Y13 Biology Curriculum 2023-2024

5 lessons side

Sept/Oct Half Term 1	**6.3.1 Ecosystems**
	(a) ecosystems, which range in size, are dynamic and are influenced by both biotic and abiotic factors. *To include reference to a variety of ecosystems of different sizes (e.g. a rock pool, a playing field, a large tree) and named examples of biotic and abiotic factors.*
	(b) biomass transfers through ecosystems. *To include how biomass transfers between trophic levels can be measured AND the efficiency of biomass transfers between trophic levels AND how human activities can manipulate the transfer of biomass through ecosystems.*
	(c) recycling within ecosystems. *To include the role of decomposers and the roles of microorganisms in recycling nitrogen within ecosystems (including Nitrosomonas, Nitrobacter, Azotobacter and Rhizobium) AND the importance of the carbon cycle, to include the role of organisms (decomposition, respiration and photosynthesis) and physical and chemical effects in the cycling of carbon within ecosystems.*
	(d) the process of primary succession in the development of an ecosystem. *To include succession from pioneer species to a climax community AND deflected succession.*
	(e) (i) how the distribution and abundance of organisms in an ecosystem can be measured (ii) the use of sampling and recording methods to determine the distribution and abundance of organisms in a variety of ecosystems.
	5.2.2 Respiration
	(a) the need for cellular respiration. *To include examples of why plants, animals and microorganisms need to respire (suitable examples could include active transport and an outline of named metabolic reactions).*
	(b) the structure of the mitochondrion. *The components of a mitochondrion, including inner and outer michondrial membranes, cristae, matrix and mitochondrial DNA.*
	(c) the process and site of glycolysis. *To include the phosphorylation of glucose to hexose bisphosphate, the splitting of hexose bisphosphate into two triose phosphate molecules and further oxidation to pyruvate AND the production of a small yield of ATP and reduced NAD.*
	(d) the link reaction and its site in the cell. *To include the decarboxylation of pyruvate to acetate, the reduction of NAD, and the combination of acetate with coenzyme A.*
	(e) the process and site of the Krebs cycle. *To include the formation of citrate from acetate and oxaloacetate and the reconversion of citrate to oxaloacetate (names of intermediate compounds are not required) AND the importance of decarboxylation, dehydrogenation, the reduction of NAD and FAD, and substrate level phosphorylation.*
	(f) the importance of coenzymes in cellular respiration. *With reference to NAD, FAD and coenzyme A.*
	(g) the process and site of oxidative phosphorylation. *To include the roles of electron carriers, oxygen and the mitochondrial cristae.*
	(h) the chemiosmotic theory. *To include the electron transport chain, proton gradients and ATP synthase in oxidative phosphorylation and photophosphorylation.*
	(i) (i) the process of anaerobic respiration in eukaryotes. *To include anaerobic respiration in mammals and yeast, and the benefits of being able to respire anaerobically AND why anaerobic respiration produces a much lower yield of ATP than aerobic respiration.* (ii) practical investigations into respiration rates in yeast, under aerobic and anaerobic conditions.
	(j) the difference in relative energy values of carbohydrates, lipids and proteins as respiratory substrates.
	(k) the use and interpretation of the respiratory quotient (RQ). *To include calculating the respiratory quotient (RQ) using the formula: RQ = CO2 produced / O2 consumed.*
	(l) practical investigations into the effect of factors such as temperature, substrate concentration and different respiratory substrates on the rate of respiration; for example, the use of respirometers.
	HALF TERM
	5.2.1 Photosynthesis
	(a) the interrelationship between the process of photosynthesis and respiration. *To include the relationship between the raw materials and products of the two processes.*
	(b) the structure of a chloroplast and the sites of the two main stages of photosynthesis. To include t*he components of a chloroplast, including outer membrane, lamellae, grana, thylakoid, stroma and DNA.*

