SVKM International School, Mumbai
– SCHEME OF WORK
A levels (9700) Batch: 2019-20

(Scope and Sequence)

Teacher: Ms. Gurismran Kaur **Subject: Biology A levels (9700)**

Week and Month	Topic	Sub topics &Learning Outcomes	Teaching activities / Integration of ICT components	Subject Assement Summative / formative	Course work / practical component	Resources
June CYCLE 1 (2 Weeks)	The diversity of life	➢ **18.1 Biodiversity** ➢ Key concepts Natural selection, Organisms in their environment ➢ a) define the terms species, ecosystem and niche ➢ b) explain that biodiversity is considered at three different levels: • variation in ecosystems or habitats • the number of species and their relative abundance • genetic variation	Use of ppts, Teacher will carry out a brainstorming exercise to indicate how much learners can recall of each term. Discuss the species concept (and difficulties in defining the term – there are over 20 definitions) before learners make notes. Learners will define the terms species, ecosystem and niche. Teacher will explain that biodiversity can be considered at a local, national and	1. Worksheet 2. Tests after completion of the topic	Analysis of correlation between abundance and distribution	SUBJECT Course : Biology CJ Clegg http://purchon.com/ecology/ http://www.ecologydictionary.org/ Cambridge international AS and A level Biology. Mary Jones

		within each species ➢ c) explain the importance of random sampling in determining the biodiversity of an area ➢ d) use suitable methods, such as frame quadrats, line transects, belt transects and mark-release-recapture, to assess the distribution and abundance of organisms in a local area ➢ e) use Spearman's rank correlation and Pearson's linear correlation to analyse the relationships between the distribution and abundance of species and abiotic or biotic	global level. Give a definition of a habitat, for reference only, e.g. the particular location and type of local environment occupied by a population or organism, characterised by its physical features or by its dominant producers. Learners volunteer the different types of medium-scale (meso) ecosystems in their region: e.g. wood/forest, lake/river, field, rocky shore (ecosystem biodiversity). Teacher will explain the importance of random sampling in determining the biodiversity of an area Teacher will explain	Students will present case histories on areas of natural importance and their current status.		SUBJECT Pearson Baccalaureate Cambridge international AS and A level Biology. Mary Jones SUBJECT Course : Biology CJ Clegg

		factors (the formula for these correlations will be provided) (see Mathematical requirements) f) use Simpson's Index of Diversity ➢ (D) to calculate the biodiversity of a habitat, using the formula D N n 1 2 = -d/c m n and state the significance of different values of D	random sampling is best demonstrated by holding up one page from a large newspaper that contains words of different sized fonts, images and blank areas. Learners discuss a method to determine how many different species and how many individuals of each species there are (and only 30 minutes to carry out the task). Teacher will explain that Simpson's Index of Diversity gives an overall measure of diversity by taking into account the number of different species in a sample and the abundance of each species. o Explain that a high D value represents high biodiversity, indicating a high	Worksheet on the taught content.		Online http://www.statstutor.ac.uk/topics/correlation/pearsons-correlationcoefficient/ http://www.statstutor.ac.uk/topics/correlation/spearmans-correlationcoefficient/ http://www.heckgrammar.co.uk/index .php?p=10310

		➢ **18.2 Classification** ➢ a) describe the classification of species into the taxonomic hierarchy of domain, kingdom, phylum, class, order, family, genus and species ➢ b) outline the characteristic features of the three domains Archaea, Bacteria and Eukarya ➢ c) outline the characteristic features of the kingdoms Protoctista, Fungi, Plantae and Animalia	number of species, evenly spread for abundance. Teacher will describe the classification of species into the taxonomic hierarchy of domain, kingdom, phylum, class, order, family, genus and species Learners suggest a method to sort all the different organisms in the world and then share ideas. Teacher will Introduce the idea of sorting as 'classification' and agree that a hierarchical approach is sensible Display a 'tree of life' with the three domains and briefly outline the other taxonomic ranks, asking for	Worksheet on the taught content.		Cambridge international AS and A level Biology. Mary Jones. SUBJECT Pearson Baccalaureate http://www.wellcome.ac.uk/Education - resources/Education-andlearning/Big-Picture/Allissues/Evolution/index.htm http://www.ucmp.berkeley.edu/alllife/threedomains.html

JULY (1st week)		➢ d) explain why viruses are not included in the three domain classification and outline how they are classified, limited to types of nucleic acid (RNA or DNA) and whether these are single stranded or double stranded ➢ **18.3 Conservation** ➢ a) discuss the threats to the biodiversity of aquatic and terrestrial ecosystems (see 18.1b)	suggestions why the species taxon is considered to be the only natural classification group. Teacher will also discuss the characteristics and features of all the kingdoms and organisms in detail. Learners note down the taxonomic ranks listed and decide a good mnemonic to help remember the hierarchical order. To check understanding of the terms, learners will give examples of specific local terrestrial and aquatic ecosystems. Teacher will discuss the global food and energy demands (from increasing population size, developing nations and increasing	Worksheet on the taught content.		http://www.eoearth.org/view/article/51cbef267896bb431f69cb9a/?topic=51cbfc78f702fc2ba8129e70 http://www.johnkyrk.com/virus.html Textbooks/Publications Bio Factsheet 32: Viruses made simpl http://environment.nationalgeographic.co.uk/environment/ http://evolution.berkeley.edu/evolibrary/news/120301_chipmunks

			industrialization) and threats that may affect ecosystems.			
		17.3.e explain why organisms become extinct, with reference to climate change, competition, habitat loss and killing by humans	Teacher will discuss what is meant by extinction, pointing out that it is a natural process and part of the theory of evolution by natural selection. Learners will list out the names of the species extinct with reasons.			http://www.bbc.co.uk/lastchancetose e/sites/about/extinction.shtml http://www.iucnredlist.org/ http://www.bbc.co.uk/lastchancetose/sites/about/extinction.shtml
		➢ b) discuss the reasons for the need to maintain biodiversity	Learners will research the reasons to maintain biodiversity. Teacher will discuss the reasons in detail including genetic, future uses, current uses, spiritual / aesthetic, etc reasons.			http://www.iucnredlist.org/ Past Paper Paper 43, June 2011, Q1 (a) Past Papers Paper 41, June 2012, Q6 (b)(ii) Paper 41, June 2013, Q9 (a) Paper 43, Nov 2013, Q5 (a)(iii)
		➢ c) discuss methods of protecting endangered species, including the roles of zoos, botanic gardens, conserved areas	Learners will discuss the needs of protecting endangered species			

