وزارة التعليم

رؤية عُمان 2040

Biology Curriculum Framework	الإطار المنهجي لمادة الأحياء
Grades (9-10) - Bilingual Program	الصفوف (9–10) – البرنامج ثنائي اللغة
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المديرية العامة للمؤسسات التعليمية الخاصة

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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 curriculum focuses 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 curriculum also ensures 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. integrated Information and Communication Technology (ICT) tools and skills.

Important Skills

The Biology Curriculum aims to enable students to achieve academic success in science while equipping them with the skills needed to develop scientific thinking. It prepares them to pursue further studies and to participate effectively in a knowledge-based society, regardless of their future academic or career pathways.

- 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 this 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 curriculum 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:

Students' learning is assessed based on the assessment objectives outlined in the Student Assessment Handbook for Science (Grades 5–10) for Private Schools, issued by the Directorate General of Educational Assessment. The handbook is circulated through the official correspondence system and is also available on the Educational Portal (www.moe.gov.om). It should be consulted when planning and implementing assessment practices in science subjects at this level (Grades 5-10).

Biology 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 this 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.

1- The numbering key: [Unit – Topic –Learning outcome]
   e.g. 7.4.2: Unit 7(Human influences on ecosystems); Topic 4 (conservation) and 2 is the second learning outcome (Justify the need to conserve non-renewable resources, limited to fossil fuels).
2- (S) skill objective.

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 approximately 70 % of suggested laboratory-related activities, such as conducting experiments, making field trips and viewing audio-visual materials, must be done. Consider the sufficient time to carry out practical experiments in the student textbook and the wok book and training students in practical skills related to them. The teachers should get benefit from the workbook and laboratory practical book that are recommended by MOE in the approved books list.

Skills

Some Proposed exercises are referred whenever possible to Specific skills.

Grade 9 (Bilingual) Biology - Learning outcomes
Semester 1

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1. Characteristics and classification of living organisms			
1.1 Characteristics of living organisms	1.1.1 Describe the characteristics of living organisms by describing: • movement as an action by an organism or part of an organism causing a change of position or place. • respiration as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism. • sensitivity as the ability to detect and respond to changes in the internal or external environment. • growth as a permanent increase in size and dry mass. • reproduction as the processes that make more of the same kind of organism. • excretion as the removal of the waste products of metabolism and substances in excess of requirements. • nutrition as the taking in of materials for energy, growth and development		
1.2 Concept and use of a classification system	1.2.1 State that organisms can be classified into groups by the features that they share. 1.2.2 Describe a species as a group of organisms that can reproduce to produce fertile offspring. 1.2.3 Describe the binomial system of naming species as an internationally agreed system in	1. Practicing classification using the key 2. Present some samples, models, and photographs to show examples of	Critical thinking and organization

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
	which the scientific name of an organism is made up of two parts showing the genus and species. 1.2.4 Construct and use dichotomous keys based on identifiable features.	organisms from the five kingdoms.	

1.3 Features of organisms	1.3.1 State the main features used to place animals and plants into the appropriate kingdoms. 1.3.2 State the main features used to place organisms into groups within the animal kingdom, limited to: a. the main groups of vertebrates: mammals, birds, reptiles, amphibians, fish. b. the main groups of arthropods: myriapods, insects, arachnids, crustaceans 1.3.3 Classify organisms using the features identified in 1.3.1 and 1.3.2. 1.3.4 State the main features used to place all organisms into one of the five kingdoms: animal, plant, fungus, prokaryote, Protoctista. 1.3.5 State the main features used to place organisms into groups within the plant kingdom, limited to ferns and flowering plants (dicotyledons and monocotyledons). 1.3.6 Classify organisms using the features identified in 1.3.4 and 1.3.5 1.3.7 State the features of viruses, limited to a protein coat and genetic material.	1. Observing samples and photographs of vertebrates and invertebrates (Focus on local examples) 2. Observing samples and photographs of monocotyledons and dicotyledons (Focus on local examples)	Observation, problem solving and critical thinking

