Beths Grammar School KS5 Biology Curriculum Map – Year 12

Term Edexcel Spec A	INTENT **Substantive Knowledge** This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	IMPLEMENTATION **Disciplinary Knowledge (Skills)** This is the action taken within a particular topic in order to gain substantive knowledge.	IMPACT **Assessment opportunities** What assessments will be used to measure student progress? Evidence of how well students have learned the intended content.
Autumn Term 1A Year 12	**Intent** Why is this taught now? **Topic 1 and Topic 2 are taught by 2 teachers in parallel. These topics should be completed by the end of the autumn term.** **Topic 1** **This topic uses the context of health risk and in particular the risk of developing cardiovascular disease (CVD) to cover content on the structure and function of the cardiovascular system, atherosclerosis and blood clotting role in CVD, correlation, causation and the concept of risks to health including determining health risk and perceptions of risk. The consideration of factors that increase the risk of CVD gives coverage of blood pressure and structure and function of carbohydrates, lipids (triglycerides) and water.**	Topic 1- Lifestyle, Health and Risk Introduction to the topic Introductory presentation (Interactive) Activity 1.1 Mark's and Peter's stories GCSE review and GCSE review test (Interactive) **Why a heart and circulation?** 1.1 Understand why many animals have a heart and circulation (mass transport to overcome limitations of diffusion in meeting the requirements of organisms). Activity 1.2 Demonstrating mass flow (Practical) Read Key biological principles box and complete questions including Checkpoint question 1.1 **Structure of the heart and location of blood vessels** 1.1 Understand why many animals have a heart and circulation (mass transport to overcome limitations of diffusion in meeting the requirements of organisms). 1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions.	

		1.4 ii) Know how the relationship between heart structure and function can be investigated practically. Activity 1.4 Structure of the heart (dissection) (Practical) Activity 1.7 Harvey's circulation experiments Activity 1.5 Structure of the heart (simulated dissection) (Interactive tutorial alternative to Activity 1.4) **<u>The transport medium</u>** 1.2 Understand the importance of water as a solvent in transport, including its dipole nature. Activity 1.3 An ideal transport medium The structure and function of blood vessels 1.3 Understand how the structures of blood vessels (capillaries, arteries and veins) relate to their functions. Activity 1.6 Investigating arteries and veins (Practical) Checkpoint question 1.2 **<u>The cardiac cycle</u>** 1.4 i) Know the cardiac cycle (atrial systole, ventricular systole and cardiac diastole) and relate the structure and operation of the mammalian heart, including the major blood vessels, to its function. Activity 1.8 The cardiac cycle (Interactive tutorial) Checkpoint question 1.3	Heart Dissection practical Heart and circulation Test

		Events that lead to atherosclerosis 1.5 Understand the course of events that leads to atherosclerosis (endothelial dysfunction, inflammatory response, plaque formation, raised blood pressure). 1.6 Understand the blood-clotting process (thromboplastin release, conversion of prothrombin to thrombin and fibrinogen to fibrin) and its role in cardiovascular disease (CVD). Activity 1.9 Atherosclerosis Activity 1.10 Blood flow **<u>Risk</u>** 1.8 Be able to analyse and interpret quantitative data on illness and mortality rates to determine health risks, including distinguishing between correlation and causation and recognising conflicting evidence. 1.10 Understand why people's perceptions of risks are often different from the actual risks, including underestimating and overestimating the risks due to diet and other lifestyle factors in the development of heart disease. Activity 1.11 Estimating risk Activity 1.12 Correlation and causation Checkpoint question 1.4 **<u>Identifying risk factors for CVD</u>** 1.9 Be able to evaluate the design of studies used to	

		determine health risk factors, including sample selection and sample size used to collect data that is both valid and reliable. Activity 1.13 Identifying health risks	
	Topic 2 **The context for this topic is a couple trying to decide whether to have a child when there is a chance that it could inherit cystic fibrosis (CF). The topic looks at the questions they may need answered. It examines the symptoms and causes of CF. It includes details of what is happening at a molecular level with protein structure and synthesis. The screening for the disease introduces some ethical issues the couple may face.** **The context is used to cover content on a wide range of biology concepts, including: structure and properties of the cell membrane and gas exchange surfaces, passive and active transport, structure and function of phospholipids and proteins; enzyme action; structure and role of DNA and RNA; the nature of the genetic code; replication; protein synthesis, gene mutations, monohybrid inheritance and the social and ethical issues related to genetic screening.**	**<u>Topic 2- Genes and Health(Teacher 2)</u>** Introduction to the topic Introductory presentation (Interactive) Activity 2.1 Making decisions Activity 2.2 Personal cystic fibrosis stories GCSE review and GCSE review test (Interactive) **<u>Diffusion and surface area to volume ratio</u>** 2.1 i) Know the properties of gas exchange surfaces in living organisms (large surface area to volume ratio, thickness of surface, difference in concentration). ii) Understand how the rate of diffusion is dependent on these properties and can be calculated using Fick's Law of Diffusion. iii) Understand how the structure of the mammalian lung is adapted for rapid gaseous exchange. 2.14 Understand how the expression of a gene mutation in people with cystic fibrosis impairs the functioning of the gaseous exchange, digestive and reproductive systems. Activity 2.3 The effect of size on uptake by diffusion (Practical) Q2.1–Q2.13 **<u>Structure of alveoli and SA:V ratio; properties of gas exchange surfaces</u>**	

