A Level Biology

Curriculum Overview

A-Level Biology - When designing a curriculum, we have strived to achieve a balanced course with challenge embedded from the start. We want to allow our students to explore the world of Biology and see the connections between all aspects of the planet that we inhabit. Biology provides foundations for understanding the natural world and is inextricably linked with the other science disciplines. Biology contributes to our changing world and is a vital driver of our future prosperity. Students will be taught essential knowledge, methods, processes, and applications of Biology, further developing their curiosity about the subject, giving them insight into how science works, and providing an appreciation of its relevance to their everyday lives and their future careers.

The scope and nature of A-Level Biology study presents a combination of Human and Plant Biology. It encourages students to be inspired, motivated and challenged by the subject matter and the achievements that this science has brought about. Students are helped to appreciate how the complex and diverse natural world can be explained with the basic principles of the big ideas, these include the building blocks of life – the biological molecules and how these interact inside cells and organisms. We then look at how these organisms regulate themselves through homeostasis and then how the organisms interact with each other in ecosystems. The interdependence of all life is explored, and the variety and survival of organisms is looked at through the sphere of genetics. Finally, we look to the future and how our knowledge of genetics can influence how we target and treat diseases. We are committed to providing a stimulating, engaging and intellectually challenging learning environment to enable all our students to develop scientific consciousness, from the basic biological molecules of organisms to species interactions within ecosystems. This will allow our students to become informed citizens and empower them to make decisions in future careers and their own lives that will benefit society as a whole.

A significant focus is placed upon developing our Biologists as exceptional practical scientists. Using the core principles of good investigative techniques and the associated maths skills. Students will experience what makes a strong and valid investigation and know how to develop their own method and carry out an investigation safely and efficiently. Building these practical skills throughout the course will enable all students to progress to university or work-based science apprenticeships with a high level of technical ability and mastery. In addition to planning and carrying out an investigation the students will have to learn how to interpret and use the data or observations that they have generated. The skills that the students acquire in data analysis are invaluable as a transferable life skill. Also, the ability to use statistical tests and determine the validity and significance of the data are wider skills that could be employed across many employment sectors. In the process of analysis also comes the need to be ruthlessly logical and to spot patterns and link that to scientific theory, again these skills are very transferable beyond a science setting.

Further rationale underpinning our curriculum design includes the careful selection of the order in which topics are taught; this enables students planned opportunities to practise their skills in the context of new knowledge. Aspects of some topics are especially taught to bridge transitions such as that from GCSE to A-Level and from Y12 to Y13. The topics of Biological molecules and DNA and evolution in Year 12 are

all taught together to allow the students to make strong connections between these core areas. This area is also revisited in the Year 13 course to allow consolidation of the year 12 learning and then building in new content leading to the application of DNA technology. Thus, students' knowledge is built up in a logical, incremental manner, which we consider to be vital to foster a thorough understanding of complex scientific concepts. The same is true for the cells and immunity topics and the larger topic of ecosystems and the environment, they are grouped together in Year 12 and then expanded upon in Year 13. Throughout the curriculum misconceptions have been identified and teachers will reflect on these in their planning and delivery of lessons. The teaching is responsive to the students and every opportunity is taken to allow students to share their own experience of the topics and discussions about the applications of Biology in the real world capitalised upon.

Periodic review and evaluation of the Biology schemes of work continue to develop and respond to our intent to develop and embed challenge, metacognition, long-term retention and scientific literacy into our curriculum. The course aims to equip our young learners with the independent study skills they need to develop to be successful in their future pathways. A series of electronic supporting materials has been created, namely a study pack to motivate and support students in their independent learning to foster a culture of hard work that leads to achievement and encourages life-long learning.

Students are actively encouraged to further their understanding of current developments through wider reading and journal articles that we circulate. We foster students' interest in Biology by taking them on trips to see working scientists discussing their fields at events like science live. We also have visiting experts delivering presentations to our cohort to expand their ideas on potential careers that they may not have considered.