Nov/Dec Half Term 2	(c) (i) the importance of photosynthetic pigments in photosynthesis. *To include reference to light harvesting systems and photosystems.* (ii) practical investigations using thin layer chromatography (TLC) to separate photosynthetic pigments.
	(d) the light-dependent stage of photosynthesis. *To include how energy from light is harvested and used to drive the production of chemicals which can be used as a source of energy for other metabolic processes (ATP and reduced NADP) with reference to electron carriers and cyclic and non-cyclic photophosphorylation AND the role of water.*
	(e) the fixation of carbon dioxide and the light-independent stage of photosynthesis. *To include how the products of the light-dependent stage are used in the light-independent stage (Calvin cycle) to produce triose phosphate (TP) with reference to ribulose bisphosphate (RuBP), ribulose bisphosphate carboxylase (RuBisCO) and glycerate 3-phosphate (GP) – no other biochemical detail is required.*
	(f) the uses of triose phosphate (TP). *To include the use of TP as a starting material for the synthesis of carbohydrates, lipids and amino acids AND the recycling of TP to regenerate the supply of RuBP.*
	(g) (i) factors affecting photosynthesis. *To include limiting factors in photosynthesis with reference to carbon dioxide concentration, light intensity and temperature, and the implications of water stress (stomatal closure) AND the effect on the rate of photosynthesis, and on levels of GP, RuBP and TP, of changing carbon dioxide concentration, light intensity and temperature.* (ii) practical investigations into factors affecting the rate of photosynthesis.
	5.1.5 Plant responses
	(a) (i) the types of plant responses. *To include the response to abiotic stress and herbivory e.g. chemical defences (such as tannins, alkaloids and pheromones), folding in response to touch (Mimosa pudica) AND the range of tropisms in plants.* (ii) practical investigations into phototropism and geotropism.
	(b) the roles of plant hormones. *To include the role of hormones in leaf loss in deciduous plants, seed germination and stomatal closure.*
	(c) the experimental evidence for the role of auxins in the control of apical dominance.
	(d) the experimental evidence for the role of gibberellin in the control of stem elongation and seed germination.
	(e) practical investigations into the effect of plant hormones on growth.
	(f) the commercial use of plant hormones. *To include the use of hormones to control ripening, the use of rooting powders and hormonal weed killers.*
	CHRISTMAS HOLIDAY
Jan/Feb Half Term 3	5.1.2 Excretion as an example of homeostatic control
	(a) the term excretion and its importance in maintaining metabolism and homeostasis. *To include reference to the importance of removing metabolic wastes, including carbon dioxide and nitrogenous waste, from the body.*
	(b) (i) the structure and functions of the mammalian liver. *To include the gross structure and histology of the liver AND the roles of the liver in storage of glycogen, detoxification and the formation of urea (the ornithine cycle covered in outline only).* (ii) the examination and drawing of stained sections to show the histology of liver tissue.
	(c) (i) the structure, mechanisms of action and functions of the mammalian kidney. *To include the gross structure and histology of the kidney, including the detailed structure of a nephron and its associated blood vessels AND the processes of ultrafiltration, selective reabsorption and the production of urine.* (ii) the dissection, examination and drawing of the external and internal structure of the kidney. (iii) the examination and drawing of stained sections to show the histology of nephrons.
	(d) the control of the water potential of the blood. *To include the role of osmoreceptors in the hypothalamus, the posterior pituitary gland, ADH and its effect on the walls of the collecting ducts.*
	(e) the effects of kidney failure and its potential treatments. *To include the problems that arise from kidney failure, including the effect on glomerular filtration rate (GFR) and electrolyte balance AND the use of renal dialysis and transplants for the treatment of kidney failure.*
	(f) how excretory products can be used in medical diagnosis. *To include the use of urine samples in diagnostic tests, with reference to the use of monoclonal antibodies in pregnancy testing and testing for anabolic steroids and drugs.*
	HALF TERM
	5.1.3 Neuronal communication