		2.1 i) Know the properties of gas exchange surfaces in living organisms (large surface area to volume ratio, thickness of surface, difference in concentration). ii) Understand how the rate of diffusion is dependent on these properties and can be calculated using Fick's Law of Diffusion. iii) Understand how the structure of the mammalian lung is adapted for rapid gaseous exchange. Activity 2.4 The structure of alveoli (Practical) Activity 2.5 Alveoli and lung surface area (Interactive) Checkpoint question 2.1 **Protein structure and function** 2.9 i) Know the basic structure of an amino acid (structures of specific amino acids are not required). ii) Understand the formation of polypeptides and proteins (amino acid monomers linked by peptide bonds in condensation reactions). iii) Understand the significance of a protein's primary structure in determining its three-dimensional structure and properties (globular and fibrous proteins and the types of bonds involved in its three-dimensional structure). iv) Know the molecular structure of a globular protein and a fibrous protein and understand how their structures relate to their functions (including haemoglobin and collagen). Activity 2.6 Proteins (Interactive) Checkpoint question 2.2 **Membrane structure** 2.2 i) Know the structure and properties of cell membranes. ii) Understand how models such as the fluid mosaic model of cell membranes are interpretations of data used to develop scientific explanations of the structure and properties of cell membranes. Activity 2.7 The fluid mosaic model	Diffusion Practical Protein Structure Test

		Build models of membranes **<u>Membrane structure</u>** Activity 2.8 Why does the colour leak out of cooked beetroot? (CORE PRACTICAL) Transport across membranes 2.3 Understand what is meant by osmosis in terms of the movement of free water molecules through a partially permeable membrane (consideration of water potential is not required). 2.4 i) Understand what is meant by passive transport (diffusion, facilitated diffusion), active transport (including the role of ATP as an immediate source of energy), endocytosis and exocytosis. ii) Understand the involvement of carrier and channel proteins in membrane transport. Activity 2.9 Methods of transport within and between cells (Practical) **<u>Membrane transport in epithelial cells</u>** 2.3 Understand what is meant by osmosis in terms of the movement of free water molecules through a partially permeable membrane (consideration of water potential is not required). 2.4 i) Understand what is meant by passive transport (diffusion, facilitated diffusion), active transport (including the role of ATP as an immediate source of energy), endocytosis and exocytosis. ii) Understand the involvement of carrier and channel proteins	Activity 2.8 Why does the colour leak out of cooked beetroot? (CORE PRACTICAL Protein structure test CORE PRACTICAL 3: Investigate membrane structure, including the effect of alcohol concentration or temperature on membrane permeability.

		in membrane transport. Activity 2.10 CFTR protein and membrane transport (Interactive) **<u>Enzyme structure and function</u>** 2.10 i) Understand the mechanism of action and the specificity of enzymes in terms of their three-dimensional structure. ii) Understand that enzymes are biological catalysts that reduce activation energy. iii) Know that there are intracellular enzymes catalysing reactions inside cells and extracellular enzymes produced by cells catalysing reactions outside of cells. 2.14 Understand how the expression of a gene mutation in people with cystic fibrosis impairs the functioning of the gaseous exchange, digestive and reproductive systems. Checkpoint questions 2.3 and 2.4	Membrane Test Enzyme and Protein Test
Autumn Term 1B Year 12	**<u>Intent</u>** Why is this taught now? **<u>Topic 1</u>** This topic uses the context of health risk and in particular the risk of developing cardiovascular disease (CVD) to cover content on the structure and function of the cardiovascular system, atherosclerosis and blood clotting role in CVD, correlation, causation and the concept of risks to health including determining health	Topic 1- Lifestyle, Health and Risk **<u>CVD risk factors – age and gender</u>** 1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD). Class discussion sharing ideas about CVD risk factors Activity 1.14 Analysis of cardiovascular disease data CVD risk factors – blood pressure	

