yield Titration practical where students use Burette and Pipette filler learning new skills to neutralise the alkali with acid and then using the concentration equation with ratios to calculate unknown concentration of Alkali	Students to test their observational skills by writing down what happens in the reaction of Group 1 Alkali metals Students to then do the practical reacting different metals in HCl and testing observational skills but also writing down key variables and writing a conclusion using PEEL Students to write down observations for the displacement of different metals using different solutions Students to write a detailed method on the extraction of copper from Copper Oxide by heating it with carbon. Students to write an evaluation based on the experiment too Students to test hydrogen gas production by reacting different metals in Acid and testing observational skills	GCSE CHEMISTRY ONLY Investigate the variables where Copper is kept constant and electrical charge is passed through different metals. Measuring the voltage. Drawing a bar chart based off results and using the reactivity series to write a justified conclusion as to why some have higher voltage Investigate the variables that affect temperature change in chemical reactions. React HCl and NaOH and measure temperature changes. Selection of different exothermic and endothermic reactions and pupils are then drawing reaction profiles	Testing the marble chips using measuring cylinder submerged into water and as the hydrogen gas is being produced water is being displaced students are checking to see how much gas is collected every ten seconds. They are then to identify variables write a method aswell as a conclusion Testing the temperature of Sodium thiosulphate and seeing how quick the cross disappears. Students to complete variables and then write a method aswell as a conclusion How the concentration of Sodium thiosulphate in water affects how quick the cross disappears. Students to identify the variables and then complete a conclusion aswell as a graph WS 2.1 – use scientific theories and explanations to develop hypotheses. WS 2.2 – plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of	

			Students to write a detailed report where they will be investigating variables, risk assessment, method, conclusion, and evaluation on the production of Copper Sulphate crystals Students to make salt crystals and write a detailed method and conclusion on what happens to the acid in terms of dissociation when it is diluted Investigating variables by reacting Acid with different metals WS 2.1 – use scientific theories and explanations to develop hypotheses. WS 2.2 – plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and		measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.	

			materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.			
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table- scroll down)		**Reacting volumes of solutions of a strong acid and a strong alkali by titration. Concentration of one of the solutions in mol/dm^3 from the reacting volumes and the known concentrations of other volumes**	**Making Soluble Salts: Preparation of dry Copper Sulphate crystals. React Sulfuric acid with insoluble copper oxide to prepare an aqueous solution of the salt copper sulphate. Then undergo filtration and prepare dry crystals by heating in a dish** **GCSE Chemistry only**	**Investigate the variables that affect temperature change in chemical reactions. React HCl and NaOH and measure temperature changes. Investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals.**	**How does concentration affect the rate of reaction. React magnesium ribbon with different concentrations of HCl and measure the volume of gas produced for each concentration. Calculate rate of reaction from a graph**	

					Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) **determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.** **Electrolysis** **Investigate what happens when two different (aq) solutions are electrolysed using inert electrodes.** **Identify the elements formed at the anode and cathode**			
Examples of Reading Opportunity								
Examples of Key Tier 2 Vocabulary		balancing			Metals Non-metals Displacement	temperature	Collision theory	
Examples of Key Tier 3 Vocabulary		Mole, atom economy,	PH indicators Base	Salts				

Examples of Numeracy				

Year 11

Chemistry

Concept	Matter		Reactions	Earth	
Unit Title	**Organic Chemistry**	**Chemical Analysis**		**Chemistry of the atmosphere**	**Using resources**
Comprising of (use spec subtitle main sections, not subsections, indicate chem only or subsections that are chem only – see AN exmample)	**C9.1 Hydrocarbons** **C9.2 fractional distillation of oil** **C9.3 Burning Hydrocarbon fuels** **C9.4 Cracking Hydrocarbons** **GCSE CHEMISTRY ONLY** **C10.1 Reactions of alkenes** **C10.2 Structures of Alcohols Carboxylic Acid and esters** **C10.3 Reactions and uses of alcohols** **C10.4 Carboxylic Acid and Esters** **C11.1 Addition Polymerisation** **C11.2 Condensation Polymerisation** **C11.3 natural polymers** **C11.4 DNA**	**C12.1 Pure Substances and Mixtures** **C12.2 Analysing Chromatograms** **C12.3 testing for gases** **GCSE CHEMISTRY ONLY** **C12.4 Tests for positive ions** **C12.5 Test for negative ions** **C12.6 Instrumental Analysis**		**C13.1 History of the atmosphere** **C13.2 our evolving atmosphere** **C13.3 Greenhouse gases** **C13.4 Global Climate Change** **C13.5 Atmospheric Pollutants**	**C14.1 Finite and renewable resources** **C14.2 Water safe to drink** **C14.3 Treating Wastewater** **C14.4 Extracting metals from ores** **C14.5 LCA** **C14.6 Reduce Reuse and Recycle** **GCSE Chemistry Only** **C15.1 Rusting** **C15.2 Useful Alloys** **C15.3 properties of Polymers** **C15.4 Glass, Ceramics and Composites** **C15.5 Making Ammonia** **C15.6 Economics of Haber Process** **C15.7 making Fertilisers in a lab** **C15.8 making fertilisers in industry**
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	End of Unit 9 Crude oil is a finite resource found in rocks due to the remains of zooplankton/algae which was buried in mud.	End of Unit 12 Students be able to know the difference between an impure and pure substance. Students to be able to write a method on chromatography and calculate Rf values		End of Unit 13 Students To know which gases are present in the atmosphere before and after Students be able to explain the greenhouse effect. Students be able to explain the effects and consequences of climate change	End of Unit 14 Students to know the difference between renewable and non-renewable energy and the impacts Students know what Potable water is and how to treat potable water Students know the process that is involved in treating wastewater

	Crude oil is a mixture of Hydrocarbons but the hydrocarbons themselves are compounds Alkanes have the general formula CnH2n+2 and Alkenes have the general formula CnH2n Know the displayed and molecular formulas of methane, ethane, propane, butane Hydrocarbons in crude oil can be separated by FD and this is by heating the crude oil and vapours enter the column, once the Boiling point is reached for a particular fraction, they will cool and condense into a liquid	Students be able to recall the key gas test for hydrogen carbon dioxide, oxygen and chlorine GCSE separates Chemistry Students be able to identify the positive and negative ions and the usage of scientific analysis such as spectroscopy		To know how pollution is caused in the atmosphere and the major contributors. Pollutants speed up the enhanced greenhouse effect	GCSE SEPARATES CHEMISTRY Students know the difference between corrosion and rusting Students know the difference between just metals and alloys Students know the properties of ceramics, composites, and polymers Students know the haber process in detail and how it makes ammonia and the impacts it has on the environment Students know how to make fertilisers in the lab and in industry
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	**C9.1 Hydrocarbons** Be able to recognise substances as alkanes given their formulae in these forms. Crude oil is a finite resource found in rocks. Crude oil is the remains of an ancient biomass consisting mainly of plankton that was buried in mud. **C9.2 fractional distillation of oil** Explain how fractional distillation works in terms of evaporation and condensation The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by fractional distillation. **C9.3 Burning Hydrocarbon fuels**	**C12.1 Pure Substances and Mixtures** Be able to use melting point data to distinguish pure from impure substances. Pure elements and compounds melt and boil at specific temperatures. Melting point and boiling point data can be used to distinguish pure substances from mixtures. Identify formulations given appropriate information. A formulation is a mixture that has been designed as a useful product. Many products are complex mixtures in which each chemical has a particular purpose. Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties **C12.2 Analysing Chromatograms** Explain how paper chromatography separates mixtures. Suggest how chromatographic methods can be used for distinguishing pure		**C13.1 History of the atmosphere** Describe the composition of the atmosphere. Draw accurate pie charts for the composition of the atmosphere. about four-fifths (approximately 80%) nitrogen · about one-fifth (approximately 20%) oxygen · small proportions of various other gases, including carbon dioxide, water vapour and noble gases **C13.2 our evolving atmosphere** **C13.3 Greenhouse gases** Given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere. One theory suggests that during the first billion years of the Earth's existence there was intense volcanic activity that released gases that formed the early atmosphere and water vapour that condensed to form the oceans. At the start of this period the Earth's atmosphere may have been like the atmospheres of Mars and Venus today, consisting of mainly carbon dioxide with little or no oxygen gas. Volcanoes also produced nitrogen which gradually built up in the atmosphere and there may have been small proportions of methane and	**C14.1 Finite and renewable resources** Students State examples of natural products that are supplemented or replaced by agricultural and synthetic products. Distinguish between finite and renewable resources given appropriate information. Natural resources, supplemented by agriculture, provide food, timber, clothing, and fuels. Finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials. **C14.2 Water safe to drink** **C14.3 Treating Wastewater** Describe the differences in treatment of ground water and salty water. Give reasons for the steps used to produce potable water. The methods used to produce potable water depend on available supplies of water and local conditions. In the UK, rain provides water with low levels of dissolved substances (fresh water) that collects in the ground, in lakes and rivers, and most potable water is produced by: · choosing an appropriate source of fresh

	Recall how boiling point, viscosity and flammability change with increasing molecular size. Some properties of hydrocarbons depend on the size of their molecules, including boiling point, viscosity and flammability. These properties influence how hydrocarbons are used as fuels. **C9.4 Cracking Hydrocarbons** Describe in general terms the conditions used for catalytic cracking and steam cracking. Recall the colour change when bromine water reacts with an alkene. Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules. Cracking can be done by various methods including catalytic cracking and steam cracking Draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions with hydrogen, water, chlorine, bromine and iodine. Alkenes are hydrocarbons with the functional group C=C. It is the generality of reactions of functional groups that determine the reactions of organic compounds.	substances from impure substance. Chromatography can be used to separate mixtures and can give information to help identify substances. Chromatography involves a stationary phase and a mobile phase. Separation depends on the distribution of substances between the phases. **C12.3 testing for gases** The test for hydrogen uses a burning splint held at the open end of a test tube of the gas. Hydrogen burns rapidly with a pop sound. The test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen. The test for carbon dioxide uses an aqueous solution of calcium hydroxide (lime water). When carbon dioxide is shaken with or bubbled through limewater the limewater turns milky (cloudy). The test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white.		ammonia. When the oceans formed, carbon dioxide dissolved in the water and carbonates were precipitated producing sediments, reducing the amount of carbon dioxide in the atmosphere. Describe the main changes in the atmosphere over time and some of the likely causes of these changes. Algae and plants decreased the percentage of carbon dioxide in the atmosphere by photosynthesis. Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter. Greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life. **C13.4 Global Climate Change** Recall two human activities that increase the amounts of each of the greenhouse gases carbon dioxide and methane. Some human activities increase the amounts of greenhouse gases in the atmosphere. These include: · carbon dioxide · methane Briefly describe four potential effects of global climate change Discuss the scale, risk and environmental implications of global climate change. Students briefly discuss what is carbon footprint and how it can be reduced **C13.5 Atmospheric Pollutants** Describe how carbon monoxide, soot (carbon particles), sulfur dioxide and oxides of nitrogen are produced by burning fuels Predict the products. The combustion of fuels is a major source of atmospheric pollutants. Most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulfur. The gases released into the atmosphere when a fuel is burned may include carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen. Solid particles and unburned hydrocarbons may also be released that form particulates in the atmosphere.	water · passing the water through filter beds · sterilising. Students can Comment on the relative ease of obtaining potable water from waste, ground and salt water. Sewage treatment includes: · screening and grit removal · sedimentation to produce sewage sludge and effluent · anaerobic digestion of sewage sludge · aerobic biological treatment of effluent. **C14.4 Extracting metals from ores** Evaluate alternative biological methods of metal extraction, given appropriate information. Copper ores are becoming scarce and new ways of extracting copper from low-grade ores include Phyto mining and bioleaching. These methods avoid traditional mining methods of digging, moving, and disposing of large amounts of rock. Phytomining uses plants to absorb metal compounds. The plants are harvested and then burned to produce ash that contains metal compounds. Bioleaching uses bacteria to produce leachate solutions that contain metal compounds. **C14.5 LCA** Carry out simple comparative LCAs for shopping bags made from plastic and paper. Life Cycle Assessments (LCAs) are carried out to assess the environmental impact of products in each of these stages: · extracting and processing raw materials · manufacturing and packaging · use and operation during its lifetime · disposal at the end of its useful life, including transport and distribution at each stage. **C14.6 Reduce Reuse and Recycle** Evaluate ways of reducing the use of limited resources, given appropriate information. The reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, energy consumption, waste and environmental impacts. Evaluate ways of reducing the use of limited resources,