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
2. Organisation of the organism			
2.1 Cell structure	2.1.1 Describe and compare the structure of a plant cell with an animal cell, limited to: cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, ribosomes, mitochondria, vacuoles. 2.1.2 Describe the structure of a bacterial cell, limited to: cell wall, cell membrane, cytoplasm, ribosomes, circular DNA, plasmids. 2.1.3 Identify the cell structures listed in 2.1.1 and 2.1.2 in diagrams and images of plant, animal and bacterial cells. 2.1.4 Describe the functions of the structures listed in 2.1.1 and 2.1.2 in plant, animal and bacterial cells 2.1.5 State that new cells are produced by division of existing cells. 2.1.5 State that new cells are produced by division of existing cells. 2.1.6 State that specialised cells have specific functions, limited to: (a) ciliated cells – movement of mucus in the trachea and bronchi (b) root hair cells – absorption (c) palisade mesophyll cells – photosynthesis (d) neurones – conduction of electrical impulses (e) red blood cells – transport of oxygen (f) sperm and egg cells (gametes) – reproduction 2.1.7 Describe the meaning of the terms: cell, tissue, organ, organ system and organism.	1. Prepare slides of plant cells (e g. onion bulb leaf, *Rhoeo discolor* leaves, rhubarb skin) and animal's cells (e. g. cheek cells) 2. Using the microscope to observe the structure of plant and animal cells. 3. Show models of plant and animal cells.	Scientific enquiry, teamwork, and Communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
2.2 Size of specimens	2.2.1 State and use the formula: magnification = image size ÷ actual size. 2.2.2. Calculate magnification and size of biological specimens using millimetres as units. 2.2.3 Convert measurements between millimetres (mm) and micrometres (μm).	Using the microscope to observe the structure of different types of specialized cells (Permanent slides) OR examine photomicrographs for some specialized cells	Observation and communication
3. Movement into and out of cells			
3.1 Diffusion	3.1.1 Describe diffusion as the net movement of particles from a region of their higher concentration to a region of their lower concentration (i.e. down a concentration gradient), as a result of their random movement. 3.1.2 State that the energy for diffusion comes from the kinetic energy of random movement of molecules and ions. 3.1.3 State that some substances move into and out of cells by diffusion through the cell membrane. 3.1.4 Describe the importance of diffusion of gases and solutes in living organisms. 3.1.5 Investigate the factors that influence diffusion, limited to: surface area, temperature, concentration gradient and distance.	Use the ink OR liquid colors in the water and smoke or perfume in the classroom air to represent diffusion	Scientific enquiry and creativity.

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.2 Osmosis	3.2.1 Describe the role of water as a solvent in organisms with reference to digestion, excretion and transport. 3.2.2 State that water diffuses through partially permeable membranes by osmosis. 3.2.3 State that water moves into and out of cells by osmosis through the cell membrane. 3.2.4 Investigate osmosis using materials such as dialysis tubing. 3.2.5 Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations. 3.2.6 State that plants are supported by the pressure of water inside the cells pressing outwards on the cell wall. 3.2.7 Describe osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane. 3.2.8 Explain the effects on plant cells of immersing them in solutions of different concentrations by using the terms: turgid, turgor pressure, plasmolysis, flaccid. 3.2.9 Explain the importance of water potential and osmosis in the uptake and loss of water by organisms.	1. Experiment of Osmosis and water flow using of osmometer OR dialysis tube. 2. Investigate the effect of sugar solutions on potato tissue. 3. Use the microscope to show the behavior of plant cells (*Rhoeo discolor)* in isotonic, hypotonic, and hypertonic solutions	Scientific enquiry and teamwork

