



KS5 Biology Curriculum Intent, Implementation, and Impact



Curriculum Intent

To develop skilled knowledgeable independent practical scientists.

The curriculum will allow all students across the academy to become successful scientists. All students will be supported to develop their understanding, motivated to secure their knowledge, and challenged to exceed expectations and maximise their potential in science.

At KS5 students choose to study specialised sciences. In biology they will significantly develop numeracy skills and increase their scientific literacy. Students will be encouraged to work independently both individually and as part of teams in their practical work, problem solving and presenting their understanding. The KS5 curriculum will help develop students for further scientific study beyond their A Level courses, and offer opportunities to explore scientific careers.

Embedding the Catholic Ethos in the Science Curriculum

“The son is the image of the invisible God, the firstborn over all creation. For in him all things were created: things in heaven and on Earth, visible and invisible, thrones or powers or rules or authorities; all things have been created through him and for him.”

Colossians 1:15-16

Science by its nature offers many opportunities for links with the Catholic Ethos of the school. All lessons in Science, like other lessons in school, start with the academy prayer. Science Labs which are also form rooms display information shared by the chaplaincy team.

The Science curriculum focuses on teaching the skills linked to the “Scientific Method” including investigative skills, analytical skills and problem solving. Science education must also address the mechanics, reasoning, and explanation behind observations of the universe and development of new technology. These can at times be at odds with some religious beliefs and where this occurs science teaching should focus on the “scientific facts” but acknowledge the relevant religious teaching.

Science and its study allows students to engage with their own religious or moral beliefs, while consider the believes of others and the scientific explanations. These can be addressed through links to the gospel values by considering:

- Awe and wonder of the universe and its creation.
- The miracle of life, both of humankind and the living kingdoms.
- Care for our self’s and the bodies God have given us.
- Service (Medicine, Veterinary, etc)
- Stewardship and care for the planet God gave us.
- Ethical and moral discussions.



KS5 Biology Curriculum Intent, Implementation, and Impact



Implementation

The following skills are delivered across the two-year curriculum

Maths skills

Units, unit prefixes, SI units, base units, derived units and non-SI units, powers of ten and standard form, converting units, Significant figures and rounding. Data handling, significant figures, decimal places.
Averages; arithmetic mean, median, mode, percentages, proportions, fractions, percentage change,
Algebra, equations, changing the subject, substitution
Graphs, straight line graphs, charts, scatter diagrams, calculating gradients, x and y-intercepts, calculation in rates, curved graphs, tangents, error bars and range bars, probability, chi-squared, student t test, correlation coefficient (Pearson's product moment).
Geometry, logarithms, rules of logarithms, base 10, natural logarithms, exponential decrease.

Practical Skills

Planning experiments, variables, choosing equipment, methods, evaluating a plan. Working Safely, risks, hazards and ethical considerations.
Taking measurements including, mass, volume, temperature, pH, etc. Using a range of laboratory equipment.
Analysing data, presenting data, correlation vs cause, conclusions, evaluations, errors, uncertainty, repeatability, accuracy and precision
Dissections, aseptic techniques, sampling techniques

Please note: the precise timings of when each topic is taught may vary from year to year depending on various factors. The timings below are a guide.



KS5 Biology Curriculum Intent, Implementation, and Impact



Science

	AUTUMN TERM	SPRING TERM	SUMMER TERM
Year 12 Implementation – Teacher One	<p>Teacher One Cells</p> <p>Cell Structure Studying cells; microscopy, cell fractionation, the electron microscope, microscope measurements and calculations. Eukaryotic cell structure, nucleus, mitochondrion, chloroplasts, endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Cell Wall, Vacuoles, structure and function. Cell Specialisation, Tissues, Organs, Organ systems. Prokaryotic cells and viruses. Mitosis, fission, and replication. The cell cycle, cancer and the control of mitosis.</p> <p>Transport across cell membranes Structure of the cell membrane; phospholipids, Proteins, Cholesterol, Glycolipids, Glycoproteins, permeability, fluid-mosaic model. Diffusion, facilitated diffusion, protein channel, carrier proteins. Osmosis, water potential, osmosis and plant cells. Active Transport. Co-transport and absorption of glucose.</p>	<p>Teacher One Cells</p> <p>Cell recognition and the immune system Defence mechanisms, phagocytosis, T-lymphocytes, cell-mediated immunity, antigens. B-lymphocytes, humoral immunity. Antibodies, monoclonal antibodies. Vaccination, active and passive immunity, herd immunity, ethics. HIV, how HIV causes AIDS, ELISA test.</p> <p>Genetic Information, Variation, and relationship between molecules. DNA, Genes and Protein Synthesis Genes and the genetic code, DNA and chromosomes, alleles. Structure of RNA; messenger RNA, transfer RNA. Polypeptide synthesis; transcription, splicing, translation, assembling proteins.</p>	<p>Teacher One Genetic Information, Variation, and relationship between molecules.</p> <p>Genetic Diversity Gene mutation; substitution of bases, deletion of bases, chromosome mutations. Meiosis and genetic variation; segregation of homologous chromosomes, genetic recombination by crossing over. Genetic Diversity and adaptations; natural selection in evolution. Types of selection; directional selection, stabilising selection.</p> <p>Biodiversity Species and Taxonomy; naming species (binomial system), courtship behaviour, principles of classification, phylogeny. Diversity within a community; index of diversity, Diversity and human activity; impact of agriculture; balancing conservation and farming. Investigating diversity; comparing characteristics, comparing DNA sequences, comparing amino acids in proteins. Investigating variation; sampling, normal distribution, mean and standard deviations</p>



