Curriculum Map

Subject: Biology Syllabus lesson split 3:2

Year group:

Time period	Year 1 Autumn	Year 1 Spring	Year 1 Summer	Year 2 Autumn	Year 2 Spring	Year 2 Summer
Content *Declarative Knowledge – 'Know What'*	**Unit 1: Biological molecules** *Monomers and polymers* -Understand that a condensation reaction joins two molecules together with the formation of a chemical bond and the elimination of water. -Understand that a hydrolysis reaction breaks a chemical bond between two molecules and involves the addition of a water molecule. *Carbohydrates* -Describe that monosaccharides are the monomers from which larger carbohydrates are made. -Know that glucose has two isomers, α-glucose and β-glucose, and be able to recognise and draw the structure of these. -Name common monosaccharides and disaccharides formed from these. -Describe the basic structure and functions of	**Unit 3: Organisms exchange substances with their environments** -Know the relationship between surface area to volume ratio and metabolic rate. -Understand adaptations of gas exchange mechanisms in insects, fish, mammals and plants. -Know the gross structure of the human gas exchange system. -Know how carbohydrases, proteases and lipases hydrolyse large biological molecules to smaller molecules for absorption in digestion. -Understand the mechanisms of absorption and the role of bile salts and micelles for lipids. -Know the role of haemoglobin in the loading, transporting and unloading of oxygen. -Explain oxygen's dissociation curve and the effects of carbon dioxide concentration (Bohr effect). -Know the structure and function of the human	**Unit 3 (continued): Transport in plants** -Understand mass transport in plants, including cohesion-tension theory of water transport in xylem and mass flow hypothesis for transporting organic substances in phloem. - Explain experimental evidence supporting mass flow theory using tracers and ringing experiments. **Unit 4 (continued): Biodiversity** *-Required practical 6: aseptic techniques and antimicrobials* *Species & taxonomy* -Describe what a species is, how they are named and explain their courtship -Explain the principles of classification -Explain how classification is related to evolution -Describe what species diversity is and calculate the species diversity index -Understand the classification system and	**Unit 5: Energy transfer in and between organisms. Photosynthesis** Understand the role of chlorophyll in absorbing energy from sunlight in the light dependent reaction (LDR). Know how energy from excited electrons is used to generate ATP and NADPH. How the production of ATP involves electron transfer of electrons down the electron transfer chain and passage of protons across chloroplast membranes and is catalysed by ATP synthase embedded in these membranes (chemiosmotic theory) Explain how photolysis of water produces photons, electrons and oxygen for the LDR. Know how the products from the LDR allow for the production of glucose and organic molecules in the light independent reaction (Calvin cycle). Describe how combination of RuBP with CO_2 using the enzyme	**Unit 6 (continued): Organisms respond to changes in their environment** -Understand the role of chemo and pressure receptors in the control of heart rate - Know the properties of slow and fast skeletal muscle fibres. -Explain the roles of actin, myosin, tropomyosin, calcium ions and ATP in myofibril contraction. -Compare the structure of a neuromuscular junction with a synapse and explain how it facilitates muscle contraction. -Know how negative and positive feedback mechanisms facilitate homeostasis -Understand factors that affect blood glucose concentration **Unit 8: The control of gene expression** -How alteration of the sequence of bases in DNA can alter the structure of proteins	**Unit 6 (continued): Organisms respond to changes in their environment** Homeostasis (continued) -The structure of the kidney and its function in osmoregulation -The roles of the hypothalamus, posterior pituitary and antidiuretic hormone (ADH) in osmoregulation. **Revision in preparation for public exams** **Revision in preparation for public exams** **Essay writing practise**

