Year 12 Topics

In year 12 we teach the following topics over the course of the year. Each topic draws on prior learning from previous years and builds on understanding from the KS3 programme of study. Each topic develops and deepens the Core knowledge that will underpin all areas of the curriculum at KS5 and onward into undergraduate courses.

Topic	Rationale	Knowledge acquisition	Key vocabulary	Skills and enrichment
3.2.1 Cell structure	All life on Earth exists as cells. These have basic features in common. Differences between cells are due to the addition of extra features. This provides indirect evidence for evolution. All cells have a cell-surface membrane and, in addition, eukaryotic cells have internal membranes.	Structure of Eukaryotic cells (epithelial cell of SI and plant) and their organelles.	Eukaryotic, Cell surface membrane, mitochondria, chloroplasts, Golgi body, lysosomes, ribosomes, RER, cell wall vacuole.	Include opportunities to develop subject specific skills plus general core skills including independence, problem solving, evaluation, analysis, creativity, literacy, numeracy and oracy <u>Numeracy skills</u> Calculation of magnification, conversion of units, significant figures. <u>Practical skills</u> Calibration of an eyepiece graticule. Biological drawings – rules and interpretation of them from exemplar drawings.
		Structure of Prokaryotic cells (bacteria) and their organelles and viruses.	Prokaryotic, murein, glycoprotein, plasmids, flagella, acellular, capsid, attachment protein.	
		Calculating cell sizes from images and electron micrographs.	Magnification, image size, real size, micrometers, nanometers,	
		Calibration of an eyepiece graticule.	Eyepiece graticule, stage micrometer, sub-divisions, field of view.	
		Methods of studying cells - microscope TEM, SEM principles and limitations.	TEM, SEM, resolution, magnification, wavelength.	
3.2.2 All cells arise from other cells	All cells arise from other cells, by binary fission in prokaryotic cells and by mitosis and meiosis in eukaryotic cells.	Mitosis – behaviour of chromosomes during IPMAT	Interphase, prophase, metaphase, anaphase, telophase, daughter cells.	<u>Numeracy skills</u> Calculation of mitotic index using cells in mitosis/total number of cells. <u>Practical skills</u> RP2 (root tip squash) prep of stained squashes of cells from root tips.
		Cell cycle and cancer	Mitosis, uncontrolled cell division, tumours.	
		Mitotic index – as a measure of cellular proliferation.	Mitotic index, cancer, root tip squash.	
		Binary fission in prokaryotic cells and viral replication.	Binary fission, Injection, nucleic acid, virus particle.	

3.2.3 Transport across cell membranes	All cells have a cell-surface membrane and, in addition, eukaryotic cells have internal membranes. The basic structure of these plasma membranes is the same and enables control of the passage of substances across exchange surfaces by passive or active transport.	Basic structure of the cell surface/plasma membrane	Phospholipids, proteins, intrinsic, extrinsic, receptor, fluid mosaic model, cholesterol.	<u>Practical skills</u> RP3 (osmosis) Production of a dilution series of solute to produce a calibration curve to determine the water potential of potato. <u>Practical skills</u> RP4 (beetroots) Investigation into the effect of a named variable (alcohol conc) into the permeability of beetroot cell membranes.
		Cell transport – diffusion and facilitated diffusion.	Phospholipid bilayer, diffuse, carrier protein, channel protein, facilitated, passive.	
		Cell transport – active transport.	ATP, hydrolysis , tertiary structure,	
		Cell transport – co-transport in the ileum of the SI including the role of Na+.	Co-transport, passive, active, ATP, inward concentration gradient, glucose, amino acids	
		Cell transport – osmosis in terms of water potential.	Water potential, lower, higher, more/less negative,	
		RP work/skill development via RP3 and RP4.	Dilution series, water potential, permeability, cell-surface membrane.	
3.2.4 Cell recognition and the immune system	Cell-surface membranes contain embedded proteins. Some of these are involved in cell signalling – communication between cells. Others act as antigens, allowing recognition of 'self' and 'foreign' cells by the immune system. Interactions between different types of cell are involved in disease, recovery from disease and prevention of symptoms occurring at a later date if exposed to the same antigen, or antigen-bearing pathogen.	Introduction- immune system basics and recap from GCSE. Passive v active immunity	Phagocytosis, memory cells, vaccination, passive, active, immunity	
		Recognising foreign cells. Antigens and antigenic variability	Antigens, foreign, self, non-self	
		Phagocytosis- "pac-man" cells	Phagocytes, chemotaxis, engulf, hydrolytic enzymes, lysozymes, digest, destroy, antigen presenting cells	
		T cells and the cell mediated response	T-lymphocytes, helper T cells, cytotoxic T cells, antigen presenting cells	
		C cells and the humoral response	B lymphocytes, foreign antigen, clonal selection, monoclonal antibodies, plasma cells, memory cells	

		Antibodies- definition, structure and uses	Antigen-antibody complex, agglutination, phagocytosis, ELISA, HIV, drug testing	
		Vaccinations- why bother?	Vaccine, dead, attenuated, herd immunity, immunological memory, primary response, secondary response	
		HIV- structure and how it affects T helper cells	HIV, antigenic variability, helper T cells, reverse transcriptase	
		AIDS- how does HIV infection lead to AIDS?	Pneumonia, cancer, flu, T cell count, immune system	
		Use of monoclonal antibodies and ELISA testing		