	risk and perceptions of risk. The consideration of factors that increase the risk of CVD gives coverage of blood pressure and structure and function of carbohydrates, lipids (triglycerides) and water	1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD). Activity 1.15 Measuring blood pressure (Interactive, Practical) Activity 1.16 Blood pressure summary **<u>CVD risk factors – dietary factors</u>** **<u>Carbohydrate structure</u>** 1.12 i) Know the difference between monosaccharides, disaccharides and polysaccharides, including glycogen and starch (amylose and amylopectin). ii) Be able to relate the structures of monosaccharides, disaccharides and polysaccharides to their roles in providing and storing energy (β-glucose and cellulose are not required in this topic). 1.13 Know how monosaccharides join to form disaccharides (sucrose, lactose and maltose) and polysaccharides (glycogen and amylose) through condensation reactions forming glycosidic bonds, and how these can be split through hydrolysis reactions. Molymods® or other models could be used. Activity 1.17 Carbohydrate structure (Interactive) **<u>Use of immobilised enzymes</u>** 1.13 Know how monosaccharides join to form disaccharides (sucrose, lactose and maltose) and polysaccharides (glycogen	

		and amylose) through condensation reactions forming glycosidic bonds, and how these can be split through hydrolysis reactions. **<u>Lipid structure</u>** 1.14 i) Know how a triglyceride is synthesised by the formation of ester bonds during condensation reactions between glycerol and three fatty acids. ii) Know the differences between saturated and unsaturated lipids. Activity 1.19 Lipids (Interactive) **<u>Energy budgets</u>** 1.11 i) Be able to analyse data on energy budgets and diet. ii) Understand the consequences of energy imbalance, including weight loss, weight gain, and development of obesity. 1.16 Understand how people use scientific knowledge about the effects of diet, including obesity indicators, body mass index and waist-to-hip ratio, exercise and smoking to reduce their risk of coronary heart disease. Discussion of BMI and waist-to-hip ratio measurements Activity 1.20 Your energy budget (Interactive) Activity 1.21 Obesity indicators (Practical) **<u>Cholesterol</u>** 1.15 i) Be able to analyse and interpret data on the possible significance for health of blood cholesterol levels and levels of high-density lipoproteins (HDLs) and low-density lipoproteins (LDLs).	Molecules Test

		ii) Know the evidence for a causal relationship between blood cholesterol levels (total cholesterol and LDL cholesterol) and cardiovascular disease (CVD). Using information in the Student Book, prepare a leaflet explaining in simple terms about HDLs and LDLs in relation to heart disease. Activity 1.22 Cholesterol and CVD **Other risk factors – genetics** 1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD). Activity 1.23 Sudden death in athletes **Other risk factors** 1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD). Activity 1.24 Are you getting enough antioxidants? Activity 1.26 Reducing stress (Interactive, Practical) Activity 1.28 Healthy heart quiz **Other risk factors** 1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD). CORE PRACTICAL 2: Investigate the vitamin C content of food and drink.	CORE PRACTICAL 2:

		Activity 1.25 Is high C all it claims to be? (CORE PRACTICAL) **<u>Effect of caffeine on the heart rate</u>** CORE PRACTICAL 1: Investigate the effect of caffeine on heart rate in Daphnia. 1.17 Be able to discuss the potential ethical issues regarding the use of invertebrates in research. Activity 1.27 Does caffeine affect heart rate? (CORE PRACTICAL) **<u>Reducing the risks of CVD</u>** 1.18 Know the benefits and risks of treatments for cardiovascular disease (CVD) (antihypertensives, statins, anticoagulants and platelet inhibitors). Reducing the risks of CVD 1.16 Understand how people use scientific knowledge about the effects of diet, including obesity indicators, body mass index and waist-to-hip ratio, exercise and smoking to reduce their risk of coronary heart disease. Activity 1.29 Making decisions Extension 1.3 Functional foods and coronary heart disease Extension 1.4 New treatments for cardiovascular diseas	Investigate the vitamin C content of food and drink. Activity 1.27 Does caffeine affect heart rate? (CORE PRACTICAL Disease Test End of Topic 1 Test
	<u>Topic 2</u> The context for this topic is a couple trying to decide whether to have a child when there is a chance that it could inherit cystic fibrosis (CF). The topic looks at the questions they may need answered. It examines the symptoms and	**<u>Topic 2- Genes and Health(Teacher 2)</u>** **<u>DNA structure</u>** 2.5 i) Know the basic structure of mononucleotides (deoxyribose or ribose linked to a phosphate and a base, including thymine, uracil, cytosine, adenine or guanine) and the structures of DNA	