Assessment

Half termly assessment in Biology consist of a mixture of extended and short answer questions and those relating to the testing of their practical knowledge and understanding.

Homework

Shorter practice questions, exam questions, practical write ups and independent work using study packs, banks of exam papers and purchased on-line resources

Clubs and/or intervention

Biology Drop in: student support, including homework and practical write-up support.; student one- to ones and target setting/ monitoring; individualised work programmes

Parental/Carer support

Homework communications set through MCAS

Helpful sources of information

AQA website, Study packs, Course and Practical Guides, Kerboodle.com, and Seneca learning. For extension tasks and higher grades, the Biological Science Review magazine is a good source of material set in alternative contexts.

Connections to future pathways

Careers: agriculturalist/farmer, agricultural scientist, andrologist, arborist, antibody formulation scientist, analytical scientist, astrobiologist, athletic trainer, audiology, biochemist, bioethicist, biologists, biomedical scientist, bioprocessing engineer, botanists, brain surgeon, cameraman, cardiologist, clinical endocrinologists, clinical social worker, conservation and environmental protection, conservation biologist, counsellor, cytogeneticist, diabetic nurse, diabetologist, dietitian, doctor, dosimetrist, ecologist, education, electroneurodiagnostic technician, embryologists, endocrinologists, endocrinology specialist nurse, environmental geneticist, environmental Health officer, environmental planner, environmental scientist, electrician, engineer, exercise physiologist, food science technician, forensics, forestry consultant, forest scientist, forestry technician, gardeners, gastroenterologist, genetic counsellor, geneticist, genetic technologist, global health researcher, gynaecologist, higher education lecturerhorticulturalist, horticultural scientist, immunologist, industrial chemist, infertility counsellor/support advisor, irrigation engineer, IVF nurse IVF doctor, jewellers, kidney dialysis nurse, laboratory technician, marine biologist, medical scientist, medical technician/engineer, microbiologist, neonatal/paediatric respiratory care specialist, naturalist, neural engineering, neuroscientist, nuclear physicist, neuroanatomist, neurobiologist, neurochemist, neurological surgeon, neurologist, neuroradiologist, nurse, nutritionist, oncologist, oncology nurse, ophthalmologist, optician, orthoptist, optometrist, paediatric endocrinologist, palaeontologist, paleobiologist, particle scientist, pathologist, pharmacist, physical therapist, physiotherapist, plant biochemist, plumber, psychiatrist, psychobiologist, psychologist, Public Health project manager, radiation therapist, radiographer, renal specialist, research assistant, research endocrinologist, research physicist, research scientist, respiratory therapist, science writer, sports nutritionist, sports and exercise nutrition, sports therapist, urologist, virologist, wellness coach, wildlife biologist, window cleaner, zoologist.

Future learning: degrees in agriculture, biology, biochemistry, biomedical science, biopharmaceuticals, botany, clinical endocrinology, conservation biology, dentistry, ecological restoration environmental engineering, environmental management, forensic science, genetics, horticulture, marine biology, medicine, microbiology, physics, social sciences, human nutrition, pharmacology, plant science, botany, respiratory therapy, optometry and visual science, paleobiology, palaeontology, taxonomy, zoology; foundation and higher apprenticeships in engineering.