	cellulose, starch and glycogen. -Describe the biochemical tests using Benedict's solution for reducing sugars and non-reducing sugars and iodine/potassium iodide for starch. *Lipids* -Identify the two groups of lipid, triglycerides and phospholipids and be able to describe their structure and the differences between them. -Describe the difference between saturated and unsaturated R-groups of fatty acids. -Describe the emulsion test for lipids *Proteins* -Know that proteins have a variety of functions within all living organisms. -Know and describe the relationship between primary, secondary, tertiary and quaternary protein structures and protein function. -Identify that amino acids are the monomers from which proteins are made. Be able to draw the general structure of an amino acid and identify the R group. -Describe that two amino acids form a dipeptide through a condensation reaction.	heart and blood vessels, including volume and pressure changes brought about by valve movements in the cardiac cycle. **Unit 4: Genetic information, variation and relationships between organisms** *DNA genes and protein synthesis- DNA & chromosomes* -Distinguish between DNA in eukaryotic organisms and prokaryotic cells. -Describe the nature of a gene -Describe the structure of a chromosome -Explain how genes are arranged on a DNA molecule -Describe the nature of homologous chromosomes -Explain what is meant by an allele -Explain how genes code for polypeptides -Describe the structure of RNA, mRNA & tRNA -Explain the processes of transcription & translation -Describe what a mutation is & explain the effect of these mutations -Explain what genetic diversity is, factors that	be able to organise organisms into their groups by their characteristics -Describe what phylogeny is and use it to explain relationships between organisms -Describe what variation is, methods of sampling, how it is measured and calculate mean & standard deviation -Species diversity index -Explain the use of techniques in investigating diversity -Explain the impact of human activities on the environment as well as solutions to these issues such as conservation. -Calculating standard deviation **Unit 5: Energy transfer in and between organisms. Energy and ecosystems** Know how sugars synthesised by plants are used as respiratory substrates or to make other biological molecules, forming biomass. Explain production using the terms GPP, NPP and respiratory losses for plants and N, I, F and R for consumers. Understand how energy is available for growth and reproduction in organisms, or available to	Rubisco, forms GP then TP as intermediates in the production of glucose or regeneration of RuBP. Identify environmental factors that limit the rate of photosynthesis. **Respiration** Anaerobic respiration is a series of complex reactions that allow for the generation of ATP. Understand and describe the processes of glycolysis, link reaction, Krebs cycle and oxidative phosphorylation. Know that synthesis of ATP by oxidative phosphorylation is associated with the transfer of electrons from reduced coenzymes NAD and FAD_2 down the electron transfer chain and passage of protons across inner mitochondrial membranes, catalysed by ATP synthase embedded in these membranes (chemiosmotic theory). Know how if respiration is only anaerobic, pyruvate can be converted to ethanol or lactate using reduced NAD. The oxidised NAD produced in this way can be used in further glycolysis.	-Totipotent and pluripotent cells -Role of oestrogen in the control of transcription -Epigenetic control of gene expression - Role of RNAi in regulation of translation -Gene expression and cancer -Uses of genome projects -Recombinant DNA technology - how fragments of DNA can be produced and amplified - The use of labelled DNA probes and DNA hybridisation to locate specific genes and alleles - The use of genetic counselling - Genetic fingerprinting	

	-Know the role of hydrogen bonds, ionic bonds and disulfide bridges in the structure of proteins. -Give a description of the biuret test for proteins and the colour change expected with a positive result. -Describe how proteins are formed. -Explain that enzymes catalyse reactions by lowering the activation energy. -Describe how enzymes are specific and so only catalyse certain reactions. -Name factors that can affect the rate of enzyme activity and how these do so. -Identify different models of enzyme action and how these describe enzyme function. *Nucleic acids are important information-carrying molecules* -Know the components and structures of DNA and RNA -Identify the bonds that hold two polynucleotide chains together as a DNA double helix -Describe how DNA replication occurs and name the enzymes involved in the process. -Evaluate the work of scientists in validating the	influence it and how it effects natural selection -Describe what selection is, factors that exert selection pressure and explain stabilising and directional selection	other trophic levels in the ecosystem through food webs. How productivity is affected by farming practices designed to increase the efficiency of energy transfer. Understand the role of microorganisms in recycling chemical elements such as phosphorus and nitrogen. Describe the processes of saprobiotic decomposition, ammonification, nitrification, nitrogen fixation and denitrification. How natural and artificial fertilisers to replace the nitrates and phosphates lost by harvesting plants and removing livestock. The environmental issues arising from the use of fertilisers including leaching and eutrophication. **Unit 7: Genetics, populations, evolution and ecosystems.** Investigating populations Fieldwork RP -Understand what makes an ecosystem and how the populations in these ecosystems can be affected by biotic and abiotic factors.	**Unit 6: Organisms respond to changes in their environment** -Know how organisms respond to internal and external stimuli -Understand and be able to use the terms kinesis, taxis and tropisms -Explain the role of receptors in establishing generator potentials -Explain nervous coordination in terms of neuron membrane permeability at resting potential and when depolarised during action potentials. -Understand synaptic transmission and predict effect of drugs **Unit 7: Genetics, populations, evolution and ecosystems.** -Know how genetic inheritance works, including the role of alleles -Understand and be able to use the terms population, gene pool, allele frequency. -Be able to explain how evolutionary change over a long period of time has resulted in a great diversity of species.		