		(national parks and marine parks), 'frozen zoos' and seed banks ➢ d) discuss methods of assisted reproduction, including IVF, embryo transfer and surrogacy, used in the conservation of endangered mammals ➢ e) discuss the use of culling and contraceptive methods to prevent overpopulation of protected and non-protected species ➢ f) use examples to explain the reasons for controlling alien species	by making conserved areas. Teacher will add on to the discussion the important concepts along with assisted reproduction methods in detail using a presentation. Learners will research examples meaningful to them, including the different reasons given to either culling or use of contraceptive methods, and explaining why one method was favoured. Learners will research examples of alien species (local, national and global) that are now considered unwelcome, and for each explain the reasons for controlling them.	Worksheet on the taught content.		1 Past Papers Paper 41, June 2011, Q3 (a) Paper 42, June 2013, Q5 Bio Factsheet 65: Conservation. http://en.wikipedia.org/wiki/Restoration_ecology http://www.ser.org/ http://www.nature.com/scitable/knowledge/library/restoration-ecology13339059 Past papers Paper 41, June 2011, Q8 (a)(b)

		➢ g) discuss the roles of non-governmental organisations, such as the World Wide Fund for Nature (WWF) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), in local and global conservation ➢ h) outline how degraded habitats may be restored with reference to local or regional examples	Teacher will discuss the role of government bodies and Measures taken by them in conservation. Teacher will discuss the concept of restoration ecology and the need for scientific planning and understanding when restoring degraded habitats or ecosystems.			
JULY CYCLE 2 (2nd Weeks)	**Genetics, population genetics and evolutionary processes**	➢ **16.1 Passage of information from parent to offspring** a) explain what is meant by homologous pairs of chromosomes	Teacher will discuss the features of homologous chromosomes Learners will list the similarities and differences between a pair of homologous chromosomes and	Worksheet		1. SUBJECT Course Biology CJ Clegg 3. Environmental Science by

	Genetics, population genetics and evolutionary proces	b) explain the meanings of the terms haploid and diploid and the need for a reduction division (meiosis) prior to fertilisation in sexual reproduction c) outline the role of meiosis in gametogenesis in humans and in the formation of pollen grains and embryo sacs in flowering plants d) describe, with the aid of photomicrographs and diagrams, the behavior of chromosomes in plant and animal cells during meiosis, and the associated behavior of the nuclear envelope, cell surface membrane and the spindle (names of the main stages are expected, but not the sub-divisions of prophase) e) explain how crossing over and random assortment of homologous chromosomes during meiosis and random fusion	note the differences between the X and Y chromosomes for understanding. Teacher will discuss the no. of chromosomes in haploid and diploid cells and also the reason why a diploid organism needs a reduction division (meiosis) to produce haploid cells. Teacher will explain the process of gametogenesis using a video and a presentation. Using the previous knowledge teacher will plan a formative on mitosis. Referring to the diagrams of mitosis and understanding of meiosis, learners will L draw a series of annotated diagrams, or annotate prepared	2. Tests after completion of the topic. Worksheet on		Cunningham & Cunningham 4. The Habitable Planet Past Papers Paper 43, June 2011, Q7 (a) Past Papers Paper 43, June 2011, Q7 (b)

	ses	of gametes at fertilisation lead to genetic variation including the expression of rare, recessive alleles	diagrams. Teacher will explain crossing over using a clay model and a video.	the taught content.		
JULY CYCLE 2 (3rd week)	**Genetics, population genetics and evolutionary processes**	**16.2 The roles of genes in determining the phenotype** a) explain the terms gene, locus, allele, dominant, recessive, codominant, linkage, test cross, F1 and F2, phenotype, genotype, homozygous and heterozygous b) use genetic diagrams to solve problems involving monohybrid and dihybrid crosses, including those involving autosomal linkage, sex linkage, codominance, multiple alleles and gene interactions (the term epistasis does not need to be used; knowledge of the expected ratio for various types of epistasis is not required. The focus is on	Teacher will discuss and test student's previous knowledge on genetics. Leaners will discuss and write the definition of the mentioned terms. learners research examples of gene mutations resulting in cystic fibrosis (differing severities).. • Learners construct a flow chart to	Worksheet on genetic diagrams to solve problems involving test crosses .	use the chi-squared test to test the significance of differences between observed and expected results	**Textbooks/Publications** *Bio Factsheet 94*: Gene Mutations *Bio Factsheet 179*: Answering Exam Questions: Mutation **Past Papers** Paper 43, June