Year 12 Overview

Term	Knowledge	Assessment	Connections to learning

Autumn 1	**3.1 Biological molecules** All life on Earth shares a common chemistry. This provides indirect evidence for evolution. Despite their great variety, the cells of all living organisms contain only a few groups of carbon-based compounds that interact in similar ways. Carbohydrates are commonly used by cells as respiratory substrates. They also form structural components in plasma membranes and cell walls. Lipids have many uses, including the bilayer of plasma membranes, certain hormones and as respiratory substrates. Proteins form many cell structures. Rich Question: Where did all life begin; how did we get these molecules on the planet?		
	Biological Molecules ➢ Recap of GCSE elements and compounds ➢ Monomers and Polymers ➢ Monosaccharides, amino acids and nucleotides are examples of monomers. ➢ A condensation reaction joins two molecules together with the formation of a chemical bond and involves the elimination of a molecule of water. ➢ A hydrolysis reaction breaks a chemical bond between two molecules and involves the use of a water molecule. ➢ Carbohydrates structure and function. ➢ Lipids structure and function. ➢ Proteins structure ➢ Practical Tasks ➢ Food Tests ➢ Glucose standard curve	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ In lesson retrieval quiz and multiple-choice hinge questions, exam questions ➢ Assessment for this half term is a GCSE bridging test (relevant GCSE knowledge recap) and a Carbohydrate and Lipid Test.	➢ Atomic structure, bonding, elements and compounds taught at GCSE (Chemistry and Trilogy) ➢ Mention the link to plastics for further explanation of monomers to polymers (alkenes- GCSE Chem) ➢ Link to KS4 Biology and Trilogy in the organisation and digestion unit in Year 10 when carbohydrates, proteins and lipids (fats) are discussed ➢ Personal Development ➢ Physical development Diet issues/awareness of life choices

<table>
<tr><td rowspan="2">Autumn 1</td><td colspan="3"><u>3.2 Cells</u>

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 arise from other cells, by binary fission in prokaryotic cells and by mitosis and meiosis in eukaryotic cells.
Rich Question: Were organelles once separate cells in their own right, was this a mutualistic relationship that led to eukaryotic cells?</td></tr>
<tr><td>Cells
➢ Cell Fractionation
➢ Microscopy
➢ Eukaryotic cells
➢ Cell specialisation and organisation
➢ Prokaryotic cells and viruses
➢ Mitosis
➢ Cell Cycle

Practical Tasks
➢ Mitosis root tip practical (REQUIRED PRAC)</td><td>➢ Exam questions (Multiple choice, structured, closed short answer, and open response)
➢ Assessed homework
➢ Required practical write ups
➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions</td><td>➢ GCSE Biology and Trilogy, first topic in Year 10 cell structure
➢ GCSE Biology and trilogy, second topic in Year 10 cell division
➢ GCSE Biology and trilogy, communicable diseases topic for knowledge of viruses and prokaryotes
➢ Cultural development
➢ The discovery of the microscope
➢ Social Development, including political and current affairs awareness
➢ COVID and pandemics</td></tr>
<tr><td>Autumn 2</td><td colspan="3"><u>3.1 Biological Molecules</u>

Proteins form many cell structures. They are also important as enzymes, chemical messengers and components of the blood. Nucleic acids carry the genetic code for the production of proteins. The genetic code is common to viruses and to all living organisms, providing evidence for evolution. The most common component of cells is water; hence our search for life elsewhere in the universe involves a search for liquid water.
Rich Question: What socio-economic factors led to the discovery of DNA
What role did women play in the discovery of the structure of DNA?</td></tr>
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	Biological Molecules ➢ Recap Protein structure ➢ Enzymes as a type of protein ➢ Enzymes structure and function and factors that affect enzymes function ➢ Enzyme model – lock and key versus induced fit ➢ Structure of RNA and DNA ➢ Function of DNA ➢ DNA replication ➢ Water – structure and function ➢ ATP – structure and function Practical Tasks: ➢ Enzyme practical (REQUIRED PRACTICAL) looking at the effect of pH/Temp/substrate concentration	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions ➢ This half terms assessment is a proteins and enzymes test	➢ Reproduction and variation unit at GCSE Biology and trilogy (DNA content) ➢ Chemistry GCSE covalent bonds (water) ➢ Link to KS4 Biology and Trilogy in the organisation and digestion unit in Year 10 when proteins are discussed ➢ Cultural development ➢ Discovery of DNA
	<u>3.2 Cells</u> 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. 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. Rich Question: What led to the discovery of the Cholera outbreak in London in 1854? What socio-economic/natural disaster/environmental factors lead to an outbreak of Cholera?		
	3.2 Cells ➢ Structure of the cell membrane ➢ Diffusion ➢ Osmosis ➢ Active Transport ➢ Co-Transport ➢ Introduction to the immune system (phagocytosis/non-specific and specific immune responses)	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups	➢ GCSE Biology and trilogy topics from Year 10 cell structure and transport. ➢ GCSE Biology and trilogy topics communicable disease and preventing and treating disease. ➢ Links to AS Biology course, students need to

