سلطنة عمان
وزارة التربية والتعليم
المديرية العامة للمدارس الخاصة
دائرة برامج ومناهج المدارس الخاصة

نظام إدارة الجودة
Quality Management System

رؤية عمان 2040
نتقدم بثقة
Moving Forward with Confidence

Syllabus	الإطار المنهجي
Biology	مادة الاحياء
Bilingual Program	برنامج ثنائي اللغة
Grade: 11-12	الصف: ١١-١٢
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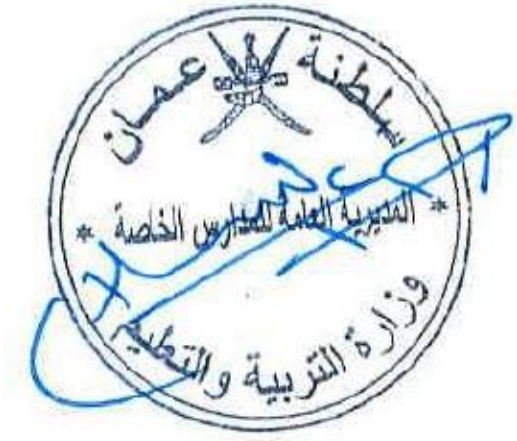

Contents

Introduction

Science plays a major role in the evolution of knowledge. It empowers us to use creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever expanding challenges. It enhances our ability to inquire, seek answers, research and interpret data. These skills lead to the construction of theories and laws that help us to explain natural phenomena and exercise control over our environment. Science is, thus, an integral component of a balanced education.

This syllabus focus on the content essential for preparing students to be engaged and productive citizens. A good foundation in the sciences will help citizens to respond to the challenges of a rapidly changing world using the scientific approach. It addresses, in addition to a specific knowledge base, the development of related skills and attitudes. Critical thinking, enquiry and reasoning are emphasized to ensure that students develop the ability to work creatively, think analytically and solve problems. The syllabus also ensure that students become aware of their moral, social, and ethical responsibilities, as well as, the benefits intrinsic to the practical application of scientific knowledge to careers in the scientific field. Teaching these standards requires teaching methods that are varied and experiential. Effective lessons will concert and incorporate with: Practical work and the science standards, the place of information and communications technology in the science standards, teaching about science, technology and society, the mathematical requirements of the science standards**.**

The overall aims of science standards are that students should:

1. develop and sustain an interest in science and its applications.
2. have a sound and systematic knowledge of important scientific facts, concepts and principles, and possess the skills needed to apply these in new and changing situations in a range of personal, domestic, industrial and environmental contexts.
3. recognize the importance of the application of scientific knowledge in the modern world and be aware of the moral, ethical, social and environmental implications.
4. develop relevant attitudes, such as a concern for accuracy and precision, objectivity, integrity, enquiry, initiative and inventiveness.
5. develop an understanding of the scientific skills essential for both further study and everyday life.
6. plan, design and perform experiments to test theories and hypotheses.
7. be proficient in the use of a range of scientific methods and techniques and in handling apparatus.
8. develop the ability to work independently and collaboratively with others when necessary.
9. integrate Information and Communication Technology (ICT) tools and skills**.**

Important Skills

- **Scientific enquiry skills:** Scientific enquiry, which ensures the development of scientific skills, intellectual and practical, should be integrated in the learning of the scientific content across all the science branches. Scientific enquiry skills include the following:

1. carry out the practical experiments to develop the practical skills which will be mentioned in details below.
2. find secondary information sources such as the resources available in the public libraries and on the Internet and use these after validation and making sure of the suitability of the subject.
3. apply Scientific knowledge and procedures to the situations of the reality Life.
4. recognizes the importance of cooperative teamwork, put work plans, distributes responsibilities, and regulates and sets specific targets for work.

- **Know how scientists are working:**

1. realize that with science we can bring great benefits to humanity also if it is abused can cause serious damage to the environment.
2. know how scientists are carrying out their work, such as environmental monitoring and control of industrial processes.
3. know how scientists publish and present their ideas and results in order to encourage debate and development.
4. know that science could lead to the emergence of ethical considerations, and discuss them.
5. know that there are many questions and considerations that cannot be answered by Science.
6. trace the historical development of some key scientific models and knows what contributions Scientists presented in this development.

- **Processing and delivery of information**

1. present qualitative and quantitative data using a variety of methods, such as descriptive texts, graphics, images, tables, and maps with the use of technology methods and computer when it is appropriate, then analyse and explain these date to extract conclusions from them.
2. use mathematical relationships routinely to calculate the quantities.
3. do calculations based on data taken from the graphs, and distinguishes between Independent and dependent variables.
4. handle data and writes reports about the results.
5. use symbolic equations to represent chemical reactions and simple physical relationships.
6. use the appropriate methods to deliver scientific information.

- **ICT application:**

This syllabus provides students with a wide range of opportunities to use ICT in their study of science in order to play a full part in modern society, students need to be confident and effective users of ICT. Opportunities for ICT include:

1. gathering information from the internet, DVDs and CD-ROMs.
2. using spreadsheets and other software to process data.
3. using animations and simulations to visualize scientific ideas.
4. using software to present ideas and information on paper and on screen.

Skills and abilities to be assessed:

The skills students are expected to develop on completion of this syllabus, have been grouped under three main headings:

1. knowledge and understanding.
2. application of knowledge and understanding, analysis and evaluation of information.
3. scientific enquiry skills and procedures.

1. Knowledge and understanding

Assessment Objectives	Skills: The ability to
Knowledge	• identify, remember and grasp the meaning of basic facts, concepts and principles.
Understanding	• select appropriate ideas, match, compare and cite examples of facts, concepts and principles in familiar situations; • explain familiar phenomena in terms of theories, models, laws and principles.

Questions testing these skills will often begin with one of the following words: define, state, describe, explain.

2. Application of knowledge and understanding, analysis and evaluation of information

Assessment Objectives	Skills: The ability to
Application	• use facts, concepts, principles and procedures in unfamiliar situations. • transform data accurately and appropriately • use common characteristics as a basis for classification • use information to identify patterns, report trends and draw inferences. • use formulae accurately
Analysis and Interpretation	• identify and recognize the component parts of a whole and interpret the relationships between those parts; • identify causal factors and show how they interact with each other; • infer, predict and draw conclusions; • make necessary and accurate calculations and recognize the limitations and assumptions of data. • present reasoned explanations for phenomena, patterns and relationships
Synthesis	• combine component parts to form a new meaningful whole; • make predictions and solve problems. • locate, select, organize and present information from a variety of sources.
Evaluation	• make reasoned judgments and recommendations based on the value of ideas and information and their implications.