JULY (4th week)	**Genetics, population genetics and evolutionary processes**	problem solving) c) use genetic diagrams to solve problems involving test crosses d) use the chi-squared test to test the significance of differences between observed and expected **17.1 Variation** a) describe the differences between continuous and discontinuous variation and explain the genetic basis of continuous (many, additive genes control a characteristic) and discontinuous variation (one or few genes control a characteristic) (examples from 16.2f may be used to illustrate discontinuous variation; height and mass may be used as examples of continuous variation) b) explain, with examples, how the environment may affect the phenotype of plants and animals. 17.1.c use the t-test to compare the variation of two different populations	show how a gene mutation can lead to symptoms of sickle cell anaemia. **(** Learners research one other condition from the list then work with others (that have covered the same condition) to produce an information sheet to present to the class to use as notes Teacher will discuss with examples the reasons for variation in the population. Teacher will also discuss the the examples and continuous and discontinuous variation. Teacher will discuss the effect of environment on the phenotype of organism.	Worksheet on) use the t-test to compare the variation of two different populations	Learners choose one example from the summary table and write a sequential	2011, Q9 (a) http://learn.genetics.utah.edu/content/variation/sources/ http://darwiniana.org/evolution.htm http://www.eoearth.org/article/Genetic_variation http://www.wellcometreeoflife.org/ **Past Papers** Paper 43, Nov 2013, Q2 (c) **Past Papers** Paper 43, June 2011, Q8

AUGUST (1st Week)	**16.2**	(see Mathematical requirements) **16.2** e) explain that gene mutation occurs by substitution, deletion and insertion of base pairs in DNA and outline how such mutations may affect the phenotype f) outline the effects of mutant alleles on the phenotype in the following human conditions: albinism, sickle cell anaemia, haemophilia and Huntington's disease g) explain the relationship between genes, enzymes and phenotype with respect to the gene for tyrosinase that is involved with the production of melanin **17.2 Natural and artificial selection** a) explain that natural selection occurs as populations have the capacity to produce many offspring that compete for resources; in the 'struggle for existence' individuals that are best adapted are most likely to survive to breed and pass on their alleles to the next generation	Teacher ill discuss the effect of mutation on the phenotype and genotype of an organism. Learners will list down different types of mutation and their effects. Learners will construct a flow chart to show how a gene mutation can lead to symptoms of sickle cell anemia Teacher will discuss the theory of natural selection with the learners. Learners will list down the examples selection pressures and describe phenotypes that are selected for and those selected	Formative Learners will construct a flow chart to show how a gene mutation can lead to symptoms of sickle cell anemia	account to explain how allele frequencies within a population can change	http://www.blackwellpublishing.com/ridley/a-z/Stabilizing_selection.asp http://www.nature.com/nature/journal/v313/n5997/abs/313047a0.html **Textbooks/Publications** *Bio Factsheet 44*: Evolution. Also useful for 17.3c).

AUGUST (2nd Week)	**Molecular biology and gene technology**	b) explain, with examples, how environmental factors can act as stabilising, disruptive and directional forces of natural selection c) explain how selection, the founder effect and genetic drift may affect allele frequencies in populations d) use the Hardy–Weinberg principle to calculate allele, genotype and phenotype frequencies in populations and explain situations when this principle does not apply	against Teacher will discuss the o two modes of selection: directional and disruptive graphs with examples. Teacher will explain how natural selection can affect the level of genetic variation for any one heritable trait by stating example of melanism. Explain that Hardy and Weinberg considered the behaviour of genes in idealised populations. Learners ork through an example to show how allele frequencies can be used to calculate genotype	Worksheet on Hardy–Weinberg principle to calculate allele, genotype and phenotype frequencies in populations and explain situations when this principle does not apply.	use the Hardy–Weinberg principle to calculate allele, genotype and phenotype frequencies in populations and explain situations when this principle does not apply \	**Textbooks/Publications** *Bio Factsheet 211*: Hardy Weinberg and population genetics. **Past Papers** Paper 42, June 2012, Q1 (a) Paper 42, June 2013, Q8 (b)

AUGUST (3rd Week)		e) describe how selective breeding (artificial selection) has been used to improve the milk yield of dairy cattle. f) outline the following examples of crop improvement by selective breeding: • the introduction of disease resistance to varieties of wheat and rice • the incorporation of mutant alleles for gibberellin synthesis into dwarf varieties so increasing yield by having a greater proportion of energy put into grain • inbreeding and hybridisation to produce vigorous, uniform varieties of maize **17.3 Evolution** a) state the general theory of evolution that organisms have changed over time b) discuss the molecular evidence that reveals similarities between closely related organisms with	frequencies and how genotype frequencies can be used to calculate allele frequencies Teacher explain that in selective breeding, humans have applied knowledge of natural selection to make 'improvements'. Learners will differentiate between natural selection and selective breeding. Use of ppts and video teacher will explain and discuss the concept of speciation and the method of origin of new species.	Worksheet		**Textbooks/Publications** *Bio Factsheet 13*: Genetic engineering **Past Papers** Paper 41, Nov 2011, Q7 **Past Papers** Paper 41, Nov 2012, Q3 (a)(ii) Paper 41, June 2013, Q2 (b)

AUGUST (4th Week) 8 sessions		reference to mitochondrial DNA and protein sequence data c) explain how speciation may occur as a result of geographical separation (allopatric speciation), and ecological and behavioural separation (sympatric speciation) d) explain the role of pre-zygotic and post-zygotic isolating mechanisms in the evolution of new species e) explain why organisms become extinct, with reference to climate change, competition, habitat loss and killing by humans **19.1 Principles of genetic technology** a) define the term recombinant DNA b) explain that genetic engineering involves the extraction of genes from one organism, or the synthesis of genes, in order to place them in another organism (of the same or another species) such that the receiving organism expresses the gene product c) describe the principles of the polymerase chain reaction (PCR) to clone and amplify DNA (the role of Taq polymerase should be emphasised)	Teacher explain and discuss the definition of recombinant DNA. Learners write a definition, qualifying with reference to recombinant plasmids and recombinant hosts. With the help of clay model and video recombinant plasmid formation will be shown. Teacher will also discuss various lab techniques used for amplification of the DNA.	Learners write a definition, qualifying with reference to recombinant plasmids and recombinant hosts	Learners research the genetically engineered protein products for treatment of people with	https://koshland-science-museum.org/sites/all/exhibits/exhibitdna/index.jsp http://learn.genetics.utah.edu/content/labs/pcr/ http://technyou.education.csiro.au/module/dna-profiling/page/220/dna-profiles-forensic-use

