Year 12 BIOLOGY Curriculum Map

We follow the AQA specification 7402 here: AS and A-level Biology Specification Specifications for first teaching in 2015

Practical skills focusing on correct usage of apparatus and techniques are covered throughout the course. The required practicals and main skills covered for each topic are outlined below, but the practical course is a holistic and synoptic with gradual mastery by students over the two KS5 years.

Term	Topic/Unit title	Essential knowledge (what students should know and understand by the end of the unit/topic)	Essential skills (what students should be able to do by the end of the unit/topic) AT = Apparatus and technique MS = maths skills PS = practical skills
Autumn **Teacher A**	3.1 Biological molecules (see pages 11-20 of Specification for full knowledge outline)	• 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. They are also important as enzymes, chemical messengers and components of the blood.	**AT f** Students could use, and interpret the results of, qualitative tests for reducing sugars, non-reducing sugars and starch. Students could use, and interpret the results of, the emulsion test for lipids. Students could use, and interpret the results of, a biuret test for proteins. AT c Students could produce a dilution series of glucose solution and use colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown solution. **Required practical 1: Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction.**

		● 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.	PS 2.4 Students could identify the variables that must be controlled in their investigation into rate of reaction. PS 3.3 Students could calculate the uncertainty of their measurements of the rate of reaction. MS 3.2 Students could select an appropriate format for the graphical presentation of the results of their investigation into the rate of enzyme controlled reactions. MS 3.6 Students could use a tangent to find the initial rate of an enzyme-controlled reaction.
Autumn **Teacher B**	3.2 Cells (see pages 20-26 of specification for full knowledge outline)	● 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. ● All cells have a cell-surface membrane and, in addition, eukaryotic cells have internal membranes. The basic structure of these membranes is the same and enables control of the passage of	**Required practical 2**: Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index. Students should measure the apparent size of cells in the root tip and calculate their actual size. MS 0.3 Calculation of a mitotic index.

		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.	AT d, e and f Students could use iodine in potassium iodide solution to identify starch grains in plant cells. **Required practical 3**: Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue. MS 3.4 Students could determine the water potential of plant tissues using the intercept of a graph of, eg, water potential of solution against gain/loss of mass. **Required practical 4**: Investigation into the effect of a named variable on the permeability of cell-surface membranes.
Spring **Teacher A**	3.3 Organisms exchange substances with their environment (see pages 26-31 of specification for full knowledge outline)	● 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.	MS 4.1 Students could be given the dimensions of cells with different shapes from which to calculate the surface area to volume ratios of these cells. **Required practical 5:** Dissection of animal or plant gas exchange system or mass transport system or of organ within such a system.

		● 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.	AT j Students could dissect mammalian lungs, the gas exchange system of a bony fish or of an insect. AT d Students could use an optical microscope to: • examine prepared mounts of gas exchange surfaces of a mammal, fish and insect, or temporary mounts of gills • examine vertical sections through a dicotyledonous leaf. AT b Students could use threeway taps, manometers and simple respirometers to measure volumes of air involved in gas exchange. MS 2.2 Students could be given values of pulmonary ventilation rate (PVR) and one other measure, requiring them to change the subject of the equation. AT b Students could set up and use a potometer to investigate the effect of a named environmental variable on the rate of transpiration.

Spring **Teacher** B	3.4 Genetic information, variation and relationships between organisms (see pages 31-37 of specification for full knowledge outline)	● 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 indirect 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.	AT d Students could examine meiosis in prepared slides of suitable plant or animal tissue. MS 0.5 Students could: • use the expression 2n to calculate the possible number of different combinations of chromosomes following meiosis, without crossing over • derive a formula from this to calculate the possible number of different combinations of chromosomes following random fertilisation of two gametes, where n is the number of homologous chromosomes pairs. MS 2.5 Students could use a logarithmic scale when dealing with data relating to large numbers of bacteria in a culture. **Required practical 6:** Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth. MS 2.3 Students could be given data from which to calculate an index of diversity and interpret the significance of the calculated value of the index.