	causes of CF. It includes details of what is happening at a molecular level with protein structure and synthesis. The screening for the disease introduces some ethical issues the couple may face. The context is used to cover content on a wide range of biology concepts, including: structure and properties of the cell membrane and gas exchange surfaces, passive and active transport, structure and function of phospholipids and proteins; enzyme action; structure and role of DNA and RNA; the nature of the genetic code; replication; protein synthesis, gene mutations, monohybrid inheritance and the social and ethical issues related to genetic screening.	and RNA (polynucleotides composed of mononucleotides linked through condensation reactions). ii) Know how complementary base pairing and the hydrogen bonding between two complementary strands are involved in the formation of the DNA double helix. Activity 2.13 Extraction of DNA (Practical) Activity 2.12 DNA model **<u>Protein synthesis</u>** 2.6 i) Understand the process of protein synthesis (transcription) including the role of RNA polymerase, translation, messenger RNA, transfer RNA, ribosomes and the role of start and stop codons. ii) Understand the roles of the DNA template (antisense) strand in transcription, codons on messenger RNA and anticodons on transfer RNA. 2.7 Understand the nature of the genetic code (triplet code, non-overlapping and degenerate). 2.8 Know that a gene is a sequence of bases on a DNA molecule that codes for a sequence of amino acids in a polypeptide chain. Activity 2.15 Nucleic acids and protein synthesis (Interactive) Activity 2.14 Working out the DNA code **<u>DNA replication</u>** 2.11 i) Understand the process of DNA replication, including the role of DNA polymerase. ii) Understand how Meselson and Stahl's classic experiment provided new data that supported the accepted theory of replication of DNA and refuted competing theories.	

		2.12 i) Understand how errors in DNA replication can give rise to mutations. ii) Understand how cystic fibrosis results from one of a number of possible gene mutations. Activity 2.16 Meselson and Stahl's experiment on DNA replication (Interactive) **<u>Monohybrid inheritance</u>** 2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote. ii) Understand patterns of inheritance, including the interpretation of genetic pedigree diagrams, in the context of monohybrid inheritance. Activity 2.17 Reebops (Practical) Checkpoint question 2.6 **<u>Monohybrid inheritance</u>** 2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote. ii) Understand patterns of inheritance, including the interpretation of genetic pedigree diagrams, in the context of monohybrid inheritance. Activity 2.18 Inheritance problems **<u>Genetic screening</u>** 2.15 i) Understand the uses of genetic screening, including the identification of carriers, pre-implantation genetic diagnosis (PGD) and prenatal testing, including amniocentesis and	DNA, Replication and protein synthesis Test

		chorionic villus sampling. ii) Understand the implications of prenatal genetic screening. 2.16 Be able to identify and discuss the social and ethical issues related to genetic screening from a range of ethical viewpoints. Activity 2.19 Genetic screening. **Genetic screening** 2.16 Be able to identify and discuss the social and ethical issues related to genetic screening from a range of ethical viewpoints Activity 2.20 Passing it on Class discussion Activity 2.21 Gene mutation – a personal story	Cystic fibrosis Test End of Topic 4 TesT
Spring Term 2A **Year 12**	**Intent** Why is this taught now? **Topic 3** The context for this topic is the most fundamental biological story there is – development from a single egg into a complex multicellular organism. The biological ideas required to understand this story are studied. The context allows a wide range of biological concepts to be studied. The topic starts by looking at cell structure and ultrastructure of eukaryote and prokaryote cells. It goes on to consider gametes and the role of meiosis in their formation and the introduction of variation. The developmental story continues with fertilisation, cell specialisation through differential gene expression and the organisation of cells in multicellular organisms.	**Topic 3- Voice of the Genone (Teacher 1)** Introduction to the topic Introductory presentation (Interactive) GCSE review and test (Interactive) **Ultrastructure of eukaryotic cells** 3.1 Know that all living organisms are made of cells, sharing some common features. 3.2 Know the ultrastructure of eukaryotic cells, including nucleus, nucleolus, ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes, and Golgi apparatus. 3.5 Be able to recognise the organelles in 3.2 from electron microscope (EM) images. Activity 3.1 Cell structure and function (Interactive)	