				Describe and explain the problems caused by increased amounts of these pollutants in the air. Carbon monoxide is a toxic gas. It is colourless and odourless and so is not easily detected	given appropriate information. The reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, energy consumption, waste and environmental impacts. Metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. Much of the energy used in the processes comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.
Examples of Key Substantive Knowledge **SEPARATES CHEMISTRY**	Know the conditions used for fermentation of sugar using yeast. Be able to recognise alcohols from their names or from given formulae. Aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast. Explain why carboxylic acids weak acids in terms of ionisation and pH are. Recognise carboxylic acids from their names or from given formulae. The first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid. The structures of carboxylic acids can be represented in the following forms: Recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group -C=C- in the monomers. Alkenes can be used to make polymers such as poly(ethene) and	**C12.4 Tests for positive ions** **C12.5 Test for negative ions** Flame tests can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests: · lithium compounds result in crimson flame · sodium compounds result in yellow flame · potassium compounds result in lilac flame · calcium compounds result in an orange-red flame · copper compounds metal ions (cations). Solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate Be able to write balanced equations for the reactions to produce the insoluble hydroxides. Solutions of copper (II), iron(II) and iron (III) ions form coloured precipitates when sodium hydroxide solution is added. Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate. Solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate			**C15.1 Rusting** Describe experiments and interpret results to show that both air and water are necessary for rusting. Explain sacrificial protection in terms of relative reactivity. Corrosion is the destruction of materials by chemical reactions with substances in the environment. Rusting is an example of corrosion. Both air and water are necessary for iron to rust. Corrosion can be prevented by applying a coating that acts as a barrier, such as greasing, painting or electroplating. Aluminium has an oxide coating that protects the metal from further corrosion. **C15.2 Useful Alloys** Recall a use of each of the alloys specified Interpret and evaluate the composition and uses of alloys other than those specified, given appropriate information. Most metals in everyday use are alloys. Bronze is an alloy of copper and tin. Brass is an alloy of copper and zinc. **C15.3 properties of Polymers** **C15.4 Glass, Ceramics and Composites** Explain how low density and high-density poly(ethene) are both produced from ethene. Explain the difference between thermosoftening and thermosetting polymers in terms of their structures. Most of the glass we use is soda-lime glass, made by heating a mixture of sand, sodium carbonate and limestone. Borosilicate glass, made from sand and

	poly(propene) by addition polymerisation. Be able to name the types of monomers from which these naturally occurring polymers are made. DNA (deoxyribonucleic acid) is a large molecule essential for life. DNA encodes genetic instructions for the development and functioning of living	**C12.6 Instrumental Analysis** State advantages of instrumental methods compared with the chemical tests in this specification. Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid. Interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set in the same form, limited to flame emission spectroscopy. Flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions.			boron trioxide, melts at higher temperatures than soda-lime glass. **C15.5 Making Ammonia** **C15.6 Economics of Haber Process** Recall a source for the nitrogen and a source for the hydrogen used in the Haber process. (HT only) Interpret graphs of reaction conditions versus rate. (HT only) Apply the principles of dynamic equilibrium to the Haber process. The Haber process is used to manufacture ammonia, which can be used to produce nitrogen-based fertilisers. The raw materials for the Haber process are nitrogen and hydrogen. **C15.7 making Fertilisers in a lab** **C15.8 making fertilisers in industry** Recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid, and phosphoric acid. Compounds of nitrogen, phosphorus and potassium are used as fertilisers to improve agricultural productivity. NPK fertilisers contain compounds of all three elements.
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Identifying variables when burning different fuels and then being able to write a conclusion linking the chain length to the rise in temperature Being able to record observations during the cracking practical ensuring students are aware of the products during cracking	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods			WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.5 – recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. WS 2.6 – make and record observations and measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.

Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down)		Investigate how paper chromatography can be used to separate and identify a mixture of food colourings. Calculate Rf value and calculate what dyes the unknown contains GCSE SEPARATES Use of chemical tests to identify the ions in unknown single ionic compounds. Use flame tests and a range of solutions to analyse a range of known ionic compounds.			Analysing and purifying a sample of water and making it safe to drink Completing the distillation of water so separating the salt from the water via condensation and evaporation
Examples of Reading Opportunity					
Examples of Key Tier 2 Vocabulary					
Examples of Key Tier 3 Vocabulary					
Examples of Numeracy					

Year 7

Biology

Concept	Organisms	Ecosystems	Genes
Unit Titles	Movement	Interdependence	Human reproduction
	Cells	Plant Reproduction and Variation	variation
Comprising Of (use spec subtitle main sections, not subsections, indicate chem only or subsection chem only- see AN example)	The reasons why organisms need a skeleton, and what are organisms are made of	All the interactions between organisms in an ecosystem The ways in which plant reproduce	What is variation and how it happens
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	How are skeleton is adapted to allow movement and protection. How cells are adapted to do particular functions	How to organisms interact in an ecosystem How to plants reproduce	How do organisms vary and How they are organisms adapted to their environment How are humans made?
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	The human skeleton main functions: support, protection, movement and the production of new blood cells. Antagonistic pairs of muscles create movement when one contracts the other relaxes Multicellular organisms are composed of cells which are organised into tissues, organs and systems to carry out life processes.	Organisms in a food web depend on each other for nutrients. So, a change in one population leads to changes in others. The population of a species is affected by the number predators and prey, disease, pollution and competition for resources such as water and nutrients.	There is variation between individuals of the same species. Some variation is inherited/environmental/both. Variation is important for the survival of a species, helping it to avoid extinction in an always changing environment.

	There are many types of specialised cells. With different shapes, organelles and adaptations for particular functions	Plants have adaptations to disperse seeds using wind, water or animals. Plants reproduce sexually to produce seeds, which are formed following	The menstrual cycle prepares the female for pregnancy and stops if the egg is fertilised by a sperm. The developing foetus relies on the mother to provide it with oxygen and nutrients, to remove waste and protect it against harmful substances
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Use of microscopes to observe cells Calculation using microscopes Devise practical to observe plant onion cell Diffusion practical variables(skittles	Interpretation of food webs	Normal distribution graphs Production of graphs for continuous and discontinuous
Examples of Reading Opportunity			
Examples of Key Tier 2 Vocabulary	Movement, specialised	Transfer, connect	Cycle, development
Examples of Key Tier 3 Vocabulary	Cell, uni-cellular, tissue, organ, diffusion, mitochondria, cell wall, cell membrane	Food chain/web Ecosystem Population Producer Consume Interdependence Pollen Ovules Pollination Fertilisation Seed Fruit Germination	Species Variation Continuous Discontinuous Gamete Fertilisation Uterus Menstruation Vagina Penis, Foetus Placenta Oviduct, Adolescence Implantation Gestation
Examples of Numeracy		Predator/prey graph based questions	Histogram and bar chart interpretation

Year 8

Biology

Concept	Organisms	Ecosystems	Genes
Unit Titles	Breathing	Respiration	Evolution
	Digestion	photosynthesis	inheritance
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	Explain how our body exchanges gases. Describe how drugs can affect our bodies. Identify what nutrients our bodies need and how we break down food	Compare and contrast aerobic and anaerobic respiration. Explain how plants produce food by photosynthesis	Linking key points of natural selection with evolution. Explain how we inherit particular characteristics
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	In gas exchange, oxygen and carbon dioxide move between alveoli and the blood. Oxygen is transported to cells for aerobic respiration and carbon dioxide, a waste product of respiration, is removed from the body. Breathing occurs through the action of muscles in the ribcage and diaphragm. The amount of oxygen required by body cells determines the rate of breathing. The body needs a balanced diet with carbohydrates, lipids, proteins, vitamins, minerals, dietary fibre and water, for its cells' energy, growth and maintenance. Organs of the digestive system are adapted to break large food molecules into small	Respiration is a series of chemical reactions, in cells, that breaks down glucose to provide energy and form new molecules. Most living things use aerobic respiration but switch to anaerobic respiration, which provides less energy, when oxygen is unavailable. Plants and algae do not eat, but use energy from light, together with carbon dioxide and water to make glucose (food) through photosynthesis. They either use the glucose as an energy source, to build new tissue, or store it for later use. Plants have specially-adapted organs that allow them to obtain resources needed for photosynthesis.	Natural selection is a theory that explains how species evolve and why extinction occurs. Biodiversity is vital to maintaining populations. Within a species variation helps against environment changes, avoiding extinction. Within an ecosystem, having many different species ensures resources are available for other populations, like humans. Inherited characteristics are the result of genetic information, in the form of sections of DNA called genes, being transferred from parents to offspring during reproduction. Chromosomes are long pieces of DNA which contain many genes. Gametes, carrying half the total number of chromosomes of each parent, combine during fertilisation.

	ones which can travel in the blood to cells and are used for life processes		
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Food tests	Investigate rate of photosynthesis	Histograms/line graphs for discontinuous and continuous data Punnet squares for inherited features
Examples of Reading Opportunity			
Examples of Key Tier 2 Vocabulary	Increase, decrease	Adapted, rate	Diverse, characteristics
Examples of Key Tier 3 Vocabulary	Breathing, trachea, bronchi, bronchioles, alveoli, ribs, diaphragm, lung volume, enzymes, fibre, carbohydrates, lipids, fats, protein, stomach, large /small intestine, gut bacteria	Aerobic, anaerobic respiration, fertilisers, photosynthesis, chlorophyll, stomata	Population, natural selection, extinct, biodiversity, competition, evolution, inherited characteristics, DNA, chromosome, Gene

Examples of Numeracy	Pie charts of inhaled/exhaled air		

Year 9

Biology

Concept	**Organisms**				**Ecosystems**	**Genes**
Unit Title	**B1 cell structure and transport**	**B2 cell division**	**B3 organisation and the digestive system**	**B4 organising animals and plants**		
Comprising of (use spec subtitle main sections, not subsections, indicate chem only or subsections that are chem only – see AN example)	**B1.1 the world of the microscope** **B1.2 animal and plant cells** **B1.3 Eukaryotic and prokaryotic cells** **B1.4 Specialisation in animal cells** **B1.5 specialisation in plant cells** **B1.6 Diffusion** **B1.7 Osmosis** **B1.9 Active transport** **B1.10 Exchanging materials**	**B2.1 Cell division** **B2.2 growth and differentiation** **B2.3 stem cells** **B2.4 stem cell dilemmas**	**B3.1 tissues and organs** **B3.2 the human digestive system** **B3.3 the chemistry of food** **B3.4 catalysts and enzymes** **B3.5 factors affecting enzymes action** **B3.6 how the digestive system works** **B3.7 making digestion efficient**	**B4.1 the blood** **B4.2 the blood vessels** **B4.3 the heart** **B4.4 helping the heart** **B4.5 breathing and gas exchange** **B4.6 tissues and organs in plants** **B4.7 transport systems in plants** **B4.8 evaporation and transpiration** **B4.9 factors affecting transpiration**		

Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	Be able to use microscopes and compare light and electron microscopes Compare and contrast eukaryotic and prokaryotic cells Compare and contrast diffusion, osmosis and active transport	Students should be able to: Understand the role of chromosomes in cells Describe the process of mitosis How cell differentiation happens animals and plants Compare the pros and cons of the use of stem cells	Students should be able to: Identify the levels of organisation of an organism The importance of enzymes in digestion Describe key parts of the digestive system	Students be able to identify and describe key parts of the circulatory system Students explain how the lungs are adapted to exchange CO2 and O2 efficiently Explain how the xylem and phloem are used in plants		
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	4.1.1.1 **Eukaryotes and prokaryotes** Plant and animal cells (eukaryotic cells) have a cell membrane, cytoplasm and genetic material enclosed in a nucleus. Bacterial cells (prokaryotic cells) are much smaller in comparison. They have cytoplasm and a cell membrane surrounded by a cell wall. The genetic material is not enclosed in a nucleus. It is a single DNA loop called plasmids. be scale and size of cells in standard form.	**4.1.1.4 Cell differentiation** explain the importance of cell differentiation. As an organism develops, cells differentiate to form different types of cells. • Most types of animal cell differentiate at an early stage. • Many types of plant cells retain the ability to differentiate throughout life. In animals, cell division is for repair and replacement. As a cell differentiates i. It has become a specialised cell.	**4.2.2.1 The human digestive system** Students should be able to use the 'lock and key theory' as a simplified model to explain enzyme action. Students should be able to recall the sites of production and the action of amylase, proteases and lipases. Students should be able to understand simple word equations but no chemical symbol equations are required. Digestive enzymes convert food into small soluble molecules that can be absorbed into the bloodstream. Cells are the basic building blocks of all living organisms. A tissue is a group of cells with a similar structure and	**4.2.2.2 The heart and blood vessels** Students should know the structure and functioning of the human heart and lungs, including how lungs are adapted for gaseous exchange. The heart is an organ that pumps blood around the body in a double circulatory system. The right ventricle pumps blood to the lungs where gas exchange takes place. The left ventricle pumps blood around the rest of the body. Knowledge of the blood vessels associated with the heart is limited to the aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries. Knowledge of the names of the heart valves is not required. Knowledge of the lungs is restricted to the trachea, bronchi, alveoli and the capillary network surrounding the alveoli. The natural resting heart rate is controlled by a group of cells located in the right atrium that act as a pacemaker. Artificial		