Questions testing these skills will often begin with one of the following words: predict, suggest, calculate or determine.

3. Scientific enquiry skills and investigations.

Assessment Objectives	Skills: The ability to
Planning and designing a practical procedure	• identify problems, make predictions, and design a practical procedure to answer a question, solve a problem or test a hypothesis. • select and use suitable apparatus for carrying out experiments accurately and safely. • take into account possible sources of errors and danger in the design of an experiment; • evaluating experimental procedures and identifying weaknesses and develop realistic strategies for improvement • Work in a way that is committed to ethical and moral standards such as honesty and authenticity of his results and writing of the used references.
Control	• Use experimental controls where appropriate; • Appreciate that, unless certain variables are controlled, experimental results may not be valid • Recognize the need to choose appropriate sample sizes, and study control groups where necessary.
Risk assessment	• Identify possible hazards in practical situations, the risks associated with these hazards, and methods of minimizing the risks.
Manipulation and measurement	• follow a detailed set or sequence of instructions; • make measurements with due regard for precision and accuracy; • handle chemicals and living organisms with care; • cut, stain and mount sections and make temporary mounts; • set up light microscope for optimum use both under low power and high power; • use the stage micrometer and eyepiece graticule for accurate measuring; • assemble and use simple apparatus and measuring instruments.
Observation, recording and reporting	• select observations relevant to the particular activity; • make accurate observations and minimise experimental errors

Assessment Objectives	Skills: The ability to
	• record observations, measurements, methods and techniques with due regard for precision, accuracy and units; • record and report unexpected results; • select and use appropriate models of recording data or observations, for example, graphs, tables, diagrams and drawings; • organize and present information, ideas, descriptions and arguments clearly and logically in a complete report, using spelling, punctuation, grammar and scientific terminology with an acceptable degree of accuracy;
Analyzing and interpreting data	• Appreciate when it is appropriate to calculate a mean, calculate a mean from a set of at least three results and recognize when it is appropriate to ignore anomalous results in calculating a mean. • Recognize patterns in data, form hypotheses and deduce relationships. • Use and interpret tabular and graphical representations of data. • Evaluate data, considering its repeatability, reproducibility and validity in presenting and justifying conclusions.
Making conclusions	• Draw conclusions that are consistent with the evidence obtained and support them with scientific explanations
Drawing	• make clear, accurate line representations of specimens, with no shading or unnecessary details; and with clean continuous lines. • label drawings accurately and use label lines which do not cross each other or carry arrowheads or dots • make drawings which are large enough to display specific details • calculate the magnification of the drawings.

الإطار المنهجي للصف الحادي عشر

Grade 11 Syllabus

Grade 11 Syllabus

The study of biology subject leads to an understanding and appreciation of the concept of life at all levels and, hence, to a greater respect and reverence for life. Students of Biology should recognize the enormous responsibility they must undertake to ensure the continuity of life in all its forms. It is incumbent on them to use this knowledge to protect, sustain, conserve and improve the variety of life in the ecosphere. Additionally, the study of Biology prepares students for careers in biological, agricultural, environmental, medical, paramedical and applied science.

Aims: Biology syllabus enables students to:

1. acquire a body of knowledge and develop an understanding of biological concepts and principles.
2. develop the ability to apply biological knowledge and skills essential for both further studies as well as in everyday life situations.
3. recognize the dynamic nature of the interrelationships between organisms and their environment.
4. develop a natural curiosity about living organisms and a respect for all living things and the environment.
5. understand how new information results in reformulation or rejection of earlier models and concepts.
6. recognize the scope of Biology from the molecular level to that of entire ecosystems.
7. develop an ability to communicate biological information in a variety of acceptable ways.
8. acquire an understanding of the scientific method and be able to apply it to solving problems, both in academic and non-academic settings.
9. appreciate the impact of biological knowledge on society and its relevance to ethical, economic, environmental and technological issues.
10. acquire training in the practical skills and thought processes associated with the study of science.

How to use grade 11 syllabus

This syllabus is arranged according to the following manner:

- **Outcomes:**

Indicate the scope of the content, including practical work which will be examined as well. However, practical work should not necessarily be limited to these objectives.
The numbering key :[Unit – Topic –Learning outcome]
e.g. 2.1.1 : Unit 2. (Biological molecules); Topic 1 (2.1 Carbohydrates and lipids); and 1 is the first learning outcome (distinguish between reducing sugar and non-reducing sugar).

- **Practical experiments and activities:**

Show some examples of active learning activities and do not represent full -scale activities can be done. It is recommended that all of the suggested laboratory-related activities, such as conducting experiments must be done. Other activities like making field trips and viewing audio-visual materials, can be done also. Take into account the sufficient time to carry out the practical experiments determined in this syllabus and explained in details in the student text book and in the teacher guide and training students in practical skills related to them. The teachers should get benefit from the student text book, teacher's resources pack from Hodder Education and teacher's digital resources from Cambridge that are recommended by MOE in the approved books list.

- **Resources for teachers to upgrade their knowledge and skills**

The main resources for the teachers are the text book and the teacher's guides. The two recommended teacher's guides in the approved books list (teacher's resource pack from Hodder Education and teacher's digital resources CD-ROM from Cambridge) provide the needed support for the teachers. They include the following:

1) Teaching guide for each chapter includes teaching plan for the chapter with resources available for each topic in the chapter, introduction about the topic, topic summary, suggested teaching methods, key terms, common misunderstandings and misconceptions, methods for supporting struggling students, methods for challenging high achievers, homework suggestions and suggested activities and practicals.
2) Answers to examination style questions (end-of-chapter questions).
3) Extra activities.
4) Homework with answer scheme.
5) Practical guidance.
6) Suggested websites.

7) Revision checklist.
8) Interactive tests.
9) Copies of diagrams and tables from text book.
10) Useful appendix.