	The role of the genome in the control of development is considered, in addition to how epigenetic changes, can modify the activation of certain genes and how both genotype and the environment influence phenotype. The study of stem cells and their use in medicine introduces ethical issues.	**Eukaryotic and prokaryotic cells** 3.4 Know the ultrastructure of prokaryotic cells, including cell wall, capsule, plasmid, flagellum, pili, ribosomes, mesosomes and circular DNA. Checkpoint question 3.1 The dynamic nature of cells illustrated by the role of rough endoplasmic reticulum and the Golgi apparatus 3.3 Understand the role of the rough endoplasmic reticulum (rER) and the Golgi apparatus in protein transport within cells, including their role in the formation of extracellular enzymes. Activity 3.2 Protein transport within cells (Interactive) **Gamete structure and function** 3.6 Understand how mammalian gametes are specialised for their functions (including the acrosome in sperm and the zona pellucida in the egg). 3.7 Know the process of fertilisation in mammals, including the acrosome reaction, the cortical reaction and the fusion of nuclei. Activity 3.4 Fertilisation in a marine worm (Practical) Activity 3.3 Gametes and fertilisation (Interactive) Checkpoint question 3.2 **Gamete formation and fertilisation** 3.7 Know the process of fertilisation in mammals, including the	Cell Structure Test

		acrosome reaction, the cortical reaction and the fusion of nuclei. 3.9 Understand the role of meiosis in ensuring genetic variation through the production of non-identical gametes as a consequence of independent assortment of chromosomes and crossing over of alleles between chromatids (details of the stages of meiosis are not required). Activity 3.5 Chromosome assortment **<u>Linkage of genes and crossing over</u>** 3.8 i) Know that a locus (loci) is the location of genes on a chromosome. ii) Understand the linkage of genes on a chromosome and sex linkage. Activity 3.6 Fruit flies, linkage and crossing over **<u>The cell cycle</u>** 3.10 Understand the role of mitosis and the cell cycle in producing identical daughter cells for growth and asexual reproduction. Annotation of cell cycle diagram Activity 3.7 Mitosis flick book Activity 3.8 The cell cycle (Interactive) Topic 4- Biodiversity and Natural Resources(Teacher 2)	Cell division Test

	Topic 4 The story of the Brazil nut tree and the interdependence of highly adapted species for survival starts this topic. This story introduces biodiversity, adaptation, evolution by natural selection, and the idea that species of value to humans are threatened by human activity and there is a need for conservation. The topic focuses on biodiversity, how it is classified and measured, and how all this diversity has come about through adaptation and natural selection. It has sections on both traditional and novel uses of plants and plant fibres and the use of chemical extracts from animals and plants, and the potential contribution to sustainability by the use of plant based products. The concern for disappearing biodiversity and loss of potential natural resources is used to highlight the need for conservation of endangered species focusing on the role of zoos and seedbanks.	**Introduction to the topic** Introductory presentation (Interactive) Activity 4.2 What is it? GCSE review (Interactive) Activity 4.1 The Galapagos Islands (Interactive) **What is a species?** 4.1 Know that over time the variety of life has become extensive but is now being threatened by human activity Introductory discussion of what is meant by biodiversity and the concept of species The concept of niche 4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical). Activity 4.3 Ecological niche of a leaf-cutter bee **Adaptations** 4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical). Activity 4.4 Well-behaved beetles (Practical)	

		Adaptations 4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical) Activity 4.5 Adaptations Activity 4.5 Adaptations Checkpoint question 4.1 **Natural selection and evolution** 4.4 Understand how natural selection can lead to adaptation and evolution. Activity 4.6 Natural selection in action (Practical) Checkpoint question 4.2 Evolution as a change in allele frequency leading to speciation 4.5 i) Understand how the Hardy-Weinberg equation can be used to see whether a change in allele frequency is occurring in a population over time. ii) Understand that reproductive isolation can lead to accumulation of different genetic information in populations, potentially leading to the formation of new species. Activity 4.7 Calculating allele frequencies **What is biodiversity?** 4.2 i) Understand the terms biodiversity and endemism. ii) Know how biodiversity can be measured within a habitat	

		using species richness and within a species using genetic diversity by calculating the heterozygosity index (H): H = number of heterozygotes number of individuals in the population iii) Understand how biodiversity can be compared in different habitats using a formula to calculate an index of diversity (D): D = Activity 4.8 What is biodiversity? Activity 4.9 The next bug thing **<u>Classification</u>** 4.6 i) Understand that classification is a means of organising the variety of life based on relationships between organisms using differences and similarities in phenotypes and in genotypes, and is built around the species concept. ii) Understand the process and importance of critical evaluation of new data by the scientific community, which leads to new taxonomic groupings, including the three domains of life based on molecular phylogeny, which are Bacteria, Archaea, Eukaryota. Activity 4.10 Being Darwin	
		<u>Classification</u> 4.6 i) Understand that classification is a means of organising the variety of life based on relationships between organisms using differences and similarities in phenotypes and in genotypes, and is built around the species concept. ii) Understand the process and importance of critical evaluation of new data by the scientific community, which leads to new taxonomic groupings, including the three domains of life based on molecular phylogeny, which are Bacteria, Archaea, Eukaryota.	Biodiversity Test