		19.1.h explain the roles of restriction endonucleases, reverse transcriptase and ligases in genetic engineering e) describe the properties of plasmids that allow them to be used in gene cloning i) explain, in outline, how microarrays are used in the analysis of genomes and in detecting mRNA in studies of gene expression. g) explain the use of genes for fluorescent or easily stained substances as markers in gene technology	. Teacher will explain and discuss how different endonucleases cleave at different, specific sequences to obtain blunt or 'sticky' / overlapping ends.. Teacher will discuss the advantages of using plasmid for genetic engineering. Teacher will show images to explain how the gene encoding GFP, green fluorescent protein (most commonly used gene), is placed between the promoter and the desired gene. Transcription of both genes occurs and GFP and the desired		the conditions listed. Provide guidance. State whether the protein could be extracted for treatment before genetic engineering techniques. ○ State the function of the protein and if the protein is deficient or Absent State how successful the treatment is and whether there are alternative treatment methods.	http://www.pbs.org/wgbh/nova/sheppard/analyze.html **Past Papers** Paper 41, June 2012, Q3 (a) **Textbooks/Publications** *Bio Factsheet 13*: Genetic engineering *Bio Factsheet 69*:Genetic engineering in agriculture *Bio Factsheet 192*: Investigating weeds and crop yield.

SEPTEMBER (1st WEEK)		19.2 c) explain the advantages of producing human proteins by recombinant DNA techniques (reference should be made to some suitable examples, such as insulin, factor VIII for the treatment of haemophilia and adenosine deaminase for treating severe combined immunodeficiency (SCID)) **19.3 Genetically modified organisms in agriculture** a) explain the significance of genetic engineering in improving the quality and yield of crop plants and livestock in solving the demand for food in the world, e.g. Bt maize, vitamin A enhanced rice (Golden riceTM) and GM salmon	product result. Teacher will discuss with learners the advantages of using recombinant DNA in various grave genetic conditions. Learners will recall and discuss selective breeding in cattle and in crop plants and discussions about the global demand for food (and energy).	Worksheet on the taught content.		**Past Papers** Paper 43, June 2011, Q5 (a) Paper 42, June 2012, Q4 (a) Textbooks/Publications Bio Factsheet 13: Genetic engineering. Bio Factsheet 106: Ethical issues in A-level Biology Bio Factsheet 137: GM Farm Scale Evaluation Trials. Past Papers Paper 43, June 2011, Q5 (b)(c)(d) Paper 42, June 2012, Q4 (e)

SEPTEMBER (2nd WEEK)		b outline the way in which the production of crops such as maize, cotton, tobacco and oil seed rape, may be increased by using varieties that are genetically modified for herbicide resistance and insect resistance 19.3.c discuss the ethical and social implications of using genetically modified organisms (GMOs) in food production d) describe and explain how gel electrophoresis is used to analyse proteins and nucleic acids, and to distinguish between the alleles of a gene (limited to the separation of polypeptides and the separation of DNA fragments cut with restriction endonucleases)	In groups, learners use resources to prepare annotated flow diagrams summarising one example of crop improvement from the list in the learning objective Learners use guidelines to research some ethical and social implications of using GMOs, and then debate and discuss these points in class With the help of a video teacher will explain electrophoresis and its type.	Worksheet on the taught content.		http://resources.schoolscience.co.uk/BBSRC/casestudies/cystic.pdf http://learn.genetics.utah.edu/content/disorders/screening/ http://www.merck.com/mmhe/sec22/ch256/ch256b.html http://www.visionresearch.eu/index.php?id=696 http://www.newscientist.com/article/dn24879-gene-therapy-restores-sightin-people-with-eye-disease.html http://www.newscientist.com/article/mg22029413.200-bubble-kid-successputs-gene-therapy-back-ontrack.html

		f) explain why promoters and other control sequences may have to be transferred as well as the desired gene **19.2 Genetic technology applied to medicine** a) define the term bioinformatics b) outline the role of bioinformatics following the sequencing of genomes, such as those of humans and parasites, e.g. Plasmodium (details of methods of DNA sequencing are not required) d) outline the advantages of screening for genetic conditions (reference may be made to tests for specific genes such as those for breast cancer, BRCA1 and BRCA2, and genes for haemophilia, sickle cell anaemia, Huntington's disease and cystic fibrosis)	Learners will work out what the term bioinformatics means with the help of a teacher. Learners suggest what is involved in genetic screening (using family history and, if the test is available, analysing tissue samples for DNA) and name conditions for which genetic screening is available. learners research and make outline notes on the genetic conditions named, then match up advantages from the brainstorm list to each condition Teacher explains that in gene therapy, the aim is for affected cells to take	Worksheet on the taught content.		http://history.nih.gov/exhibits/genetics /sect4.htm http://www.genemedresearch.ox.ac.uk/genetherapy/cfgt.html http://www.extremetech.com/extreme /171873-naked-dna-gene-therapyused-to-non-invasively-cure-heartdisease http://ghr.nlm.nih.gov/handbook/therapy/procedures

