KS5 Curriculum Map – Biology:

Topic	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	Disciplinary Knowledge (Skills) This is the action taken within a particular topic in order to gain substantive knowledge.	Assessment Opportunities What assessments will be used to measure student progress?
Biological Molecules	• Structure and function of monomers and polymers. • Examples of use. • Enzyme theory and action including the lock and key model and induced fit. • Factors affecting enzyme action. • Enzyme inhibition.	• Explain condensation and hydrolysis reactions. • Correctly identify bonds and their use. • Recall the tests for all biological molecules. • Describe the two models of enzyme action. • Analyse graphs showing how factors affect the rate of enzyme action.	• Safely perform all tests for biological molecules. • Analyse the results to reach a valid conclusion. • Practical to investigate the impact of pH, temperature and substrate concentration on enzyme action. • Required practical 1. • Topic test Carbohydrates and Lipids. • Topic test Proteins and enzymes.
Exchange	• ATP. • Properties of water. • Exchange between organisms and their environment with reference to single celled organisms, insects, fish, plants and humans. • Risk factors for lung disease. • Structure of the digestive system. • Starch, protein and lipid digestion, with reference to co-transport.	• Describe the structures, synthesis and roles of ATP. • Describe the properties of water and the importance of the water molecule in living things. • Describe inorganic ions and their roles. • Describe the relationship between the size of an organism or structure and its surface area to volume ratio. • Describe the exchange surface in living things and how structure relates to function.	• SA:V calculation. • Calculate rate of exchange. • Interpret graphs including tidal volumes and breathing rates. • Calculate pulmonary ventilation rates. • Practical: Counting stomata. • Interpreting graphs relating to correlations between risk factors for lung disease and occurrence of lung disease.

		• Describe the limitations of exchange surfaces with reference to water loss. • Describe the difference between ventilation and exchange in mammalian lungs. • Recognise correlations and causal relationships. • Identify links between environmental factors and lung disease. • Recall the structure and function of the digestive system. • Explain the process of digestion in starch, proteins and lipids.	• Practical: Peak flow (not suitable during pandemic). • Starch digestion practical. • pH on bile salts practical. • Topic test.
Mass Transport	• Structure and role of haemoglobin. • Oxygen dissociation curves. • Circulatory system of a mammal. • Structure of the heart and vessels. • Risk factors associated with cardiovascular disease. • The cardiac cycle. • Tissue fluid formation. • Transport of water and organic substances in plants.	• Describe the structure and function of haemoglobin. • Interpret and explain oxygen dissociation curves with reference to the loading and unloading of oxygen, and to the environment the organism lives in. • Describe the key features of a mammalian circulatory system and label key components. • Label the key features of the heart and explain the key features of the cardiac cycle with reference to volume and pressure. • Label key features of blood vessels and relate to function. • Describe the formation of tissue fluid. • Describe movement of water through the xylem with reference to transpiration, evaporation and cohesion tension. • Describe the mass flow mechanism for the transport of organic substances in the phloem. • Describe and evaluate the mass flow mechanism with reference to tracers and ringing experiments.	• Analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease. • Calculate cardiac output and interpret graphs relating to pressure and volume changes in the heart. • Required practical number 5. • Topic test. • Exam questions and extended writing. • Interpret data collected using a potometer.

Statistical Tests	• Standard deviation and error bars. • Chi-squared. • T-test. • Spearman's rank. • Probability and chance.	• Correctly identify when to use a particular statistical test. • Correctly perform each statistical test. • Effectively use the four statistical tests to identify the degree of significance of data collected. • Define probability and chance and interpret a given probability value in terms of acceptance or rejection of a null hypothesis, using 0.05 as the critical probability value.	• Successful use of statistical tests to determine the significance of data. • Exam questions. • Practical activities to design experiments that collect appropriate data for a statistical test.
Cell Structure	• Methods of studying cells. • The electron microscope. • Microscope measurements and calculations. • Eukaryotic cell structure. • Cell specialisation and organisation. • Prokaryotic cells and viruses.	• To use the equation triangle for calculating the size of image, magnification and size of object. • Describe cell fraction and explain how ultracentrifugation works. • To explain differences between scanning and transmission electron microscopes including limitations. • To be able to calibrate an eye piece graticule. • Describe the structure and function of eukaryotic cell structures found in animal and plant cells. • To describe how cells are arranged into tissues, organs, organ systems and give examples. • Comparison of prokaryotic and eukaryotic cells. • Label the basic structure of a virus.	• To be able to prepare a microscope slide and do a biological drawing in line with exam board specifications. • Mathematical skills. • Exam questions. • Topic test on cell structure.
Transport across cell surface membranes	• Structure of cell surface membrane. • Transport across membrane using diffusion, facilitated diffusion, osmosis and active transport. • Co-transport and absorption of glucose in the ileum.	• Explain the fluid mosaic model of the cell membrane structure. • Distinguish the difference between diffusion and facilitated diffusion. • To explain how water potential affects water movement including the effects of solutes. • Explain the process of active transport and the conditions required.	• Required practical 3. • Required practical 4. • Exam questions. • Mathematical skills. • Topic test: Transport across cell surface membrane.