		Activity 4.11 New ideas in biology Checkpoint question 4.3	
Spring Term 2B Year 12	**Intent** Why is this taught now? **Topic 3** The context for this topic is the most fundamental biological story there is – development from a single egg into a complex multicellular organism. The biological ideas required to understand this story are studied. The context allows a wide range of biological concepts to be studied. The topic starts by looking at cell structure and ultrastructure of eukaryote and prokaryote cells. It goes on to consider gametes and the role of meiosis in their formation and the introduction of variation. The developmental story continues with fertilisation, cell specialisation through differential gene expression and the organisation of cells in multicellular organisms. The role of the genome in the control of development is considered, in addition to how epigenetic changes, can modify the activation of certain genes and how both genotype and the environment influence phenotype. The study of stem cells and their use in medicine introduces ethical issues.	**Topic 3- Voice of the Genome- Teacher 1** **The stages of mitosis** CORE PRACTICAL 5: Prepare and stain a root tip squash to observe the stages of mitosis. Activity 3.9 Observing mitosis (CORE PRACTICAL) Checkpoint question 3.4 **Totipotency** 3.11 i) Understand what is meant by the terms 'stem cell', 'pluripotency' and 'totipotency'. ii) Be able to discuss the way society uses scientific knowledge to make decisions about the use of stem cells in medical therapies. Activity 3.11 Plant tissue culture (Practical) Checkpoint question 3.5 **Stem cell research** 3.11 i) Understand what is meant by the terms 'stem cell, pluripotency and totipotency'. ii) Be able to discuss the way society uses scientific knowledge to make decisions about the use of stem cells in medical therapies. Activity 3.12 Ethical concerns about stem cell research	CORE PRACTICAL 5: Prepare and stain a root tip squash to observe the stages of mitosis.

		The role of the nucleus in the control of development 3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including the lac operon. Activity 3.13 Acetabularia experiments (Interactive) **<u>Differential gene expression</u>** 3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including the lac operon. Activity 3.14 Induction of □-galactosidase (Practical) Cellular organisation 3.13 Understand how the cells of multicellular organisms are organised into tissues, tissues into organs and organs into systems. 3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including the lac operon. Checkpoint question 3.6 **<u>Differential gene expression</u>**	

	Topic 4 The story of the Brazil nut tree and the interdependence of highly adapted species for survival starts this topic. This story introduces biodiversity, adaptation, evolution by natural selection, and the idea that species of value to humans are threatened by human activity and there is a need for conservation. The topic focuses on biodiversity, how it is classified and measured, and how all this diversity has come about through adaptation and natural selection. It has sections on both traditional and novel uses of plants and plant fibres and the use of chemical extracts from animals and plants, and the potential contribution to sustainability by the use of plant based products. The concern for disappearing biodiversity and loss of potential natural resources is used to highlight the need for conservation of endangered species focusing on the role of zoos and seedbanks.	3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including the lac operon. Activity 3.15 Modelling flowers Topic 4- Biodiversity and Natural Resources **<u>Measuring biodiversity</u>** 4.2 i) Understand the terms biodiversity and endemism. ii) Know how biodiversity can be measured within a habitat using species richness and within a species using genetic diversity by calculating the heterozygosity index (H): H = number of heterozygotes number of individuals in the population iii) Understand how biodiversity can be compared in different habitats using a formula to calculate an index of diversity (D): D = Activity 4.12 Exploring biodiversity Activity 4.13 Comparing biodiversity Measuring genetic diversity 4.2 i) Understand the terms biodiversity and endemism. ii) Know how biodiversity can be measured within a habitat using species richness and within a species using genetic diversity by calculating the heterozygosity index (H): H = number of heterozygotes number of individuals in the population iii) Understand how biodiversity can be compared in different habitats using a formula to calculate an index of diversity (D):	Gene Expression

		D = Activity 4.14 Natterjack toads and genetic diversity **<u>Structure of plant cells</u>** 4.7 Know the ultrastructure of plant cells (cell walls, chloroplasts, amyloplasts, vacuole, tonoplast, plasmodesmata, pits and middle lamella) and be able to compare it with animal cells. 4.8 Be able to recognise the organelles in 4.7 from electron microscope (EM) images. Activity 4.15 Plant and animal cells (Interactive) **<u>Structure and function of starch and cellulose</u>** 4.9 Understand the structure and function of the polysaccharides starch and cellulose, including the role of hydrogen bonds between β-glucose molecules in the formation of cellulose microfibrils. 4.10 Understand how the arrangement of cellulose microfibrils and secondary thickening in plant cell walls contributes to the physical properties of xylem vessels and sclerenchyma fibres in plant fibres that can be exploited by humans. Activity 4.16 Cellulose structure (Interactive) Checkpoint question 4.5 Structure and location of specialised cells within the plant stem 4.10 Understand how the arrangement of cellulose microfibrils and secondary thickening in plant cell walls contributes to the physical properties of xylem vessels and sclerenchyma fibres in	Biodiversity Test