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.3 Active transport	3.3.1 Describe active transport as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration (i.e. against a concentration gradient), using energy from respiration. 3.3.2 Explain the importance of active transport as a process for movement of molecules or ions across membranes, including ion uptake by root hairs. 3.3.3 State that protein carriers move molecules or ions across a membrane during active transport.	Show video about active transport	ICT application
4 Biological molecules			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
4.1 Biological molecules.	4.1.1 List the chemical elements that make up: carbohydrates, fats and proteins. 4.1.2 State that large molecules are made from smaller molecules, limited to: (a) starch, glycogen and cellulose from glucose (b) proteins from amino acids (c) fats and oils from fatty acids and glycerol 4.1.3 Describe the use of: (a) iodine solution test for starch (b) Benedict's solution test for reducing sugars (c) biuret test for proteins (d) ethanol emulsion test for fats and oils (e) DCPIP test for vitamin C 4.1.4 Describe the structure of a DNA molecule: (a) two strands coiled together to form a double helix (b) each strand contains chemicals called bases (c) bonds between pairs of bases hold the strands together (d) the bases always pair up in the same way: A with T, and C with G (full names are not required).	1. Construct simple models for some macromolecules (carbohydrates, fats, proteins, and DNA). 2. Testing presence of carbohydrates, proteins, and fats by using chemical tests.	Scientific enquiry, problem solving and teamwork
5 Enzymes			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
5.1 Enzymes	5.1.1 Describe a catalyst as a substance that increases the rate of a chemical reaction and is not changed by the reaction. 5.1.2 Describe enzymes as proteins that are involved in all metabolic reactions, where they function as biological catalysts. 5.1.3 Describe why enzymes are important in all living organisms in terms of a reaction rate necessary to sustain life. 5.1.4 Describe enzyme action with reference to the shape of the active site of an enzyme being complementary to its substrate and the formation of products. 5.1.5 Investigate and describe the effect of changes in temperature and pH on enzyme activity with reference to optimum temperature and denaturation. 5.1.6 Explain enzyme action with reference to: active site, enzyme-substrate complex, substrate and product. 5.1.7 Explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate. 5.1.8 Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation. 5.1.9 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation.	1. Show videos about action and specificity of enzymes. 2. Construct a model for the specificity of enzymes. 3. Give a presentation about the use of enzymes in industry OR medicine OR food production.	ICT application, teamwork and communication
5 Diseases and immunity			

6.1 Diseases and immunity	6.1.1 Describe a pathogen as a disease-causing organism. 6.1.2 Describe a transmissible disease as a disease in which the pathogen can be passed from one host to another. 6.1.3 State that a pathogen is transmitted: (a) by direct contact, including through blood and other body fluids (b) indirectly, including from contaminated surfaces, food, animals and air 6.1.4 Describe the body defenses, limited to: skin, hairs in the nose, mucus, stomach acid and white blood cells 6.1.5 Explain the importance of the following in controlling the spread of disease: (a) a clean water supply (b) hygienic food preparation (c) good personal hygiene (d) waste disposal 6.1.6 Describe active immunity as defense against a pathogen by antibody production in the body. 6.1.7 State that each pathogen has its own antigens, which have specific shapes. 6.1.8 Describe antibodies as proteins that bind to antigens leading to direct destruction of pathogens or marking of pathogens for destruction by phagocytes. 6.1.9 State that specific antibodies have complementary shapes which fit specific antigens. 6.1.10 Explain that active immunity is gained after an infection by a pathogen or by vaccination. 6.1.11 Outline the process of vaccination: (a)weakened pathogens or their antigens are put into the body. (b) the antigens stimulate an immune response by lymphocytes which produce antibodies (c) memory cells are produced that give long-term immunity 6.1.12 Explain the role of vaccination in controlling the spread of diseases. 6.1.13 Explain that passive immunity is a short-term defence against a pathogen by antibodies acquired from another individual, including across the placenta and in breast milk. 6.1.14 Explain the importance of breast-feeding for the development of passive immunity in infants. 6.1.15 State that memory cells are not produced in passive immunity.	1. Collect data about the number of students that got any of the transmissible diseases and present these data according to the type of the microorganisms OR way of transmission using graphs and tables showing distribution of these transmitted diseases in the class. 2. Write a report about any of the recent transmitted diseases in Oman (e.g., Crimean–Congo haemorrhagic fever) 3. Show a video about the types of body defines 4. Give a presentation about some topics (e.g. vaccination and controlling the spread of diseases) 5. Arrange a Visit a to the health center and collect information about a range of available vaccinations.	Processing and delivery of information, observation, ICT application, teamwork and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
6 Plant Nutrition			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
7.1 Photosynthesis	7.1.1 Describe photosynthesis as the process by which plants synthesise carbohydrates from raw materials using energy from light. 7.1.2 State the word equation for photosynthesis as: carbon dioxide + water → glucose + oxygen in the presence of light and chlorophyll 7.1.3 State that chlorophyll is a green pigment that is found in chloroplasts. 7.1.4 State that chlorophyll transfers energy from light into energy in chemicals, for the synthesis of carbohydrates. 7.1.5 Outline the subsequent use and storage of the carbohydrates made in photosynthesis, limited to: (a) starch as an energy store (b) cellulose to build cell walls (c) glucose used in respiration to provide energy (d) sucrose for transport in the phloem (e) nectar to attract insects for pollination 7.1.6 Explain the importance of: (a) nitrate ions for making amino acids (b) magnesium ions for making chlorophyll 7.1.7 Investigate the need for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls. 7.1.8 Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis. 7.1.9 Investigate and describe the effect of light and dark conditions on gas exchange in an aquatic plant using hydrogen carbonate indicator solution. 7.1.10 State the balanced chemical equation for photosynthesis as: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ 7.1.11 Identify and explain the limiting factors of photosynthesis in different environmental conditions.	Experiments to investigate Photosynthesis: 1. Testing leaves for starch. 2. Is light necessary for photosynthesis? 3. Is Oxygen produced during photosynthesis? 4. The effect of changing light intensity and CO_2 conc. on the rate of photosynthesis.	Scientific enquiry, problem solving and teamwork