	4.1.1.2 Animal and plant cells Students should be able to explain how the main sub-cellular structures, are related to their functions. Compare organelles is plant and animal cells. Plant and algal cells also have a cell wall made of cellulose, which strengthens the cell. **4.1.1.3 Cell specialisation** explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism. Cells may be specialised to carry out a particular function: • sperm cells, nerve cells and muscle cells in animals • root hair cells, xylem and phloem cells in plants. **4.1.1.5 Microscopy** understand how microscopy techniques have developed over time • explain how electron microscopy has increased understanding of sub-	**4.1.2.1 Chromosomes** The nucleus of a cell contains chromosomes made of DNA molecules. Each chromosome carries genes. In body cells the chromosomes are in pairs. **4.1.2.2. Mitosis and the cell cycle** Cells divide in a series of stages called the cell cycle. Students should be able to describe the stages of the cell cycle, including mitosis. During the cell cycle the genetic material is doubled and then divided into two identical cells. Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. The DNA replicates to form two copies of each chromosome. In mitosis one set of chromosomes is pulled to each end of the cell and the	function. Organs are aggregations of tissues performing specific functions. Organs are organised into organ systems, which work together to form organisms The digestive system is an example of an organ system in which several organs work together to digest and absorb food. Students should be able to relate knowledge of enzymes to Metabolism. Students should be able to describe the nature of enzyme molecules and relate their activity to temperature and pH changes Digestive enzymes convert food into small soluble molecules that can be absorbed into the bloodstream. Carbohydrase break down carbohydrates to simple sugars. Amylase is a carbohydrase which breaks down starch. Proteases break down proteins to amino acids. Lipases break down lipids (fats) to glycerol and fatty acids. The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used in respiration. Bile is made in the liver and stored in the gall bladder. It is alkaline to neutralise hydrochloric acid from the stomach. It also emulsifies fat	pacemakers are electrical devices used to correct irregularities in the heart rate. The body contains three different types of blood vessel: • arteries • veins • capillaries. Students should be able to explain how the structure of these vessels relates to their functions. Students should be able to use simple compound measures such as rate and carry out rate calculations for blood flow. **4.2.2.3 Blood** Blood is a tissue consisting of plasma, in which the red blood cells, white blood cells and platelets are suspended. Students should know the functions of each of these blood components. Students should be able to recognise different types of blood cells in a photograph or diagram, and explain how they are adapted to their functions. **4.2.2.4 Coronary heart disease: a non-communicable disease** Coronary heart disease. Fatty material builds up in coronary arteries reducing blood flow to the heart muscle. Stents can be used to keep the coronary arteries open. Statins reduce cholesterol levels, so fatty material is deposited more slowly. Faulty heart valves can be replaced with biological or mechanical ones. Heart failure can be treated with a heart and lung transplant. Artificial hearts can be used whilst waiting for a transplant, or to allow the heart to rest and recover.		

	cellular structures. An electron microscope has much higher magnification and resolving power than a light microscope structures. calculations involving magnification, real size and image size using the formula: magnication = size of image size of real object Students should be able to express answers in standard form if appropriate. **4.1.3.1. Diffusion** Substances may move into and out of cells across the cell membranes via diffusion. Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas, resulting in a net movement from an area of higher concentration to an area of lower concentration. diffusion linked to oxygen and carbon dioxide in gas exchange, and of the waste product urea	nucleus divides. Finally the cytoplasm and cell membranes divide to form two identical cells. Cell division by mitosis is important in the growth and development of multicellular organisms. Give example where mitosis is occurring. **4.1.2.3. Stem cells** A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. describe the function of stem cells in embryos, in adult animals and in the meristems in plants. Stem cells from human embryos can be cloned and made to differentiate into most different types of human cells. Stem cells from adult bone marrow can form	to form small droplets which increases the surface area. The alkaline conditions and large surface area increase the rate of fat breakdown by lipase	**4.2.3.1 Plant tissues** Plant organs and Plant tissues. The leaf. Plant organs include stems, roots and leaves. Organs are made up of different tissues, eg meristem tissue at growing tips. The leaf is the organ of photosynthesis. Examples of tissues in a leaf: epidermis, palisade and spongy mesophyll, xylem, phloem, guard cells and stomata. How these tissues are adapted for their function. **4.2.3.2 Plant organ system** Plant transport systems. The roots, stem and leaves form a plant transport system. Root hair cells absorb water by osmosis and mineral ions by diffusion and active transport. (See next lesson). Xylem tissue transports water and dissolved ions. The flow of water from the roots to leaves is called the transpiration stream. Xylem tissue is composed of hollow tubes strengthened with lignin. Phloem tissue transports dissolved sugars from the leaves to other parts of the plant. The movement of food through phloem is called translocation. Phloem cells have pores in their end walls for movement of cell sap.		

	from cells into the blood plasma for excretion in the kidney. explain how different factors affect the rate of diffusion.: • the difference in concentrations (concentration gradient) • the temperature • the surface area of the membrane. A single-celled organism has a relatively large surface area to volume ratio. This allows sufficient transport of molecules into and out of the cell to meet the needs of the organism. WS 1.2 Recognise, draw and interpret diagrams that model diffusion. Use of isotonic drinks and high energy drinks in sport. calculate and compare surface area to volume ratios. Students should be able to explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area to volume ratio. explain how the small intestine and lungs in mammals, gills	many types of cells including blood cells. Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant. Treatment with stem cells may be able to help conditions such as diabetes and paralysis. In therapeutic cloning an embryo is produced with the same genes as the patient. Stem cells from the embryo are not rejected by the patient's body so they may be used for medical treatment. The use of stem cells has potential risks such as transfer of viral infection, and some people have ethical or religious objections. Stem cells from meristems in plants can be used to produce clones of plants quickly and economically. • Rare species can be cloned to protect from extinction. • Crop plants with special features such as				

	in fish, and the roots and leaves in plants, are adapted for exchanging materials. In multicellular organisms. The effectiveness of an exchange surface is increased by: • having a large surface area • a membrane that is thin, to provide a short diffusion path • (in animals) having an efficient blood supply • (in animals, for gaseous exchange) being ventilated. **4.1.3.2. Osmosis** Water may move across cell membranes via osmosis. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane. **4.1.3.3. Active transport** Active transport moves substances from a more dilute solution to a more concentrated solution (against a	disease resistance can be cloned to produce large numbers of identical plants for farmers.				

	concentration gradient). This requires energy from respiration. Active transport allows mineral ions to be absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth. It also allows sugar molecules to be absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration. Sugar molecules are used for cell respiration. Students should be able to: • describe how substances are transported into and out of cells by diffusion, osmosis and active transport • explain the differences between the three processes.					
Separate Science Key Substantive Knowledge						
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	Use a light microscope to observe, draw and label a selection of plant and animal cells.	S 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of	Use qualitative reagents to test for a range of carbohydrates, lipids and proteins	S 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.		

	A scale magnification must be included Investigate the effect of a range of concentrations of salt or sugar solutions	measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods	Investigate the effect of pH on the rate of reaction of amylase enzyme.	WS 2.6 – make and record observations and measurements using a range of apparatus and methods		
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table- scroll down)	Biology RP1- microscopes Use a light microscope to observe, draw and label a selection of plant and animal cells. A scale magnification must be included Biology RP2 osmosis Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue		Biology RP3 food tests Use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; Biuret reagent for protein Biology RP4 Enzymes Investigate the effect of pH on the rate of reaction of amylase enzyme. Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds. Temperature must be controlled by use of a water bath or electric heater			
Examples of Reading Opportunity						

Examples of Key Tier 2 Vocabulary	Transport, scale	Specialised, cycle	System, breakdown	System, factor		
Examples of Key Tier 3 Vocabulary	Cell, Eukaryotic, prokaryotic, cell membrane, cytoplasm, ribosomes, mitochondria, chloroplasts, vacuole, microscopes, specialised cells, root hair cell, xylem, phloem, diffusion, osmosis, active transport, surface area to volume ratio	Mitosis, cell cycle, differentiate, stem cell, cloning, embryonic/adult stem cells, therapeutic cloning	Digestive system, enzymes, carbohydrates, lipids, fatty acids, glycerol, proteins, amino acids, denatured, active site, metabolism, pH, temperature	Red blood cells, white blood cells, platelets, plasma, urea, haemoglobin, Arteries, veins, capillaries, circulatory system, valves, pulmonary vein/artery, atrium, ventricle, aorta, vena cava, stent, statins, pacemaker, gas exchange, alveoli, xylem, phloem, palisade, translocation, guard cells, stomata, transpiration, potometer		
Examples of Numeracy	Calculation of magnification Data analysis Scale conversions					

Year 10

Biology

Concept	Organisms								Ecosystems	Genes
Unit Title	**B5 Communicable diseases**	**B6 preventing and treating disease**	**B7 Non-communicable diseases**	B8 Photosynthesis	**B9 Respiration**	B10 The human nervous system	B11 Hormonal Coordination	B12 Homeostasis in action(biology)		
Comprising Of (use spec subtitle main sections, not subsections, indicate chem only or subsection chem only-see AN example)	**B5.1 Health and disease** **B5.2 pathogens and disease** **B5.3 Growing bacteria in the lab (biology)** **B5.4 preventing bacterial growth (Biology)** **B5.5 Preventing infections** **B5.6 viral diseases** **B5.7 bacterial diseases** **B5.8 Diseases caused by fungi and protists** **B5.9 Human defence responses** **B5.10 More about plant diseases (Biology)**	**B6.1 Vaccination** **B6.2Antibiotics and painkillers** **B6.3 Discovering drugs** **B6.4 Developing drugs** **B6.5 Making monoclonal antibodies(biology)** **B6.6 Uses of monoclonal antibodies**	**B7.1 Non-communicable diseases** **B7.2 Cancer** **B7.3 Smoking and the risk of disease** **B7.4 Diet, exercise and disease** **B7.5 Alcohol and other carcinogens**	**B8.1 Photosynthesis** **B8.2 the rate of photosynthesis** **B8.3 How plants use glucose** **B8.4 Making the most of photosynthesis**	**B9.1 Aerobic respiration** **B9.2 the response to exercise** **B9.3 Anaerobic respiration** **B9.4 Metabolism and the liver**	**B10.1 Principles of homeostasis** **B10.2 The structure and function of the nervous system** **B10.3 Reflex actions** **B10.4 The brain(biology)** **B10.5 The eye (biology)** **B10.6 Common problems in the eye(biology)**	**B11.1 Principles of hormonal control** **B11.2 Control of blood glucose level** **B11.3 Treating Diabetes** **B11.4 The role of negative feedback** **B11.4 Human reproduction** **B11.5 Hormones and the menstrual cycle** **B11.7 The artificial control of fertility**	**B12.1 Controlling body temperature** **B12.2 Removing waste products** **B12.3 The human kidney** **B12.4 Dialysis – an artificial kidney** **B12.5 Kidney transplants**		

	B5.11 Plant defence responses (Biology)						**B11.8 Infertility treatments** **B11.9 Plant hormones and responses (Biology)** **B11.10 Using plant hormones (Biology)**			
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)	Understand the different pathogens that can cause communicable disease, including bacteria, viruses, and protists, and how these can be spread between organisms Explain the different defence mechanisms of the human body and plants	Explain the prevention of disease by vaccination, how the immune system works and what is meant by antigens and antibodies. outline the processes of clinical trials including double blind trials and using placebos.	Recall the general causes and treatment of cancer and the risks of diseases from smoking as well as the dangers of smoking whilst pregnant. Identify the connection between obesity and type 2 diabetes. Understand the effect of alcohol on the brain and liver	Identify and explain adaptations of leaves to achieve maximum efficiency and understand the concept of limiting factors s Explain the use of greenhouses and how the conditions can be monitored and manipulated to achieve the highest rate of	Describe the process of respiration and write the balanced symbol equation. Recall the response of humans to exercise, including changes in heart rate, breathing rate, and breakdown of glycogen be able to write the word equation for anaerobic respiration including how lactic	Explain the importance of being able to respond to environmental changes and coordinate behaviour. Explain how the nervous system is adapted for its functions. Describe the functions of the main structures in the nervous system. Explain the role of chemicals at synapses. Describe and use different methods to measure reaction time. Required practical Make a plan	Describe the endocrine system and define the term hormone. Relate hormone release and hormone action to the control system model introduced. Label a diagram of the organs in the endocrine system. Explain why the pituitary gland is often called the master gland. Compare the actions of the nervous and endocrine systems.	Explain how our body monitors and regulates its temperature. Explain how our body removes waste. What is the function of our kidneys and link this to dialysis		