	Practical Activities ➢ Permeability of cell membrane (beetroot REQUIRED PRAC) ➢ Osmosis in potatoes (REQUIRED PRAC)	➢ Assessment this half term is a cells test on all content so far. ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	link the structure of a phospholipid from Biological molecules (Lipids section) to their function here as part of the cell membrane. ➢ Cultural development ➢ Cholera
Spring 1	**<u>3.2 Finish Cells:</u>** 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. Rich Question: What have we learned about vaccination as a result of the COVID pandemic? Why would some people choose not to be vaccinated? **<u>3.3 Exchange and Transport:</u>** The internal environment of a cell or organism is different from its external environment. The exchange of substances between the internal and external environments takes place at exchange surfaces. To truly enter or leave an organism, most substances must cross cell plasma membranes. In large multicellular organisms, the immediate environment of cells is some form of tissue fluid. Most cells are too far away from exchange surfaces, and from each other, for simple diffusion alone to maintain the composition of tissue fluid within a suitable metabolic range. In large organisms, exchange surfaces are associated with mass transport systems that carry substances between the exchange surfaces and the rest of the body and between parts of the body. Mass transport maintains the final diffusion gradients that bring substances to and from the cell membranes of individual cells. It also helps to maintain the relatively stable environment that is tissue fluid. Rich Question: What are the ethical issues involved with dissections?		

	➢ Cell immunity complete ➢ Vaccination ➢ HIV 3.3 Exchange and Transport ➢ Surface Area to Volume Ratio ➢ Gas exchange in: ➢ Insects ➢ Fish ➢ Plants ➢ Humans ➢ Enzymes and Digestion Practical Activities ➢ Fish Gill Dissection ➢ Lung Dissection	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment Exchange and Transport Test ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ For the cells content see previous links in Autumn 2 ➢ Link back to AS Biology knowledge from Biological molecules (proteins topic) ➢ GCSE Biology and Trilogy the topics, cell structure and organisation, organisation and the digestive system and organising plants and animals. ➢ 6. Cultural development HIV crisis and treatment developments 5. Moral Development Dissections
	<u>3.4 Genetic information, variation and relationships between organisms</u> Biological diversity – biodiversity – 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 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. Rich Question: Why do some people disagree with the idea of natural selection and the theory of evolution?		
	3.4 Genetics ➢ DNA and Protein Synthesis ➢ Gene mutation	➢ Exam questions (Multiple choice, structured, closed	➢ Link back to Biological molecules in AS Biology DNA work

	➢ Meiosis ➢ Genetic variation ➢ Adaptation ➢ Types of Selection Practical Activities ➢ Microbiology Practical (REQUIRED PRAC)	short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Reproduction and variation unit at GCSE Biology and trilogy (DNA content) ➢ 2. Social Development, including political and current affairs awareness ➢ Antibiotic resistance
Spring 2	**<u>3.3 Exchange and Transport</u>** Most cells are too far away from exchange surfaces, and from each other, for simple diffusion alone to maintain the composition of tissue fluid within a suitable metabolic range. In large organisms, exchange surfaces are associated with mass transport systems that carry substances between the exchange surfaces and the rest of the body and between parts of the body. Mass transport maintains the final diffusion gradients that bring substances to and from the cell membranes of individual cells. It also helps to maintain the relatively stable environment that is tissue fluid. Rich Question: Blood doping – discuss the ethical issues?		
	3.3 Exchange and Transport (cont..) ➢ Mass transport Haemoglobin ➢ Circulatory system and the heart ➢ Tissue Fluid ➢ Transport in plants (phloem and xylem) Practical Activities Heart Dissection (REQUIRED PRAC)	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment All of AS content tested ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE: Organising plants and animals topic Moral – Ethical dissection