There is also a list of approved supplementary resources for teachers that support them in their teaching. These resources include:

1) Cambridge International AS & A Level Complete Biology (Student Book) from Oxford University Press which is compulsory for all teachers.
2) Biology for Cambridge International AS & A Level Practical Workbook from Cambridge University Press which is compulsory for all teachers.
3) Biology for Cambridge International AS & A Level Workbook from Cambridge University Press which is optional for teachers.
4) Cambridge International AS & A Level Biology Practical Skills from Hodder Education which is optional for teachers.
5) Cambridge International AS & A Level Biology Students Book Whiteboard eTextbook from Hodder Education which is optional for teachers.

Some other resources as websites are listed in this syllabus can provide support for teachers for this syllabus. Some of these resources are interactive and the animations are suitable for this syllabus. The range of resources covers a large area of this syllabus so it is well worth exploring these sites before the course starts to discover relevant resources that can be used or recommended to students when appropriate.

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
1. Cell Structure		
1.1.Cells as the basic units of living organisms	1.1.1 describe and interpret electron micrographs and drawings of typical animal and plant cells as seen with the electron microscope. 1.1.2 recognize the following cell structures and outline their functions: • cell surface membrane • Microvilli • Cilia • nucleus, nuclear envelope and nucleolus • rough endoplasmic reticulum • smooth endoplasmic reticulum • Golgi body (Golgi apparatus or Golgi complex) • mitochondria • ribosomes • lysosomes • centrioles and microtubules • chloroplasts • cell wall • plasmodesmata • large permanent vacuole and tonoplast of plant cells. 1.1.3 compare the structure of typical animal and plant cells by making temporary preparations of live material and using photomicrographs. 1.1.4 use an eyepiece graticule and stage micrometer scale to measure cells and be familiar with units (millimeter, micrometer, nanometer) used in cell studies. 1.1.5 explain and distinguish between resolution and magnification, with reference to light microscopy and electron microscopy. 1.1.6 state that ATP is produced in mitochondria and chloroplasts and outline the role of ATP in cells. 1.1.7 outline key structural features of typical prokaryotic cells as seen in a typical bacterium (including: unicellular, 1-5μm diameter, peptidoglycan cell walls, lack of organelles surrounded by double membranes, naked circular DNA, ribosomes). 1.1.8 compare and contrast the structure of typical prokaryotic cells with typical eukaryotic cells. 1.1.9 outline the key features of viruses as non-cellular structures.	**Practical 1.1 B** Preparing a slide of onion epidermal cells **)** (Cambridge CD) **OR** **Practical 1.3** Preparing a slide of Elodea leaf cell. (Cambridge CD) **Experiment (2)**: Practical 1.2 Preparing a slide of human cheek cells. (Cambridge CD)

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
2. Biological molecules		
2.1. Carbohydrates and lipids**.**	2.1.1. distinguish between reducing sugar and non-reducing sugar . 2.1.2. define the terms monomer, polymer, macromolecule, monosaccharide, disaccharide and polysaccharide. 2.1.3. explain the formation of a glycosidic bond by condensation. 2.1.4. describe the breakage of glycosidic bonds in polysaccharides and disaccharides by hydrolysis. 2.1.5. describe the molecular structure of polysaccharides including starch (amylose and amylopectin), glycogen and cellulose and relate these structures to their functions in living organisms. 2.1.6. discuss the molecular structure of a triglyceride with reference to the formation of ester bonds and relate the structure of triglycerides to their functions in living organisms. 2.1.7. distinguish between saturated and unsaturated triglycerides. 2.1.8. illustrate the structure of a phospholipid and relate the structure of phospholipids to their functions in living organisms. 2.1.9. carry out tests for reducing sugars and non-reducing sugars, the iodine in potassium iodide solution test for starch, the emulsion test for lipids to identify the contents of solutions.	**Practical 2.1** Tests for biological molecules.(Cambridge CD)
2.2. Proteins and water	2.2.1. describe the structure of an amino acid and the formation and breakage of a peptide bond. 2.2.2. define the terms primary structure, secondary structure, tertiary structure and quaternary structure of proteins. 2.2.3. determine the importance of protein in living organisms. 2.2.4. explain how hydrogen bonding occurs between water molecules. 2.2.5. discuss some key properties of water that make life possible (limited to solvent action , specific heat capacity, cohesion and adhesion). 2.2.6. carry out the biuret test for proteins to identify the contents of solutions.	**Practical 2.1** Tests for biological molecules. (Cambridge CD)

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
3. Enzymes		
3.1. Mode of action of enzymes	3.1.1. explain that enzymes are globular proteins which catalyze metabolic reactions. 3.1.2. state the function of enzymes inside cells (intracellular enzymes) and outside cells (extracellular enzymes). 3.1.3. explain the mode of action of enzymes in terms of an active site, enzyme/substrate complex, lowering of activation energy and enzyme specificity (the lock and key hypothesis and the induced fit hypothesis should be included). 3.1.4. investigate the progress of an enzyme-catalyzed reaction by measuring rates of formation of products (for example, using catalase) or rates of disappearance of substrate (for example, using amylase)	**Practical 3.1** Following the course of an enzyme-catalysed reaction using amylase**.** (Cambridge CD). **Practical 3.7** Following the course of an enzyme-catalysed reaction, using catalase. (Cambridge CD)
3.2. Factors that affect enzyme action	3.2.1. explain the effects of the following factors on the rate of enzyme-catalysed reactions: • temperature. • pH (using buffer solutions). • enzyme concentration. • substrate concentration. 3.2.2. investigate the effects of temperature on the rate of enzyme-catalysed reactions.	**Practical 3.2** Investigating the effect of temperature on the activity of trypsin. (Cambridge CD)
4. Cell membranes and transport		
4.1. Fluid mosaic membranes	4.1.1. describe and explain the fluid mosaic model of membrane structure. 4.1.2. outline the roles of the components of cell surface membranes, including phospholipids, cholesterol, glycolipids, proteins and glycoproteins. 4.1.3. outline the roles of cell surface membranes including references to carrier proteins, channel proteins, cell surface receptors and cell surface antigens. 4.1.4. Investigate the properties of cell membranes.	**Practical 4.1** Investigating the properties of cell membranes**.** (Cambridge CD)