		• To explain the role of co-transport and the absorption of glucose in the ileum.	
Nucleic acids and protein synthesis	• The structure of RNA and DNA. • DNA replication. • DNA, Chromosomes and the Genetic code. • The structure of mRNA and tRNA. • Protein synthesis: transcription and splicing. • Protein synthesis: translation.	• To describe the differences between the structure of RNA and DNA and how they are related to their function. • To explain the semi-conservative process of DNA replication and discuss evidence for this process. • To explain how genes code for polypeptides. • To describe the differences between DNA in prokaryotic cells and eukaryotic cells. • To explain the nature of homologous chromosomes. • To describe the role of messenger RNA (mRNA) and transfer RNA (tRNA). • To explain how pre-mRNA is produced and modified to form mRNA. • To explain how a polypeptide is synthesised during translation.	• Exam questions. • Mathematical skills. • Topic test DNA and Protein Synthesis.
Cell division and diversity	• Mitosis and the Cell Cycle. • Gene mutations. • Meiosis and genetic variations. • Genetic diversity and adaptation. • Types of selection. • Quantitative investigations of variation.	• To be able to distinguish the stages of mitosis in animal cells. • To explain how mitosis is controlled and how cancer and its treatment relates to the cell cycle. • To explain how deletion and substitution of bases results in a different amino acid sequence. • To describe the process of meiosis and explain how it creates genetic variation. • Describe what factors influence genetic diversity and how it enables natural selection. • Describe environmental factors which exert selection pressure.	• Required Practical 2. • Required Practical 6. • To be able to interpret life cycles of animals and plants. • Distinguish stages of mitosis using electro micrographs. • Work out mitotic index. • To be able to calculate standard deviation. • To interpret error bars on graphical data. • Topic test: Mitosis and Meiosis

		• To distinguish between stabilising and directional selection using antibiotic resistance as an example. • To explain what is meant by the mean and standard deviation.	
Cell recognition and the immune system	• Defence mechanisms and phagocytosis. • T lymphocytes and cell mediated immunity. • B lymphocytes and humoral immunity. • Antibodies. • Vaccination. • Human Immunodeficiency Virus (HIV). • ELISA tests.	• To explain the difference between specific and non-specific defence systems including the process of phagocytosis. • To explain the role of T-cells and cell mediated immunity. • To explain the role of B-cells and the production of antibodies including the roles of plasma cells and memory cells in the secondary immune response. • To be able to label the antibody structure and discuss its function. • Explain how monoclonal antibodies are produced and used. • Describe the features of an effective vaccination programme including ethical issues associated. • Describe the structure of HIV and explain how it replicates. • Explain how the ELISA test works.	• Interpret graphs of primary and secondary response. • Exam questions. • Extended writing on the ethics of vaccinations. • Topic test immunology.
Biodiversity	• Species and taxonomy. • Diversity within a community. • Species diversity and human activities. • Investigating diversity.	• To explain the concept of a species and how they are named. • To explain the principles of classification and how they are related to evolution. • To explain the importance of courtship behaviour for the survival of the species. • Explain how the diversity index is used to measure species diversity. • Describe the impact of agriculture on species diversity. • Explain the importance of conservation.	• Calculating the index of diversity. • Research for conservation methods. • Extended writing. • Exam Questions. • Topic test: Biodiversity.