SEPTEMBER (3rd WEEK)		e) outline how genetic diseases can be treated with gene therapy and discuss the challenges in choosing appropriate vectors, such as viruses, liposomes and naked DNA (reference may be made to SCID, inherited eye diseases and cystic fibrosis) f) discuss the social and ethical considerations of using gene testing and gene therapy in medicine b) outline the way in which the production of crops such as maize, cotton, tobacco and oil seed rape may be increased by using varieties that are genetically modified for herbicide resistance and insect resistance	up the normal, non-mutated gene and produce the normal, functioning protein product. Teacher will discuss the social and ethical considerations of using gene testing and gene therapy in medicine (reference should be made to genetic conditions for which treatments exist and where none exist, also to IVF, embryo biopsy	SUMMATIVE WILL BE TAKEN		
		12.1 Energy a) outline the need for energy in living organisms, as illustrated by anabolic reactions, such as DNA replication and protein synthesis, active transport, movement and the maintenance of body temperature	Learners will brainstorm ideas to construct a disorganised set of statements including examples from prokaryotes and eukaryotes.	1. Worksheet Tests after completion of the topic		http://www.rsc.org/Education/Teachers/Resources/cfb/index.html

October (1st week)		b) describe the features of ATP that make it suitable as the universal energy currency list the four stages in aerobic respiration (glycolysis, link reaction, Krebs cycle and oxidative phosphorylation) and state where each occurs in eukaryotic cells. 12.2.b outline glycolysis as phosphorylation of glucose and the subsequent splitting of fructose 1,6-bisphosphate (6C) into two triose phosphate molecules, which are then further oxidised to pyruvate with a small yield of ATP and reduced NAD	Learners give headings for main uses of energy in organisms, accompanied by bullet-point notes. o Teacher will use questioning to remind learners of the structure of an ATP molecule. Ensure learners realise that energy is released at each step of the complete hydrolysis of ATP: ATP □ ADP □ AMP (Learners recall an overall equation for aerobic respiration: glucose + oxygen □ energy + water + carbon dioxide o State that ATP should be substituted for 'energy'. Teacher gives the introduction and over all view of each stage of respirtion. Teacher will explain that glycolysis occurs	Worksheet on the taught content.		**Textbooks/Publications** *Bio Factsheet 129*: ATP – what it is, what it does **Past Papers** Paper 41, June 2011, Q7 (a)

October (2nd WEEK)		12.2.c explain that, when oxygen is available, pyruvate is converted into acetyl (2C) coenzyme A in the link reaction 12.2.d outline the Krebs cycle, explaining that oxaloacetate (a 4C compound) acts as an acceptor of the 2C fragment from acetyl coenzyme A to form citrate (a 6C compound), which is reconverted to oxaloacetate in a series of small steps. 12.2.e explain that reactions in the Krebs cycle involve decarboxylation and dehydrogenation and the reduction of NAD and FAD	in the cytoplasm (in virtually every organism) in both anaerobic and aerobic respiration Learners copy out a skeleton flow diagram of glycolysis, with glucose, the two intermediates, and pyruvate shown (missing intermediate stages could be signified by the correct number of arrows in between). Teacher will explain that pyruvate travels from the cytosol through the inner and outer mitochondrial membranes to enter the matrix where the link reaction occurs. Learners will build up the simple diagram showing the required steps in the Krebs cycle, including the number of carbon atoms for the three named compounds.	. Worksheet		**Textbooks/Publications** Jones, Fosbery, Taylor, Gregory, has on page 205 (2007), or on page 277 (2013), a balance sheet of ATP use and synthesis. This could be used to give learners an idea of the difference in relative energy released. **Past Papers** Paper 41, June

		c) explain that ATP is synthesised in substrate-linked reactions in glycolysis and in the Krebs cycle 12.2.g explain that during oxidative phosphorylation: energetic electrons release energy as they pass through the electron transport system the released energy is used to transfer protons across the inner mitochondrial membrane protons return to the mitochondrial. outline the process of oxidative phosphorylation including the role of oxygen as final electron acceptor (no details of the carriers are required) e) explain that the synthesis of ATP is associated with the electron transport chain on the membranes of mitochondria and chloroplasts (see 12.2g)	Teacher will help the learners add annotations to the Krebs cycle: dehydrogenation occurs: the NADH and FADH contain hydrogen atoms protons and electrons (from the respiratory substrate) o decarboxylation of intermediates occurs: carbon dioxide is given of Learners label a basic diagram of the membrane carriers of the electron transport chain (ETC) and the ATP synthase (synthetase) complex in the inner mitochondrial / crista membrane (include labels for the mitochondrial matrix	Worksheet on the taught content.		2011, Q7 (b)(ii) Paper 41, Nov 2011, Q6 (c) http://www.science.smith.edu/departments/Biology/Bio231/etc.html Textbooks/Publications Bio Factsheet 12: Respiration Past Papers Paper 42, June 2013, Q4 (a)(i) http://www.stolaf.edu/people/giannini/flashanimat/metabolism/mido%20e%20transport.swf

		d) outline the roles of the coenzymes NAD, FAD and coenzyme A in respiration 12.2.i describe the relationship between structure and function of the mitochondrion using diagrams and electron micrographs 12.2.k explain the production of a small yield of ATP from respiration in anaerobic conditions in yeast and	and the inter-membrane space). Teacher will explain the process in detail with the help of a video and presentation Learners will outline the process of oxidative phosphorylation and understand the role pf oxygen. Teacher will form a link between ATP synthesis an electron transport. Teacher will explain that many enzymes require a non-protein (co-)factor, in their active site to help in catalysis, and that organic cofactors that associate with the enzyme during catalysis and then dissociate are known as coenzymes From electron micrographs of	Worksheet on the taught content.	carry out investigations, using simple respirometers, to measure the effect of temperature on the respiration rate of germinating seeds or small invertebrates.	Past Papers Paper 43, June 2011, Q6 (c) **Online** http://www.phschool.com/science/biology_place/labbench/lab5/features.html http://www.biologymad.com/master.html?http://www.biologymad.com/PhotosynResp/PhotosynResp.htm **Textbooks/Publications** King p.80-83 Siddiqui p.101-103