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
7.2 Leaf structure	7.2.1 State that most leaves have a large surface area and are thin, and explain how these features are adaptations for photosynthesis. 7.2.2 Identify in diagrams and images the following structures in the leaf of a dicotyledonous plant: chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, air spaces, vascular bundles, xylem and phloem. 7.2.3 Explain how the structures listed in 6.2.2 adapt leaves for Photosynthesis.	Using the microscope to observe the internal leaf structure (prepared slides of a transverse section of a dicotyledonous leaf)	Scientific enquiry

Grade 9 (Bilingual) Biology - Learning outcomes
Semester 2

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
8. Human Nutrition			
8.1 Diet	8.1.1 Describe what is meant by a balanced diet. 8.1.2 State the principal dietary sources and describe the importance of: (a) carbohydrates (b) fats and oils (c) proteins (d) vitamins, limited to C and D (e) mineral ions, limited to calcium and iron (f) fiber (roughage) (g) water 8.1.3 State the causes of scurvy and rickets.	1. Nutrients tests 2. Put tables to show the diet that fits groups of individuals according to their age and their work. 3. Show a video about the effect of nutrients' deficiency on humans. 4. Give a presentation about national statistics on obesity, coronary heart disease and diabetes and discuss actions of the health institutions to deal with the obesity.	ICT application, teamwork and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
8.2 Digestive system	8.2.1 Identify in diagrams and images the main organs f the digestive system, limited to: (a) alimentary canal: mouth, oesophagus, stomach, small intestine (Duodenum and ileum) and large intestine (colon, rectum, anus) (b) associated organs: salivary glands, pancreas, liver and gall bladder 8.2.2 Describe the functions of the organs of the digestive system listed in 7.2.1, in relation to: (a) ingestion – the taking of substances, e.g. food and drink, into the body (b) digestion – the breakdown of food (c) absorption – the movement of nutrients from the intestines into the blood (d) assimilation – uptake and use of nutrients by cells (e) egestion – the removal of undigested food from the body as faeces	Identifying the different parts of sheep's digestive system	Observation and communication
8.3 Physical digestion	8.3.1 Describe physical digestion as the breakdown of food into smaller pieces without chemical change to the food molecules. 8.3.2 State that physical digestion increases the surface area of food for the action of enzymes in chemical digestion. 8.3.3 Identify in diagrams and images the types of human teeth: incisors, canines, premolars and molars. 8.3.4 Describe the structure of human teeth, limited to: enamel, dentine, pulp, nerves, blood vessels and cement, and understand that teeth are embedded in bone and the gums. 8.3.5 Describe the functions of the types of human teeth in physical digestion of food. 8.3.6 Describe the function of the stomach in physical digestion. 8.3.7 Outline the role of bile in emulsifying fats and oils to increase the surface area for chemical digestion.	1. Constructing a teeth model 2. Show a video about structure and types of human teeth	Creativity, Observation, and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
8.4 Chemical digestion	8.4.1 Describe chemical digestion as the breakdown of large insoluble molecules into small soluble molecules. 8.4.2 State the role of chemical digestion in producing small soluble molecules that can be absorbed. 8.4.3 Describe the functions of enzymes as follows: (a) amylase breaks down starch to simple reducing sugars (b) proteases break down protein to amino acids (c) lipase breaks down fats and oils to fatty acids and glycerol 8.4.4 State where, in the digestive system, amylase, protease and lipase are secreted and where they act. 8.4.5 Describe the functions of hydrochloric acid in gastric juice, limited to killing harmful microorganisms in food and providing an acidic pH for optimum enzyme activity. 8.4.6 Describe the digestion of starch in the digestive system: (a) amylase breaks down starch to maltose (b) maltase breaks down maltose to glucose on the membranes of the epithelium lining the small intestine. 8.4.7 Describe the digestion of protein by proteases in the digestive system: (a) pepsin breaks down protein in the acidic conditions of the stomach (b) trypsin breaks down protein in the alkaline conditions of the small intestine 8.4.8 Explain that bile is an alkaline mixture that neutralizes the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action.	1. Show a video about the chemical digestion 2. Experiments to investigate chemical digestion: a) The action of salivary amylase on starch b) The action of pepsin on egg-white protein c) The action of lipase on lipids.	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
8.5 Absorption	8.5.1 State that the small intestine is the region where nutrients are absorbed. 8.5.2 State that most water is absorbed from the small intestine but that some is also absorbed from the colon. 8.5.3 Explain the significance of villi and microvilli in increasing the internal surface area of the small intestine 8.5.4 Describe the structure of a villus. 8.5.5 Describe the roles of capillaries and lacteals in villi.	1. Identifying the structure of villus using a model. 2. Show a video about Absorption	Observation and communication
9. Transport in plants			
9.1 Xylem and Phloem	9.1.1 State the functions of xylem and phloem: (a) xylem – transport of water and mineral ions, and support (b) phloem – transport of sucrose and amino acids 9.1.2 Identify in diagrams and images the position of xylem and phloem as seen in sections of roots, stems and leaves of non-woody dicotyledonous plants. 9.1.3 Relate the structure of xylem vessels to their function, limited to: (a) thick walls with lignin (details of lignification are not required) (b) no cell contents (c) cells joined end to end with no cross walls to form a long continuous tube.	1. Using the microscope to examine the root hair cells 2. Using the microscope to observe the xylem and phloem (permanent slides) 3. Investigate water transport in plants (Tracing xylem).	Scientific enquiry, observation, and teamwork
9.2 Water uptake	9.2.1 Identify in diagrams and images root hair cells and state their functions. 9.2.2 State that the large surface area of root hairs increases the uptake of water and mineral ions. 9.2.3 Outline the pathway taken by water through the root, stem and leaf as: root hair cells, root cortex cells, xylem, mesophyll cells. 9.2.4 Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant.	Investigate the effect of temperature and humidity on rates of water uptake by using the potometer.	Scientific enquiry, observation, and teamwork