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
4.2. Movement of substances into and out of cells	4.2.1. explain the processes of diffusion, facilitated diffusion, osmosis in plants and animals, active transport, and bulk transport (endocytosis and exocytosis) (no calculations involving water potential will be set). 4.2.2. state factors that affecting the rate of diffusion. 4.2.3. calculate surface areas and volumes of simple shapes (e.g. cubes) to illustrate the principle that surface area to volume ratios decrease with increasing size. 4.2.4. investigate the effect of changing surface area to volume ratio on diffusion using agar blocks of different sizes. 4.2.5. explain the movement of water between cells and solutions with different water potentials and explain the different effects on plant and animal cells. 4.2.6. discus the meaning of (solute potential, pressure potential).	**Practical 4.6** Rates of diffusion in 'cells' of different sizes. (Cambridge CD)
5. The mitotic cell cycle		
5.1. Replication and division of nuclei and cells.	5.1.1. outline the importance and role of the nucleus. 5.1.2. state the features of the chromosomes. 5.1.3. describe the structure of a chromosome, limited to DNA, histone proteins, chromatids, centromere and telomeres. 5.1.4. state the significant differences between the two types of nuclear division. 5.1.5. describe the stages of the cell cycle. 5.1.6. describe, with the aid of photomicrographs and diagrams, the behavior of chromosomes in plant and animal cells during the mitotic cell cycle and the associated behavior of the nuclear envelope, cell surface membrane and the spindle (names of the main stages of mitosis are expected). 5.1.7. observe and draw the mitotic stages visible in prepared onion root tip slides and in permanent slides for stages of mitotic cycle in root tips cells. 5.1.8. explain the importance of mitosis in the production of genetically identical cells, growth, cell replacement, repair of tissues and asexual reproduction. 5.1.9. outline the significance of mitosis in cell replacement and tissue repair by stem cells. 5.1.10. state that uncontrolled cell division can result in the formation of a tumor. 5.1.11. explain stages in the development of cancer.	**Practical:** Observing chromosomes during different stages of mitosis in onion root tip cells.(Cambridge CD)

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 2		
6. Transport in plants		
6.1. Structure of transport tissues	6.1.1. outline why transport system needed in plants. 6.1.2. describe the structure of stems, roots and leaves in dicotyledonous plants. 6.1.3. explain how the following structures are related to their functions: • Epidermis • Parenchyma • Collenchyma • Endodermis • Mesophyll • Pericycle 6.1.4. examine and draw from prepared slides plan diagrams of transverse sections of stems, roots and leaves of herbaceous dicotyledonous plants. 6.1.5. describe the structure of the two transport tissues in plants: xylem and phloem. 6.1.6. explain how structures of xylem and phloem are related to their function.	**Practical 7.1** Investigating stem, root and leaf structure. (Cambridge CD + the lab manual from MOE)
6.2. Transport mechanisms	6.2.1 explain the movement of water between plant cells, and between them and their environment, in terms of water potential. (No calculations involving water potential will be set). 6.2.2 illustrate how hydrogen bonding of water molecules is involved with movement in the xylem by cohesion-tension in transpiration pull and adhesion to cellulose cell walls. 6.2.3 describe the pathways and the mechanisms by which water and mineral ions are transported from soil to xylem and from roots to leaves (include reference to the symplastic pathway, apoplastic pathway, plasomodesmata, endodermis and Casparian strip). 6.2.4 define transpiration and explain that it is an inevitable consequence of gas exchange in plants. 6.2.5 demonstrate the structure of stomata and its role in transpiration. 6.2.6 investigate the water loss from a leaf surface by using cobalt chloride paper and compare the density of stomata on the lower and upper surfaces of a leaf. 6.2.7 discuss the effect the following factors on the rate of transpiration: • humidity	**Practical** Investigate the water loss from a leaf surface. Page 139 /140 **(Hodder text book)** **OR**

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
	• temperature • air movement 6.2.8 investigate experimentally and explain the factors that affect transpiration rate using simple potometer, 6.2.9 define xerophytes and explain with examples how their features help the plants to conserve water. 6.2.10 examine samples to show how Marram grass, *Acacia tortilis* and *Prosopis juliflora* from Omani environment are adapted to reduce water loss by transpiration. 6.2.11 define translocation. 6.2.12 state that assimilates, such as sucrose and amino acids, move between sources (e.g. leaves and storage organs) and sinks (e.g. buds, flowers, fruits, roots and storage organs) in phloem sieve tubes. 6.2.13 explain how sucrose is loaded into phloem sieve tubes by companion cells using proton pumping and the co-transporter mechanism in their cell surface membranes. 6.2.14 describe mass flow in phloem sap down a hydrostatic pressure gradient from source to sink. 6.2.15 differentiate between sieve tubes and xylem vessels.	**Practical 7.5:** Investigating stomatal density.(Cambridge CD) **Practical** Measuring the rate of transpiration using potometer (under different condition) Page 142 **(Hodder text book)** **OR** **Practical 7.3**: Investigating the rate of transpiration of a leafy shoot using a potometer. (Cambridge CD + the lab manual from MOE)

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
7. Transport in mammals		
7.1. The circulatory system	7.1.1. state that the mammalian circulatory system is a closed double circulation consisting of a heart, blood vessels and blood. 7.1.2. describe the main component of blood (blood plasma, platelets, RBCs, WBCs) and outline their roles. 7.1.3. observe and make plan diagrams of the structure of arteries, veins and capillaries using prepared slides and be able to recognize these vessels using the light microscope. 7.1.4. explain the relationship between the structure and function of arteries, veins and capillaries. 7.1.5. state the differences between blood, tissue fluid and lymph. 7.1.6. explain the exchange of materials between blood and cells via tissue fluid. 7.1.7. outline the role of lymphatic system. 7.1.8. describe the role of hemoglobin in carrying oxygen and carbon dioxide with reference to the role of carbonic anhydrase, the formation of haemoglobinic acid and carbaminohaemoglobin. 7.1.9. demonstrate the significance of the oxygen dissociation curves of adult oxyhaemoglobin at different carbon dioxide concentrations (the Bohr effect).	**Practical 8.1** Microscopy of blood vessels. (Cambridge CD + the lab manual from MOE)
7.2. The heart	7.2.1. describe the external and internal structure of the mammalian heart. 7.2.2. make a diagrammatic section through the heart to show blood vessels, arteries and valves and relate each to its function. 7.2.3. explain the differences in the thickness of the walls of the different chambers in terms of their functions with reference to resistance to flow. 7.2.4. describe the cardiac cycle (including blood pressure changes during systole and diastole). 7.2.5. explain how heart action is initiated and controlled. 7.2.6. show how electrocardiography is used to detect heart conditions and list some of these conditions.	**Practical 8.3** Heart dissection. (Cambridge CD + the lab manual from MOE)
8. Gas exchange in mammals		
8.1. The gas exchange system	8.1.1. describe the gross structure of the human gas exchange system. 8.1.2. describe the structure of the walls of the trachea, bronchi, bronchioles and alveoli indicating the distribution of cartilage, ciliated epithelium, goblet cells, smooth muscle, elastic tissue, squamous epithelium and blood vessels. 8.1.3. recognize ciliated epithelium, cilia, goblet cells, mucous glands, cartilage smooth muscle and elastic fibers by using photomicrographs and electron micrographs of the gas exchange system and describe the functions of these cells and tissues.	**Practical 9.1**