	3.4 Genetic information, variation and relationships between organisms 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. Rich Question: Why should we care about biodiversity on the planet?		
	3.4 Genetics cont…. ➢ Biodiversity ➢ Species and taxonomy ➢ Diversity in a community ➢ Investigating Diversity ➢ Calculating Species Index of Diversity	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment All of AS content ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Reproduction and variation unit at GCSE Biology and trilogy ➢ Ecological sampling at GCSE Biology and Trilogy ➢ Moral – ethical issues of global warming and habitat distruction
Summer 1	**Revision of All of AS content and Key Practical Skills and Maths skills** Particular Focus on Practical skills: PS 1.1 Solve problems set in practical contexts, PS 1.2 Apply scientific knowledge to practical context, PS 2.1 Comment on experimental design and evaluate scientific methods, PS 2.2 Present data in appropriate ways, PS 2.3 Evaluate results and draw conclusions with reference to measurement uncertainties and errors, PS 2.4 Identify variables including those that must be controlled.		

	Maths Skills relevant to Practical activities: PS 3.1 Plot and interpret graphs, PS 3.2 Process and analyse data using appropriate mathematical skills, PS 3.3 Consider margins of error, accuracy and precision of data. Revisit the core maths competencies as outlined in the specification through a variety of contexts in exam questions.		
	Revision of AS content All previously mentioned topics studied throughout the year will be revisited and past questions completed in these areas There will be a focus on practical skills and maths skills We will also cover the statistical tests: The chi-squared test to test the significance of the difference between observed and expected results The Student's t-test The correlation coefficient	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment: 2 Full AS mock papers ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Maths skills from GCSE and potentially core Maths and A-Level Maths if students are studying these courses. ➢ All Science GCSE practical skills acquired ➢ 3. Physical Development Students learn how to physically use delicate and precise pieces of equipment throughout AS
	<u>Start A-Level Biology course</u> **<u>3.7 Genetics, populations, evolution and ecosystems</u>** Populations of different species live in communities. Competition occurs within and between these populations for the means of survival. Within a single community, one population is affected by other populations, the biotic factors, in its environment. Populations within communities are also affected by, and in turn affect, the abiotic (physicochemical) factors in an ecosystem. Rich Question: Why are ecosystems and their health so important to human survival?		
	<u>Populations in Ecosystems</u> ➢ Population number ➢ Competition ➢ Predation	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups	➢ Previous AS knowledge from 3.4 genetics ➢ GCSE Biology and Trilogy sampling and ecosystems work

		➢ Assessment AS Mock Papers ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	Moral – effect of biodiversity loss on the planet – link to global warming
Summer 2	**3.7 Genetics, populations, evolution and ecosystems** Populations of different species live in communities. Competition occurs within and between these populations for the means of survival. Within a single community, one population is affected by other populations, the biotic factors, in its environment. Populations within communities are also affected by, and in turn affect, the abiotic (physicochemical) factors in an ecosystem. Rich Question: Why should we conserve animal and plant species, cost versus reward analysis?		
	Populations in Ecosystems ➢ Sampling ➢ Succession ➢ Conservation Practical Activities Quadrat Sampling practical (random and transect). (REQUIRED PRAC)	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment Chapter 19 End of Topic ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Previous AS knowledge from 3.4 genetics ➢ GCSE Biology and Trilogy sampling and ecosystems work Moral – effect of biodiversity loss on the planet – link to global warming
	3.5 Energy transfers within and between organisms Life depends on continuous transfers of energy. In communities, the biological molecules produced by photosynthesis are consumed by other organisms, including animals, bacteria and fungi. Some of these are used as respiratory substrates by these consumers.		

