Year 13 Curriculum Overview

Week	Teacher 1	Teacher 2
1	**Respiration** **5.2.2(a)** the need for cellular respiration,examples of why plants, animals and microorganisms need to respire eg. active transport and an outline of named metabolic reactions. **5.2.2(f)** the importance of coenzymes in cellular respiration	**Communication and Homeostasis** **5.1.1(a)** the need for communication systems in multicellular organisms, plant and animals, internal and external
	5.2.2(c) the process and site of glycolysis, 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	**5.1.1(b)** the communication between cells by cell signalling between adjacent cells and distant cells
2	**5.2.2(b)** the structure of the mitochondrion, inner and outer mitochondrial membranes, cristae, matrix and mitochondrial DNA	**5.1.1(c)** the principles of homeostasis, receptors, effectors, negative and positive feedback
	5.2.2(d) the link reaction and its site in the cell, formation of Acetyl CoA by the decarboxylation of pyruvate and the reduction of NAD to NADH **5.2.2(e)** the process and site of the Krebs cycle, formation of citrate from the acetyl group of acetyl CoA and oxaloacetate and the reconversion of citrate to oxaloacetate the importance of decarboxylation, dehydrogenation, the reduction of NAD and FAD, and substrate level phosphorylation	**5.1.1(d)** the physiological and behavioural responses involved in temperature control in ectotherms and endotherms: hypothalamus, receptors, effectors and behavioural responses
3	**5.2.2(g)** the process and site of oxidative phosphorylation, roles of electron carriers, oxygen and the mitochondrial cristae	**Excretion as a Homeostatic Mechanism** **5.1.2(a)** the term excretion and its importance in maintaining metabolism and homeostasis including removal of carbon dioxide and

	5.2.2(h) the chemiosmotic theory, electron transport chain, proton gradients and ATP synthase in oxidative phosphorylation and photophosphorylation	nitrogenous waste
	5.2.2(i) (i) the process of anaerobic respiration in eukaryotes; 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	**5.1.2(b)** (i) the structure and functions of the mammalian liver the roles of the liver in storage of glycogen, detoxification and the formation of urea (the ornithine cycle covered in outline only)
4	**5.2.2(j)** the difference in relative energy values of carbohydrates, lipids and proteins as respiratory substrates **5.2.2(k)** the use and interpretation of the respiratory quotient (RQ): RQ = CO_2 produced /O_2 consumed	**5.1.2(c)** (i) the **structure**, mechanisms of action and functions of the mammalian kidney
	(ii) practical investigations into respiration rates in yeast, under aerobic and anaerobic conditions **PAG 12** Yeast	**5.1.2(c)** (i) the structure, **mechanisms of action and functions of the mammalian kidney**
5	**5.2.2(l)** practical investigations into the effect of factors such as temperature, substrate concentration and different respiratory substrates on the rate of respiration using a respirometer	**5.1.2(c)** (i) the structure, **mechanisms of action and functions of the mammalian kidney** (iii) the examination and drawing of stained sections to show the **histology of nephrons**
	Photosynthesis **5.2.1(a)** the interrelationship between the process of photosynthesis and respiration, relationship between the raw materials and products of the two processes	(ii) the dissection, examination and drawing of the external and internal structure of the kidney **PAG 1 and 2**
6	**5.2.1(b)** the structure of a chloroplast and the sites of the two main stages of photosynthesis; outer membrane, lamellae, grana, thylakoid, stroma and DNA	**5.1.2(d)** the control of the water potential of the blood : the role of osmoreceptors in the hypothalamus, the posterior pituitary gland, ADH and its effect on the walls of the collecting ducts
	5.2.1(c) (i) the importance of photosynthetic pigments in photosynthesis, light harvesting systems and photosystems	**5.1.2(e)** the effects of kidney failure and its potential treatments to include effect on glomerular filtration rate (GFR) and electrolyte balance

		and haemodialysis and peritoneal dialysis as well as transplants - possible research
7	(ii) practical investigations using thin layer chromatography (TLC) to separate photosynthetic pigments **PAG 6** Chromatography	**5.1.2(f)** how excretory products can be used in medical diagnosis, the use of urine samples in diagnostic tests, with reference to the use of monoclonal antibodies in pregnancy testing, testing for anabolic steroids and drugs
	ii) practical investigations using thin layer chromatography (TLC) to separate photosynthetic pigments **PAG 6** Chromatography	**Hormonal Communication** **5.1.4(a)** endocrine communication by hormones, secretion into blood detected by target cells and tissues **5.1.4(b)** the structure and functions of the adrenal glands to include hormones secreted by the cortex and medulla and their functions
8	**5.2.1(d)** the light-dependent stage of photosynthesis,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 photophosphorylaton AND the role of water	**5.1.4(b)** the structure and functions of the adrenal glands to include hormones secreted by the cortex and medulla and their functions
	5.2.1(e) the fixation of carbon dioxide and the light independent stage of photosynthesis, products of the LDR are used in the LIR (Calvin cycle) to produce triose phosphate (TP) with reference to ribulose bisphosphate (RuBP), ribulose bisphosphate carboxylase (RuBisCO) and glycerate 3-phosphate (GP)	**5.1.4(c)** (i) the histology of the pancreas (ii) the examination and drawing of stained sections of the pancreas to show the histology of the endocrine tissues
9	**5.2.1(f)** the uses of triose phosphate as a starting material for the synthesis of carbohydrates, lipids and amino acids AND the recycling of TP to regenerate the supply of RuBP	**5.1.4(d)** how blood glucose concentration is regulated, 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