		• To explain the use of a range of techniques in comparing genetic diversity within and between species.	
Energy and Ecosystems	• Food chains, energy transfer, and productivity. • Nutrient cycles, including nitrogen, phosphorous, and decay. • Use of natural and artificial fertilisers. • Environmental issues concerning the use of nitrogen-containing fertilisers.	• Explain how energy is entered, transferred and lost between organisms in an ecosystem. • Explain what is meant by GPP and NPP and use appropriate formulas to calculate values using given data. • Describe the stages involved in decay and how nutrients are recycled. • Describe the role of mycorrhizae in nutrient cycles. • Describe why fertilisers are needed in agricultural ecosystems, how they increase productivity and the main environmental effects with reference to species diversity, leaching and eutrophication.	• Calculate net and primary production. • Calculate the efficiency of energy transfers. • Interpret data and graphs relating to energy transfers. • Evaluate the use of fertilisers, considering the effects on the environment. • Topic test: Energy and Ecosystems. • Exam style questions.
Homeostasis	• Principles of homeostasis. • Feedback mechanisms. • Hormones and the regulation of blood glucose concentration. • Diabetes and its control. • Kidney anatomy, the role of the nephron and osmoregulation. • The role of hormones in osmoregulation.	• Explain the importance of homeostasis and how the control mechanisms are coordinated. • Explain what homeostasis is and how it helps to control homeostatic processes. • Distinguish between positive and negative feedback. • Explain how hormones work, with reference to adrenaline on regulating blood glucose. • Explain the roles of organs and hormones in the regulation of blood glucose. • Distinguish between type 1 and type 2 diabetes and how they are controlled. • Describe the structure of the nephron and relate it to the function. • Explain the role of hormones in osmoregulation.	• Keywords. • Interpret information in reference to positive and negative feedback. • Interpret graphs showing blood glucose levels to determine if someone is likely to be diabetic. • Required practical 11. • Topic test: Homeostasis. • Exam style questions.

Respiration	• Glycolysis, link reaction and Krebs cycle. • Oxidative phosphorylation. • Anaerobic respiration.	• Describe the main stages of and the products formed in glycolysis, the link reaction and the Krebs cycle. • Explain the significance of each stage with reference to coenzymes and ATP. • Explain the process of oxidative phosphorylation in the electron transfer chain. • Explain the process of anaerobic respiration and how it differs from aerobic respiration. • Make comparisons between anaerobic respiration in mammals and microorganisms.	• Interpret experimental data relating to respiration to determine factors affecting the rate. • Required practical 9. • Extended writing. • Topic test: Respiration. • Exam style questions.
Response to Stimuli and Nervous Coordination	• Survival and response. • Plant growth factors. • A reflex arc. • Receptors. • Control of heart rate. • Neurones, the nervous system and nerve impulse. • Passage and speed of an action potential. • Structure and function of the synapse. • Transmission across a synapse. • Drugs and the synapse.	• Define stimulus, response, taxis, kinesis and tropism. • Explain the response in plants to specific stimuli. • Explain how a specific reflex arc works with reference to sensory, intermediate and motor neurones and how it improves likelihood of survival. • Describe the main features of the Pacinian corpuscle, rod and cone cells and how it relates to function. • Describe and explain how the heart rate is controlled with reference to chemoreceptors and pressure receptors. • Explain how the autonomic nervous system controls heart rate. • Draw and label a myelinated motor neurone and link to function. • Describe the nature of the resting and action potential and how it works within a neurone. • Compare and contrast an action potential in a myelinated and unmyelinated neurone. • Describe the factors that affect the speed of the action potential with reference to the	• Required practical 10. • Interpreting old practical data on IAA in plants. • Calculate loss of neurones over time. • Topic test. • Interpretation of graphs relating to axon membrane potential difference. • Exam style questions.

		refractory period and the all-or-nothing principle. • Describe the structure and function of the synapse and explain how information is transmitted. • Research and describe how drugs affect the nervous system.	
Muscles	• Structure of skeletal muscle and types of muscle fibre. • Neuromuscular junctions. • Contraction of skeletal muscles.	• Label gross and microscopic structure of a skeletal muscle and relate key features to function. • Distinguish between the two types of muscle fibre. • Describe what happens at a neuromuscular junction when a nerve impulse is received and compare to a synapse. • Explain the mechanism of contraction in skeletal muscles. • Evaluate evidence for the sliding filament mechanism.	• End of topic test. • Exam style questions. • Appropriate use of keywords.
Synoptic Essay	• Plan synoptic essays. • Write synoptic essays.	• Identify links between topics in relation to a synoptic essay question. • Plan an essay that is logically structured and links appropriate detail and difficulty. • Mark example essays to establish good habits. • Write an essay that includes appropriate detail, is well structured and grammatically correct in order to answer a synoptic essay question.	• Synoptic essay plan. • Synoptic essay.
Populations and Ecosystems	• Variation in Population size. • Intraspecific and interspecific competition. • Predation. • Succession and conservation of habitats.	• To be able to define all key terms such as environment, communities, population and niche. • To explain how factors influence population size. • Describe how competition influences population size.	• Required Practical 12. • Mark-release- recapture calculations. • Interpreting predator- prey graphs. • Mathematical skills. • Exam questions. • Topic Test: Populations.