			AT k Students could: • design appropriate methods to ensure random sampling • carry out random sampling within a single population • use random samples to investigate the effect of position on the growth of leaves. MS 1.2 Students could use standard scientific calculators to calculate the mean values of data they have collected or have been given. MS 1.10 Students could calculate, and interpret the values of, the standard deviations of their mean values.
Summer **Teacher A**	3.7 Genetics, populations, evolution and ecosystems (see pages 48-53 of specification for full knowledge outline) This topic continues in Year 13 Autumn term	● 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.	**Required practical 12:** Investigation into the effect of a named environmental factor on the distribution of a given species. AT k Students could: • investigate the distribution of organisms in a named habitat using randomly placed frame quadrats, or a belt transect • use both percentage cover and frequency as measures of abundance of a sessile species.

			AT h Students could use the mark-release-recapture method to investigate the abundance of a motile species.
Summer 2 **Teacher B**	3.5 Energy transfers in and between organisms (see pages 37-42 of specification for full knowledge outline) This topic continues in Year 13 Autumn term	● Life depends on continuous transfers of energy. ● 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. ● 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.	MS 0.1 Students could be given data from which to calculate gross primary production and to derive the appropriate units. AT a Students could carry out investigations to find the dry mass of plant samples or the energy released by samples of plant biomass. MS 2.4 Students could be given data from which to calculate: • the net productivity of producers or consumers from given data • the efficiency of energy transfers within ecosystems. MS 0.3 Students could be given data from which to calculate percentage yields.

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Term	Topic/Unit title	Essential knowledge (what students should know and understand by the end of the unit/topic)	Essential skills (what students should be able to do by the end of the unit/topic)
Autumn 1 **Teacher A**	3.7 Genetics, populations, evolution and ecosystems (see pages 48-53 of specification for full knowledge outline) This topic continues from Year 12 Summer term	● 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. ● Two forces affect genetic variation in populations: genetic drift and natural selection. Genetic drift can cause	MS 0.3 Students could use information to represent phenotypic ratios in monohybrid and dihybrid crosses. MS 1.4 Students could show understanding of the probability associated with inheritance. MS 1.9 Students could use the X2test to investigate the significance of differences between expected and observed phenotypic ratios. AT k Students could collect data about the frequency of observable phenotypes within a single population. MS 2.4 Students could calculate allele, genotype and phenotype frequencies from

		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.	appropriate data using the Hardy–Weinberg equation. MS 1.5 Students could apply their knowledge of sampling to the concept of genetic drift. PS 1.2 Students could devise an investigation to mimic the effects of random sampling on allele frequencies in a population. AT l Students could use computer programs to model the effects of natural selection and of genetic drift.
Autumn **Teacher B**	3.5 Energy transfers in and between organisms (see pages 37-42 of specification for full knowledge outline) This topic continues from Year 12 Summer term	● 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	AT a Students could devise and carry out experiments to investigate the effect of named environmental variables on the rate of photosynthesis using aquatic plants, algae or immobilised algal beads. **Required practical 7:** Use of chromatography to investigate the pigments isolated from leaves of different plants, eg, leaves from shade-tolerant and shade-intolerant plants or leaves of different colours.

		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. ● 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.	**Required practical 8**: Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts. **Required practical 9**: Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms.
Spring **Teacher A**	3.6 Organisms respond to changes in their internal and external environments (see pages 42-48 of specification for full knowledge outline)	● 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. ● In contrast, mammalian hormones stimulate their target cells via the blood system. They are specific to the tertiary structure of receptors on	**Required practical 10:** Investigation into the effect of an environmental variable on the movement of an animal using either a choice chamber or a maze. AT h Students could design and carry out investigations into: • the sensitivity of temperature receptors in human skin • habituation of touch receptors in human skin • resolution of touch receptors

		their target cells and produce responses that are usually slow, long-lasting and widespread. ● Plants control their response using hormone-like growth substances.	AT h Students could design and carry out an investigation into the effect of a named variable on human pulse rate. MS 2.2 Students could use values of heart rate (R) and stroke volume (V) to calculate cardiac output (CO), using the formula CO = R × V AT d Students could examine prepared slides of skeletal muscle using an optical microscope. AT h Students could investigate the effect of repeated muscular contraction on the rate of muscle fatigue in human vo;unteers. **Required practical 11:** Production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample.
Spring 2	3.8 The control of gene expression (see pages 53-58 of specification for full knowledge outline)	● 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	AT g Students could investigate the specificity of restriction enzymes using extracted DNA and electrophoresis. AT g Students could use gel electrophoresis to produce 'fingerprints' of food dyes.

Teacher B		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.	
Summer **Teacher A + B**	Revision phase	Focus on ● review of complex topics ● essays ● required practical revision ● exam technique ● command words ● mathematical requirements	