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3.4.1 DNA, genes and chromosomes	Biological diversity - is reflected in the vast number of species of organisms, in the variation of individual characteristics within a single species and in the variation of cell types within a single multicellular organism. Differences between species reflect genetic differences. Differences between individuals within a species could be the result of genetic factors, of environmental factors, or a combination of both. A gene is a section of DNA located at a particular site on a DNA molecule, called its locus. The base sequence of each gene carries the coded genetic	DNA introduction and GCSE recap	Genes, DNA, chromosomes, DNA is DUN	
		Structure and role of DNA and RNA	Bases, triplets, codons, introns and exons	
		Eukaryotic cells v prokaryotic cells		
		DNA replication and Boris Johnson	DNA helicase, hydrogen bonds, semi conservative, Mel and Stahl	
		Transcription	Ribozymes, mRNA, pre-mRNA, ribosomes, linear	
		Translation	mRNA, ribosomes, cytoplasm,	
		Comparison of transcription, translation and DNA replication		

	information that determines the sequence of amino acids during protein synthesis. The genetic code used is the same in all organisms, providing evidence for evolution. Genetic diversity within a species can be caused by gene mutation, chromosome mutation or random factors associated with meiosis and fertilisation. This genetic diversity is acted upon by natural selection, resulting in species becoming better adapted to their environment. Variation within a species can be measured using differences in the base sequence of DNA or in the amino acid sequence of proteins. Biodiversity within a community can be measured using species richness and an index of diversity.	Mutations	Deletion, frame shift, substitution (MSN), carcinogen, mutagenic	
				Include opportunities to develop subject specific skills plus general core skills including independence, problem solving, evaluation, analysis, creativity, literacy, numeracy and oracy

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3.4.5 Species and taxonomy	The following ideas need to be covered to support the concept of Biodiversity and species diversity • The concept of a species. • Courtship behaviour • Phylogenetic classification • Hierarchical classification into taxonomic ranks. • The binomial identification of species • Advances in technology that help to clarify evolutionary relationships between organisms.	Definition of a species	Group, organisms, morphology, successful, interbreed, fertile, offspring	Students will be expected to: • Apply knowledge to interpret information and data about courtship behaviours. • Apply knowledge to interpret data and draw conclusions on evolutionary relationships. • Explain why immunological comparisons are a valid way of determining evolutionary relationships. • Explain why these techniques allow us to classify more accurately than comparing anatomical features.
		Reasons for the difficulties of defining species	Hybrid, variation	
		Stages of courtship display	Stimulus response chain, series, element, continuation, termination	
		How courtship display supports the perpetuation of species through species recognition and successful mating	Species recognition, innate behaviour, attract, mating ability, sexually receptive, synchronise, pair bond	
		The definition of Phylogenetic Hierarchy	Evolutionary history, groups, no overlap	
		Evidence to support Phylogenetic classification	Morphology, behaviour, biochemistry, homologous features, fossil record, embryology	
		Process of Taxonomical classification		
		The Binomial system of classification	Domain, Kingdom,	

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3.4.6 Biodiversity within a community	Biodiversity and species diversity is a module will allows some of the prior learning on species, adaptation, evolution,	Biodiversity and genetic diversity?	Variety, frequency, alleles , population, adapt, survive, characteristics, range	Students will be expected to: • explain what is meant by the terms biodiversity, species richness and index of diversity
		Biotic and abiotic factors that affect Biodiversity	Mutation, interbreeding, competition, predation, disease,	

	genetic comparison to be put into a 'real world' context whereby human impact on the environment can be evaluated.		hunting, climate change, habitat destruction	• calculate the index of diversity when supplied with relevant information $d = \frac{N\ (N-1)}{\Sigma\ n\ (n-1)}$ • interpret information and draw conclusions from the index of diversity for different habitats • explain how farming techniques impact on biodiversity, and the reason why these techniques are used • evaluate conservation techniques, and why these must be balanced with farming.
		Genetic bottleneck	Population reduction >50%, reduced genetic diversity, interbreeding	
		Founder effect	New (founder) population, decreased population, reduced allele frequency, decreased genetic diversity, genetic drift	
		Selective breeding	Artificial selection, favourable characteristics, gene pool reduction, mutation	
		What is species diversity and why do some habitats have a high species diversity?	Richness, evenness, niches, habitats, food sources, adaptation, coarl reef, tropical rainforest, desert	
		The factors that affect species diversity including human impact	Agriculture, monoculture, herbicide, deforestation, hedgerow removal,	
		How to calculate the index of diversity (d)?		
		How to interpret the index of diversity? And what do the values tell you about and ecosystem and Biodiversity?	Richness, evenness, decreas, increase, human activity, pollution	

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3.4.7 Investigating diversity	Evidence for relationships between species and methods for investigating variation	The process of DNA hybridisation	ssDNA, dsDNA, denature, Hydrogen bonds, renature, hybrid, homoduplex, temperature, increments, T50,	Students will be expected to demonstrate the following skills: • Design methods to ensure random sampling • Carry out random sampling within a single population • Use random samples to investigate the effect of aspect on leaf growth. • Calculate and interpret mean values and the standard deviation around the mean. • Analyse, interpret and evaluate scientific information and evidence to make judgements and reach conclusions and design/refine practical design and procedures.
		Biochemical analysis of base sequences of DNA and mRNA.	Base sequence, specific gene,	
		Biochemical analysis of amino acid sequences	common/universal protein, Haemaglobin, Cytochrome C, relationships	
		How to interpret data to suggest evolutionary relationships within and between species	Similarities, differences, comparisons, common ancestor, evolution	
		Advantages and disadvantages of different analysis techniques	Error, bias, degenerate nature of DNA, sample size,	
		Changes to evolutionary relationships due to technological developments	Variation, reliability,	
		How to carry out random sampling effectively	Qaudrat, random number, grid	
		Methods of presenting raw data	Results table, kite diagram, scatter graph	
		What is mean and standard deviation?	Spread of data, mean, reliability	
		How to calculate mean and standard deviation		