	Watson-Crick model of DNA replication. *ATP* -Know the structure of ATP and its importance as a source of immediate energy within cells. -Describe how ATP is hydrolysed and resynthesized. *Water* -Explain that water is an important biological molecule due to its many properties. Name its different properties and examples of where this is important in organisms. *Inorganic ions* -Describe the role of inorganic ions in organisms. Namely hydrogen ions, sodium ions and phosphate ions. **Unit 2: Cells** *Cell structure;* -Understand the ultrastucture of animal and plant cells, prokaryotes and viruses -Explain mitosis and the cell cycle -Understand how cancer arises -Using and calibrating a microscope, magnification calculations and measuring cells -Explain the life cycles of bacteria and viruses *Transport across membranes;*		-Know how succession occurs from colonisation of a pioneer species to a climax community.			

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	-Understand past and present models of the cell membrane -Know how molecules can move or are transported across membranes -Understand water potential *Cell recognition and the immune system;* -How we acquire immunity and cells of the immune system -Understand antibodies and vaccinations -Know how HIV develops and how to identify it using ELISA					
Skills *Procedural Knowledge – 'Know How'*	**Unit 1:** *-Required Practical 1:* Design and carry out an investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. **Unit 2:** -Know how to use an eyepiece graticule and stage micrometer to calibrate a microscope. -Design and carry out investigations into cell fractionation to look at cell ultrastrucure. *Required practical* *Cell fractionation of plant tissue to separate starch and catalase.* Design and carry out investigations to stain root cells to calculate	Unit 3: -Dissect gas exchange systems of insects, fish and mammalian lungs. -Use visking tubing models to investigate the absorption of the products of digestion. *-Required practical 5: Dissection of an animal organ within the mass transport system.* **Unit 4:** -Know how to work out the impact of the change of an amino acid sequence on the protein formed.	**Unit 3:** -Use a potometer to investigate named variables on rates of transpiration. -Interpret evidence from tracer and ringing experiments and to evaluate the evidence for and against the mass flow hypothesis. **Unit 4:** -Know how to calculate the median, mode and mean. -Investigate the effect of antibiotics on microbes by making their own plates and analysing the results -Calculating the species biodiversity index Unit 5 Students manipulate data to calculate gross	**Unit 5** *Required practical 7:* Use of chromatography to investigate the pigments isolated from leaves of different plants, eg shade tolerant / intolerant plants or leaves of different colours. *Required practical 8*: Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts Devise and carry out experiments to investigate the effect of named environmental variables on the rate of photosynthesis using immobilised algal beads.	**Unit 6:** -Design and carry out an investigation into the effect of a named variable on human pulse rate. *-Required practical 11: production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample*. **Unit 8:** -Produce tissue cultures of explants of cauliflower -Evaluate the use of stem cells in treating human disorders -Interpret data provided from investigations into gene expression	Exam technique practise using past paper questions Essay writing skills with practise synoptic essays

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	mitotic index and produce a calibration curve. -Know how to plot and interpret a calibration graph to calculate cell permeability and water potential. *Required practical* *Preparation of stained cells for calculating mitotic index* *Required practical* *The production of a dilution series to produce a calibration curve with which to identify and calculate the water potential of a plant tissue* *Required practical* *Investigation into the effect of a named variable on the permeability of cell-surface membranes.*		primary production, net productivity of producers or consumers and the efficiency of energy transfers within ecosystems, and derive the appropriate units. **Unit 7:** -Know how to estimate the size of a population using: • randomly placed quadrats, or quadrats along a belt transect • the mark-release-recapture method, including the assumptions made when using this method. *Required practical 12:* Investigation into the effect of a named environmental factor on the distribution of a given species. -Know how to select and use appropriate statistical tests to analyse data e.g student t-test, chi squared.	*Required practical 9:* Investigation into the effect of a named variable on the rate of respiration of cultures of single celled organisms. **Unit 6:** -Design and carry out investigations into the effects of IAA on root growth in seedlings. -Know how to plot and interpret an action potential graph in terms of potential difference. *-Required practical 10:* *Investigate the effect of an environmental variable on the movement of an animal using a choice chamber* **Unit 7:** Know how to use genetic diagrams to interpret, or predict, the results of: • monohybrid and dihybrid crosses involving dominant, recessive and codominant alleles •crosses involving sex-linkage, autosomal linkage, multiple alleles and epistasis. -Know how to use the Hardy-Weinberg equation to calculate the frequency of alleles, genotypes and phenotypes in a population	-Evaluate appropriate data for the relative influences of genetic and environmental factors on phenotype -Evaluate evidence showing correlations between genetic and environmental factors and various forms of cancer -Interpret information relating to the way in which an understanding of the roles of oncogenes and tumour suppressor genes could be used in the prevention, treatment and cure of cancer - Evaluate the ethical, financial and social issues associated with the use and ownership of recombinant DNA technology in agriculture, industry and medicine -Carry out electrophoresis -Interpret data showing the results of gel electrophoresis	