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
9.3 Transpiration	9.3.1 Describe transpiration as the loss of water vapour from leaves. 9.3.2 State that water evaporates from the surfaces of the mesophyll cells into the air spaces and then diffuses out of the leaves through the stomata as water vapour. 9.3.3 Investigate and describe the effects of variation of temperature and wind speed on transpiration rate. 9.3.4 Explain how water vapour loss is related to: the large internal surface area provided by the interconnecting air spaces between mesophyll cells and the size and number of stomata. 9.3.5 Explain the mechanism by which water moves upwards in the xylem in terms of a transpiration pull that draws up a column of water molecules, held together by forces of attraction between water molecules. 9.3.6 Explain the effects on the rate of transpiration of varying the following factors: temperature, wind speed and humidity. 9.3.7 Explain how and why wilting occurs.		

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
9.4 Translocation	9.4.1 Describe translocation as the movement of sucrose and amino acids in phloem from sources to sinks. 9.4.2 Describe: (a) sources as the parts of plants that release sucrose or amino acids (b) sinks as the parts of plants that use or store sucrose or amino acids 9.4.3 Explain why some parts of a plant may act as a source and a sink at different times.		
10. Transport in Animals			
10.1 Circulatory systems	10.1.1 Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood. 10.1.2 Describe the single circulation of a fish. 10.1.3 Describe the double circulation of a mammal. 10.1.4 Explain the advantages of a double circulation.	Show a video about the two types of blood circulation and the first scientists to describe theses circulations	ICT application and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
10.2 Heart	10.2.1 Identify in diagrams and images the structures of the mammalian heart, limited to: muscular wall, septum, left and right ventricles, left and right atria, one-way valves and coronary arteries. 10.2.2 State that blood is pumped away from the heart in arteries and returns to the heart in veins. 10.2.3 State that the activity of the heart may be monitored by: ECG, pulse rate and listening to sounds of valves closing. 10.2.4 Investigate and describe the effect of physical activity on the heart rate. 10.2.5 Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors including diet, lack of exercise, stress, smoking, genetic predisposition, age and sex. 10.2.6 Discuss the roles of diet and exercise in reducing the risk of coronary heart disease. 10.2.7 Identify in diagrams and images the atrioventricular and semilunar valves in the mammalian heart. 10.2.8 Explain the relative thickness of: (a) the muscle walls of the left and right ventricles (b) the muscle walls of the atria compared to those of the ventricles 10.2.9 Explain the importance of the septum in separating oxygenated and deoxygenated blood. 10.2.10 Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves. 10.2.11 Explain the effect of physical activity on the heart rate.	1. Identify the structures of the mammalian heart using sheep's Heart 2. Investigate the effect of physical activity on the pulse rate (use excel to present data)	Scientific enquiry, ICT application and team work