March/April Half Term 4	(a) the roles of mammalian sensory receptors in converting different types of stimuli into nerve impulses. *To include an outline of the roles of sensory receptors (e.g. Pacinian corpuscle) in responding to specific types of stimuli and their roles as transducers.*
	(b) the structure and functions of sensory, relay and motor neurones. *To include differences between the structure and function of myelinated and non-myelinated neurones.*
	(c) the generation and transmission of nerve impulses in mammals. *To include how the resting potential is established and maintained, and how an action potential is generated (including reference to positive feedback) and transmitted in a myelinated neurone AND the significance of the frequency of impulse transmission.*
	(d) the structure and roles of synapses in neurotransmission. *To include the structure of a cholinergic synapse AND the action of neurotransmitters at the synapse and the importance of synapses in summation and control.*
	5.1.5 Animal responses
	(g) the organisation of the mammalian nervous system. *To include the structural organisation of the nervous system into the central and peripheral systems AND the functional organisation into the somatic and autonomic nervous systems.*
	(h) the structure of the human brain and the functions of its parts. *To include the gross structure of the human brain AND the functions of the cerebrum, cerebellum, medulla oblongata, hypothalamus and pituitary gland.*
	(i) reflex actions. *To include knee jerk reflex and blinking reflex, with reference to the survival value of reflex actions.*
	(j) the coordination of responses by the nervous and endocrine systems. *To include the 'fight or flight' response to environmental stimuli in mammals AND the action of hormones in cell signalling (studied in outline only) with reference to adrenaline (first messenger), activation of adenylyl cyclase, and cyclic AMP (second messenger).*
	(k) the effects of hormones and nervous mechanisms on heart rate.
	(l) (i) the structure of mammalian muscle and the mechanism of muscular contraction. *To include the structural and functional differences between skeletal, involuntary and cardiac muscle AND the action of neuromuscular junctions AND the sliding filament model of muscular contraction and the role of ATP, and how the supply of ATP is maintained in muscles by creatine phosphate.* (ii) the examination of stained sections or photomicrographs of skeletal muscle.
	EASTER HOLIDAY
April/May Half Term 5	6.3.2 Sustainability
	(c) the reasons for, and differences between, conservation and preservation. *To include the economic, social and ethical reasons for conservation of biological resources.*
	(d) how the management of an ecosystem can provide resources in a sustainable way. *Examples to include timber production and fishing.*
	(e) the management of environmental resources and the effects of human activities. *To include how ecosystems can be managed to balance the conflict between conservation/ preservation and human needs e.g. the Masai Mara region in Kenya and the Terai region of Nepal, and peat bogs AND the effects of human activities on the animal and plant populations and how these are controlled in environmentally sensitive ecosystems e.g. the Galapagos Islands, Antarctica, Snowdonia National Park, the Lake District.*

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4 lessons side

	Module 5 – Communication, homeostasis and energy
	5.1.1 Communication and homeostasis
	(a) the need for communication systems in multicellular organisms. *To include the need for animals and plants to respond to changes in the internal and external environment and to coordinate the activities of different organs.*
	(b) the communication between cells by cell signalling. *To include signalling between adjacent cells and signalling between distant cells.*
	(c) the principles of homeostasis. *To include the differences between receptors and effectors, and the differences between negative feedback and positive feedback.*
	(d) the physiological and behavioural responses involved in temperature control in ectotherms and endotherms. *To include endotherms – peripheral temperature receptors, the role of the hypothalamus and effectors in skin and muscles; behavioural response; and ectotherms – behavioural responses.*
	5.1.4 Hormonal communication

Sept/Oct Half Term 1

(a) endocrine communication by hormones. *To include secretion of hormones into the blood, transport by the blood, and detection by target cells or tissues.*

(b) the structure and functions of the adrenal glands. *Adrenal glands as an example of endocrine glands, to include the hormones secreted by the cortex and medulla and their functions.*

(c) (i) the histology of the pancreas. *To include the endocrine tissues.* (ii) the examination and drawing of stained sections of the pancreas to show the histology of the endocrine tissues.