				photosynthesis.	affects the body and how it is broken down	to investigate a factor on human reaction time.				
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)	**4.3.1.1 Communicable (infectious) diseases** explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants. Students should be able to explain how the spread of.diseases can be reduced or prevented. Pathogens are microorganisms that cause infectious disease. Pathogens may be viruses, bacteria, protists or fungi. They may infect plants or animals and can be spread by direct contact, by water or by air. Bacteria and viruses may reproduce rapidly inside the body. Bacteria may produce poisons (toxins) that damage tissues and make us feel ill. Viruses live and reproduce inside cells, causing cell damage. **4.3.1.2. Viral diseases** Measles is a viral disease showing	**4.3.1.7. Vaccination** Students should be able to explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to stimulate the white blood cells to produce antibodies. If the same	**4.2.2.4 Coronary heart disease: a non-communicable disease** Students should be able to evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant. In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle. Stents are used to	**4.4.1.1 Photosynthetic reaction** Photosynthesis is represented by the equation: carbon dioxide + water light glucose + oxygen Students should recognise the chemical symbols: CO2 , H2O, O2 and C6 H12O6 . Students should be able to describe photosynthesis as an endothermic reaction in which energy is transferre	**4.4.2.1 Aerobic and anaerobic respiration** The energy transferred supplies all the energy needed for living processes. Respiration in cells can take place aerobically (using oxygen) or anaerobically (without oxygen), to transfer energy. Students should be able to compare the processes of aerobic and	**4.5.1 Homeostasis** Homeostasis maintains optimal conditions for enzyme action and all cell functions. In the human body, these include control of: •• blood glucose concentration •• body temperature •• water levels. These automatic control systems may involve nervous responses or chemical responses. All control systems include: •• cells called receptors, which detect	**4.5.3.1 Human endocrine system** Describe the principles of hormonal coordination and control by the human endocrine system. The endocrine system is composed of glands which secrete chemicals called hormones directly into the bloodstream. That blood carries the hormone to a target organ where it produces an effect. Compare to the nervous system the effects are slower but act for longer. The pituitary gland in the brain is a			

	symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise. For this reason most young children are vaccinated against measles. The measles virus is spread by inhalation of droplets from sneezes and coughs. HIV initially causes a flu-like illness. Unless successfully controlled with antiretroviral drugs the virus attacks the body's immune cells. Late stage HIV infection, or AIDS, occurs when the body's immune system becomes so badly damaged it can no longer deal with other infections or cancers. HIV is spread by sexual contact or exchange of body fluids such as blood which occurs when drug users share needles. Tobacco mosaic virus (TMV) is a widespread plant pathogen affecting many species of plants including tomatoes. It gives a distinctive 'mosaic' pattern of discolouration on the	pathogen re-enters the body the white blood cells respond quickly to produce the correct antibodies, preventing infection. Students do not need to know details of vaccination schedules and side effects associated with specific vaccines. **4.3.1.8 Antibiotics and painkillers** Students should be able to explain the use of antibiotics and other medicines in treating disease. Antibiotics, such as penicillin, are medicines that help to	keep the coronary arteries open. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit. In some people heart valves may become faulty, preventing the valve from opening fully, or the heart valve might develop a leak. Students should understand the consequences of faulty valves. Faulty heart valves can be replaced using biological or mechanical valves. In the case of heart failure a donor heart, or heart and lungs can be transplanted. Artificial hearts are occasionally	d from the environment to the chloroplasts by light **4.4.1.2 Rate of photosynthesis** Students should be able to explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis. Students should be able to: • measure and calculate rates of photosynthesis • extract and	anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred. Organisms need energy for: •• chemical reactions to build larger molecules •• movement •• keeping warm. Aerobic respiration is represented by the equation: glucose + oxygen carbon dioxide + water	stimuli (changes in the environment) •• coordination centres (such as the brain, spinal cord and pancreas) that receive and process information from receptors •• effectors, muscles or glands, which bring about responses which restore optimum levels. **4.5.2.1 Structure and function** The nervous system enables humans to react to their surroundings and to coordinate their behaviour. Information from	'master gland' which secretes several hormones into the blood in response to body conditions. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects. Be able to identify the position of the following on a diagram of the human body: • pituitary gland • pancreas • thyroid • adrenal gland • ovary • testes **4.5.3.2 Control of blood glucose concentration** Blood glucose concentration is monitored and controlled by the pancreas. If the blood glucose concentration is			

	leaves which affects the growth of the plant due to lack of photosynthesis **4.3.1.3. Bacterial diseases** Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. In the UK, poultry are vaccinated against Salmonella to control the spread. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the toxins they secrete. Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the antibiotic penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with antibiotics or the use	cure bacterial disease by killing infective bacteria inside the body. It is important that specific bacteria should be treated by specific antibiotics. WS 1.4 The use of antibiotics has greatly reduced deaths from infectious bacterial diseases. However, the emergence of strains resistant to antibiotics is of great concern. There are links with this content to Culturing microorganisms (biology only). There are links with this content to Resistant	used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest as an aid to recovery. **4.2.2.5 Health issues** Students should be able to describe the relationship between health and disease and the interactions between different types of disease. Health is the state of physical and mental well-being. Diseases, both communicable and non-communicable, are major causes of ill health. Other factors including diet, stress and life situations may have a profound effect on both physical and mental health.	interpret graphs of photosynthesis rate involving one limiting factor • plot and draw appropriate graphs selecting appropriate scale for axes • translate information between graphical and numeric form. (HT only) These factors interact and any one of them may be the factor that limits photosynthesis. (HT only) Students should be able to	Students should recognise the chemical symbols: $C_6H_{12}O_6$, O_2, CO_2 and H_2O. Anaerobic respiration in muscles is represented by the equation: glucose lactic acid As the oxidation of glucose is incomplete in anaerobic respiration much less energy is transferred than in aerobic respiration. Anaerobic respiration in plant and yeast cells is	receptors passes along cells (neurones) as electrical impulses to the central nervous system (CNS). The CNS is the brain and spinal cord. The CNS coordinates the response of effectors which may be muscles contracting or glands secreting hormones. stimulus receptor coordinator effector response Students should be able to explain how the various structures in a reflex arc – including the sensory neurone, synapse, relay neurone and motor	too high, the pancreas produces the hormone insulin that causes glucose to move from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen for storage. Be able to explain how insulin controls blood glucose (sugar) levels in the body. Type 1 diabetes is a disorder in which the pancreas fails to produce sufficient insulin. It is characterised by uncontrolled high blood glucose levels and is normally treated with insulin injections. In Type 2 diabetes the body cells no longer respond to insulin			

	of a barrier method of contraception such as a condom. **4.3.1.4. Fungal diseases** Rose black spot is a fungal disease where purple or black spots develop on leaves, which often turn yellow and drop early. It affects the growth of the plant as photosynthesis is reduced. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves. **4.3.1.5. Protist diseases** The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by preventing the vectors, mosquitos, from	bacteria. Antibiotics cannot kill viral pathogens. Painkillers and other medicines are used to treat the symptoms of disease but do not kill pathogens. It is difficult to develop drugs that kill viruses without also damaging the body's tissues **4.3.1.9 Discovery and development of drugs** Students should be able to describe the process of discovery and development of potential new medicines, including preclinical and clinical testing. Traditionally	Different types of disease may interact. • Defects in the immune system mean that an individual is more likely to suffer from infectious diseases. • Viruses living in cells can be the trigger for cancers. • Immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma. • Severe physical ill health can lead to depression and other mental illness. Students should be able to translate disease incidence information between graphical and numerical forms, construct and interpret	explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor. (HT only) Students should understand and use inverse proportion – the inverse square law and light intensity in the context of photosynthesis. (HT only) Limiting factors are important in the economics of enhancing the conditions in	represented by the equation: glucose ethanol + carbon dioxide Anaerobic respiration in yeast cells is called fermentation and has economic importance in the manufacture of bread and alcoholic drinks. **4.4.2.2 Response to exercise** During exercise the human body reacts to the increased demand for energy. The heart rate, breathing rate and	neurone – relate to their function. Students should understand why reflex actions are important. Reflex actions are automatic and rapid; they do not involve the conscious part of the brain.	produced by the pancreas. A carbohydrate controlled diet and an exercise regime are common treatments. Obesity is a risk factor for Type 2 diabetes. Students should be able to compare Type 1 and Type 2 diabetes and explain how they can be treated. WS 1.3 Evaluate information around the relationship between obesity and diabetes, and make recommendations taking into account social and ethical issues. Students should be able to extract information and interpret data from graphs that show the effect of insulin in blood			

	breeding and by using mosquito nets to avoid being bitten.	drugs were extracted from plants and microorganisms. • The heart drug digitalis originates from foxgloves. • The painkiller aspirin originates from willow. • Penicillin was discovered by Alexander Fleming from the Penicillium mould. Most new drugs are synthesised by chemists in the pharmaceutical industry. However, the starting point may still be a chemical extracted from a plant. New medical drugs have to be tested and trialled before being used to check that	frequency tables and diagrams, bar charts and histograms, and use a scatter diagram to identify a correlation between two variables. **4.2.2.6 The effect of lifestyle on some non-communicable diseases** Students should be able to: • discuss the human and financial cost of these non-communicable diseases to an individual, a local community, a nation or globally • explain the effect of lifestyle factors including diet, alcohol and smoking on the incidence of non-communicable	greenhouses to gain the maximum rate of photosynthesis while still maintaining profit. **4.4.1.3. Uses of glucose from photosynthesis** The glucose produced in photosynthesis may be: • used for respiration • converted into insoluble starch for storage • used to produce fat or oil for storage • used to produce cellulose, which	breath volume increase during exercise to supply the muscles with more oxygenated blood. If insufficient oxygen is supplied anaerobic respiration takes place in muscles. The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt. During long periods of vigorous activity muscles become fatigued and stop		glucose levels in both people with diabetes and people without diabetes. MS 2c (HT only) If the blood glucose concentration is too low, the pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood. (HT only) Students should be able to explain how glucagon interacts with insulin in a negative feedback cycle to control blood glucose (sugar) levels in the body. **4.5.3.4 Hormones in human reproduction** Students should be able to			

		they are safe and effective. New drugs are extensively tested for toxicity, efficacy and dose. Preclinical testing is done in a laboratory using cells, tissues and live animals. Clinical trials use healthy volunteers and patients. • Very low doses of the drug are given at the start of the clinical trial. • If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug. • In double blind trials, some patients are given a placebo	diseases at local, national and global levels. Risk factors are linked to an increased rate of a disease. They can be: • aspects of a person's lifestyle • substances in the person's body or environment. A causal mechanism has been proven for some risk factors, but not in others. • The effects of diet, smoking and exercise on cardiovascular disease. • Obesity as a risk factor for Type 2 diabetes. • The effect of alcohol on the liver and brain function. • The effect of smoking on lung disease and lung cancer. • The effects of	strengthens the cell wall • used to produce amino acids for protein synthesis. To produce proteins, plants also use nitrate ions that are absorbed from the soil	contracting efficiently. HT only) Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells. **4.4.2.3 Metabolism**		describe the roles of hormones in human reproduction, including the menstrual cycle. During puberty reproductive hormones cause secondary sex characteristics to develop. Oestrogen is the main female reproductive hormone produced in the ovary. At puberty eggs begin to mature and one is released approximately every 28 days. This is called ovulation. Testosterone is the main male reproductive hormone produced by the testes and it stimulates sperm production. Several			

			smoking and alcohol on unborn babies. • Carcinogens, including ionising radiation, as risk factors in cancer. Many diseases are caused by the interaction of a number of factors. **4.2.2.7. Cancer** Students should be able to describe cancer as the result of changes in cells that lead to uncontrolled growth and division. Benign tumours are growths of abnormal cells which are contained in one area, usually within a membrane. They do not invade other parts of the body. Malignant tumour cells are cancers. They		Metabolism is the sum of all the reactions in a cell or the body. The energy transferred by respiration in cells is used by the organism for the continual enzyme controlled processes of metabolism that synthesise new molecules. Metabolism includes: •• conversion of glucose to starch, glycogen and cellulose •• the formation of lipid molecules		hormones are involved in the menstrual cycle of a woman. • Follicle stimulating hormone (FSH) causes maturation of an egg in the ovary. • Luteinising hormone (LH) stimulates the release of the egg. • Oestrogen and progesterone are involved in maintaining the uterus lining. (HT only) Students should be able to explain the interactions of FSH, oestrogen, LH and progesterone, in the control of the menstrual cycle. (HT only) Students should be able to extract and interpret data from graphs showing hormone levels during the			

			invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours. Scientists have identified lifestyle risk factors for various types of cancer. There are also genetic risk factors for some cancers.		from a molecule of glycerol and three molecules of fatty acids •• the use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins •• respiration •• breakdown of excess proteins to form urea for excretion.		menstrual cycle. **4.5.3.5 contraception Fertility c**an be controlled by a variety of hormonal and non-hormonal methods of contraception. These include: •• oral contraceptives that contain hormones to inhibit FSH production so that no eggs mature •• injection, implant or skin patch of slow release progesterone to inhibit the maturation and release of eggs for a number of months or years •• barrier methods such as condoms and diaphragms which prevent the			

							sperm reaching an egg •• intrauterine devices which prevent the implantation of an embryo or release a hormone •• spermicidal agents which kill or disable sperm •• abstaining from intercourse when an egg may be in the oviduct •• surgical methods of male and female sterilisation 4.5.3.6 The use of hormones to treat infertility (HT only) This includes giving FSH and LH in a 'fertility drug' to a woman. She may then become pregnant in the normal way.			