		plant fibres that can be exploited by humans. CORE PRACTICAL 6: Identify sclerenchyma fibres, phloem sieve tubes and xylem vessels and their location within stems through a light microscope. 4.11 Know the similarities and differences between the structures, position in the stem and function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes). Activity 4.17 Looking at plant stems (Core Practical) Movement of water and minerals through the xylem 4.12 Understand the importance of water and inorganic ions (nitrate, calcium ions and magnesium ions) to plants 4.11 Know the similarities and differences between the structures, position in the stem and function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes). Activity 4.18 Water transport in plants (Interactive) Mineral deficiency CORE PRACTICAL 7: Investigate plant mineral deficiencies. Activity 4.19 Sick plants (Core Practical) Note that this will need to be set up earlier in the lesson sequence if plants are going to have time to grow.	CORE PRACTICAL 6: Identify sclerenchyma fibres, phloem sieve tubes and xylem vessels and their location within stems through a light microscope. Activity 4.17 Looking at plant stems (Core Practical) Movement of water and minerals through the xylem CORE PRACTICAL 7: Investigate plant mineral deficiencies. Activity 4.19 Sick plants (Core Practical)

		Translocation in plants 4.11 Know the similarities and differences between the structures, position in the stem and function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes). Activity 4.20 Translocation in plants **<u>Strength testing of plant fibres</u>** CORE PRACTICAL 8: Determine the tensile strength of plant fibres. 4.10 Understand how the arrangement of cellulose microfibrils and secondary thickening in plant cell walls contributes to the physical properties of xylem vessels and sclerenchyma fibres in plant fibres that can be exploited by humans. Activity 4.21 Extraction of 'fibres' from plants (Core Practical) Antibacterial properties of plants CORE PRACTICAL 9: Investigate the antimicrobial properties of plants, including aseptic techniques for the safe handling of bacteria. 4.14 Understand the conditions required for bacterial growth. Activity 4.22 Why do they put mint in toothpaste? Would garlic be better? (Core Practical) **<u>Drug testing</u>** 4.13 Understand the development of drug testing from historic to contemporary protocols, including William Withering's digitalis soup, double blind trials, placebo, three-phased testing.	Plant Cells and Transport Test CORE PRACTICAL 8: Determine the tensile strength of plant fibres. Activity 4.21 Extraction of 'fibres' from plants (Core Practical) CORE PRACTICAL 9: Investigate the antimicrobial properties of plants, including aseptic techniques for the safe handling of bacteria.

		Activity 4.23 Testing a new drug	
Summer Term 3A Year 12	**<u>Intent</u>** Why is this taught now? Topic 3 The context for this topic is the most fundamental biological story there is – development from a single egg into a complex multicellular organism. The biological ideas required to understand this story are studied. The context allows a wide range of biological concepts to be studied. The topic starts by looking at cell structure and ultrastructure of eukaryote and prokaryote cells. It goes on to consider gametes and the role of meiosis in their formation and the introduction of variation. The developmental story continues with fertilisation, cell specialisation through differential gene expression and the organisation of cells in multicellular organisms. The role of the genome in the control of development is considered, in addition to how epigenetic changes, can modify the activation of certain genes and how both genotype and the environment influence phenotype. The study of stem cells and their use in medicine introduces ethical issues.	Topic 3- Voice of the Genome 3.15 Understand how some phenotypes are affected by multiple alleles for the same gene at many loci (polygenic inheritance) as well as the environment and how this can give rise to phenotypes that show continuous variation. Activity 3.16 Many genes can affect a single characteristic How phenotype is a result of genotype and environment – human height 3.14 i) Understand how phenotype is the result of an interaction between genotype and the environment. ii) Know how epigenetic changes, including DNA methylation and histone modification, can modify the activation of certain genes. iii) Understand how epigenetic changes can be passed on following cell division. Activity 3.17 Are we still getting taller? (Interactive, Practical) How phenotype is a result of genotype and environment – hair colour 14 Explain how phenotype is the result of an interaction between genotype and the environment (eg animal hair colour, human height, monoamine oxidase A (MAOA) and cancers), but the data on the relative contributions of genes and environment is often difficult to interpret. How phenotype is a result of genotype and environment –	