	5.2.1(g) (i) factors affecting photosynthesis, **carbon dioxide concentration**, **light intensity** and **temperature**, and the implications of **water stress** (stomatal closure)	**5.1.4(d)** how blood glucose concentration is regulated, 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
10	**5.2.1(g)** (i) factors affecting photosynthesis on levels of **GP**, **RuBP** and **TP**	**5.1.4(e)** the difference between type 1 and 2 diabetes **5.1.4(f)** the potential treatments for diabetes mellitus, the use of insulin produced by genetically modified bacteria and the potential use of stem cells to treat diabetes mellitus - possible research homework
	(ii) practical investigations into factors affecting the rate of photosynthesis **PAG 12** Rate of Photosynthesis	**Neuronal Communication** **5.1.3(a)** the roles of mammalian sensory receptors in converting different types of stimuli into nerve impulses (e.g. Pacinian corpuscle)
11	(ii) practical investigations into factors affecting the rate of photosynthesis **PAG 12** Rate of Photosynthesis	**5.1.3(b)** the structure and functions of sensory, relay and motor neurons to include myelinated and non-myelinated neurones
	Animal Response **5.1.5(g)** the organisation of the mammalian nervous system, central and peripheral systems AND the functional organisation into the somatic and autonomic nervous systems	**5.1.3(c)** the generation and transmission of nerve impulses in mammals, resting potential, action potential, positive feedback and frequency of impulse
12	**5.1.5(h)** the structure of the human brain and the functions of its parts AND the functions of the cerebrum, cerebellum, medulla oblongata, hypothalamus and pituitary gland.	**5.1.3(d)** the structure and roles of synapses in neurotransmission to include a cholinergic synapse, the action of neurotransmitters at the synapse and the importance of synapses in summaton and control, including inhibitory and excitatory synapses
	5.1.5(i) Reflex actions to include knee jerk reflex and blinking reflex, with reference to the survival value of reflex action	**Plant Responses 5.1.5(a)** (i) the types of plant responses, the response to abiotic stress and herbivory e.g. chemical defences (such as tannins, alkaloids and pheromones), folding in response to touch (Mimosa pudica) (ii) practical investigations into phototropism and geotropism

13	**5.1.5(j)** the coordination of responses by the nervous and endocrine systems, '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)	**5.1.5(b)** the roles of plant hormones in leaf loss in deciduous plants, seed germination and stomatal closures
	5.1.5(k) the effects of hormones and nervous mechanisms on heart rate	**5.1.5(c)** the experimental evidence for the role of auxins in the control of apical dominance **5.1.5(d)** the experimental evidence for the role of gibberellin in the control of stem elongation and seed germination
14	**5.1.5(l)** (i) the structure of mammalian muscle and the mechanism of muscular contraction, structural and functional differences between skeletal, involuntary and cardiac muscle	**5.1.5(e)** practical investigations into the effect of plant hormones on growth **5.1.5(f)** the commercial use of plant hormones, to control ripening, the use of rooting powders and hormonal weed killers
	5.1.5(l) 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	**Cloning and Biotechnology** **6.2.1(a)** (i) natural clones in plants and the production of natural clones for use in horticulture
15	**PAG 11** Investigation into the measurement of an animal response - exercise and pulse rate	(ii) how to take plant cuttings as an example of a simple cloning technique, dissection of a selection of plant material to produce cuttings
	Cellular Control Recap of DNA, transcription and translation from Year 12, including RNA polymerase, mRNA, tRNA, rRNA, codon, anticodon and triplet code	**6.2.1(b)** (i) the production of artificial clones of plants by micropropagation and tissue culture (ii) the arguments for and against artificial cloning in plants
16	**6.1.1(a)** types of gene mutations and their possible effects on protein production and function, substitution, insertion or	**6.2.1(c)** natural clones in animal species, examples (twins formed by embryo splitting)