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Key Questions	Unit 1:	Unit 3:	Unit 3:	Unit 5:	Unit 6:	Unit 6:
	Can you explain that all living things have a similar biochemical basis? From which smaller units are larger molecules made? How are polymers formed from monomers? Which conditions can cause changes to the activity of an enzyme? Why is water considered the most important biological molecule? How is DNA replicated? **Unit 2:** What is the ultrastucture of the cell and what is the purpose of each organelle? How can we measure a cell accurately using a light microscope? How does a prokaryote differ from a eukaryote? How do different molecules pass across cell membranes? What is the immune system and how does it work? What are antibodies and how do they contribute to immunity?	How does surface area to volume ratio determine the need for specialised exchange surfaces? How are surfaces adapted for gas exchange? How does digestion of large biological molecules allow absorption into the circulatory system? How does the heart control volume, pressure and unidirectional flow of blood through blood vessels? **Unit 4:** What is the structure of a chromosome? How do the structures of mRNA, tRNA and rRNA differ? How does meiosis lead to variation within a species? Explain what happens in the process of protein synthesis including transcription, splicing and translation. What are the effects of the different types of mutations?	How is water transported from plant roots to leaves in xylem? How is sugar made in the leaves translocated to all parts of the plant in phloem vessels? **Unit 4:** What is genetic diversity? How do we organise organisms? How can we use phylogeny to demonstrate evolution? Describe the three domains and exp[lain why the classification system changed. Distinguish between directional and stabilising selection. How has agriculture impacted species diversity? **Unit 5** How is energy from sunlight captured by plants passed on to other organisms in the food chain? Why is energy lost in this process and how can efficiency be improved? How are the nitrate and phosphate ions recycled	How is energy from sunlight converted to organic sugars by photosynthesising plants? How does regeneration of RuBP allow for the continuation of the Calvin cycle? What are the limiting factors affecting the rate of photosynthesis in plants? How is the energy in organic sugars used in respiration to form ATP? Why is the energy released in aerobic respiration so much greater than that from anaerobic respiration? How do respiratory inhibitors such as toxins exert their effects? **Unit 6:** How does growth facilitate movement in plants? How can external stimuli trigger voluntary and involuntary responses? impulses in nerve cells? How are signals passed within and between neurons in the nervous system? **Unit 7:** How does inheritance work?	How is heart rate regulated? How does stimulation of a motor neuron lead to muscle contraction? What is negative feedback? How is homeostasis achieved? How does insulin help diabetics regulate their own blood sugar level? **Unit 8:** How can mutations lead to a non-functional protein? How is transcription and translation regulated? How can epigenetics influence gene expression? How can scientists genetically modify organisms? What is a genetic fingerprint? How are they produced?	Unit 6: How is water volume regulated in the body? How can the body prevent dehydration by producing a concentrated urine?