(d) how blood glucose concentration is regulated. *To include the action of insulin and glucagon as an example of negative feedback, and the role of the liver AND the control of insulin secretion, with reference to potassium channels and calcium channels in the beta cells of the pancreas.*

(e) the differences between Type 1 and Type 2 diabetes mellitus. *To include the causes of Type 1 and Type 2 diabetes and the treatments used for each.*

(f) the potential treatments for diabetes mellitus. *To include the use of insulin produced by genetically modified bacteria and the potential use of stem cells to treat diabetes mellitus.*

Module 6 – Genetics, evolution and ecosystems

6.1.1 Cellular control

(a) types of gene mutations and their possible effects on protein production and function. *To include substitution, insertion or deletion of one or more nucleotides AND the possible effects of these gene mutations (i.e. beneficial, neutral or harmful).*

(b) the regulatory mechanisms that control gene expression at the transcriptional level, post- transcriptional level and post-translational level. *To include control at the transcriptional level - lac operon, and transcription factors in eukaryote; post-transcriptional level - the editing of primary mRNA and the removal of introns to produce mature mRNA; and post-translational level - the activation of proteins by cyclic AMP.*

(c) the genetic control of the development of body plans in different organisms. *To include an appreciation that homeobox gene sequences in plants, animals and fungi are similar and highly conserved AND the role of Hox genes in controlling body plan development.*

(d) the importance of mitosis and apoptosis as mechanisms controlling the development of body form. *To include an appreciation that the genes which regulate the cell cycle and apoptosis are able to respond to internal and external cell stimuli e.g. stress.*

HALF TERM

Nov/Dec Half Term 2

6.1.2 Patterns of inheritance

(a) (i) the contribution of both environmental and genetic factors to phenotypic variation. *To include examples of both genetic and environmental contributions – environmental examples could include diet in animals and etiolation or chlorosis in plants.* (ii) how sexual reproduction can lead to genetic variation within a species. *To include meiosis and the random fusion of gametes at fertilisation.*

(b) (i) genetic diagrams to show patterns of inheritance. *To include monogenic inheritance, dihybrid inheritance, multiple alleles, sex linkage and codominance.* (ii) the use of phenotypic ratios to identify linkage (autosomal and sex linkage) and epistasis. *To include explanations of linkage and epistasis.*

(c) using the chi-squared ($\chi 2$) test to determine the significance of the difference between observed and expected results. *The formula for the chi-squared ($\chi 2$) test will be provided.*

(d) the genetic basis of continuous and discontinuous variation. *To include reference to the number of genes that influence each type of variation.*

(e) the factors that can affect the evolution of a species. *To include stabilising selection and directional selection, genetic drift, genetic bottleneck and founder effect.*

(f) the use of the Hardy–Weinberg principle to calculate allele frequencies in populations. *The equations for the Hardy–Weinberg principle will be provided.*

(g) the role of isolating mechanisms in the evolution of new species. *To include geographical mechanisms (allopatric speciation) and reproductive mechanisms (sympatric speciation).*

(h) (i) the principles of artificial selection and its uses. *To include examples of selective breeding in plants and animals AND an appreciation of the importance of maintaining a resource of genetic material for use in selective breeding, including wild types.* (ii) the ethical considerations surrounding the use of artificial selection. *To include a consideration of the more extreme examples of the use of artificial selection to 'improve' domestic species e.g. dog breeds.*