		in mammalian muscle tissue. 12.2.j distinguish between respiration in aerobic and anaerobic conditions in mammalian tissue and in yeast cells, contrasting the relative energy released by each (a detailed account of the total yield of ATP from the aerobic respiration of glucose is not required) 12.2.h carry out investigations to determine the effect of factors such as temperature and substrate concentration on the rate of respiration of yeast using a redox indicator (e.g. DCPIP or methylene blue) f) explain the relative energy values of carbohydrate, lipid and protein as respiratory substrates and explain why lipids are particularly energy-rich	mitochondria, learners identify the outer and inner membrane, cristae and matrix. With the help of a teacher learners construct an annotated diagram summarising how the structure of a mitochondrion is adapted for its functions Teacher will use flow diagrams to explain the lactate pathway in mammals and the ethanol pathway in yeast, with learners providing the main outline of glycolysis (glucose to pyruvate) and naming the location (cytoplasm. Learners suggest what is meant by respiration: brainstorm ideas such as: the release of energy from			http://mutuslab.cs.uwindsor.ca/schurko/animations/bombcal/animation4.htm

			food; the production of ATP; ATP for use by the cell; the process occurs in the cell. Learners will differentitate both the process with the help of teacher.			
		g) define the term respiratory quotient (RQ) and determine RQs from equations for respiration	Learners consider ratios of C, H and O, to explain and note down the relative energy values of proteins, carbohydrates and lipids, noting that lipids, with proportionately more hydrogen per g of substrate, will yield more energy Learners write out the definition of respiratory quotient and the formula to use when calculating RQ values. Teacher will explain the link between high RQ values and			http://www.biologymad.com/master.html?http://www.biologymad.com/PhotosynResp/PhotosynResp.htm

			anaerobic respiration Exam Summative			
. November (1st Week)	**Mammalian physiology, control and coordination**	**15.1 Control and co-ordination in mammals** a) compare the nervous and endocrine systems as communication systems that co-ordinate responses to changes in the internal and external environment (see 14.1a and 14.1b) b) describe the structure of a sensory neurone and a motor neurone c) outline the roles of sensory receptor cells in detecting stimuli and stimulating the transmission of nerve impulses in sensory neurones (a suitable example is the	Teacher will discuss the need for communication between organs in a multicellular organism and how activities need to be controlled and coordinated. Teacher will use a brainstorm session to gauge learner knowledge and to discuss the main features of each. And differentiate between them. With the help of a diagram or photomicrograph teacher will describe the structure of sensory and motor neurone. Learners annonate and label the diagrams. Learners will be asked	Learners complete unlabelled and incomplete diagrams (the diagrams could lack nuclei, myelin sheaths and synaptic knobs). **(F)**		Bioscope – has images of nerves (LS and TS). http://www.udel.edu/Biology/Wags/histopage/colorpage/cp/cp.htm http://www.s-cool.co.uk/a-level/biology/nervous-and-hormonal-control **Textbooks/Publications** *Bio Factsheet 38*: Animal hormones and hormone action. King p. 151-152 Siddiqui p.164-167, 171 **Past Papers**

November (2nd Week)		chemoreceptor cell found in human taste buds) d) describe the functions of sensory, relay and motor neurones in a reflex arc describe and explain the transmission of an action potential in a myelinated neurone and its initiation from a resting potential (the importance of sodium and potassium ions in impulse transmission should be emphasised) f) explain the importance of the myelin sheath (saltatory conduction) in determining the speed of nerve impulses and the refractory period in determining their frequency g) describe the structure of a cholinergic synapse and explain how it functions, including the role of calcium ions h) outline the roles of synapses in the nervous system in allowing transmission in one direction and in allowing connections between one neurone and many others (summation, facilitation and inhibitory synapses are not required) i) describe the roles of neuromuscular junctions, transverse system tubules and sarcoplasmic reticulum in stimulating contraction in striated muscle	to brainstorm list the different sensory receptors in humans and name the forms of energy received by each receptor. Describe the sensory neurone with a resting potential and explain how a stimulus leads to membrane depolarisation and impulse transmission Teacher will explain the transmission of nerve impulse on detail to students with the help of a video. Teacher will discuss the synapse and its importance. Teacher will also discuss the impact of the drugs on the synapse with the hakp of presentation. Learners study one or more labelled diagrams and establish that: striated muscle is voluntary; skeletal	Students will be given a protected area as a case study to be presented to highlight the Subject of it.		Paper 41, June 2011, Q9 (a) http://www.bu.edu/histology/p/21601ooa.htm

November (3rd Week)		j) describe the ultrastructure of striated muscle with particular reference to sarcomere structure k) explain the sliding filament model of muscular contraction including the roles of troponin, tropomyosin, calcium ions and ATP 14.1.a discuss the importance of homeostasis in mammals and explain the principles of homeostasis in terms of internal and external stimuli, receptors, central control, coordination systems, effectors (muscles and glands)	muscle, the multinucleate cells are also known as muscle fibres and contain a bundle of myofibrils. Teacher will discuss the idea of a sarcomere (see 15.1.i diagrams) as the basic unit of contraction, a repeating unit of a pattern made by thick and thin protein filaments. . o Discuss the role of the released calcium ions in binding to sites on troponin and shifting the position of tropomyosin to expose the myosin binding sites Learners write an explanation of what is meant by homeostasis. o Explain that they should think of main ideas and use appropriate terminology Learners use separate cards (limit 10-12) to			http://www.biologymad.com/master.html?http://www.biologymad.com/Homeostasis/Homeostasis.html http://www.biologyonline.org/4/1_physiological_homeostasis.htm http://scienceaid.co.uk/biology/humans/homeostasis.html http://science.jrank.org/pages/3365/Homeostasis.html Textbooks/Publications Bio Factsheet 28: Feedback control mechanisms Bio Factsheet 161: Negative Feedbac http://www.patient.co.uk/doctor/urine-dipstick-analysis http://www.medicinenet.com/urine_tests_for_diabetes/a