		monoamine oxidase A (MAOA) and cancers 14 Explain how phenotype is the result of an interaction between genotype and the environment (eg animal hair colour, human height, monoamine oxidase A (MAOA) and cancers), but the data on the relative contributions of genes and environment is often difficult to interpret. Activity 3.18 Genes or the environment	Gene Expression Test End of Topic 3 Test
	Topic 4 The story of the Brazil nut tree and the interdependence of highly adapted species for survival starts this topic. This story introduces biodiversity, adaptation, evolution by natural selection, and the idea that species of value to humans are threatened by human activity and there is a need for conservation. The topic focuses on biodiversity, how it is classified and measured, and how all this diversity has come about through adaptation and natural selection. It has sections on both traditional and novel uses of plants and plant fibres and the use of chemical extracts from animals and plants, and the potential contribution to sustainability by the use of plant based products. The concern for disappearing biodiversity and loss of potential natural resources is used to highlight the need for conservation of endangered species focusing on the role of zoos and seedbanks.	Topic 4- Biodiversity and Natural Resources **<u>Uses of seed-stored starch</u>** 4.15 Understand how the uses of plant fibres and starch may contribute to sustainability, including plant-based products to replace oil-based plastics. Activity 4.24 Superheating starch (Practical) Activity 4.25 Is your lifestyle sustainable? **<u>The role of zoos</u>** 4.16 Be able to evaluate the methods used by zoos and seed banks in the conservation of endangered species and their genetic diversity, including scientific research, captive breeding programmes, reintroduction programmes and education. Activity 4.26 Animal dating agency **<u>The role of zoos</u>** 4.16 Be able to evaluate the methods used by zoos and seed banks in the conservation of endangered species and their genetic diversity, including scientific research, captive breeding	

		programmes, reintroduction programmes and education. Activity 4.27 Putting them back. Checkpoint question 4.7 **<u>Seedbanks</u>** 4.16 Be able to evaluate the methods used by zoos and seed banks in the conservation of endangered species and their genetic diversity, including scientific research, captive breeding programmes, reintroduction programmes and education. Activity 4.28 More than just saving seeds	Sustainability and Conservation Test End of Topic 4 Test
Summer Term 3B Year 12	**<u>Intent</u>** Why is this taught now? This topic uses the context of climate change to develop understanding of a wide range of biological ideas. The topic uses the iconic example of the polar bear and the Arctic tundra as the storyline to introduce the topic and it is returned to at various points through the topic. The topic content starts with a consideration of ecosystems, the role of biotic and abiotic factors in determining the number and distribution of organisms in a habitat, and succession with the idea of niche revisited. The reliance of ecosystems on photosynthesis and the transfer of energy between trophic levels is studied before looking in detail at climate change. Throughout the topic there is a focus on the use of scientific evidence to support ideas and theories, including the evidence for climate change and the theory of evolution. The impact of climate change on organisms is considered and this provides the opportunity to revisit ideas about enzymes introduced in Topic	Teacher 1-Topic 5- On the wild side **<u>Photosynthesi</u>**s 5.5 Understand the overall reaction of photosynthesis as requiring energy from light to split apart the strong bonds in water molecules, storing the hydrogen in a fuel (glucose) by combining it with carbon dioxide and releasing oxygen into the atmosphere. 5.6 Understand how phosphorylation of ADP requires energy and that hydrolysis of ATP provides an immediate supply of energy for biological processes. 5.7 Understand the light-dependent reactions of photosynthesis including how light energy is trapped by exciting electrons in chlorophyll and the role of these electrons in generating ATP, reducing NADP in photophosphorylation and producing oxygen through photolysis of water. 5.8 i) Understand the light-independent reactions as reduction of carbon dioxide using the products of the light-dependent reactions (carbon fixation in the Calvin cycle, the role of GP,	

	2. The topic concludes by looking at the carbon cycle and methods to reduce atmospheric carbon dioxide.	GALP, RuBP and RUBISCO). ii) Know that the products are simple sugars that are used by plants, animals and other organisms in respiration and the synthesis of new biological molecules (polysaccharides, amino acids, lipids and nucleic acids). CORE PRACTICAL 11: Investigate photosynthesis using isolated chloroplasts (the Hill reaction). 5.9 Understand the structure of chloroplasts in relation to their role in photosynthesis. Activity 5.5 Investigating photosynthesis (CORE PRACTICAL) Activity 5.4 Photosynthesis (Interactive) Activity 5.6 How Calvin won the Nobel Prize (Optional) Checkpoint question 5.3	CORE PRACTICAL 11: Investigate photosynthesis using isolated chloroplasts (the Hill reaction).