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			between organic and inorganic forms? What are the implications of using natural and artificial fertilisers? **Unit 7:** What makes up an ecosystem? How can populations within an ecosystem be affected by biotic and abiotic factors? How can population sizes be estimated?	How can we calculate the probability of different phenotypes? How are new species formed? What is the theory behind natural selection and evolution?		
Assessment	End of unit tests End of topic tests HBL assessed tasks RP 1, 2, 3, 4	End of unit tests End of topic tests HBL assessed tasks RP 5 & 6	Threshold exams End of unit tests RP 12	End of unit tests End of topic tests HBL assessed tasks RP 7, 8, 9, 10	Trial exams End of unit tests End of topic tests HBL assessed tasks RP 11	Practise exam papers Practise synoptic essays A level exams Practical skills endorsement
Literacy/Numeracy/ SMSC/Character	**Unit 1:** **Literacy** -Reading and understanding technical language from biological review papers surrounding the important of biological molecules. **Numeracy** -Calculate the rate of reaction in an enzyme controlled reaction **Unit 2:** **Literacy** Reading and understanding technical language from biological review papers	**Unit 3:** Calculate surface area:volume ratios of different shapes from cell dimensions. Calculations involving pulmonary ventilation rate (PVR), requiring them to change the subject of the equation: PV R = tidal volume × breathing rate. -Change the subject of the equation: CO = stroke volume × heart rate to calculate unknown variables.	**Numeracy** Calculate net primary productivity using NPP = GPP – R Calculate net productivity using N = I – F +R **Unit 7:** **Literacy** Evaluate evidence concerning issues relating to the conservation of species and habitats and consider conflicting evidence. **Numeracy** Use given data to calculate the size of a population.	**Unit 6:** Numeracy Use appropriate units when calculating the maximum frequency of impulse conduction given the refractory period of a neurone. Graphical representation of information including negative values of potential difference. **SMSC** -Ethical implications of using living organisms in investigations, including safety, handling and humane disposal (pest). -Appreciation of vision differences, including	**Unit 6:** Numeracy Use values of heart rate (R) and stroke volume (V) to calculate cardiac output (CO), using the formula CO = R × V SMSC -Show understanding of type I and type II diabetes, and the requirement for a type I diabetic to regulate their own blood sugar through insulin administration. -Evaluate the positions of health advisers and the food industry in relation to the increased incidence	Literacy -Long and short answer exams questions -Synoptic essay

	surrounding current issues in medicine. **Numeracy** Use given data to calculate the size of different cells. Graphical representation of information including, calibration curves and extrapolating data and negative values of water potential. **SMSC** Ethical implications of understanding transmission of disease, including HIV. Understanding that evidence is not always proven to be correct when thinking about scientific research- the MMR debate. **Character** Tolerance - consider alternative views on the use antibodies and vaccinations. Confidence, resilience - carry out complex practical steps to fractionate plant tissue, and cell membrane permeability.	SMSC -Interpret information relating to effects of lung disease on gas exchange. -Recognise correlations and causal relationships. -Interpret data relating to the effects of pollution and smoking on lung disease. -Analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease -Evaluate conflicting evidence associated with risk factors affecting cardiovascular disease **Unit 4:** **Literacy** Evaluate the effect of humans on the environment **Numeracy** Calculating possible combinations following meiosis $(2n^2)^2$ Interpreting graphs of stabilising and directional selection	Understand the principles of sampling as applied to scientific data. Understand the terms mean, median and mode. Select and use a statistical test. Understand measures of dispersion, including standard deviation and range. **SMSC** Show understanding of the need to manage the conflict between human needs and conservation in order to maintain the sustainability of natural resources.	long/short sightedness and color blindness. -Effect of alcohol and drug use on neural response. -Degenerative diseases such as Parkinsons and MND **Unit 7:** **Numeracy** Represent phenotypic ratios (monohybrid and dihybrid crosses). Use ratios, fractions and percentages. Understand the probability associated with genetic inheritance. Use the Hardy-Weinberg equation and other statistical principles such as the chi-squared test. **SMSC** Research genetic diseases and the impact this can have on people's lives. Consider the role technology has played in the ability of finding out a person's risk of certain inherited diseases, and the social and moral implications of this. Appreciate and understand the role humans have played in changing the populations of other species. Understand the importance of conservation.	of type II diabetes. **Unit 8:** **Numeracy** - Interpret data provided from investigations into gene expression -Translate information between graphical, numerical and algebraic forms **SMSC** Consider alternative views on use of recombinant DNA technology for use in agriculture, industry and medicine Evaluate the use of genome projects Evaluate the use of genetic fingerprinting in forensic science and paternity testing **Character** Tolerance - consider alternative views on the use of recombinant DNA technology and genetic fingerprinting Confidence, resilience - carry out complex practical steps to produce DNA fragments, amplify DNA and carry out gel electrophoresis	

		Calculating the species biodiversity index Calculating standard deviation and interpreting graphs standard deviation **SMSC** Diseases linked to genetic mutations can have a big impact on peoples lives or possibly be life limiting. Students may have encountered these. Seeing both sides of the arguments for the methods used in agriculture VS conservation of biodiversity Conservation in terms of zoos can be controversial as its not 'natural' Some students may find discussions about DNA and genetics difficult due to their family history (e.g. family separation, adoption, fostering) **Character** Resilience needed when calculating standard deviation and species diversity index as well as interpretation of the results of these Tolerance for others views on genetics and conservation.				