			write out definitions and features of the terms stimulus, receptor, effector, control centre, response. Learners write out the simple definition using resources .			rticle.htm **Past Papers** Paper 41, Nov 2011, Q2 (a)
		14.1.c outline the roles of the nervous system and endocrine system in coordinating homeostatic mechanisms, including thermoregulation, osmoregulation and the control of blood glucose concentration. 14.1.d describe the deamination of amino acids and outline the formation of urea in the urea cycle (biochemical detail of the urea cycle is not required)	Using a named example, learners draw a flow chart to summarise homeostatic control and negative feedback, showing the named receptor(s), effector(s) and control centre (if present). Using resources, learners outline the involvement of the nervous system and endocrine system in each of the named mechanisms, including naming, and describing the role of, any hormones			http://www.ilng.in/pdf/mtg_bio_final.pdf http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/U/UreaCycle.html Textbooks/Publications Bio Factsheet 59: Excretion
		14.1.e describe the gross structure of the kidney and the detailed structure of the nephron with its associated blood vessels using photomicrographs and electron micrographs	Describe how deamination removes the toxic part of an		Dissection of lamb kidney	http://www.biologyreference.com/BlCe/Blood-Sugar-

December (1st Week)		14.1.f describe how the processes of ultrafiltration and selective reabsorption are involved with the formation of urine in the nephron. 14.1.h explain how the blood glucose concentration is regulated by negative feedback control mechanisms, with reference to insulin and glucagon 14.1.i outline the role of cyclic AMP as a second messenger with reference to the stimulation of liver cells by adrenaline and glucagon 14.1.j describe the three main stages of cell signalling in the control of blood glucose by adrenaline as follows: hormone-receptor interaction at the cell surface (see 4.1c)) formation of cyclic AMP which binds to kinase proteins an enzyme cascade involving 14.1.k explain the principles of operation of dip sticks containing glucose oxidase and peroxidase enzymes, and biosensors that can be used for quantitative measurements of glucose in blood	amino acid molecule, forming highly toxic ammonia, and leaves a useful keto acid (chemical energy for respiration or conversion for energy storage). Using the photograph learners will annotate the diagram of a kidney and nephron. Learners annotate diagrams to explain how the structure of the capsule and glomerulus allows the process of ultrafiltration to occur. o Explain the role of the basement membrane as the true dialysing filter, .With the help of a diagram learners will recall the negative feedback with respecr to insulin and glucagon. Teacher with the help of a flow chart will			Regulation.html http://www.mydr.com.au/gastrointestinal-health/pancreas-and-insulin Textbooks/Publications Bio Factsheet 145: Blood sugar and its control Past Papers Paper 43, Nov 2011, Q7 http://www.southernbiological.com/kits-and-equipment/specialisedlaboratory-and-field-equipment/urinetesting/g10-41-diastix/ Textbooks/Publications Bio Factsheet 157: Diabetes – Management or Cure? Bio Factsheet 167: Biosensors

December CYCLE 7 (2nd Week)	**Plant physiology and biochemistry**	and urine. l) explain the roles of the hormones FSH, LH, oestrogen and progesterone in controlling changes in the ovary and uterus during the human menstrual cycle m) outline the biological basis of contraceptive pills containing oestrogen and/or progesterone **13.1 Photosynthesis as an energy transfer process** b) state the sites of the light dependent and the light independent stages in the chloroplast	explain how secondary messengers play role n activating the other cell. Learners will understand cell signaling by a video and discussion. Remind learners how a dipstick is used to detect glucose and then explain the principles of operation before learners make notes. o Learners write out a worded reaction and explain why a reaction catalysed by glucose oxidase will confirm the presence of glucose Learners review the endocrine system and hormones with a short written test. Discuss the different origins of the named hormones involved in the menstrual cycle, explaining target	A review may be necessary of the	Learners study separate absorption graphs for	http://resources.teachnet.ie/foneill/photo.html

		c) describe the role of chloroplast pigments (chlorophyll a, chlorophyll b, carotene and xanthophyll) in light absorption in the grana. d) interpret absorption and action spectra of chloroplast pigments e) use chromatography to separate and identify chloroplast pigments and carry out an investigation to compare the chloroplast pigments in different plants (reference should be made to Rf values in identification) f) describe the light dependent stage as the photoactivation of chlorophyll resulting in the	tissues differ. Learners will outline the role of each hormone in the menstrual cycle. Learners with the help of a teacher understand the role of hormones in contraception. state the sites of the light dependent and the light independent stages in the chloroplast Project or show an image or diagram of a chloroplast and check learner knowledge from Unit 1 by a question and answer session. Learners will recall the the role of chlorophyll pigment. Teacher will add on explanation to chlorophyll as a reaction center. Learners study	anatomy of the leaf, so that learners can visualize mesophyll tissue and mesophyll cells containing chloroplasts. Worksheet on absorption spectrum.	each of the chloroplast pigments (i.e. each has a characteristic absorption spectrum): check understanding with a worksheet. Chromatography experiment.	http://www.saps.org.uk/secondary/teaching-resources/283-photosynthesis-how-does-chlorophyll-absorb-light-energy http://phototroph.blogspot.ca/ **Textbook/Publications** *Bio Factsheet 63*: Pigments in plants

