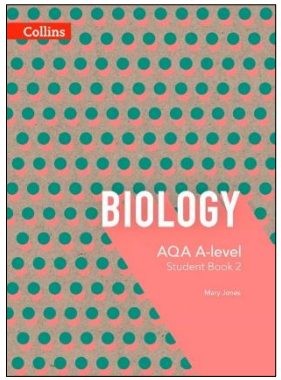
Collins

AQA A-level Biology Year 2

Scheme of Work



Scheme of Work
AQA A-level Biology Year 2 of A-level

This course covers the requirements of the second year of the AQA AS and A-level Biology specification. These schemes of work are designed to accompany the use of Collins' AQA A-level Biology Year 2 Student Book.

Each chapter is matched to the Specification Content and we have shown in which chapters the six Required Practicals may be carried out, to help you plan for these and the sourcing of necessary equipment. We have assumed that 120 one-hour lessons will be taught during the year to cover the specification.

The schemes suggested are of course flexible, and editable, to correspond with your timetabling and to enable you to plan your own route through the course.

AQA A-level Biology Year 2 of A-level: 120 hours

Chapters	Specification Content	Required Practicals
CHAPTER 1 Photosynthesis	3.5.1 Photosynthesis The light-dependent reaction in such detail as to show that: • chlorophyll absorbs light, leading to photoionisation of chlorophyll • some of the energy from electrons released during photoionisation is conserved in the production of ATP and reduced NADP • the production of ATP involves electron transfer associated with the transfer of electrons down the electron transfer chain and passage of protons across chloroplast membranes and is catalysed by ATP synthase embedded in these membranes(chemiosomotic theory) • photolysis of water produces protons, electrons and oxygen. The light-independent reaction uses reduced NADP from the light-dependent reaction to form a simple sugar. The hydrolysis of ATP, also from the light-dependent reaction, provides the additional energy for this reaction. The light-independent reaction in such detail as to show that: • carbon dioxide reacts with ribulose bisphosphate (RuBP) to form two molecules of glycerate 3-phosphate (GP). This reaction is catalysed by the enzyme rubisco • ATP and reduced NADP from the light-dependent reaction are used to reduce GP to triose phosphate • some of the triose phosphate is used to regenerate RuBP in the Calvin cycle • some of the triose phosphate is converted to useful organic substances.	Required practical 7: Use of chromatography to investigate the pigments isolated from leaves of different plants, e.g., leaves from shade-tolerant and shade-intolerant plants or leaves of different colours. Required practical 8: Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts.
CHAPTER 2 Respiration	3.5.2 Respiration Respiration produces ATP. Glycolysis is the first stage of anaerobic and aerobic respiration. It occurs in the cytoplasm and is an anaerobic process. Glycolysis involves the following stages:	Required practical 9: Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms.

	• phosphorylation of glucose to glucose phosphate, using ATP • production of triose phosphate • oxidation of triose phosphate to pyruvate with a net gain of ATP and reduced NAD. If respiration is only anaerobic, pyruvate can be converted to ethanol or lactate using reduced NAD. The oxidised NAD produced in this way can be used in further glycolysis. If respiration is aerobic, pyruvate from glycolysis enters the mitochondrial matrix by active transport. Aerobic respiration in such detail as to show that: • pyruvate is oxidised to acetate, producing reduced NAD in the process • acetate combines with coenzyme A in the link reaction to produce acetylcoenzyme A • acetylcoenzyme A reacts with a four-carbon molecule, releasing coenzyme A and producing a six-carbon molecule that enters the Krebs cycle • in a series of oxidation-reduction reactions, the Krebs cycle generates reduced coenzymes and ATP by substrate-level phosphorylation, and carbon dioxide is lost • synthesis of ATP by oxidative phosphorylation is associated with the transfer of electrons down the electron transfer chain and passage of protons across inner mitochondrial membranes and is catalysed by ATP synthase embedded in these membranes (chemiosomotic theory) • other respiratory substrates include the breakdown products of lipids and amino acids, which enter the Krebs cycle.	
CHAPTER 3 Energy in ecosystems	3.5.3 Energy and ecosystems In any ecosystem, plants synthesise organic compounds from atmospheric, or aquatic, carbon dioxide. Most of the sugars synthesised by plants are used by the plant as respiratory substrates. The rest are used to make other groups of biological molecules. These biological molecules form the biomass of the plants. Biomass can be measured in terms of mass of carbon or dry mass of tissue per given area per given time. The chemical energy store in dry biomass can be estimated using calorimetry.	