							In Vitro Fertilisation (IVF) treatment. •• IVF involves giving a mother FSH and LH to stimulate the maturation of several eggs. •• The eggs are collected from the mother and fertilised by sperm from the father in the laboratory. •• The fertilised eggs develop into embryos. •• At the stage when they are tiny balls of cells, one or two embryos are inserted into the mother's uterus (womb). **4.5.3.7 Negative feedback (HT only)** Adrenaline is produced by the adrenal glands in times of fear or stress. It			

							increases the heart rate and boosts the delivery of oxygen and glucose to the brain and muscles, preparing the body for 'flight or fight'. Thyroxine from the thyroid gland stimulates the basal metabolic rate. It plays an important role in growth and development. Thyroxine levels are controlled by negative feedback .			
Separate Science Key Substantive Knowledge	**4.3.3.1 Detection and identification of plant diseases** HT only) Plant diseases can be detected by: • stunted growth • spots on leaves • areas of decay (rot) • growths • malformed stems or	**4.3.2.1. Producing monoclonal antibodies** describe how monoclonal antibodies are produced. Monoclonal				**4.5.2.2 The brain (biology only** Students should be able to identify the cerebral cortex,	**4.5.4.1 Control and coordination** Plants produce hormones to coordinate and control growth and	**4.5.3.3 Maintaining water and nitrogen balance in the body (biology only)** Students should be able to explain the effect on cells		

	leaves • discolouration • the presence of pests. (HT only) Identification can be made by: • reference to a gardening manual or website • taking infected plants to a laboratory to identify the pathogen • using testing kits that contain monoclonal antibodies. Plants can be infected by a range of viral, bacterial and fungal pathogens as well as by insects. Knowledge of plant diseases is restricted to tobacco mosaic virus as a viral disease, black spot as a fungal disease and aphids as insects. Plants can be damaged by a range of ion deficiency conditions: • stunted growth caused by nitrate deficiency • chlorosis caused by magnesium deficiency. Knowledge of ions is limited to nitrate ions needed for protein synthesis and therefore growth, and magnesium ions needed to make chlorophyll	antibodies are produced from a single clone of cells. The antibodies are specific to one binding site on one protein antigen and so are able to target a specific chemical or specific cells in the body. They are produced by stimulating mouse lymphocytes to make a particular antibody. The lymphocytes are combined with a particular kind of tumour cell to make a cell called a hybridoma cell. The hybridoma cell can both divide and make the antibody. Single				cerebellum and medulla on a diagram of the brain, and describe their functions. (HT only) Students should be able to explain some of the difficulties of investigating brain function and treating brain damage and disease. (HT only) Neuroscientists have been able to map the regions of the brain to particular functions by studying patients with brain damage, electrically stimulating different parts of the brain and using MRI scanning techniques. The complexity	responses to light (phototropism) and gravity (gravitropism or geotropism). Unequal distributions of auxin cause unequal growth rates in plant roots and shoots. (HT only) Gibberellins are important in initiating seed germination. (HT only) Ethene controls cell division and ripening of fruits. (HT only) The mechanisms of how gibberellins and ethene work are not Required. **4.5.4.2 Use of plant hormones (HT only)** Plant growth hormones are used in agriculture and horticulture.	of osmotic changes in body fluids. Water leaves the body via the lungs during exhalation. Water, ions and urea are lost from the skin in sweat. There is no control over water, ion or urea loss by the lungs or skin. Excess water, ions and urea are removed via the kidneys in the urine. If body cells lose or gain too much water by osmosis they do not function efficiently. (HT only) The digestion of proteins from the diet results in excess amino acids which need to be excreted safely. In the liver these amino acids are deaminated to form ammonia. Ammonia is toxic and so it is immediately converted to urea for safe excretion. Students should		

	4.3.3.2 Plant defence responses Students should be able to describe physical and chemical plant defence responses. Physical defence responses to resist invasion of microorganisms. • Cellulose cell walls. • Tough waxy cuticle on leaves. • Layers of dead cells around stems (bark on trees) which fall off. Chemical plant defence responses. • Antibacterial chemicals. • Poisons to deter herbivores. Mechanical adaptations. • Thorns and hairs deter animals. • Leaves which droop or curl when touched. • Mimicry to trick animals	hybridoma cells are cloned to produce many identical cells that all produce the same antibody. A large amount of the antibody can be collected and purified. **4.3.2.2. Uses of monoclonal antibodies** Students should be able to describe some of the ways in which monoclonal antibodies can be used. Some examples include: • for diagnosis such as in pregnancy tests • in laboratories to measure the levels of hormones and other				and delicacy of the brain makes investigating and treating brain disorders very difficult. **4.5.2.3 The eye (biology only)** Students should be able to relate the structures of the eye to their functions. This includes: •• accommodation to focus on near or distant objects •• adaptation to dim light. The eye is a sense organ containing receptors sensitive to light intensity and colour. identify the following	Auxins are used: •• as weed killers •• as rooting powders •• for promoting growth in tissue culture. Ethene is used in the food industry to control ripening of fruit during storage and transport. Gibberellins can be used to: •• end seed dormancy •• promote flowering •• increase fruit size.	be able to describe the function of kidneys in maintaining the water balance of the body. The kidneys produce urine by filtration of the blood and selective reabsorption of useful substances such as glucose, some ions and water. Knowledge of other parts of the urinary system, the structure of the kidney and the structure of a nephron is not required. Students should be able to translate tables and bar charts of glucose, ions and urea before and after filtration. MS 4a (HT only) Students should be able to describe the effect of ADH on the permeability of the kidney tubules. (HT only) The water level in		

		chemicals in blood, or to detect pathogens • in research to locate or identify specific molecules in a cell or tissue by binding to them with a fluorescent dye • to treat some diseases: for cancer the monoclonal antibody can be bound to a radioactive substance, a toxic drug or a chemical which stops cells growing and dividing. It delivers the substance to the cancer cells without harming other cells in the body. Students are not expected to recall any specific tests or treatments but given				structures on a diagram of the eye and explain how their structure is related to their function: •• retina •• optic nerve •• sclera •• cornea •• iris •• ciliary muscles •• suspensory ligaments. To focus on a near object: •• the ciliary muscles contract •• the suspensory ligaments loosen •• the lens is then thicker and refracts light rays strongly. To focus on a distant object: •• the ciliary muscles relax •• the suspensory ligaments are pulled tight		the body is controlled by the hormone ADH which acts on the kidney tubules. ADH is released by the pituitary gland when the blood is too concentrated and it causes more water to be reabsorbed back into the blood from the kidney tubules. This is controlled by negative feedback. People who suffer from kidney failure may be treated by organ transplant or by using kidney dialysis. Students should know the basic principles of dialysis.		

		appropriate information they should be able to explain how they work. Monoclonal antibodies create more side effects than expected. They are not yet as widely used as everyone hoped when they were first developed				•• the lens is then pulled thin and only slightly refracts light rays. Two common defects of the eyes are myopia (short sightedness) and hyperopia (long sightedness) in which rays of light do not focus on the retina. •• Generally these defects are treated with spectacle lenses which refract the light rays so that they do focus on the retina. •• New technologies now include hard and soft contact lenses, laser surgery to change the shape of the cornea and a				

						replacement lens in the eye.				
Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)	(biology only) investigate the effect of antiseptics or antibiotics on bacterial growth	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods	Investigate the effect of light intensity on the rate of photosynthesis	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods	Plan and carry out an investigation into the effect of a factor on human reaction time. extract and interpret data from graphs, charts and tables, about the functioning of the nervous system.	(biology only)) Investigate the effect of light or gravity on the growth of germinating seeds	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods		
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down)	Biology only RP5 Microbes (biology only) investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition			Biology RP 6 Photosynthesis Investigate the effect of light intensity on the rate of photosynt		Biology RP 7 Reaction times Plan and carry out an investigation into the effect of a factor on human reaction time.	Biology only RP 8 Germination (biology only)) Investigate the effect of light or gravity on the growth of germinating seeds. Record results as both length			

				hesis using an aquatic organism such as pondweed			measurements and as careful, labelled biological drawings to show the effect			
Examples of Reading Opportunity										
Examples of Key Tier 2 Vocabulary	Identification, symptom	Discovery, produce	Risk, effect	Rate, factor	Response, increase	Reaction, function	Impact, coordination	Loss, regulates		
Examples of Key Tier 3 Vocabulary	Communicable, non-communicable, agar, measles, virus, bacteria, salmonella, STI, rose black spot, proists, malaria, immune system, skin, mucus, cilia	Vaccination, herd immunity, double blind trials, pre-clinical, clinical trials, placebo, monoclonal	Cancer, tumour benign, malignant, carcinogens, diabetes, alcohol, radiation,	Glucose, endothermic, photosynthesis, adaptations, light, temperature, cellulose, starch, greenhouse,	Aerobic, anaerobic, exothermic, mitochondria, glycogen, lactic acid, oxygen debt, liver	Homeostasis, receptors, stimuli, effectors, neurones, sensory, motor neurones, reflex , relay, synapse, brain,. Cerebral cortex, cerebellum, medulla, suspensory ligaments, ciliary muscles, myopia, hyperopia	Endocrine, hormones, insulin, adrenaline, gland, pituitary, oestrogen, testosterone, FSH, ovaries, pancreas, thyroid, adrenal, testes, diabetes, glucagon, negative feedback, puberty, menstrual cycle, LH, progesterone, contraception, infertility treatment, phototropism, gravitropism, auxins,	Thermoregulatory , vasodilation, vasoconstriction, kidneys, ADH, dialysis		

Examples of Numeracy						translate information about reaction times between numerical and graphical forms.				

Year 11

Biology

Concept	**Organisms**	**Ecosystems**			**Genes**		
Unit Title		**B16 Adaptations, Interdependence and competition**	**B17 Organising an Ecosystem**	**B18 Biodiversity and Ecosystems**	**B13 Reproduction**	**B14 variation and Evolution**	**B15 Genetics and Evolution**
Comprising Of (use spec subtitle main sections, not subsections, indicate chem only or subsection chem only-see AN example)		**B16.1 The importance of communities** **B16.2 Organisms in their environment** **B16.3 Distribution and Abundance** **B16.4 Competition in animals** **B16.5 Competition In plants**	**B17.1 Feeding relationships (biology)** **B17.2 materials cycling** **B17.3 The carbon Cycle** **B17.4 Rates of decomposition (biology)**	**B18.1 The Human population explosion** **B18.2 land and water pollution** **B18.3 Air pollution** **B18.4 Deforestation and peat destruction** **B18.5 Global warming**	**B13.1 Types of reproduction** **B13.2 Cell division in sexual reproduction** **B13.3 The best of both worlds(biology)** **B13.4 DNA and the genome** **B13.5 DNA structure and Protein synthesis (Biology)**	**B14.1 Variation** **B14.2 Evolution by natural selection** **B14.3 Selective breeding** **B14.4 Genetic engineering** **B14.5 Cloning (Biology)** **B14.6 adult cell cloning (biology)**	**B15.1 The history of genetic (biology)** **B15.2 Theories of evolution (biology)** **B15.3 Accepting Darwin's ideas (Biology)** **B15.4 Evolution and speciation (Biology)** **B15.5 Evidence for evolution**