KS5 Biology Curriculum Intent, Implementation, and Impact



Science

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Year 12 Implementation – Teacher Two</p>	<p>Teacher Two Biological Molecules Biological Molecules Bonding and formation of molecules, polymerisation and macromolecules, condensation and hydrolysis reactions, Metabolism, The mole and Molar Solutions, Atoms, Isotopes and Ions, Carbohydrates; life based on carbon, marking large molecules, testing for sugars, monosaccharides, disaccharides and polysaccharides. Starch; testing for starch, Glycogen, Cellulose. Lipids, Triglycerides (structure and properties) phospholipids, testing for lipids. Proteins, amino acids, peptide bonds, structure of protein-polypeptides, testing for proteins, Enzymes actions, enzymes as catalysts, enzyme structure, induced fit model. Factors affecting enzymes action; measuring rate, effect of temperature, pH and concentration. Enzyme inhibition; competitive inhibitors, non-competitive inhibitors</p> <p>Nucleic Acid Structure of RNA and DNA, nucleotide structure, Base pairing, the double helix, DNA stability, function of DNA. DNA replication. Energy and ATP; structure of ATP, synthesis of ATP, ATP storing energy, roles of ATP. Water and its functions; dipolar molecule, water and H-bonding, SHC, SLH, cohesion and surface tension, Importance of water to organisms</p>	<p>Teacher Two Organisms exchange systems with their environment</p> <p>Exchange Exchange between organisms and their environment; surface area to volume ratio. Gas exchange in unicellular organisms, insects, fish (gills and counter current exchange), and leaves (stomata). Limiting water loss (in insects and plants). Human gas exchange system; mammalian lungs, breathing (inspiration & expiration), gas exchange in the lungs. Enzymes and digestion, absorption of the products of digestion; structure of the ileum.</p>	<p>Teacher Two Organisms exchange systems with their environment</p> <p>Mass Transport Haemoglobin, loading and unloading oxygen, oxygen dissociation curves, effect of carbon dioxide concentration. Circulatory system of a mammal, features of transport systems. Structure of the human heart, supplying the heart with oxygen. The Cardiac Cycle, diastole, atrial systole, ventricular systole, valves, cardiac output. Blood Vessels; arteries, veins and capillaries, structure and function. Tissue fluid. Transport of water in Xylem; movement of water through; stomata, cells of the leaf, and xylem. Transport of organic substances in the phloem; mechanism of translocation. Investigating transport in plants; ringing experiments, tracer experiments,</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Impact</p>	<p>Each topic includes the following assessments:</p> <ul style="list-style-type: none"> • End of Topic Knowledge Checker. • CPAC assessment of required practical's • Past paper practice <p>End of Term Synoptic assessment assesses all content from this term.</p>	<p>Each topic includes the following assessments:</p> <ul style="list-style-type: none"> • End of Topic Knowledge Checker. • CPAC assessment of required practical's • Past paper practice <p>End of Term Synoptic assessment assesses all content from the Autumn and Spring terms</p>	<p>Each topic includes the following assessments:</p> <ul style="list-style-type: none"> • End of Topic Knowledge Checker. • CPAC assessment of required practical's • Past paper practice <p>End of Year Synoptic assessment assesses all content from this year.</p>