	Gross primary production (GPP) is the chemical energy store in plant biomass, in a given area or volume, in a given time. Net primary production (NPP) is the chemical energy store in plant biomass after respiratory losses to the environment have been taken into account, ie NPP = GPP – R where GPP represents gross productivity and R represents respiratory losses to the environment. This net primary production is available for plant growth and reproduction. It is also available to other trophic levels in the ecosystem, such as herbivores and decomposers. The net production of consumers (N), such as animals, can be calculated as: N = I – F + R where I represents the chemical energy store in ingested food, F represents the chemical energy lost to the environment in faeces and urine and R represents the respiratory losses to the environment.	
CHAPTER 4 **Nutrient cycles**	3.5.4 Nutrient cycles Nutrients are recycled within natural ecosystems, exemplified by the nitrogen cycle and the phosphorus cycle. Microorganisms play a vital role in recycling chemical elements such as phosphorus and nitrogen. • The role of saprobionts in decomposition. • The role of mycorrhizae in facilitating the uptake of water and inorganic ions by plants. • The role of bacteria in the nitrogen cycle in sufficient detail to illustrate the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification. (The names of individual species of bacteria are not required). The use of natural and artificial fertilisers to replace the nitrates and phosphates lost by harvesting plants and removing livestock. The environmental issues arising from the use of fertilisers including leaching and eutrophication.	
CHAPTER 5 **Survival and response**	3.6.1.1 Survival and response Organisms increase their chance of survival by responding to changes in their environment.	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.

	In flowering plants, specific growth factors move from growing regions to other tissues, where they regulate growth in response to directional stimuli. The effect of different concentrations of indoleacetic acid (IAA) on cell elongation in the roots and shoots of flowering plants as an explanation of gravitropism and phototropism in flowering plants. Taxes and kineses as simple responses that can maintain a mobile organism in a favourable environment. The protective effect of a simple reflex, exemplified by a three-neurone simple reflex. Details of spinal cord and dorsal and ventral roots are not required. 3.6.1.2 Receptors The Pacinian corpuscle should be used as an example of a receptor to illustrate that: • receptors respond only to specific stimuli • stimulation of a receptor leads to the establishment of a generator potential. The basic structure of a Pacinian corpuscle. Deformation of stretch-mediated sodium ion channels in a Pacinian corpuscle leads to the establishment of a generator potential. The human retina in sufficient detail to show how differences in sensitivity to light, sensitivity to colour and visual acuity are explained by differences in the optical pigments of rods and cones and the connections rods and cones make in the optic nerve. 3.6.1.3 Control of heart rate Myogenic stimulation of the heart and transmission of a subsequent wave of electrical activity. The roles of the sinoatrial node (SAN), atrioventricular node (AVN) and Purkyne tissue in the bundle of His. The roles and locations of chemoreceptors and pressure receptors and the roles of the autonomic nervous system and effectors in	

	controlling heart rate.	
CHAPTER 6 Coordination by the nervous system	3.6.2.1 Nerve impulses The structure of a myelinated motor neurone. The establishment of a resting potential in terms of differential membrane permeability, electrochemical gradients and the movement of sodium ions and potassium ions. Changes in membrane permeability lead to depolarisation and the generation of an action potential. The all-or-nothing principle. The passage of an action potential along non-myelinated and myelinated axons, resulting in nerve impulses. The nature and importance of the refractory period in producing discrete impulses and in limiting the frequency of impulse transmission. Factors affecting the speed of conductance: myelination and saltatory conduction; axon diameter; temperature. 3.6.2.2 Synaptic transmission The detailed structure of a synapse and of a neuromuscular junction. The sequence of events involved in transmission across a cholinergic synapse in sufficient detail to explain: • unidirectionality • temporal and spatial summation • inhibition by inhibitory synapses. A comparison of transmission across a cholinergic synapse and across a neuromuscular junction. Students should be able to use information provided to predict and explain the effects of specific drugs on a synapse. (Recall of the names and mode of action of individual drugs will not be required.)	
CHAPTER 7 Muscle power	3.6.3 Skeletal muscles are stimulated to contract by nerves and act as effectors	

	Muscles act in antagonistic pairs against an incompressible skeleton. Gross and microscopic structure of skeletal muscle. The ultrastructure of a myofibril. The roles of actin, myosin, calcium ions and ATP in myofibril contraction. The roles of calcium ions and tropomyosin in the cycle of actinomyosin bridge formation. (The role of troponin is not required.) The roles of ATP and phosphocreatine in muscle contraction. The structure, location and general properties of slow and fast skeletal muscle fibres.	
CHAPTER 8 Homeostasis	3.6.4.1 Principles of homeostasis and negative feedback Homeostasis in mammals involves physiological control systems that maintain the internal environment within restricted limits. The importance of maintaining a stable core temperature and stable blood pH in relation to enzyme activity. The importance of maintaining a stable blood glucose concentration in terms of availability of respiratory substrate and of the water potential of blood. Negative feedback restores systems to their original level. The possession of separate mechanisms involving negative feedback controls departures in different directions from the original state, giving a greater degree of control. Students should be able to interpret information relating to examples of negative and positive feedback. 3.6.4.2 Control of blood glucose concentration The factors that influence blood glucose concentration. The role of the liver in glycogenesis, glycogenolysis and gluconeogenesis. The action of insulin by:	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.