		B16.6 Adapt and survive **B16.7 Adaptation in animals** **B16.8 Adaptation in plants**		**B18.6 The impact of change (biology)** **B18.7 maintaining biodiversity** **B18.8 Trophic levels and biomass (biology)** **B18.9 Biomass transfers** **B18.10 factors affecting food security (biology)** **B18.11 making food production more efficient (biology)** **B18.12 Sustainable food production(biology)**	**B13.6 Gene expression and mutation (Biology)** **B13.7 Inheritance in action** **B13.8 More about genetics** **B18.9 Inherited disorders** **B13.10 Screening for genetic disorders**	**B14.7 Ethics of genetic technologies**	**B15.6 Fossils and extinction** **B15.7 More about extinction** **B15.8 Antibiotic resistant bacteria** **B15.9 Classification** **B15.10 New systems of classification**
Composite Knowledge/End Point (big idea that should be answered at the end of a unit)		Recall the precise meaning of community, population, habitat, ecosystem, abiotic factor, and biotic factor. Explain how organisms are adapted to their environments-with examples. Measured the distribution of organisms with quadrats and transects.	Recall the main feeding relationships within a community and understand how the numbers of predators and prey are inter-related Understand how materials are recycled List factors that affect decomposition and the rate of decay.	Explain the reasons for and the effects of the human population explosion. understand the effect of different types of pollution including land, water, and air pollution. give examples of some of the actions being taken to stop the reduction in biodiversity. how biomass is transferred from one trophic level to the next, pyramids	Explain main differences between sexual and asexual reproduction. How sexual reduction results in variation. Understand the benefits of studying the human genome Be able to interpret and construct punnet squares Explain how some disorders on inherited	What causes variation How evolution is linked to natural selection. What is selective breeding. The principles of genetic engineering and how it can applied to help crops grow Discuss the advantages and disadvantages of genetic engineering/GMO	Explain the theory of evolution and identify evidence for the theory Explain how new species arise Explain how organisms can become extinct. What is meant by antibiotic resistance and how it arises, what can be done to reduce it happening The principles of the classification system, why and how it has changed over time

				of biomass, and the efficiency of this energy transfer			
Examples of Key Substantive Knowledge (specific subject knowledge relied upon for later study or to grasp the composite idea for that unit)		**4.7.1.1 Communities** Students should be able to describe: • different levels of organisation in an ecosystem from individual organisms to the whole ecosystem • the importance of interdependence and competition in a community. Students should be able to, when provided with appropriate information: • suggest the factors for which organisms are competing in a given habitat • suggest how organisms are adapted to the conditions in which they live. An ecosystem is the interaction of a community of living organisms (biotic) with the non-living (abiotic) parts of	**4.7.2.1 Levels of organisation** Students should understand that photosynthetic organisms are the producers of biomass for life on Earth. Feeding relationships within a community can be represented by food chains. All food chains begin with a producer which synthesises molecules. This is usually a green plant or alga which makes glucose by photosynthesis. A range of experimental methods using transects and quadrats are used by ecologists to determine the distribution and abundance of species in an ecosystem. In relation to abundance of organisms students should be able to: • understand the	**4.7.3.1 Biodiversity** Biodiversity is the variety of all the different species of organisms on earth, or within an ecosystem. A great biodiversity ensures the stability of ecosystems by reducing the dependence of one species on another for food, shelter and the maintenance of the physical environment. The future of the human species on Earth relies on us maintaining a good level of biodiversity. Many human activities are reducing biodiversity and only recently have measures been taken to try to stop this reduction. **4.7.3.2 Waste management**	**4.6.1.2 Meiosis** Cells in reproductive organs divide by meiosis to form gametes. When a cell divides to form gametes: • copies of the genetic information are made • the cell divides twice to form four gametes, each with a single set of chromosomes • all gametes are genetically different from each other. Gametes join at fertilisation to restore the normal number of chromosomes. The new cell divides by mitosis. The number of cells increases. As the embryo develops cells differentiate **4.6.1.4 DNA and the genome** The genetic material in the nucleus of a cell is composed of a chemical called DNA. DNA is a polymer made up of two strands forming a	**4.6.2.1 Variation** Differences in the characteristics of individuals in a population is called variation and may be due to differences in: • the genes they have inherited (genetic causes) • the conditions in which they have developed (environmental causes) • a combination of genes and the environment. Students should be able to: • state that there is usually extensive genetic variation within a population of a species • recall that all variants arise from mutations and that: most have no effect on the phenotype; some influence phenotype; very few determine phenotype. Mutations occur continuously. Very rarely a mutation will lead to a new phenotype. If the new phenotype is suited to	**4.6.3.4 Evidence for evolution** Students should be able to describe the evidence for evolution including fossils and antibiotic resistance in bacteria. The theory of evolution by natural selection is now widely accepted. Evidence for Darwin's theory is now available as it has been shown that characteristics are passed on to offspring in genes. There is further evidence in the fossil record and the knowledge of how resistance to antibiotics evolves in bacteria. **4.6.3.5 Fossils** Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks. Fossils may be formed: • from parts of organisms that have not decayed because one or more of the

		their environment. To survive and reproduce, organisms require a supply of materials from their surroundings and from the other living organisms there. Plants in a community or habitat often compete with each other for light and space, and for water and mineral ions from the soil. Animals often compete with each other for food, mates and territory. Within a community each species depends on other species for food, shelter, pollination, seed dispersal etc. If one species is removed it can affect the whole community. This is called interdependence. A stable community is one where all the species and environmental factors are in balance so that population sizes	terms mean, mode and median • calculate arithmetic means • plot and draw appropriate graphs selecting appropriate scales for the axes. Producers are eaten by primary consumers, which in turn may be eaten by secondary consumers and then tertiary consumers. Consumers that kill and eat other animals are predators, and those eaten are prey. In a stable community the numbers of predators and prey rise and fall in cycles. **4.7.2.2 How materials are cycled** Students should: • recall that many different materials cycle through the abiotic and biotic components of an ecosystem • explain the importance of the carbon and water cycles to living organisms. All materials in the living	Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Unless waste and chemical materials are properly handled, more pollution will be caused. Pollution can occur: • in water, from sewage, fertiliser or toxic chemicals • in air, from smoke and acidic gases • on land, from landfill and from toxic chemicals. Pollution kills plants and animals which can reduce biodiversity **4.7.3.3. Land use** Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste. The destruction of peat bogs, and other areas of peat to produce garden compost, reduces	double helix. The DNA is contained in structures called chromosomes. A gene is a small section of DNA on a chromosome. Each gene codes for a particular sequence of amino acids, to make a specific protein. The genome of an organism is the entire genetic material of that organism. The whole human genome has now been studied and this will have great importance for medicine in the future. Students should be able to discuss the importance of understanding the human genome. This is limited to the: • search for genes linked to different types of disease • understanding and treatment of inherited disorders • use in tracing human migration patterns from the past **4.6.1.6 Genetic inheritance**	an environmental change it can lead to a relatively rapid change in the species. **4.6.2.2 Evolution** Students should be able to describe evolution as a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species. The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago. Students should be able to explain how evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment. If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.	conditions needed for decay are absent • when parts of the organism are replaced by minerals as they decay • as preserved traces of organisms, such as footprints, burrows and rootlet traces. Many early forms of life were soft-bodied, which means that they have left few traces behind. What traces there were have been mainly destroyed by geological activity. This is why scientists cannot be certain about how life began on Earth. We can learn from fossils how much or how little different organisms have changed as life developed on Earth **4.6.3.6 Extinction** Extinctions occur when there are no remaining individuals of a species still alive. Students should be able to describe factors which may contribute to the extinction of a species.

		remain fairly constant. **4.7.1.2 Abiotic factors** Students should be able to explain how a change in an abiotic factor would affect a given community given appropriate data or context. Abiotic (non-living) factors which can affect a community are: • light intensity • temperature • moisture levels • soil pH and mineral content • wind intensity and direction • carbon dioxide levels for plants • oxygen levels for aquatic animals. **4.7.1.3. Biotic factors** Students should be able to explain how a change in a biotic factor might affect a given community given appropriate data or context. Biotic (living) factors which can	world are recycled to provide the building blocks for future organisms. The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis. The water cycle provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated. Students are not expected to study the nitrogen cycle. Students should be able to explain the role of microorganisms in cycling materials through an ecosystem by returning carbon to the atmosphere as carbon dioxide and mineral ions to the soil.	the area of this habitat and thus the variety of different plant, animal and microorganism species that live there (biodiversity). The decay or burning of the peat releases carbon dioxide into the atmosphere. **4.7.3.4. Deforestation** Large-scale deforestation in tropical areas has occurred to: • provide land for cattle and rice fields • grow crops for biofuels. **4.7.3.5 Global warming** Students should be able to describe some of the biological consequences of global warming. Levels of carbon dioxide and methane in the atmosphere are increasing, and contribute to 'global warming'	Students should be able to explain the terms: • gamete • chromosome • gene • allele • dominant • recessive • homozygous • heterozygous • genotype • phenotype. Some characteristics are controlled by a single gene, such as: fur colour in mice; and red-green colour blindness in humans. Each gene may have different forms called alleles. The alleles present, or genotype, operate at a molecular level to develop characteristics that can be expressed as a phenotype. A dominant allele is always expressed, even if only one copy is present. A recessive allele is only expressed if two copies are present (therefore no dominant allele present). If the two alleles present are the same the organism is homozygous for that	**4.6.2.3 Selective breeding** Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics. Humans have been doing this for thousands of years since they first bred food crops from wild plants and domesticated animals. Selective breeding involves choosing parents with the desired characteristic from a mixed population. They are bred together. From the offspring those with the desired characteristic are bred together. This continues over many generations until all the offspring show the desired characteristic. The characteristic can be chosen for usefulness or appearance: • Disease resistance in food crops.	**4.6.3.7 Resistant bacteria** Bacteria can evolve rapidly because they reproduce at a fast rate. Mutations of bacterial pathogens produce new strains. Some strains might be resistant to antibiotics, and so are not killed. They survive and reproduce, so the population of the resistant strain rises. The resistant strain will then spread because people are not immune to it and there is no effective treatment. MRSA is resistant to antibiotics. To reduce the rate of development of antibiotic resistant strains: • doctors should not prescribe antibiotics inappropriately, such as treating non-serious or viral infections • patients should complete their course of antibiotics so all bacteria are killed and none survive to mutate and form resistant strains

		affect a community are: • availability of food • new predators arriving • new pathogens • one species outcompeting another so the numbers are no longer sufficient to breed **4.7.1.4. Adaptations** Students should be able to explain how organisms are adapted to live in their natural environment, given appropriate information. Organisms have features (adaptations) that enable them to survive in the conditions in which they normally live. These adaptations may be structural, behavioural or functional. Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration.		**4.7.3.6. Maintaining biodiversity** Students should be able to describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. Scientists and concerned citizens have put in place programmes to reduce the negative effects of humans on ecosystems and biodiversity. These include: • breeding programmes for endangered species • protection and regeneration of rare habitats • reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop • reduction of deforestation and carbon dioxide emissions by some governments • recycling resources rather than dumping waste in landfill.	trait, but if the alleles are different they are heterozygous. Most characteristics are a result of multiple genes interacting, rather than a single gene. Students should be able to use direct proportion and simple ratios to express the outcome of a genetic cross. Students should be able to complete a Punnett square diagram and extract and interpret information from genetic crosses and family trees. (HT only) Students should be able to construct a genetic cross by Punnett square diagram and use it to make predictions using the theory of probability. **4.6.1.7 Inherited disorders** Some disorders are inherited. These disorders are caused by the inheritance of certain alleles.	• Animals which produce more meat or milk. • Domestic dogs with a gentle nature. • Large or unusual flowers Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects. **4.6.2.4 Genetic engineering** Students should be able to describe genetic engineering as a process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic. Plant crops have been genetically engineered to be resistant to diseases or to produce bigger better fruits. Bacterial cells have been genetically engineered to produce useful substances such as human insulin to treat diabetes.	• the agricultural use of antibiotics should be restricted. The development of new antibiotics is costly and slow. It is unlikely to keep up with the emergence of new resistant strains. **4.6.4 Classification of living organisms** Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus. Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species. Organisms are named by the binomial system of genus and species As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed. Due to evidence available

		These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles.			• Polydactyly (having extra fingers or toes) is caused by a dominant allele. • Cystic fibrosis (a disorder of cell membranes) is caused by a recessive allele. Students should make informed judgements about the economic, social and ethical issues concerning embryo screening, given appropriate information. **4.6.1.8 Sex determination** Ordinary human body cells contain 23 pairs of chromosomes. 22 pairs control characteristics only, but one of the pairs carries the genes that determine sex. • In females the sex chromosomes are the same (XX). • In males the chromosomes are different (XY). Students should be able to carry out a genetic cross to show sex inheritance.	Students should be able to explain the potential benefits and risks of genetic engineering in agriculture and in medicine and that some people have objections. Crops that have had their genes modified in this way are called genetically modified (GM) crops. GM crops include ones that are resistant to insect attack or to herbicides. GM crops generally show increased yields. Concerns about GM crops include the effect on populations of wild flowers and insects. Some people feel the effects of eating GM crops on human health have not been fully explored. Modern medical research is exploring the possibility of genetic modification to overcome some inherited disorders (HT only) Students should be able to describe the main steps in the process of	from chemical analysis there is now a 'three domain system' developed by Carl Woese. In this system organisms are divided into: • archaea (primitive bacteria usually living in extreme environments) • bacteria (true bacteria) • eukaryota (which includes protists, fungi, plants and animals) Evolutionary trees are a method used by scientists to show how they believe organisms are related. They use current classification data for living organisms and fossil data for extinct organisms

						genetic engineering. (HT only) In genetic engineering: • enzymes are used to isolate the required gene; this gene is inserted into a vector, usually a bacterial plasmid or a virus • the vector is used to insert the gene into the required cells • genes are transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with desired characteristics	
Separate Science Key Substantive Knowledge			**4.7.2.3. Decomposition** Students should be able to explain how temperature, water and availability of oxygen affect the rate of decay of biological material. Students should be able to: • calculate rate changes in the decay of biological material • translate information between numerical and graphical form • plot and draw appropriate graphs	**4.7.4.1 Trophic levels** Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain. Level 1: Plants and algae make their own food and are called producers. Level 2: Herbivores eat plants/algae and	**4.6.1.3 Advantages and disadvantages of sexual and asexual reproduction (biology only)** Advantages of sexual reproduction: • produces variation in the offspring • if the environment changes variation gives a survival advantage by natural selection • natural selection can be speeded up by humans in selective breeding to increase food production.	**4.6.2.5 Cloning (biology only)** Tissue culture: using small groups of cells from part of a plant to grow identical new plants. This is important for preserving rare plant species or commercially in nurseries. Cuttings: an older, but simple, method used by gardeners to produce many identical new plants from a parent plant. Embryo transplants: splitting	**4.6.3.1 Theory of evolution (biology only)** Darwin proposed the theory of evolution by natural selection. • Individual organisms within a particular species show a wide range of variation for a characteristic. • Individuals with characteristics most suited to the environment are more likely to survive to breed successfully. • The characteristics that have enabled