	Photosynthesis and respiration are not 100% efficient. The transfer of biomass and its stored chemical energy in a community from one organism to a consumer is also not 100% efficient. Rich Question: What is the ethical concern when using fertilisers for farming?		
	Energy and Ecosystems ➢ Food Chains and Energy Transfer ➢ Productivity ➢ Nutrient Cycles ➢ Fertilisers ➢ Environmental concerns with fertilisers	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment All of AS content ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Ecology, Biodiversity and organising an ecosystem topics from GCSE Biology and Trilogy ➢ Previous AS Biology topics on ecology ➢ Moral – effect of biodiversity loss on the planet – link to global warming

Year 13 Overview

Term	Knowledge	Assessment	Connections to learning
Autumn 1	**3.5 Energy transfers within and between organisms** Life depends on continuous transfers of energy. In photosynthesis, light is absorbed by chlorophyll and this is linked to the production of ATP. In respiration, various substances are used as respiratory substrates. The hydrolysis of these respiratory substrates is linked to the production of ATP. In both respiration and photosynthesis, ATP production occurs when protons diffuse down an electrochemical gradient through molecules of the enzyme ATP synthase, embedded in the membranes of cellular organelles. The process of photosynthesis is common in all photoautotrophic organisms and the process of respiration is common in all organisms, providing indirect evidence for evolution. Rich Question: Global food production, do we need to rethink our approach, looking at hydroponics as a potential solution?		

	Photosynthesis ➢ Photosynthesis overview – structure of a leaf and chloroplast ➢ Light-Dependent reaction ➢ Light-Independent reaction ➢ Limiting Factors Practical Activities ➢ Chromatography of leaf pigments (REQUIRED PRAC) ➢ Effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts. (REQUIRED PRAC) Respiration ➢ Glycolysis ➢ Link and Krebs cycle ➢ Oxidative Phosphorylation ➢ Anaerobic Respiration Practical Activities ➢ Effect of temperature on the rate of respiration of cultures of single-celled (yeast) organisms. (REQUIRED PRAC)	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment respiration and photosynthesis test. ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	GCSE Biology and Trilogy respiration and photosynthesis topics. GCSE Biology and Trilogy cells topic, yeast GCSE Chemistry: paper chromatography Moral – effect of biodiversity loss on the planet – link to global warming. Also the moral and ethical issues associated with the way we produce food.
Autumn 1	**<u>3.6 Organisms respond to changes in their internal and external environment</u>** A stimulus is a change in the internal or external environment. A receptor detects a stimulus. A coordinator formulates a suitable response to a stimulus. An effector produces a response. Receptors are specific to one type of stimulus. Nerve cells pass electrical impulses along their length. A nerve impulse is specific to a target cell only because it releases a chemical messenger directly onto it, producing a response that is usually rapid, short-lived and localised. Plants control their response using hormone-like growth substances. Rich Question: Is it ethical to use animals in lab tests?		

	Responses to stimuli ➢ Survival and response ➢ Plant growth factors ➢ Reflex Arc ➢ Receptors ➢ Control of heart rate Practical Activities ➢ Effect of an environmental variable on the movement of an animal using either a choice chamber or a maze. (REQUIRED PRAC)	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment AS paper as revision. ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ Link back to AS topic of exchange for the heart ➢ GCSE Biology and trilogy homeostasis and nervous system topics ➢ 1. Personal Development ➢ 3. Physical development ➢ Diet issues/awareness of life choices – heart disease ➢ Moral – ethical use of maggots in choice chamber
	<u>3.6 Organisms respond to changes in their internal and external environment</u> Nerve cells pass electrical impulses along their length. A nerve impulse is specific to a target cell only because it releases a chemical messenger directly onto it, producing a response that is usually rapid, short-lived and localised. Rich Question: What effect can drugs have on the transmission in the synapse?		
Autumn 2	Nervous Co-ordination and Muscles ➢ Neurones ➢ Nerve Impulses ➢ Action potential ➢ Speed of nerve impulse ➢ Structure and function of synapses ➢ Transmission across a synapse ➢ Structure of skeletal muscle ➢ Contraction of skeletal muscle	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment, stimulus and response test. ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ GCSE Biology and trilogy homeostasis and nervous system topics ➢ Moral – use of blood doping