KS5 Biology Curriculum Intent, Implementation, and Impact



	AUTUMN TERM	SPRING TERM	SUMMER TERM
Year 13 Implementation – Teacher One	<p>Teacher One Energy Transfer in and Between Organisms Photosynthesis Photosynthesis, structure of the leaf, equation, structure and roles of chloroplasts. Light dependent reaction; oxidation and reduction, making ATP, photolysis of water. Light independent reaction; the Calvin cycle, measuring photosynthesis.</p> <p>Respiration Glycolysis, energy yields, link reaction and Krebs cycle. Oxidative phosphorylation, electron transfer chain and synthesis of ATP, alternative respiratory substrates. Anaerobic respiration, production of ethanol, production of lactate, energy yields.</p> <p>Energy and Ecosystems Food chains and energy transfer, biomass, productivity, Nutrient Cycles; nitrogen cycle, phosphorous cycle. Natural and artificial fertilisers. Nitrogen based fertilisers and the environment</p> <p>Organisms respond to changes in their environment Response to Stimuli Survival and response; taxes, kineses, tropisms Plant growth factors; gravitropism, phototropism, role of IAA. A reflex arc; nervous organisation, the spinal cord. Receptors; Pacinian corpuscle, receptors in the eye. Control of heart rate; autonomic nervous system, modifying heart rate, chemoreceptors, pressure receptors.</p>	<p>Teacher One Organisms respond to changes in their environment Nervous Coordination and Muscles Neurones and nervous coordination, types of neurone. The nerve impulse; resting potential, action potential. Passage of an action potential along myelinated and unmyelinated axons. Speed of the nerve impulse; factors affecting speed, all-or-nothing principle, the refractory period. Structure and function of synapses; inhibition, transmission across a synapse. Structure of skeletal muscle; types of muscle fibre, neuromuscular junctions, sliding filament mechanism, energy supply during muscle contraction.</p> <p>Homeostasis Principles of Homeostasis, control mechanisms, thermoregulation in ectotherms and endotherms. Feedback mechanisms; negative feedback. Hormones and regulation of blood glucose concentration; mode of action, role of the pancreas, role of the liver, factors that influence blood glucose concentration, insulin and β cells, glucagon and α cells, role of adrenaline. Diabetes and its control, types of diabetes. Control of blood water potential; structure of the nephron, structure of the kidney, role of the nephron in the osmoregulation, role of hormones in osmoregulation.</p>	<p>Revision of all A Level content.</p> <p>Completion of outstanding required practicals.</p> <p>Paper 3 – practical skills practice.</p> <p>All other exam practice.</p>



KS5 Biology Curriculum Intent, Implementation, and Impact



Year 13 Implementation – Teacher Two	<p>Teacher Two</p> <p>Genetics, populations, evolution and ecosystems</p> <p>Inherited Change Genotype and phenotype, genes and alleles. Monohybrid inheritance; genetic crosses, probability, Dihybrid inheritance. Codominance and multiple alleles. Sex-linkage; haemophilia, pedigree charts. Autosomal linkage. Epistasis. Chi-squared test.</p> <p>Populations and Evolution Population Genetics; Hardy-Weinberg principle. Variation in phenotype; variation due to genetic factors, variation due to largely environmental influences. Natural selection, over-population of offspring in natural selection, the role of variation in natural selection. Effect of different forms of selection on evolution; stabilising selection, directional selection, disruptive selection, peppered moths. Isolation and speciation; allopatric speciation, sympatric speciation.</p> <p>Populations in ecosystems Ecosystems, populations, community, habitats, ecological niche. Variation in population size; growth curves, population size, abiotic factors. Competition; intraspecific competition, interspecific competition. Predation, predator-prey relationship. Investigating populations ; quadrats, random sampling, systematic sampling, transect lines, mark-release-recapture techniques. Succession. Conservation of habitats; managing succession, conflicting interests.</p>	<p>Teacher Two</p> <p>The Control of Gene Expression</p> <p>Gene Expression Substitution of bases, deletion of bases, types of gene mutation, causes of mutation, mutagenic agents. Stem cells and totipotency; cell differentiation and specialisation. Regulation of transcription and translation; effect of oestrogen on gene transcription. Epigenetic control of gene expression. Gene expression and cancer; types of tumour, genetic control of cell division. Genome projects; sequencing genomes, DNA sequencing, the proteome.</p> <p>Recombinant DNA Technology Producing DNA fragments, using reverse transcriptase, using restriction endonucleases, the gene machine. In Vivo Cloning – use of vectors, preparing the DNA fragment for insertion, insertion of DNA fragment into a vector, introducing DNA into host cells, marker genes. In Vitro gene cloning; polymerase chain reaction. Comparing in vivo and in vitro cloning. Locating genes, genetic screening and counselling; DNA probes, DNA hybridisation, location specific alleles of genes, Genetic Screening, personalised medicine, genetic counselling. Genetic Fingerprinting and its uses.</p>	
Impact	<p>Each topic includes the following assessments:</p> <ul style="list-style-type: none"> • End of Topic Knowledge Checker. • CPAC assessment of required practicals • Past paper practice <p>Mock One will take place during November</p>	<p>Each topic includes the following assessments:</p> <ul style="list-style-type: none"> • End of Topic Knowledge Checker. • CPAC assessment of required practicals • Past paper practice <p>Mock Two will take place during February.</p>	<p>A Level Exams start in late May and continue into June.</p>