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
	8.1.4. investigate the mammalian gas exchange system by dissecting the lungs and bronchial system of a mammal (sheep or goat). 8.1.5. interpret the mechanism of inspiration and expiration. 8.1.6. describe the process of gas exchange between air in the alveoli and the blood.	Investigating the mammalian gas exchange system. (Cambridge CD+ the lab manual from MOE)
9. Infectious diseases		
9.1. Infectious diseases	9.1.1. differentiate between an infectious disease and a non-infectious disease. 9.1.2. state the name and type of causative organism (pathogen) of each of the following diseases: cholera, tuberculosis (TB) and HIV/AIDS. 9.1.3. explain how cholera, TB and HIV/AIDS are transmitted. 9.1.4. state the symptoms and treatments for cholera, tuberculosis (TB) and HIV/AIDS. 9.1.5. describe the structure of HIV and the mechanism of how HIV infects a white blood cell. 9.1.6. discuss the prevention and control of cholera, TB and HIV/AIDS.	
9.2. Antibiotics	9.2.1. describe how bacteria differ in sensitivity to antibiotics. 9.2.2. outline how antibiotics (e. g penicillin) acts on bacteria but not viruses. 9.2.3. explain how bacteria become resistant to antibiotics with reference to mutation and selection. 9.2.4. discuss the consequences of antibiotic resistance and the steps that can be taken to reduce its impact.	
10. Immunity		
10.1. The immune system	10.1.1. design a scheme for all types of white blood cells demonstrating the shape and function of each. 10.1.2. explain the meaning of an antigen and state the difference between self antigens and non-self antigens. 10.1.3. state that phagocytes (macrophages and neutrophils) have their origin in bone marrow and describe their mode of action. 10.1.4. explain the meaning of the term immune response, making reference to the terms antigen, self and non-self. 10.1.5. describe the modes of action of B-lymphocytes and T-lymphocytes. 10.1.6. state the role of memory cells in long-term immunity 10.1.7. explain the significance of the increase in white blood cell count in humans with infectious diseases.	

Grade 11 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
10.2. Antibodies and vaccination	10.2.1. relate the molecular structure of antibodies to their functions. 10.2.2. outline the hybridoma method for the production of monoclonal antibodies. 10.2.3. outline the use of monoclonal antibodies in the diagnosis of disease, in the treatment of disease and for pregnancy testing. 10.2.4. distinguish between active and passive, natural and artificial immunity and explain how vaccination can control disease. 10.2.5. discuss the reasons why vaccination programmes have eradicated smallpox, but not measles, tuberculosis (TB), malaria or cholera.	

Yearly plan for grade 11

	Grade 11– semester one	No. of lessons		Grade 11– semester two	No. of lessons
1	Cell structure	10	**6**	Transport in plants	14
2	Biological molecules	12	**7**	Transport in mammals	14
3	Enzymes	7	**8**	Gas exchange and smoking	7
4	Cell membranes and transport	9	**9**	Infectious disease	7
5	The mitotic cell cycle	10	**10**	Immunity	10
Total		48	Total		52

Resources for teachers to upgrade their knowledge and skills

Teacher support	http://www.cie.org.uk/teaching-and-learning/
How to teach	https://www.international.heacademy.ac.uk/
Past paper resource	http://papers.xtremepapers.com/CIE http://papers.xtremepapers.com/CIE/Cambridge%20International%20A%20and%20AS%20Level/
Teaching strategies	http://www.teachthought.com/pedagogy/instructional-strategies/50-teaching-strategies-to-jumpstart-your-teacher-brain/
Syllabus topics and interactive resources	1. www.abpischools.org.uk/age-range/16-19 2. www.bbsrc.ac.uk/engagement/schools/keystage5/ 3. www.johnkyrk.com 4. www.cellsalive.com 5. www.dnalc.org 6. www.garlandscience.com 7. biology-pages.info 8. illuminatepublishing.com 9. www.microbiologyonline.org.uk 10. www.nuffieldfoundation.org/practical-biology 11. www.hoddereducation.co.uk 12. www2.estrellamountain.edu/faculty/farabee/biobk/biobooktoc.html 13. www.saps.org.uk/secondary 14. www.biology.arizona.edu 15. www.cellimagelibrary.org 16. www.rothamsted.ac.uk/notebook/index.php?area=&page 17. www.arkive.org

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10. https://education.ohio.gov/getattachment/Topics/Teaching/Educator-Evaluation-System/How-to-Design-and-Select-Quality-Assessments/DOK-Compared-to-Blooms-Taxonomy.pdf.aspx
11. https://www.csun.edu/science/ref/reasoning/questions_blooms/blooms.html
12. International AS and A level Biology Syllabus (9610). For teaching from September 2016 onwards. For International AS exams May/June 2017 onwards For International A-level exams May/June 2018 onwards. Oxford International AQA Examinations, United Kingdom. oxfordaqaexams.org.uk.

الإطار المنهجي للصف الثاني عشر

Grade 12 Syllabus

Grade 12 Syllabus

The study of biology subject leads to an understanding and appreciation of the concept of life at all levels and, hence, to a greater respect and reverence for life. Students of Biology should recognize the enormous responsibility they must undertake to ensure the continuity of life in all its forms. It is incumbent on them to use this knowledge to protect, sustain, conserve and improve the variety of life in the ecosphere. Additionally, the study of Biology prepares students for careers in biological, agricultural, environmental, medical, paramedical and applied science.