<table>
<tr><td></td><td colspan="3"><u>3.6 Organisms respond to changes in their internal and external environment</u>

In contrast, mammalian hormones stimulate their target cells via the blood system. They are specific to the tertiary structure of receptors on their target cells and produce responses that are usually slow, long-lasting and widespread.
Rich Question: What should we do as a society to reduce the burden of type 2 diabetes on the NHS?</td></tr>
<tr><td></td><td>Homeostasis
➢ Principles of homeostasis
➢ Positive and negative feedback
➢ Blood glucose control
➢ Diabetes
➢ Blood water potential control
➢ Kidney structure and the nephron and osmoregulation</td><td>➢ Exam questions (Multiple choice, structured, closed short answer, and open response)
➢ Assessed homework
➢ Required practical write ups
➢ Assessment: Homeostasis test.
➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions</td><td>➢ GCSE Biology and trilogy homeostasis and nervous system topics
➢ Moral – burden of treatment from lifestyle diseases</td></tr>
<tr><td>Spring 1</td><td colspan="3"><u>3.7 Genetics, populations, ecosystems and evolution</u>

The theory of evolution underpins modern Biology. All new species arise from an existing species. This results in different species sharing a common ancestry, as represented in phylogenetic classification. Common ancestry can explain the similarities between all living organisms, such as common chemistry (eg all proteins made from the same 20 or so amino acids), physiological pathways (eg anaerobic respiration), cell structure, DNA as the genetic material and a ‘universal’ genetic code. The individuals of a species share the same genes but (usually) different combinations of alleles of these genes. An individual inherits alleles from their parent or parents. A species exists as one or more populations. There is variation in the phenotypes of organisms in a population, due to genetic and environmental factors.
Rich question: Why might some people disagree with the evidence of fossils and common ancestry genetics?</td></tr>
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	Inherited Change ➢ Recap Mendelian inheritance from GCSE ➢ Monohybrid Inheritance ➢ Probability and genetic crosses (punnet squares) ➢ Dihybrid inheritance ➢ Co-dominance and multiple alleles ➢ Sex-linkage ➢ Autosomal linkage ➢ Epistasis ➢ Chi-Squared Test	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ This directly links to AS genetics content and natural selection and evolution topics, including classification. Also a solid understanding of meiosis is required, this should be recapped. ➢ Due to the way we structure the course Populations in ecosystems is taught at the end of Year 12, this directly fits with this series of lessons so needs to be revisited here too. ➢ As previously stated this all links back to genetics, evolution and ecosystems from GCSE ➢ Spiritual – looking at the creationism approach opposed to evolution
Spring 1	**<u>3.8 The Control of Gene Expression</u>** Cells are able to control their metabolic activities by regulating the transcription and translation of their genome. Although the cells within an organism carry the same coded genetic information, they translate only part of it. In multicellular organisms, this control of translation enables cells to have specialised functions, forming tissues and organs. There are many factors that control the expression of genes and, thus, the phenotype of organisms. Some are external, environmental factors, others are internal factors. The expression of genes is not as simple as once thought, with epigenetic regulation of transcription being increasingly recognised as important. Humans are learning how to control the expression of genes by altering the epigenome, and how to alter genomes and proteomes of organisms. This has many medical and technological applications. Consideration of cellular control mechanisms underpins the content of this section. Students who have studied it should develop an understanding of the ways in which organisms		