CHRISTMAS HOLIDAY

6.1.3 Manipulating genomes

Jan/Feb Half Term 3	(a) the principles of DNA sequencing and the development of new DNA sequencing techniques. *To include the rapid advancements of the techniques used in sequencing, which have increased the speed of sequencing and allowed whole genome sequencing e.g. high-throughput sequencing.*
	(b) (i) how gene sequencing has allowed for genome-wide comparisons between individuals and between species. *With reference to bioinformatics and computational biology, and how these fields are contributing to biological research into genotype–phenotype relationships, epidemiology, and searching for evolutionary relationships.* (ii) how gene sequencing has allowed for the sequences of amino acids in polypeptides to be predicted. (iii) how gene sequencing has allowed for the development of synthetic biology.
	(c) the principles of DNA profiling and its uses. *To include forensics and analysis of disease risk.*
	(d) the principles of the polymerase chain reaction (PCR) and its application in DNA analysis.
	(e) the principles and uses of electrophoresis for separating nucleic acid fragments or proteins.
	(f) (i) the principles of genetic engineering. *To include the isolation of genes from one organism and the placing of these genes into another organism using suitable vectors.* (ii) the techniques used in genetic engineering. *To include the use of restriction enzymes, plasmids and DNA ligase to form recombinant DNA with the desired gene and electroporation.*
	(g) the ethical issues (both positive and negative) relating to the genetic manipulation of animals (including humans), plants and microorganisms. *To include insect resistance in genetically modified soya, genetically modified pathogens for research and 'pharming' i.e. genetically modified animals to produce pharmaceuticals AND issues relating to patenting and technology transfer e.g. making genetically modified seed available to poor farmers.*
	(h) the principles of, and potential for, gene therapy in medicine. *To include the differences between somatic cell gene therapy and germ line cell gene therapy.*
	HALF TERM
March/April Half Term 4	6.2.1 Cloning and biotechnology
	(a) (i) natural clones in plants and the production of natural clones for use in horticulture. *To include examples of natural cloning and the methods used to produce clone (various forms of vegetative propagation).* (ii) how to take plant cuttings as an example of a simple cloning technique. *To include dissection of a selection of plant material to produce cuttings.*
	(b) (i) the production of artificial clones of plants by micropropagation and tissue culture. (ii) the arguments for and against artificial cloning in plants. *To include an evaluation of the uses of plant cloning in horticulture and agriculture.*
	(c) natural clones in animal species. *To include examples of natural clones (twins formed by embryo splitting).*
	(d) (i) how artificial clones in animals can be produced by artificial embryo twinning or by enucleation and somatic cell nuclear transfer (SCNT). (ii) the arguments for and against artificial cloning in animals. *To include an evaluation of the uses of animal cloning (examples including in agriculture and medicine), and issues of longevity of cloned animals.*
	(e) the use of microorganisms in biotechnological processes. *To include reasons why microorganisms are used e.g. economic considerations, short life cycle, growth requirements AND processes including brewing, baking, cheese making, yoghurt production, penicillin production, insulin production and bioremediation.*
	(f) the advantages and disadvantages of using microorganisms to make food for human consumption. *To include bacterial and fungal sources.*
	(g) (i) how to culture microorganisms effectively, using aseptic techniques. (ii) the importance of manipulating the growing conditions in batch and continuous fermentation in order to maximise the yield of product required.
	(h) (i) the standard growth curve of a microorganism in a closed culture. (ii) practical investigations into the factors affecting the growth of microorganisms.
	(i) the uses of immobilised enzymes in biotechnology and the different methods of immobilisation. *To include methods of enzyme immobilisation AND an evaluation of the use of immobilised enzymes in biotechnology. Examples could include: glucose isomerase for the conversion of glucose to fructos, penicillin acyclase for the formation of semi-synthetic penicillins (to which some penicillin- resistant organisms are not resistant), lactase for the hydrolysis of lactose to glucose and galactose, aminoacyclase for production of pure samples of L-amino acids, glucoamylase for the conversion of dextrins to glucose, and nitrilase for the conversion of acrylonitrile to acrylamide (for use in the plastics industry).*
	EASTER HOLIDAY
..	6.3.2 Populations

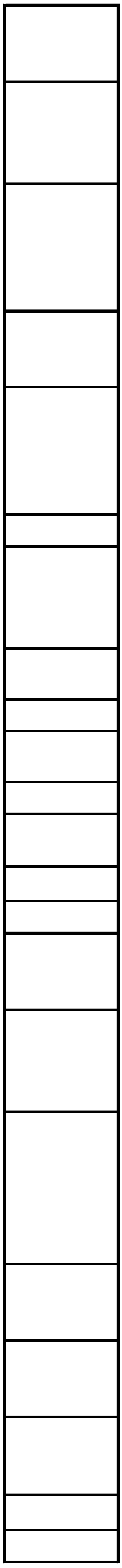
May Half Term 5	
	(a) the factors that determine size of a population. To include the significance of limiting factors in determining the carrying capacity of a given environment and the impact of these factors on final population size
	(b) interactions between populations. *To include predator–prey relationships considering the effects on both predator and prey populations AND interspecific and intraspecific competition.*