	deletion of one or more nucleotides AND the possible effects of these gene mutations (i.e. beneficial, neutral or harmful)	**6.2.1(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 - possible research
	6.1.1(b) the regulatory mechanisms that control gene expression at the transcriptional level, posttranscriptional level and post-translational level • transcriptional level: lac operon, and transcription factors in eukaryotes • post-transcriptional level: the editing of primary mRNA and the removal of introns to produce mature mRNA • post-translational level: the activation of proteins by cyclic AMP	**6.2.1(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 - possible research
17	**6.1.1(c)** the genetic control of the development of body plans in different organisms, homeobox gene sequences in plants, animals and fungi are similar and highly conserved AND the role of Hox genes in controlling body plan development	**6.2.1(e)** the use of microorganisms in biotechnological processes e.g. economic considerations, short life cycle, growth requirements AND processes including brewing, baking, cheese making, yoghurt production, penicillin production, insulin production and bioremediation
	6.1.1(d) the importance of mitosis and apoptosis as mechanisms controlling the development of body form,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.	**6.2.1(f)** the advantages and disadvantages of using microorganisms to make food for human consumption include bacterial and fungal sources
18	**Manipulating Genomes** **6.1.3(e)** the principles and uses of electrophoresis for separating nucleic acid fragments or proteins	**6.2.1(g)** (i) how to culture microorganisms effectively, using aseptic techniques, an opportunity for serial dilutions and culturing on agar plates **PAG 7** Microbial Techniques and Serial Dilutions
	6.1.3(a) the principles of DNA sequencing and the development of new DNA sequencing techniques, rapid advancements of the techniques used in sequencing, which	(ii) the importance of manipulating the growing conditions in batch and continuous fermentation in order to maximise the yield of product required

	have increased the speed of sequencing and allowed whole genome sequencing e.g. high-throughput sequencing	**6.2.1(h)** (i) the standard growth curve of a microorganism in a closed culture, include the formula for number of individual organisms
19	**6.1.3(b)** (i) how gene sequencing has allowed for genome-wide comparisons between individuals and between species (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	**6.2.1(i)** the uses of immobilised enzymes in biotechnology and the different methods of immobilisation, methods of enzyme immobilisation AND an evaluation of the use of immobilised enzymes in biotechnology
	6.1.3(d) the principles of the polymerase chain reaction (PCR) and its application in DNA analysis	**6.2.1(i)** practical - immobilised enzymes and yeast cells
20	**6.1.3(c)** the principles of DNA profiling and its uses; forensics and analysis of disease risk	**Ecosystems** **6.3.1(a)** ecosystems, which range in size, are dynamic and are influenced by both biotic and abiotic factors, all terminology
	6.1.3(f) (i) the principles of genetic engineering	**6.3.1(b)** biomass transfers through ecosystems, how biomass transfers between trophic levels can be measured AND the efficiency of biomass transfers between trophic levels, efficiency calculation, manipulation by humans
21	(ii) the techniques used in genetic engineering, use of restriction enzymes, plasmids and DNA ligase to form recombinant DNA with the desired gene and electroporation	**6.3.1(c)** recycling within ecosystems, nitrogen cycle
	6.1.3(g) the ethical issues (both positive and negative) relating to the genetic manipulation of animals (including humans), plants and microorganisms, 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	**6.3.1(c)** recycling within ecosystems, carbon cycle

	and technology transfer e.g. making genetically modified seed available to poor farmers	
22	**6.1.3(h)** the principles of, and potential for, gene therapy in medicine, differences between somatic cell gene therapy and germ line cell gene therapy	**6.3.1(d)** the process of primary succession in the development of an ecosystem, from pioneer species to a climax community AND deflected succession
	Inheritance **6.1.2(a)** (i) the contribution of both environmental and genetic factors to phenotypic variation, examples of both genetic and environmental contributions – environmental examples could include diet in animals and etolaton or chlorosis in plants	**6.3.1(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
23	ii) how sexual reproduction can lead to genetic variation within a species, meiosis and the random fusion of gametes at fertlisaton	**Populations and Sustainability** **6.3.2(a)** the factors that determine size of a population, the significance of limiting factors in determining the carrying capacity of a given environment and the impact of these factors on final population size
	6.1.2(b) (i) genetic diagrams to show patterns of inheritance and **mono**genic inheritance	**6.3.2(b)** interactions between populations, predator–prey relationships considering the effects on both predator and prey populations AND interspecific and intraspecific competition
24	(i) **di**hybrid inheritance, multple alleles, sex linkage and codominance	**6.3.2(c)** the reasons for, and differences between, conservation and preservation,economic, social and ethical reasons for conservation of biological resources
	(ii) the use of phenotypic ratios to identify linkage (autosomal and sex linkage) and epistasis	**6.3.2(d)** how the management of an ecosystem can provide resources in a sustainable way, timber production and fishing
25	**6.1.2(c)** using the chi-squared ($\chi 2$) test to determine the significance of the difference between observed and expected results - equation provided	**6.3.2(e)** the management of environmental resources eg. the Masai Mara region in Kenya and the Terai region of Nepal, peat bogs **and** the effects of human activities eg. Galapagos Islands, Antarctica, Snowdonia National Park, the Lake District

	6.1.2(d) the genetic basis of continuous and discontinuous variation, reference to the number of genes that influence each type of variation	
26	**6.1.2(e)** the factors that can affect the evolution of a species, stabilising selection and directional selection, genetic drift, genetic bottleneck and founder effect	
	6.1.2(f) the use of the Hardy–Weinberg principle to calculate allele frequencies in populations - equation provided	
27	**6.1.2(g)** the role of isolating mechanisms in the evolution of new species, geographical mechanisms (allopatric speciation) and reproductive mechanisms (sympatric speciation)	
	6.1.2(h) (i) the principles of artificial selection and its uses, 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, more extreme examples of the use of artificial selection to 'improve' domestic species e.g. dog breeds	