Aims: Biology syllabus enables students to:

1. acquire a body of knowledge and develop an understanding of biological concepts and principles.
2. develop the ability to apply biological knowledge and skills essential for both further studies as well as in everyday life situations.
3. recognize the dynamic nature of the interrelationships between organisms and their environment.
4. develop a natural curiosity about living organisms and a respect for all living things and the environment.
5. understand how new information results in reformulation or rejection of earlier models and concepts.
6. recognize the scope of Biology from the molecular level to that of entire ecosystems.
7. develop an ability to communicate biological information in a variety of acceptable ways.
8. acquire an understanding of the scientific method and be able to apply it to solving problems, both in academic and non-academic settings.
9. appreciate the impact of biological knowledge on society and its relevance to ethical, economic, environmental and technological issues.
10. acquire training in the practical skills and thought processes associated with the study of science.

How to use grade 12 syllabus

This syllabus is arranged according to the following manner:

- **Outcomes:**

Indicate the scope of the content, including practical work which will be examined as well. However, practical work should not necessarily be limited to these objectives.

The numbering key:[Unit – Topic –Learning outcome]
e.g. 1.1.1 : **Unit 1**. (1. Energy and respiration); **Topic 1** (1.1 Energy); and **1 is the first learning outcome** (1.1.1outline 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.).

- **Practical experiments and activities:**

Show some examples of active learning activities and do not represent full -scale activities can be done. It is recommended that all of the suggested laboratory-related activities, such as conducting experiments must be done. Other activities like making field trips and viewing audio-visual materials, can be done also. Take into account the sufficient time to carry out the practical experiments determined in this syllabus and explained in details in the student text book and in the teacher guide and training students in practical skills related to them. The teachers should get benefit from the student text book, teacher's guide (CD) from Hodder Education and teacher's resource CD-ROM from Cambridge that are recommended by MOE in the approved books list.

- **Resources for teachers to upgrade their knowledge and skills**

The main resources for the teachers are the text book and the teacher's guides. The two recommended teacher's guides in the approved books list (teacher's guide (CD) from Hodder Education and teacher's resource CD-ROM from Cambridge) provide the needed support for the teachers. They include the following:

11) Teaching guide for each chapter includes teaching plan for the chapter with resources available for each topic in the chapter, introduction about the topic, topic summary, suggested teaching methods, key terms, common misunderstandings and misconceptions, methods for supporting struggling students, methods for challenging high achievers, homework suggestions and suggested activities and practicals.

12) Answers to examination style questions (end-of-chapter questions).
13) Extra activities.
14) Homework with answer scheme.
15) Practical guidance.
16) Suggested websites.
17) Revision checklist.
18) Interactive tests.
19) Copies of diagrams and tables from text book.
20) Useful appendix.

Some other resources as websites are listed in this syllabus can provide support for teachers for this syllabus. Some of these resources are interactive and the animations are suitable for this syllabus. The range of resources covers a large area of this syllabus so it is well worth exploring these sites before the course starts to discover relevant resources that can be used or recommended to students when appropriate.

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
1. Energy and respiration		
1.2 Energy	1.2.1 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. 1.2.2 describe the features and the basic structure of ATP that make it suitable as the universal energy currency (Chemical structure of ATP is not required) . 1.2.3 explain that ATP is synthesized in substrate-linked reactions in glycolysis and in the Krebs cycle. 1.2.4 outline the roles of the coenzymes NAD, FAD and coenzyme A in respiration. (Chemical structures are not required) 1.2.5 explain that the synthesis of ATP is associated with the electron transport chain on the membranes of mitochondria and chloroplasts. 1.2.6 explain the relative energy values of carbohydrate, lipid and protein as respiratory substrates and why lipids are particularly energy-rich. 1.2.7 define the term respiratory quotient (RQ). 1.2.8 determine RQs from a given equation for respiration of carbohydrates, proteins and lipids.	
1.3 Respiration	1.3.1 state the four stages in aerobic respiration (glycolysis, link reaction, Krebs cycle and oxidative phosphorylation) and where each occurs in eukaryotic cells. 1.3.2 describe the process of glycolysis. 1.3.3 explain that, when oxygen is available, pyruvate is converted into acetyl (2C) coenzyme A in the link reaction. 1.3.4 explain the steps of Krebs cycle to involve decarboxylation, dehydrogenation and the reduction of NAD^+ and FAD. 1.3.5 outline the process of oxidative phosphorylation including the role of oxygen as the final electron acceptor (no details of the carriers are required). 1.3.6 explain the following during oxidative phosphorylation (chemiosmosis is included): • energetic electrons release energy as they pass through the electron transport system.	

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
	• the released energy is used to transfer protons across the inner mitochondrial membrane. (calculating the energy release from ATP hydrolysis is not required) • protons return to the mitochondrial matrix by facilitated diffusion through ATP synthase providing energy for ATP synthesis (details of ATP synthase are not required). 1.3.7 describe the relationship between structure and function of the mitochondrion using diagrams and electron micrographs. 1.3.8 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 required considering the yield of 32 ATP molecules). 1.3.9 explain the production of a small yield of ATP from respiration in anaerobic conditions in yeast and in mammalian muscle tissue, including the concept of oxygen debt. 1.3.10 carry an investigation 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). 1.3.11 carry out investigations, using simple respirometers, to measure the effect of temperature on the respiration rate of germinating seeds or small invertebrates.	**Practical 12.1:** Investigating the effect of temperature on dehydrogenase activity in yeast. (Cambridge CD+ Experiment (1) in the lab manual from MOE) **Practical 12.2:** Investigating the rate of respiration of small organisms using a simple respirometer (A, B and C) (Cambridge CD + Experiment (2) in the lab manual from MOE)
2. photosynthesis		
2.1 Photosynthesis as an energy transfer process	2.1.1 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. 2.1.2 state the sites of the light dependent and the light independent stages in the chloroplast. 2.1.3 describe the role of chloroplast pigments (chlorophyll a, chlorophyll b, carotene and xanthophyll) in light absorption in the grana. 2.1.4 interpret absorption and action spectra of chloroplast pigments	**Practical 13.1:**