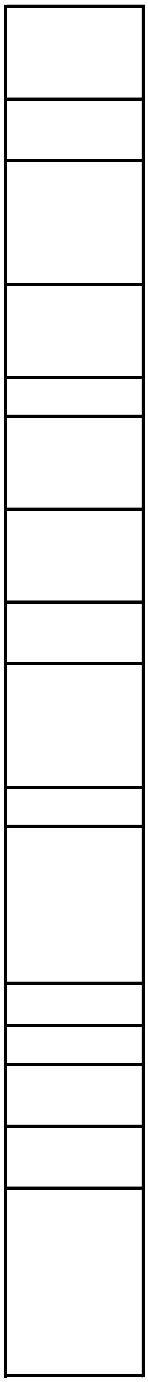
Skills Common to Both Sides of the Course

Module 1 Practical Skills
1.1.1 Planning
a) Experimental design, including to solve problems set in a practical context. *Including selection of suitable apparatus, equipment and techniques for the proposed experiment. Learners should be able to apply scientific knowledge based on the context of the specification to the practical context.*
b) Identification of variables that must be controlled, where appropriate.
c) Evaluation that an experimental method is appropriate to meet the expected outcomes.
1.1.2 Implementing
a) How to use a wide range of practical apparatus and techniques correctly.
b) Appropriate units for measurements.
c) Presenting observations and data in an appropriate format.
1.1.3 Analysis
a) Processing, analyzing and interpreting qualitative and quantitative experimental results. *Including reaching valid conclusions, where appropriate.*
b) Use of appropriate mathematical skills for analysis of quantitative data. *See below for a list of mathematical skills.*
c) Appropriate use of significant figures.
d) Plotting and interpreting suitable graphs form experimental results, including (i) selection and labelling of axes with appropriate scales, quantitaties and units (ii) measurements of gradients and intercepts.
1.1.4 Evaluation
a) How to evaluate results and draw conclusions.
b) The identification of anomalies in experimental measurements.
c) The limitations in experimental procedures.
d) Precision and accuracy of measurements and data, including margins of error, percentage errors and uncertainties in apparatus.
e) The refining of experimental design by suggestion of improvements to the procedures and apparatus.
Mathematical Requirements
M0.1 Recognise and make use of appropriate units in calculations.
M0.2 Recognise and use expressions in decimal and standard form.
M0.3 Use ratios, fractions and percentages.
M0.4 Estimate results.
M0.5 Use calculators to find and use power, exponential and logarithmic functions.
M1.1 Use an appropriate number of significant figures.
M1.2 Find arithmetic means.
M1.3 Construct and interpret frequency tables and diagrams, bar charts and histograms.
M1.4 Understand simple probability.
M1.5 Understand the principles of sampling as applied to scientific data.
M1.6 Understand the terms mean, median and mode.
M1.7 Use a scatter diagram to identify a correlation between two variables.
M1.8 Make order of magnitude calculations.
M1.9 Select and use a statistical test.
M1.10 Understand measures of dispersion, including standard deviation and range.
M1.11 Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined.

M2.1 Understand and use the symbols =,<,>.
M2.2 Change the subject of an equation.
M2.3 Substitute numerical values into algebraic equations using appropriate units for physical quantities.
M2.4 Solve algebraic equations.
M2.5 Use logarithms in relation to quantities that range over several orders of magnitude.
M3.1 Translate information between graphical, numerical and algebraic forms.
M3.2 Plot two variables from experimental or other data.
M3.3 Understand that y = mx + c represents a linear relationship.
M3.4 Determine the intercept of a graph.
M3.5 Calculate the rate of change from a graph showing a linear relationship.
M3.6 Draw and use the slope of a tangent to a curve as a measure of the rate of change.
M4.1 Calculate the circumferences, surface areas and volumes of regular shapes.

(v)



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