	• attaching to receptors on the surfaces of target cells • controlling the uptake of glucose by regulating the inclusion of channel proteins in the surface membranes of target cells • activating enzymes involved in the conversion of glucose to glycogen. The action of glucagon by: • attaching to receptors on the surfaces of target cells • activating enzymes involved in the conversion of glycogen to glucose • activating enzymes involved in the conversion of glycerol and amino acids into glucose. The role of adrenaline by: • attaching to receptors on the surfaces of target cells • activating enzymes involved in the conversion of glycogen to glucose. The second messenger model of adrenaline and glucagon action, involving adenyl cyclate, cyclic AMP (cAMP) and protein kinase. The causes of types I and II diabetes and their control by insulin and/or manipulation of the diet. 3.6.4.3 Control of blood water potential Osmoregulation as control of the water potential of the blood. The roles of the hypothalamus, posterior pituitary and antidiuretic hormone (ADH) in osmoregulation. The structure of the nephron and its role in: • the formation of glomerular filtrate • reabsorption of glucose and water by the proximal convoluted tubule • maintaining a gradient of sodium ions in the medulla by the loop of Henle • reabsorption of water by the distal convoluted tubule and collecting ducts.	
CHAPTER 9 Genes and inheritance	3.7.1 Inheritance The genotype is the genetic constitution of an organism.	

	The phenotype is the expression of this genetic constitution and its interaction with the environment. There may be many alleles of a single gene. Alleles may be dominant, recessive or codominant. In a diploid organism, the alleles at a specific locus may be either homozygous or heterozygous. The use of fully labelled genetic diagrams to interpret, or predict, the results of: • monohybrid and dihybrid crosses involving dominant, recessive and codominant alleles • crosses involving sex-linkage, autosomal linkage, multiple alleles and epistasis. Use of the chi-squared (χ^2) test to compare the goodness of fit of observed phenotypic ratios with expected ratios.	
CHAPTER 10 Populations	3.7.2 Populations Species exist as one or more populations. A population as a group of organisms of the same species occupying a particular space at a particular time that can potentially interbreed. The concepts of gene pool and allele frequency. The Hardy–Weinberg principle provides a mathematical model, which predicts that allele frequencies will not change from generation to generation. The conditions under which the principle applies. The frequency of alleles, genotypes and phenotypes in a population can be calculated using the Hardy–Weinberg equation: $p^2 + 2pq + q^2 = 1$ where p is the frequency of one (usually the dominant) allele and q is the frequency of the other (usually recessive) allele of the gene. 3.7.4 Populations in ecosystems	Required Practical 12: Investigation into the effect of a named environmental factor on the distribution of a given species

	Populations of different species form a community. A community and the non-living components of its environment together form an ecosystem. Ecosystems can range in size from the very small to the very large. Within a habitat, a species occupies a niche governed by adaptation to both abiotic and biotic conditions. An ecosystem supports a certain size of population of a species, called the carrying capacity. This population size can vary as a result of: • the effect of abiotic factors • interactions between organisms: interspecific and intraspecific competition and predation. The size of a population can be estimated using: • randomly placed quadrats, or quadrats along a belt transect, for slow-moving or non-motile organisms • the mark-release-recapture method for motile organisms. The assumptions made when using the mark-release-recapture method. Ecosystems are dynamic systems. Primary succession, from colonisation by pioneer species to climax community. At each stage in succession, certain species may be recognised which change the environment so that it becomes more suitable for other species with different adaptations. The new species may change the environment in such a way that it becomes less suitable for the previous species. Changes that organisms produce in their abiotic environment can result in a less hostile environment and change biodiversity. Conservation of habitats frequently involves management of succession.	
CHAPTER 11 Evolution and speciation	3.7.3 Evolution may lead to speciation Individuals within a population of a species may show a wide range of variation in phenotype. This is due to genetic and environmental factors. The primary source of genetic variation is mutation. Meiosis and the random fertilisation of gametes during sexual reproduction produce further genetic variation.	