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
	Semester 1	
	2.1.5 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). 2.1.6 describe the light dependent stage as the photo-activation of chlorophyll resulting in the photolysis of water and the transfer of energy to ATP and reduced NADP (cyclic and non-cyclic photophosphorylation should be described in outline only). 2.1.7 explain the three main stages of the Calvin cycle (Numbers of molecules required to produce one glucose molecule are required): • fixation 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. 2.1.8 outline the conversion of Calvin cycle intermediates to carbohydrates, lipids and amino acids and their uses in the plant cell.	Investigating pigments in a leaf by paper chromatography. (Cambridge CD+ Experiment (3) in the lab manual from MOE)
2.2 Investigation of limiting factors	2.2.1 explain the term limiting factor in relation to photosynthesis. 2.2.2 describe the effects of changes in light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis. 2.2.3 explain how an understanding of limiting factors is used to increase crop yields in protected environments, such as glasshouses. 2.2.4 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*.	Practical 13.3: Investigating the effects of limiting factors on the rate of photosynthesis. (Cambridge CD+ Experiment (4) in the lab manual from MOE

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
3. Homeostasis		
3.1 Homeostasis in mammals	3.1.1 discuss the importance of homeostasis in mammals. 3.1.2 explain the term negative feedback and how it is involved in homeostatic mechanisms. 3.1.3 outline the roles of the nervous system and endocrine system in coordinating homeostatic mechanisms, including thermoregulation, osmoregulation and the control of glucose concentration. 3.1.4 compare the endocrine and nervous systems. 3.1.5 define the pancreas as endocrine gland. (detailed structure of pancreas is not required). 3.1.6 determine the function of the two types of cells in islets of Langerhans. 3.1.7 explain how the blood glucose concentration is regulated by negative feedback control mechanisms, with reference to insulin and glucagon. 3.1.8 discuss the two forms of diabetes considering: symptoms, treatment and prevention. 3.1.9 explain the principle of biosensors as a quantitative measurement of glucose. 3.1.10 define excretion. 3.1.11 demonstrate the deamination of amino acids and the formation of urea in the urea cycle (biochemical detail of the urea cycle is not required). 3.1.12 Investigate the structure of the kidney. 3.1.13 describe the gross structure of the kidney and the detailed structure of the nephron with its associated blood vessels using diagrams, photomicrographs and electron micrographs. 3.1.14 describe the processes of urine formation in the nephron. (All the 5 steps are included) 3.1.15 explain the roles of the hypothalamus, posterior pituitary, ADH and collecting ducts in osmoregulation. 3.1.16 describe the structure and role of stomata in plants. 3.1.17 describe the structure and function of guard cells. 3.1.18 explain the mechanism by which guard cells open and close stomata. 3.1.19 outline how abscisic acid causes guard cells to close the stomata.	**Practical 14.1** Investigating the structure of the kidney(Cambridge CD+ Experiment (5) in the lab manual from MOE)

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities**
Semester 1		
4. Control and Coordination		
4.1 Control and co-ordination in mammals	4.1.1 compare the nervous and endocrine systems as communication systems that co-ordinate responses to changes in the internal and external environment. 4.1.2 illustrate the components of the nervous system. 4.1.3 state the types of neurons and their function. 4.1.4 differentiate between a sensory neurone and a motor neurone in terms of structure and function. 4.1.5 outline the roles of sensory receptor cells in detecting stimuli and stimulating the transmission of nerve impulses in sensory neurons. (The pacinian corpuscle is included) 4.1.6 define and describe reflex arc. (Spinal reflex) 4.1.7 observe and draw the structure of spinal cord in prepared slides. 4.1.8 describe the functions of sensory, relay and motor neurones in a reflex arc. 4.1.9 define action potential and resting potential. 4.1.10 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 emphasized). 4.1.11 describe the refractory period. 4.1.12 explain the all or nothing principle. 4.1.13 explain the importance of the myelin sheath (salutatory conduction). 4.1.14 describe the structure of synapses and a cholinergic synapse. 4.1.15 explain how a cholinergic synapse functions, including the role of calcium ions. 4.1.16 outline the roles of synapses in the nervous system in allowing transmission in one direction. 4.1.17 describe the ultrastructure and functions of striated muscle with particular reference to sarcomere structure and function. 4.1.18 outline the roles of neuromuscular junctions, transverse system tubules and sarcoplasmic reticulum in stimulating contraction in striated muscle. 4.1.19 observe and draw the structure of skeletal muscles and tissues in prepared slides. 4.1.20 explain the sliding filament model of muscular contraction including the roles of troponin, tropomyosin, calcium ions ATP. 4.1.21 outline the role of human endocrine system in control and coordination. (the roles of hormones in the menstrual cycle is not included).	**Practical :** Observing the permanent slides of spinal cord and skeletal muscle cells. (Cambridge CD+ Experiment (6) in the lab manual from MOE) Experiment (7) :Examination of the structure of Skeletal muscle using permanent prepared slides Experiment (7) in the lab manual from MOE)

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities** (Teacher's resource CD-ROM from Cambridge)
Semester 2		
5. Nucleic acids and protein synthesis		
5.1 Structure and replication of DNA	5.1.1 describe the structure of nucleotides including the phosphorylated nucleotide ATP (structural formulae are not required, but to include reference to adenine and guanine as purines and to cytosine, thymine and uracil as pyrimidines. Structural formulae for bases are not required but the recognition that purines have a double ring structure and pyrimidines have a single ring structure should be included). 5.1.2 compare the structure of RNA and DNA including the importance of base pairing and the different hydrogen bonding between bases. (refer to activity 6.1) 5.1.3 explain the semi-conservative replication of DNA during interphase. 5.1.4 Carry out the extraction of DNA from onion bulb/ strawberry/ banana/ kiwi cells).	**Activity 6.1** Differences between DNA and RNA(Cambridge CD) **Practical:** Simulation of DNA (Deoxyribonucleic Acid) structure and replication (Cambridge CD) **Practical 6.1** Extracting DNA from onion bulb / strawberry/ banana/ kiwi cells). (Cambridge CD+ Experiment (8) in the lab manual from MOE)