December CYCLE 7 (3rd Week)		photolysis of water and the transfer of energy to ATP and reduced NADP (cyclic and non-cyclic photophosphorylation should be described in outline only) 13.1.a explain that energy transferred as ATP and reduced NADP from the light dependent stage is used during the light independent stage (Calvin cycle) of photosynthesis to produce complex organic molecules g) outline the three main stages of the Calvin cycle: • fixation by rubisco of carbon dioxide by combination with ribulose bisphosphate (RuBP), a 5C compound, to yield two molecules of GP (PGA), a 3C compound • the reduction of GP to triose phosphate (TP) involving ATP and reduced NADP • the regeneration of ribulose bisphosphate (RuBP) using ATP h) describe, in outline, the conversion of Calvin cycle intermediates to carbohydrates, lipids and amino acids and their uses in the plant cell.	separate absorption graphs for each of the chloroplast pigments (i.e. each has a characteristic absorption spectrum): check understanding with a worksheet Learners will perform chromatography experiment to understand the process. Use a diagram to ask learners questions about what happens in a photosystem learners build up the 'Z-scheme' to produce an outline of non-cyclic photophosphorylation and include explanations In groups learners construct a large, poster-sized concept map / spider diagram with photosynthesis as			http://www.vcbio.science.ru.nl/en/image-gallery/show/PL0130/ http://www.vcbio.science.ru.nl/en/fesem/applets/chloroplast/ http://faculty.uca.edu/johnc/Chloroplast_and_microbodies.jpg

JANUARY (1 WEEK)		13.3.a describe the relationship between structure and function in the chloroplast using diagrams and electron micrographs **13.2 Investigation of limiting factors** a) explain the term limiting factor in relation to photosynthesis b) explain the effects of changes in light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis c) explain how an understanding of limiting factors is used to increase crop yields in protected	a topic Discuss why the light dependent stage of photosynthesis needs to occur when no glucose has yet been made (allows the transfer of light energy to ATP and reduced NADP). Teacher will discuss calvin cycle in detail along with the enzyme catalyzed reaction at each step of breaking down glucose. Learners will make an outline cycle with all necessary enzymes and products. Learners identify: the photosynthetic organism (plant); the organ of photosynthesis (leaf); the main photosynthetic tissue (palisade mesophyll); the organelle of photosynthesis	Learners draw a generalised graph showing the rate of photosynthesis on the y-axis and the factor on the x-axis		http://www.icrisat.org/crop-sorghum.htm http://en.wikipedia.org/wiki/Sorghum http://users.rcn.com

		environments, such as glasshouses d) carry out an investigation to determine the effect of light intensity or light wavelength on the rate of photosynthesis using a redox indicator (e.g. DCPIP) and a suspension of chloroplasts (the Hill reaction) e) carry out investigations on the effects of light intensity, carbon dioxide and temperature on the rate of photosynthesis using whole plants, e.g. aquatic plants such as Elodea and Cabomba **13.3 Adaptations for photosynthesis** b) explain how the anatomy and physiology of the leaves of C4 plants, such as maize or sorghum, are adapted for high rates of carbon fixation at high temperatures in terms of: • the spatial separation of initial carbon fixation from the light dependent stage (biochemical details of the C4 pathway are required in outline only) • the high optimum temperatures of the enzymes involved	(chloroplast); the structures of the chloroplast. Show learners a number of definitions of the term limiting factor. As a group produce an explanation to note down that is in the context of photosynthesis Learners suggest the factors that may affect the rate of photosynthesis, and discuss ways in which the rate could be measured Explain that knowledge of limiting factors can be used to control the growing conditions of commercial crops, especially in protected environments With the help of data sheets learners will analize the data and			/jkimball.ma.ultranet/BiologyPages/C/C4plants.html http://www.marietta.edu/~biol/biomes/photosynthesis.htm www.biologymad.com/resources/Crop%20Plants.pps **Past Papers** Paper 43, June 2011, Q4 http://labs.biology.ucsd.edu/schroeder/clickablegc.html#figure1 http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/A/ABA.html http://www.plant-hormones.info/abscisicacid.htm **Textbooks/Publications**

JANUARY (2nd WEEK)		15.2.a describe the rapid response of the Venus fly trap to stimulation of hairs on the lobes of modified leaves and explain how the closure of the trap is achieved **14.2 Homeostasis in plants** a) explain that stomata have daily rhythms of opening and closing and also respond to changes in environmental conditions to allow diffusion of carbon dioxide and regulate water loss by transpiration b) describe the structure and function of guard cells and explain the mechanism by which they open and close stomata	interpret the results. Learners review C3 photosynthesis by completing worksheets with gaps or by rearranging cards describing stages and then suggest why the term C3 plant is used. Explain that rubisco can also catalyse the oxygenation of RuBP. Display photographs of the Venus fly trap plant and its modified leaves. o Leaners brainstorm uses of nitrogen in plants. Learners link stomatal opening and closure to transpiration (Unit 4) and photosynthesis With the help of			*Bio Factsheet 48*: Tackling exam questions: plant growth substances *Bio Factsheet 111*: Plant Growth Substances **Past Papers** Paper 43, June 2011, Q11 (a)

JANUARY (4th & 5th WEEK)		c) describe the role of abscisic acid in the closure of stomata during times of water stress (the role of calcium ions as a second messenger should be emphasised) 15.2.b explain the role of auxin in elongation growth by stimulating proton pumping to acidify cell walls 15.2.c describe the role of gibberellin in the germination of wheat or barley. 16.3.d explain how gibberellin activates genes by causing the breakdown .	photomicrograph and video learners will understand the process of opening and closing of stomata. Teacher will describe the role of abscisic acid (ABA) as a 'stress hormone' to help plants survive difficult environmental conditions such as drought. Discuss how cell division and cell elongation will lead to plant growth and stem elongation. Introduce gibberellin as a hormone that promotes germination by breaking seed dormancy. Explain that DELLA proteins are			

		Paper 5 variants solving in class and discussion.	regulators of growth: they bind to transcription factors necessary for expression of genes coding for growth proteins.			