			selecting appropriate scales for the axes. Gardeners and farmers try to provide optimum conditions for rapid decay of waste biological material. The compost produced is used as a natural fertiliser for growing garden plants or crops. Anaerobic decay produces methane gas. Biogas generators can be used to produce methane gas as a fuel. 4**.7.2.4 Impact of environmental change** Students should be able to evaluate the impact of environmental changes on the distribution of species in an ecosystem given appropriate information. Environmental changes affect the distribution of species in an ecosystem. These	are called primary consumers. Level 3: Carnivores that eat herbivores are called secondary consumers. Level 4: Carnivores that eat other carnivores are called tertiary consumers. Apex predators are carnivores with no predators. Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble food molecules then diffuse into the microorganism. **4.7.4.2 Pyramids of biomass** Pyramids of biomass can be constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of the pyramid. WS 1.2 Students should be able to construct accurate pyramids	Advantages of asexual reproduction: • only one parent needed • more time and energy efficient as do not need to find a mate • faster than sexual reproduction • many identical offspring can be produced when conditions are favourable Some organisms reproduce by both methods depending on the circumstances. • Malarial parasites reproduce asexually in the human host, but sexually in the mosquito. • Many fungi reproduce asexually by spores but also reproduce sexually to give variation. • Many plants produce seeds sexually, but also reproduce asexually by runners such as strawberry plants, or bulb division such as daffodils. **4.6.1.5 DNA structure (biology only)**	apart cells from a developing animal embryo before they become specialised, then transplanting the identical embryos into host mothers Adult cell cloning: • The nucleus is removed from an unfertilised egg cell. • The nucleus from an adult body cell, such as a skin cell, is inserted into the egg cell. • An electric shock stimulates the egg cell to divide to form an embryo. • These embryo cells contain the same genetic information as the adult skin cell. • When the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development.	these individuals to survive are then passed on to the next generation. The theory of evolution by natural selection was only gradually accepted because: • the theory challenged the idea that God made all the animals and plants that live on Earth • there was insufficient evidence at the time the theory was published to convince many scientists • the mechanism of inheritance and variation was not known until 50 years after the theory was published. **4.6.3.2 Speciation (biology only)** Students should be able to: • describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection • explain the impact of these ideas on biology Students should be able to describe the

			changes include: • temperature • availability of water • composition of atmospheric gases. The changes may be seasonal, geographic or caused by human interaction	of biomass from appropriate data **4.7.4.3. Transfer of biomass** Students should be able to: • describe pyramids of biomass • explain how biomass is lost between the different trophic levels. Producers are mostly plants and algae which transfer about 1% of the incident energy from light for photosynthesis. Only approximately 10% of the biomass from each trophic level is transferred to the level above it. Losses of biomass are due to: • not all the ingested material is absorbed, some is egested as faeces • some absorbed material is lost as waste, such as carbon dioxide and water in respiration and water and urea in urine. Large amounts of glucose are used in respiration	Students should be able to describe DNA as a polymer made from four different nucleotides. Each nucleotide consists of a common sugar and phosphate group with one of four different bases attached to the sugar. DNA contains four bases, A, C, G and T. A sequence of three bases is the code for a particular amino acid. The order of bases controls the order in which amino acids are assembled to produce a particular protein. The long strands of DNA consist of alternating sugar and phosphate sections. Attached to each sugar is one of the four bases. The DNA polymer is made up of repeating nucleotide units. (HT only) Students should be able to: • recall a simple description of protein synthesis • explain simply how the structure of DNA affects the protein made		steps which give rise to new species. **4.6.3.3 The understanding of genetics (biology only)** Students should be able to: • describe the development of our understanding of genetics including the work of Mendel • understand why the importance of Mendel's discovery was not recognised until after his death In the early 20th century it was observed that chromosomes and Mendel's 'units' behaved in similar ways. This led to the idea that the 'units', now called genes, were located on chromosomes. In the mid-20th century the structure of DNA was determined and the mechanism of gene function worked out. This scientific work by many scientists led to the gene theory being developed

				4.7.5.1 Factors affecting food security Biological factors which are threatening food security include: • the increasing birth rate has threatened food security in some countries • changing diets in developed countries means scarce food resources are transported around the world • new pests and pathogens that affect farming • environmental changes that affect food production, such as widespread famine occurring in some countries if rains fail • the cost of agricultural inputs • conflicts that have arisen in some parts of the world which affect the availability of water or food. Sustainable methods must be found to feed all people on Earth.	• describe how genetic variants may influence phenotype: a) in coding DNA by altering the activity of a protein: and b) in non-coding DNA by altering how genes are expressed. (HT only) In the complementary strands a C is always linked to a G on the opposite strand and a T to an A. (HT only) Students are not expected to know or understand the structure of mRNA, tRNA, or the detailed structure of amino acids or proteins. (HT only) Students should be able to explain how a change in DNA structure may result in a change in the protein synthesised by a gene. (HT only) Proteins are synthesised on ribosomes, according to a template. Carrier molecules bring specific amino acids to add to the growing protein chain in the correct order. (HT only) When the protein chain is		

				4.7.5.2 Farming techniques the efficiency of food production can be improved by restricting energy transfer from food animals to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. Some animals are fed high protein foods to increase growth. **4.7.5.3 Sustainable fisheries** Fish stocks in the oceans are declining. It is important to maintain fish stocks at a level where breeding continues or certain species may disappear altogether in some areas. Control of net size and the introduction of fishing quotas play important roles in conservation of fish	complete it folds up to form a unique shape. This unique shape enables the proteins to do their job as enzymes, hormones or forming structures in the body such as collagen. (HT only) Mutations occur continuously. Most do not alter the protein, or only alter it slightly so that its appearance or function is not changed. (HT only) A few mutations code for an altered protein with a different shape. An enzyme may no longer fit the substrate binding site or a structural protein may lose its strength. (HT only) Not all parts of DNA code for proteins. Non-coding parts of DNA can switch genes on and off, so variations in these areas of DNA may affect how genes are expressed.		

				stocks at a sustainable level. **4.7.5.4. Role of biotechnology** Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food. The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified. A genetically modified bacterium produces human insulin. When harvested and purified this is used to treat people with diabetes. GM crops could provide more food or food with an improved nutritional value such as golden rice		

Examples of Key Disciplinary Knowledge (methods/framework to establish knowledge)		Measure the population size of a common species in a habitat. Use sampling techniques Investigate the effect of competition on plants. one tray of spaced out seeds and one with crowded seeds. Application of surface area to volume ratio to adaptation in plants and animals	(biology only) Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change Interpretation and production of food webs/chains	Students be able to interpret data on greenhouse production linked to climate change. Be able to interpret and produce pyramids of biomass Calculate the bio-accumulation of a toxic substance in an ecosystem	Interpret and make Punnett square diagrams to predict the percentage chance of inherited disorders being passed and sex determination.	Interpret information about genetic engineering techniques and to make informed judgements about issues concerning cloning and genetic engineering, including GM crops Explain the potential benefits and risks of cloning in agriculture and in medicine and that some people have ethical objections.	Students should be able to extract and interpret information from charts, graphs and tables such as evolutionary trees Interpret evolutionary trees
Required Practical (use spec towards back for list and add overview here then fill RP table I have made after Y11 table-scroll down to see)		Biology RP 9 Population and distribution Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species	Biology RP 10 Biology only Decay (biology only) Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change				

Examples of Reading Opportunity							
Examples of Key Tier 2 Vocabulary		Sample, level	Rate, impact	Technique, transfer	Sequenece, advantage, disadvantage	Identical, select	Resist, class
Examples of Key Tier 3 Vocabulary		Communities, stable, abiotic, biotic, quadrats, transect, competition, adaptation, extremophiles, camouflage	Biomass, producers, primary/secondary consumers, predators, prey, decay, water cycle, carbon cycle, photosynthesis, respiration, combustion, decomposition,	Biodiversity, waste, water/land/air pollution, acid rain, smog, deforestation, peat bog, greenhouse effect, climate change, global warming, breeding programmes, trophic levels, pyramid of biomass, sustainability	Asexual, sexual reproduction, meiosis, variation, fertilisation, natural selection, DNA, genome, bases, nucleotide, mutation, alleles, homozygote, heterozygote, genotype, phenotype, dominant, recessive, punnet square, sex chromosomes, polydactyly, cystic fibrosis, carriers, genetic engineering,	Variation, environmental, inherited, natural selection, mutation, evolution, selective breeding, genetic engineering, GMO, cloning,	Evolution, Darwin, speciation, fossils, extinction, antibiotic resistance, classification, kingdoms, , evolutionary trees
Examples of Numeracy		Mean calculations, Estimates of organisms in area	Prey/predators numbers comparison.	Graph interpretation		Graphs for continuous and discontinuous, categoric variation	

Disciplinary Knowledge via KS4 Required Practicals

Discipline	Year	Unit	Overview	Apparatus and techniques	Working Scientifically	Maths Skills
Biology RP1	Year 9	Cells and organisation microscopes	Use a light microscope to observe, draw and label a selection of plant and animal cells. A scale magnification must be included	AT 1- Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH AT 7- Use of appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings		MS 1d, 3a – use estimations to judge the relative size or area of sub-cellular structures.
Biology RP2	Year 9	Cells and organisation osmosis	Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue	AT 1 – use appropriate apparatus to record mass and time. AT 3 – use appropriate apparatus and techniques to observe and measure the process of osmosis. AT 5 – measure the rate of osmosis by water uptake	WS 2.1 – use the theory of osmosis to create hypotheses on plant tissue. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of mass. WS 2.7 – evaluate the method and suggest possible improvements and further investigations. WS 3.1 – present observations and other data in graphical form.	MS 1a, 1c – use simple compound measures of rate of water uptake. MS 1c – use percentages and calculate percentage gain and loss of mass of plant tissue. MS 2b – find mean mass of plant tissue. MS 4a, 4b, 4c, 4d – plot, draw and interpret appropriate graphs.

					WS 3.2 – translate mass data into graphical form.	
Biology RP3	Year 9	Cells and organisation Food tests	Use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; Biuret reagent for protein	AT 2 – safe use of a Bunsen burner and a boiling water bath. AT 8 – use of qualitative reagents to identify biological molecules.	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, and health and safety considerations	
Biology RP 4	Year 9	Cells and organisation Enzymes	Investigate the effect of pH on the rate of reaction of amylase enzyme. Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds. Temperature must be controlled by use	AT 1 – use appropriate apparatus to record the volumes of liquids, time and pH. AT 2 – safe use of a water bath or electric heater. AT 5 – measure the rate of reaction by the colour change of iodine indicator. AT 8 – use of qualitative iodine reagent to identify starch by continuous sampling	WS 2.1 – use scientific theories and explanations and hypothesis on how pH affects amylase activity. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements, and health and safety. WS 2.5 – describe the appropriate sampling technique to ensure samples are representative. WS 2.6 – make and record observations and measurements of time. WS 3.1 – present a graph of amylase activity against pH. WS 3.2 – translate numeric data into graphical form. .	MS 1a, 1c – carry out rate calculations for chemical reactions

			of a water bath or electric heater			
Biology RP5	Year 10	microbes	(biology only) investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition	AT 1 – use appropriate apparatus to record length and area. AT 3 – use appropriate apparatus and techniques to observe and measure the process of bacterial growth. AT 4 – safe and ethical use of bacteria to measure physiological function and response to antibiotics and antiseptics in the environment. AT 8 – the use of appropriate techniques and qualitative reagents in problem-solving contexts to find the best antibiotic to use or the best concentration of antiseptic to use	WS 2.1 – develop hypotheses about the effectiveness of the antibiotics or antiseptics to be used. WS 2.2 – plan experiments to make observations, test hypotheses and explore phenomena. WS 2.4 – have due regard for accuracy of measurements, and health and safety when using bacterial cultures.	MS 5c – calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr2 .
Biology RP 6	Yr10	photosynthesis	Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed	AT 1 – use appropriate apparatus to record the rate of production of oxygen gas produced; and to measure and control the temperature of water in a large beaker that acts as a 'heat shield'. AT 2 – use a thermometer to measure and control temperature of water bath. AT 3 – use appropriate apparatus and techniques to observe and measure the	WS 2.1 – use scientific theories and explanations to develop hypotheses on how light intensity affects the rate of photosynthesis. WS 2.2 – plan experiments to test hypotheses. WS 2.5 – recognise that multiple samples will be needed at each light intensity. WS 2.6 – make and record observations of gas production.	MS 1a, 1c – measure and understand the rate of photosynthesis reactions. MS 4a, 4c – plot and draw appropriate graphs of rate of photosynthesis against light intensity selecting appropriate scale for axes. MS 3a, 3d (HT) – understand and use inverse proportion: the inverse square law and light intensity in the context of photosynthesis.