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities** (Teacher's resource CD-ROM from Cambridge)
Semester 2		
5.2 Protein synthesis	5.2.1 state that a polypeptide is coded for by a gene and that a gene is a sequence of nucleotides that forms part of a DNA molecule. 5.2.2 explain the way in which the nucleotide sequence codes for the amino acid sequence in a polypeptide. (Start and stop codons are required) 5.2.3 describe how the information in DNA is used during transcription and translation to construct polypeptides, including the role of messenger RNA (mRNA), transfer RNA (tRNA) and the ribosomes. 5.2.4 state that a gene mutation is a change in the sequence of nucleotides that may result in an altered polypeptide with reference to the nucleotide sequence for *HbA* (normal) and *HbS* (sickle cell) alleles of the gene for the β-globin polypeptide.	
6. Inherited change		
6.1 Passage of information from parent to offspring	6.1.1 define homologous pairs of chromosomes. 6.1.2 explain the meanings of the terms haploid and diploid and the need for a reduction division (meiosis) prior to fertilisation in sexual reproduction. 6.1.3 outline the role of meiosis in gametogenesis in humans and in the formation of pollen grains and embryo sacs in flowering plants. 6.1.4 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). 6.1.5 Observe, identify and draw the stages of meiosis in permanent slides. 6.1.6 illustrate how crossing over and random assortment of homologous chromosomes during meiosis and random fusion of gametes at fertilisation lead to genetic variation including the expression of rare, recessive alleles.	**Practical :** Observing the stages of meiosis in permanent slides. Cambridge CD+ Experiment (9) in the lab manual from MOE)

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities** (Teacher's resource CD-ROM from Cambridge)
Semester 2		
6.2 The roles of genes in determining the phenotype	6.2.1 define the terms gene, locus, allele, dominant, recessive, codominant, linkage, test cross, F1 and F2, phenotype, genotype, homozygous and heterozygous. 6.2.2 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 problem solving). 6.2.3 use genetic diagrams to solve problems involving test crosses. 6.2.4 explain that gene mutation occurs by substitution, deletion and insertion of base pairs in DNA and outline how such mutations may affect the phenotype. 6.2.5 outline the effects of mutant alleles on the phenotype in the following human conditions: albinism, sickle cell anaemia, haemophilia and Huntington's disease. 6.2.6 explain the relationship between genes, enzymes and phenotype with respect to the gene for tyrosinase that is involved with the production of melanin.	• **Activity 16.1** Using models to investigate genetic crosses (Cambridge CD)
7. Selection		
7.1 Variation	7.1.1 describe the differences between continuous and discontinuous variation. 7.1.2 explain the genetic basis of continuous (many, additive genes control a characteristic) and discontinuous variation (one or few genes control a characteristic). 7.1.3 study the inheritance of some human phenotypic characters. 7.1.4 explain, with examples, how the environment may affect the phenotype of plants and animals. 7.1.5 explain why genetic variation is important in selection.	**Practical activity 17.1** A simulation of natural selection. (Cambridge CD) **OR** video about natural selection. (Cambridge CD) Experiment (10): Study the inheritance of some human phenotypic characters Experiment (10) in the lab manual from MOE)

Grade 12 (Bilingual) Biology - Learning outcomes		
Subtopics	**Learning Outcomes**	**Practical work + Activities** (Teacher's resource CD-ROM from Cambridge)
Semester 2		
8. **Genetic technology**		
8.1 Principles of genetic technology	8.1.1 define the term genetic engineering and recombinant DNA. 8.1.2 describe the steps of gene transfer using insulin production as an example. 8.1.3 describe the tools available to the genetic engineer and their functions considering the following: ▪ Enzymes: a. Restrictions endonucleases. b. Ligase. ▪ Vectors (to include only plasmid). ▪ Genes coding for easily identifiable substances that can be used as markers. 8.1.4 discuss the advantages of insulin production by genetic engineering. 8.1.5 describe the principals of gel electrophoresis. 8.1.6 discus the uses of gel electrophoresis. 8.1.7 explain the method of gel electrophoresis (Names of stains used are not required). 8.1.8 simulate how gel electrophoresis can be used to separate DNA fragments of varying size. 8.1.9 state an example of the uses of genetic technology in medicine including: Factor VIII – a blood clotting proteins 8.1.10 state examples of the uses of genetic technology in agriculture including: • Herbicide resistant crops. • Insect resistant crops. • Genetically modified salmon.	**Practical:** Virtual DNA gel electrophoresis (Or video about electrophoresis). (Cambridge CD) Experiment (11) Simulating gel electrophoresis.Experiment (11) in the lab manual from MOE)

Yearly plan for grade 12

	Grade 12– semester one	No. of Lessons		Grade 12– semester two	No. of Lessons
1	Energy and respiration	12	5	Nucleic acids and protein synthesis	13
2	Photosynthesis	12	6	Inherited change	13
3	Homeostasis	11	7	Selection	6
4	Control and coordination	13	8	Genetic technology	12
Total		48	Total		44

Resources for teachers to upgrade their knowledge and skills

Teacher support	http://www.cie.org.uk/teaching-and-learning/
How to teach	https://www.international.heacademy.ac.uk/
Past paper resource	http://papers.xtremepapers.com/CIE http://papers.xtremepapers.com/CIE/Cambridge%20International%20A%20and%20AS%20Level/
Teaching strategies	http://www.teachthought.com/pedagogy/instructional-strategies/50-teaching-strategies-to-jumpstart-your-teacher-brain/
Syllabus topics and interactive resources	18. www.abpischools.org.uk/age-range/16-19 19. www.bbsrc.ac.uk/engagement/schools/keystage5/ 20. www.johnkyrk.com 21. www.cellsalive.com 22. www.dnalc.org 23. www.garlandscience.com 24. biology-pages.info 25. illuminatepublishing.com 26. www.microbiologyonline.org.uk 27. www.nuffieldfoundation.org/practical-biology 28. www.hoddereducation.co.uk 29. www2.estrellamountain.edu/faculty/farabee/biobk/biobooktoc.html 30. www.saps.org.uk/secondary 31. www.biology.arizona.edu 32. www.cellimagelibrary.org 33. www.rothamsted.ac.uk/notebook/index.php?area=&page 34. www.arkive.org

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End of Biology Syllabus