		• Explain how predator-prey relationships affect population size. • Explain how to use a quadrat and transect to obtain quantitative data. • Explain how to use mark-release – recapture method. • Describe the changes that occur during succession. • Explain how to manage succession to help conserve habitats.	
Inherited Change, Populations and evolution	• Monohybrid inheritance. • Dihybrid inheritance and probability and genetic crosses. • Co-dominance and multiple alleles. • Sex linkage autosomal linkage and Epistasis. • Chi-Squared test in relation to genetics Population Genetics. • Variation in Phenotype. • Natural Selection. • Effects of different forms of selection on evolution. • Isolation and Speciation.	• To be able to define the genetic terminology. • Explain how a single gene is inherited. • Explain how single and two different genes on different chromosomes are inherited. • Explain why results of genetic results differ from predicted results. • To explain how co-dominance and multiply alleles affect inheritance. • To explain how sex-linked diseases are inherited. • To describe and explain how autosomal linkage affects the combinations of alleles in gametes. • To explain the effects of Epistasis. • To demonstrate how Chi-Square test is used in Genetics. • To be able to use the Hardy Weinberg Principle to calculate allele frequencies. • To describe variations due to genetic and environmental factors. • To explain the role of variation in selection and describe the effects of different forms of selection on evolution. • To explain how new species are formed by allopatric and sympatric speciation.	• Complete various types of genetic crosses. • Mathematic Skills to calculate Hardy Weinberg and interpret the Chi-Squared Test. • Extended writing on Speciation. • Exam Questions. • Topic Tes: Inheritance and Population Genetics.

Photosynthesis	• Photosynthesis overview. • The light-dependent and light-independent reaction. • Factors affecting the rate of photosynthesis	• To be able to explain how the plant leaf is adapted to carry out photosynthesis. • To explain the processes of oxidation and reduction reactions in the light-dependent cycle. • Explain how ATP and NADPH is made during the light-dependent reaction. • Describe the role of photolysis in the light-dependent reaction. • Describe the roles of ATP and NADPH in the light in-dependent reaction. • Describe the events of the Calvin Cycle.	• Required Practical 7. • Required Practical 8. • Exam Questions. • Research different Pigments and their absorption wavelengths. • Mathematical skills. • Topic Test: Photosynthesis.
Gene Expression	• Gene Mutations. • Stem Cells and Totipotency. • Regulation of Transcription and Translation. • Epigenetic control and gene expression. • Gene expression and Cancer. • Genome Project.	• To explain how different types of gene mutations lead to different amino acid sequences in polypeptides. • To explain how cells lose their totipotency and become specialised. • To describe cell differentiation and cell specialisation. • Explain how pluripotent stem cells can be used to treat humans. • Explain how Oestrogen siRNA effects gene expression. • Explain the effect of epigenetic factors on DNA and histones. • Explain the effects of decreased acetylation and increased methylation of DNA. • Distinguish between benign and malignant tumours. • The role of oncogenes and tumour suppressor genes in the development of tumours. • To know the importance of genome sequencing projects.	• Extended writing skills. • Exam questions. • Research task on Stems cells and cancer. • Mathematical skills. • Topic Test: Gene Expression.

Recombinant DNA Technology	• Producing DNA fragments. • In-vivo gene cloning. • The use of Vectors. • In-vitro gene cloning and polymerase chain reaction (PCR). • Locating genes, genetic screening and counselling. • Genetic fingerprinting.	• To explain how complementary DNA is made using reverse transcriptase. • To explain how restriction endonucleases are used to cut DNA into fragments. • To explain the importance of sticky ends when inserting vectors. • Describe and explain how gene markers are used. • To explain how the polymerase chain reaction is carried out. • Describe how DNA probes are used to screen for heritable condition. • To explain the technique of gel electrophoresis with regards to genetic fingerprinting.	• Extended writing skills. • Exam questions. • Mathematical skills. • Topic Test: Recombinant DNA Technology.