	Predation, disease and competition for the means of survival result in differential survival and reproduction, ie natural selection. Those organisms with phenotypes providing selective advantages are likely to produce more offspring and pass on their favourable alleles to the next generation. The effect of this differential reproductive success on the allele frequencies within a gene pool. The effects of stabilising, directional and disruptive selection. Evolution as a change in the allele frequencies in a population. Reproductive separation of two populations can result in the accumulation of difference in their gene pools. New species arise when these genetic differences lead to an inability of members of the populations to interbreed and produce fertile offspring. In this way, new species arise from existing species. Allopatric and sympatric speciation. The importance of genetic drift in causing changes in allele frequency in small populations.	
CHAPTER 12	3.8.1 Alteration of the sequence of bases in DNA can alter the structure of proteins Gene mutations might arise during DNA replication. They include addition, deletion, substitution, inversion, duplication and translocation of bases. Gene mutations occur spontaneously. The mutation rate is increased by mutagenic agents. Mutations can result in a different amino acid sequence in the encoded polypeptide. • Some gene mutations change only one triplet code. Due to the degenerate nature of the genetic code, not all such mutations result in a change to the encoded amino acid. • Some gene mutations change the nature of all base triplets downstream from the mutation, ie result in a frame shift. 3.8.2.1 Most of a cell's DNA is not translated Totipotent cells are cells that can mature into any type of body cell.	

	During development, totipotent cells translate only part of their DNA, resulting in cell specialisation. Totipotent cells occur only for a limited time in mammalian embryos. Pluripotent, multipotent and unipotent cells are found in mature mammals. They can divide to form a limited number of different cell types. • Pluripotent stem cells can divide in unlimited numbers and can be used in treating human disorders. • Unipotent cells, exemplified by cardiomycetes. • Induced pluripotent stem cells (iPS cells) can be produced from unipotent cells using appropriate protein transcription factors. 3.8.2.2 Regulation of transcription and translation In eukaryotes, transcription of target genes can be stimulated or inhibited when specific transcriptional factors move from the cytoplasm into the nucleus. The role of the steroid hormone, oestrogen, in initiating transcription. Epigenetic control of gene expression in eukaryotes. Epigenetics involves heritable changes in gene function, without changes to the base sequence of DNA. These changes are caused by changes in the environment that inhibit transcription by: • increased methylation of the DNA or • decreased acetylation of associated histones. The relevance of epigenetics on the development and treatment of disease, especially cancer.	

	In eukaryotes and some prokaryotes, translation of the mRNA produced from target genes can be inhibited by RNA interference (RNAi). 3.8.2.3 Gene expression and cancer The main characteristics of benign and malignant tumours. The role of the following in the development of tumours: • tumour suppressor genes and oncogenes • abnormal methylation of tumour suppressor genes and oncogenes • increased oestrogen concentrations in the development of some breast cancers.	
CHAPTER 13	3.8.3 Using genome projects Sequencing projects have read the genomes of a wide range of organisms, including humans. Determining the genome of simpler organisms allows the sequences of the proteins that derive from the genetic code (the proteome) of the organism to be determined. This may have many applications, including the identification of potential antigens for use in vaccine production. In more complex organisms, the presence of non-coding DNA and of regulatory genes means that knowledge of the genome cannot easily be translated into the proteome. Sequencing methods are continuously updated and have become automated. 3.8.4.1 Recombinant DNA technology Recombinant DNA technology involves the transfer of fragments of DNA from one organism, or species, to another. Since the genetic code is universal, as are transcription and translation mechanisms, the transferred DNA can be translated within cells of the recipient (transgenic) organism. Fragments of DNA can be produced by several methods, including:	

	• conversion of mRNA to complementary DNA (cDNA), using reverse transcriptase • using restriction enzymes to cut a fragment containing the desired gene from DNA • creating the gene in a 'gene machine'. Fragments of DNA can be amplified by in vitro and in vivo techniques. The principles of the polymerase chain reaction (PCR) as an in vitro method to amplify DNA fragments. The culture of transformed host cells as an in vivo method to amplify DNA fragments. • The addition of promoter and terminator regions to the fragments of DNA. • The use of restriction endonucleases and ligases to insert fragments of DNA into vectors. Transformation of host cells using these vectors. • The use of marker genes to detect genetically modified (GM) cells or organisms. (Students will not be required to recall specific marker genes in a written paper.) 3.8.4.**2** Differences in DNA between individuals of the same species can be exploited for identification and diagnosis of heritable conditions The use of labelled DNA probes and DNA hybridisation to locate specific alleles of genes. The use of labelled DNA probes that can be used to screen patients for heritable conditions, drug responses or health risks. The use of this information in genetic counselling and personalised medicine.	

	Students should be able to evaluate information relating to screening individuals for genetically determined conditions and drug responses. 3.8.4.3 Genetic fingerprinting An organism's genome contains many variable number tandem repeats (VNTRs). The probability of two individuals having the same VNTRs is very low. The technique of genetic fingerprinting in analysing DNA fragments that have been cloned by PCR, and its use in determining genetic relationships and in determining the genetic variability within a population. The use of genetic fingerprinting in the fields of forensic science, medical diagnosis, animal and plant breeding.	