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<tr><td></td><td colspan="3">and cells control their activities. This should lead to an appreciation of common ailments resulting from a breakdown of these control mechanisms and the use of DNA technology in the diagnosis and treatment of human diseases.
Rich Question: Should we manipulate peoples genetics to help cure disease or is this playing god?</td></tr>
<tr><td></td><td>Gene Expression
➢ Gene mutation
➢ Stem cells
➢ Regulation of transcription and translation
➢ Epigenetic control of gene expression
➢ Genome Projects</td><td>➢ Exam questions (Multiple choice, structured, closed short answer, and open response)
➢ Assessed homework
➢ Required practical write ups
➢ Assessment at end of ½ term
➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions</td><td>➢ This links back to many topics in AS Biology, it is a great opportunity to revisit DNA structure, transcription and translation and also cell organelles involved in protein synthesis and proteins from Biological molecules.
➢ Moral/spiritual - is gene technology playing god?</td></tr>
<tr><td>Spring 2</td><td colspan="3"><u>3.7 Genetics, populations, ecosystems and evolution</u>

The individuals of a species share the same genes but (usually) different combinations of alleles of these genes. An individual inherits alleles from their parent or parents. A species exists as one or more populations. There is variation in the phenotypes of organisms in a population, due to genetic and environmental factors. Two forces affect genetic variation in populations: genetic drift and natural selection. Genetic drift can cause changes in allele frequency in small populations. Natural selection occurs when alleles that enhance the fitness of the individuals that carry them rise in frequency. A change in the allele frequency of a population is evolution. If a population becomes isolated from other populations of the same species, there will be no gene flow between the isolated population and the others. This may lead to the accumulation of genetic differences in the isolated population, compared with the other populations. These differences may ultimately lead to organisms in the isolated population becoming unable to breed and produce fertile offspring with organisms from the other populations. This reproductive isolation means that a new species has evolved.</td></tr>
</table>

	Populations and Evolution ➢ Population genetics (Hardy-Weinberg) ➢ Variation in phenotype ➢ Natural Selection ➢ Different forms of selection ➢ Isolation and speciation	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ This directly links to AS genetics content and natural selection and evolution topics, including classification. Due to the way we structure the course Populations in ecosystems is taught at the end of Year 12, this directly fits with this series of lessons so needs to be revisited here too. ➢ As previously stated this all links back to genetics, evolution and ecosystems from GCSE
Spring 2	**<u>3.8 The Control of Gene Expression</u>** Cells are able to control their metabolic activities by regulating the transcription and translation of their genome. Although the cells within an organism carry the same coded genetic information, they translate only part of it. In multicellular organisms, this control of translation enables cells to have specialised functions, forming tissues and organs. There are many factors that control the expression of genes and, thus, the phenotype of organisms. Some are external, environmental factors, others are internal factors. The expression of genes is not as simple as once thought, with epigenetic regulation of transcription being increasingly recognised as important. Humans are learning how to control the expression of genes by altering the epigenome, and how to alter genomes and proteomes of organisms. This has many medical and technological applications. Consideration of cellular control mechanisms underpins the content of this section. Students who have studied it should develop an understanding of the ways in which organisms and cells control their activities. This should lead to an appreciation of common ailments resulting from a breakdown of these control mechanisms and the use of DNA technology in the diagnosis and treatment of human diseases. Rich Question: How far should we take DNA technology, what are the ethical and moral concerns?		

	Recombinant DNA technology ➢ Producing DNA fragments ➢ In vivo gene cloning ➢ In vitro gene cloning ➢ Genetic screening and counselling ➢ Genetic fingerprinting	➢ Exam questions (Multiple choice, structured, closed short answer, and open response) ➢ Assessed homework ➢ Required practical write ups ➢ Assessment at end of ½ term ➢ In lesson retrieval quiz and multiple choice hinge questions, exam questions	➢ This topic relies on all the previous DNA knowledge from across the course ➢ Moral/spiritual - is gene technology playing god?