				process of oxygen gas production. AT 4 – safe and ethical use and disposal of living pondweed to measure physiological functions and responses to light. AT 5 – measuring rate of reaction by oxygen gas production.	WS 3.1 – present a graph of light intensity against rate of photosynthesis. WS 3.2 – translate numeric data into graphical form.	
Biology RP7	Year 11	Measuring Reaction time	Plan and carry out an investigation into the effect of a factor on human reaction time.	AT 1 – use appropriate apparatus to record time. AT 3 – selecting appropriate apparatus and techniques to measure the process of reaction time. AT 4 – safe and ethical use of humans to measure physiological function of reaction time and responses to a chosen factor		MS 4a – translate information between numerical and graphical forms
Biology RP 8	Year 11	Germination	(biology only)) Investigate the effect of light or gravity on the growth of germinating seeds. Record results as both length measurements and as careful, labelled biological drawings to show the effects	AT 1 – use appropriate apparatus to record length and time. AT 3 – selecting appropriate apparatus and techniques to measure the growth of shoots or roots. AT 4 – safe and ethical use of plants to measure physiological function of growth in response to light or gravity. AT 7 – observations of biological specimens to	WS 2.2 – plan experiments to make observations to explore the phenomena of plant responses. WS 2.3 – apply knowledge of a range of techniques, apparatus and materials appropriate to the experiment. WS 2.6 – make and record observations and measurements using length and biological drawings.	

				produce labelled scientific drawings	WS 2.7 – suggest improvements and further investigations. WS 3.1 – present observations as tables, graphs or drawings.	
Biology RP9	Year 11	Population distribution	Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species	AT 1 – use appropriate apparatus to record length and area. AT 3 – use transect lines and quadrats to measure distribution of a species. AT 4 – safe and ethical use of organisms and response to a factor in the environment. AT 6 – application of appropriate sampling techniques to investigate the distribution and abundance of organisms in an ecosystem via direct use in the field. AT 8 – use of appropriate techniques in more complex contexts including continuous sampling in an investigation.	WS 2.1 – develop hypotheses regarding distribution of a species as a consequence of a factor. WS 2.2 – plan experiments to test hypotheses on distribution. WS 2.3 – apply a range of techniques, including the use of transects and quadrats, and the measurement of an abiotic factor.	MS 1d, 3a – estimates of population size based on sampling. MS 2b – calculate arithmetic means. MS 2d – understand principles of sampling. MS 2f – understand the terms mean, mode and median as applied to ecological data. MS 4c – plot and draw appropriate graphs selecting appropriate scales for the axes
Biology RP 10	Year 11	decay	(biology only) Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change	AT 1 – use appropriate apparatus to record temperature and pH. AT 3 – the use of appropriate apparatus to measure anaerobic decay. AT 4 – safe use of microorganisms. AT 5 – measurement of rate of decay by pH change.	WS 2.1 – use scientific theories to make a hypothesis about the effect of temperature on rate of decay. WS 2.4 – carry out experiments with due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.	MS 1c – calculate rate changes in the decay of biological material. MS 4a – translate information between numerical and graphical form. MS 4c – plot and draw appropriate graphs selecting appropriate scales for the axes.

					WS 2.6 – make and record observations and measurements. WS 2.7 – evaluate method and identify possible improvements.	
Chemistry RP1	Year 10	Chemical Changes	Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.	AT 2 – safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater. AT 3 – use of appropriate apparatus and techniques for conducting chemical reactions, including appropriate reagents. AT 4 – safe use of a range of equipment to purify and/or separate chemical mixtures including evaporation, filtration, crystallisation. AT 6 – safe use and careful handling of liquids and solids, including careful mixing of reagents under controlled conditions.	WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.	
Chemistry RP2	Year 10	Chemical Changes	(Chemistry only) Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only)	AT 1 – use of appropriate apparatus to make and record a range of measurements accurately, including volume of liquids. AT 8 – the determination of concentrations of strong acids and strong alkalis.	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and	MS 1a – recognise and use expressions in decimal form. MS 1c – use ratios, fractions, and percentages. MS 2a – use an appropriate number of significant figures.

			determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.		measurements using a range of apparatus and methods.	
Chemistry RP3	Year 10	Chemical Changes	Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.	AT 3 – use of appropriate apparatus and techniques for conducting and monitoring chemical reactions. AT 7 – use of appropriate apparatus and techniques to draw, set up and use electrochemical cells for separation and production of elements and compounds. AT 8 – use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests for hydrogen, oxygen and chlorine.	WS 2.1– use scientific theories and explanations to develop hypotheses. WS 2.2 – plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and	

					measurements using a range of apparatus and methods.	
Chemistry RP4	Year 10	Energy Changes	Investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals.	AT 1 – use of appropriate apparatus to make and record a range of measurements accurately, including mass, temperature, and volume of liquids. AT 3 – use of appropriate apparatus and techniques for conducting and monitoring chemical reactions. AT 5 – making and recording of appropriate observations during chemical reactions including changes in temperature. AT 6 – safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes.	WS 2.1 – use scientific theories and explanations to develop hypotheses. WS 2.2 – plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.	MS 1a – recognise and use expressions in decimal form. MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 4a – translate information between graphical and numeric form. MS 4c – plot two variables from experimental or other data.
Chemistry RP5	Year 10	The Rate and Extent of Chemical Change	Investigate how changes in concentration	AT 1 – use of appropriate apparatus to make and record a range of measurements	WS 2.1 – use scientific theories and explanations to develop hypotheses. WS 2.2 –	MS 1a – recognise and use expressions in decimal form.

			affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity. This should be an investigation involving developing a hypothesis	accurately, including mass, time, temperature, and volume of liquids and gases. AT 3 – use of appropriate apparatus and techniques for conducting and monitoring chemical reactions. AT 5 – making and recording of appropriate observations during chemical reactions including the measurement of rates of reaction by a variety of methods such as production of gas and colour change. AT 6 – safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes	plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.	MS 1c – use ratios, fractions and percentages. MS 1d – make estimates of the results of simple calculations. MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 4a – translate information between graphical and numeric form. MS 4b – understand that y = mx + c represents a linear relationship. MS 4c – plot two variables from experimental or other data. MS 4d – determine the slope and intercept of a linear graph. MS 4e – draw and use the slope of a tangent to a curve as a measure of rate of change.
Chemistry RP6	Year 11	Chemical Analysis	Investigate how paper chromatography can be used to separate and tell the difference between coloured	AT 1 – use of appropriate apparatus to make and record a range of measurements accurately. AT 4 – safe use of a range of equipment to purify and/or separate chemical mixtures including chromatography.	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.	

			substances. Students should calculate Rf values.		WS 2.6 – make and record observations and measurements using a range of apparatus and methods.	
Chemistry RP7	Year 11	Chemical Analysis	Use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections Flame tests through to Sulfates.	AT 2 – safe use of a Bunsen burner. AT 8 – use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame tests, precipitation reactions.	WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.6 – make and record observations and measurements using a range of apparatus and methods.	
Chemistry RP8	Year 11	Using Chemistry	Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.	AT 2 – safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater. AT 3 – use of appropriate apparatus and techniques for the measurement of pH in different situations. AT 4 – safe use of a range of equipment to purify and/or separate chemical mixtures including evaporation, distillation.	WS 2.3 – apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 2.4 – carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. WS 2.5 – recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. WS 2.6 – make and record observations and	

					measurements using a range of apparatus and methods. WS 2.7 – evaluate methods and suggest possible improvements and further investigations.	
Physics RP1	9	Specific heat capacity	An investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.	AT 1 use of appropriate apparatus to measure mass, time and temperature accurately AT 5 use in a safe manner appropriate apparatus to measure energy changes/transfers and associated values such as work done	WS 2.1 – use the theory of specific heat capacity to create hypotheses on investigating specific heat capacity WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of mass, potential difference, current and temperature.	MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 3b – change the subject of an equation. MS 3c – substitute numerical values into algebraic equations using appropriate units for physical quantities.
Physics RP2 (separates only)	9	Thermal insulation	Investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.	AT 1 use of appropriate apparatus to make and record a range of measurements accurately, including time, volume and temperature AT 5 safe use of appropriate apparatus in a range of contexts to measure energy changes/transfers and associate values such as work done	WS 2.1 – use the theory of refraction to create hypotheses on the behaviour of light. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of angles of incidence and reflection/refraction.	MS 2a – use an appropriate number of significant figures. MS 2c – construct and interpret frequency tables and diagrams, bar charts and histograms. MS 4c – plot two variables from experimental or other data. MS 5c – calculate areas of triangles and rectangles, surface areas and volumes of cubes

Physics RP 3	10	Resistance	Use circuit diagrams to set up and check appropriate circuits to investigate the factors that affect the resistance of an electrical circuit. This should include • the length of a wire at constant temperature • combinations of resistors in series and parallel. I-V characteristics Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements including a filament lamp, a resistor and a diode at constant temperature.	AT 1 use of appropriate apparatus to make and record a range of measurements accurately including length AT 6 use of appropriate apparatus to measure current, potential difference (voltage) and resistance and to explore the characteristics of a variety of circuit elements AT 7 use circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements	WS 2.1 – use the theory of potential difference and current to create hypotheses on resistance. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of potential difference and current. WS 3.1 – present graphs of length of wire and resistance as well as potential difference-current graphs for the bulb, diode and resistor agai WS 3.2 – translate numeric data into graphical form. .	MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 4b – understand that y = mx + c represents a linear relationship. MS 4c – plot two variables from experimental or other data. MS 4d – determine the slope and intercept of a linear graph
Physics RP 4	10	Density	Use appropriate apparatus to	AT 1 use appropriate apparatus to make and record	WS 2.1 – use the theory of particles to create hypotheses	MS 2a – use an appropriate number of significant figures.

			make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects and by a displacement technique for irregularly shaped objects.	a range of measurements accurately including length, mass and volume. Use of such measurements to determine densities of solid and liquid objects	on density. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of mass and volume.	MS 2b – find arithmetic means MS 5c – calculate areas of triangles and rectangles, surface areas and volumes of cubes
RP 5	10	Force and extension	Investigate the relationship between force and extension of a spring.	AT 1 use appropriate apparatus to make and record a range of measurements accurately including length AT 2 use appropriate apparatus to measure and observe the effect of forces including the extension of springs	WS 2.1 – use the theory of Hooke's Law to create hypotheses on the extension of a spring. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of weight and spring length.. WS 3.1 – present a graph of force against extension WS 3.2 – translate numeric data into graphical form. .	MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 4a – translate information between graphical and numeric form. MS 4b – understand that y = mx + c represents a linear relationship. MS 4c – plot two variables from experimental or other data.

RP 6	10	Acceleration	Investigate • the effect of varying the force on the acceleration of an object of constant mass • the effect of varying the mass of an object on the acceleration produced by a constant force.	AT 1 use appropriate apparatus to make and record a range of measurements accurately including length, mass and time AT 2 use appropriate apparatus to measure and observe the effect of forces AT 3 use appropriate apparatus and techniques to measure motion, including determination of speed and rate of change of speed (acceleration/deceleration)	WS 2.1 – use the theory of forces to create hypotheses on acceleration. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of force, mass and time. WS 3.1 – present a graph of force against acceleration WS 3.2 – translate numeric data into graphical form. .	MS 2a – use an appropriate number of significant figures. MS 2b – find arithmetic means. MS 2g – use a scatter diagram to identify a correlation between two variables. MS 4a – translate information between graphical and numeric form. MS 4b – understand that y = mx + c represents a linear relationship. MS 4c – plot two variables from experimental or other data.
RP 7	11	Waves	Make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves • in a ripple tank • in a solid.	AT 4 make observations of waves in fluids and solids to identify the suitability of apparatus to measure speed, frequency and wavelength	WS 2.1 – use the theory of energy transfer in waves to create hypotheses on waves. WS 2.2 – plan experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of time and length. WS 3.1 – present a graph of amylase activity against pH. WS 3.2 – translate numeric data into graphical form. .	MS 2g – use a scatter diagram to identify a correlation between two variables. MS 4c – plot two variables from experimental or other data. MS 5a – use angular measures in degrees. MS 5b – visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.
RP 8	11	Radiation and absorption	Investigate how the amount of infrared radiation absorbed or	AT 1 use appropriate apparatus to make and record a range of measurements accurately including	WS 2.1 – use the theory of infrared waves to create hypotheses on radiation and absorption. WS 2.2 – plan	MS 2c – construct and interpret frequency tables and diagrams, bar charts and histograms

			radiated by a surface depends on the nature of that surface.	temperature AT 4 make observations of the effects of the interaction of electromagnetic waves with matter	experiments to test hypotheses. WS 2.4 – have due regard for accuracy of measurements and health and safety. WS 2.6 – make and record observations and measurements of temperature and time WS 3.1 – present a graph of colour of tube against temperature change. WS 3.2 – translate numeric data into graphical form. .	