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
10.3 Blood vessels	10.3.1 Describe the structure of arteries, veins and capillaries, limited to: relative thickness of wall, diameter of the lumen and the presence of valves in veins. 10.3.2 State the functions of capillaries. 10.3.3 Identify in diagrams and images the main blood vessels to and from the: (a) heart, limited to vena cava, aorta, pulmonary artery and pulmonary vein (b) lungs, limited to pulmonary artery and pulmonary vein (c) kidney, limited to renal artery and renal vein 10.3.4 Explain how the structure of arteries and veins is related to the pressure of the blood that they transport. 10.3.5 Explain how the structure of capillaries is related to their functions. 10.3.6 Identify, in diagrams and images, the main blood vessels to and from the liver as: hepatic artery, hepatic veins and hepatic portal vein.	Using of microscope to examine the structure of blood vessels (Prepared slides)	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
10.4 Blood	10.4.1 List the components of blood as: red blood cells, white blood cells, platelets and plasma. 10.4.2 Identify red and white blood cells in photomicrographs and diagrams 10.4.3 State the functions of the following components of blood: (a) red blood cells in transporting oxygen, including the role of hemoglobin. (b) white blood cells in phagocytosis and antibody production (c) platelets in clotting (details are not required) (d) plasma in the transport of blood cells, ions, nutrients, urea, hormones and carbon dioxide. 10.4.4 State the roles of blood clotting as preventing blood loss and the entry of pathogens. 10.4.5 Identify lymphocytes and phagocytes in photomicrographs and diagrams. 10.4.6 State the functions of: (a) lymphocytes – antibody production (b) phagocytes – engulfing pathogens by phagocytosis 10.4.7 Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh.	Using of microscope to identify the blood cells (Prepared slides)	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
11. Gas Exchange in Humans			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
11.1 Gas Exchange in Humans	11.1.1 Describe the features of gas exchange surfaces in humans, limited to: large surface area, thin surface, good blood supply and good ventilation with air. 11.1.2 Identify in diagrams and images the following parts of the breathing system: lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries. 11.1.3 Investigate the differences in composition between inspired and expired air using limewater as a test for carbon dioxide. 11.1.4 Describe the differences in composition between inspired and expired air, limited to oxygen, carbon dioxide and water vapour. 11.1.5 Investigate and describe the effects of physical activity on the rate and depth of breathing.	1. Construct a model to explain the mechanism of breathing. 2. Using limewater as a test for carbon dioxide in exhaled air. 3. Effects of physical activity on rate and depth of breathing	Scientific enquiry, creativity, ICT application, teamwork and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
12. Respiration			
12.1 Respiration	12.1.1 State the uses of energy in living organisms, including muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature. 12.1.2 Investigate and describe the effect of temperature on respiration in Yeast.		
12.2 Aerobic respiration	12.2.1 Describe aerobic respiration as the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy. 12.2.2 State the word equation for aerobic respiration as: glucose + oxygen → carbon dioxide + water 12.2.3 State the balanced chemical equation for aerobic respiration as: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	1. Measurement of oxygen consumption using a respirometer. 2. Measurement of carbon dioxide and heat release.	Scientific enquiry, ICT application, teamwork and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
12.3 Anaerobic respiration	12.3.1 Describe anaerobic respiration as the chemical reactions in cells that break down nutrient molecules to release energy without using oxygen. 12.3.2 State that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration. 12.3.3 State the word equation for anaerobic respiration in yeast as: glucose → alcohol + carbon dioxide 12.3.4 State the word equation for anaerobic respiration in muscles during vigorous exercise as: glucose → lactic acid 12.3.5 State the balanced chemical equation for anaerobic respiration in yeast as: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ 12.3.6 State that lactic acid builds up in muscles and blood during vigorous exercise causing an oxygen debt. 12.3.7 Outline how the oxygen debt is removed after exercise, limited to: (a) continuation of fast heart rate to transport lactic acid in the blood from the muscles to the liver (b) continuation of deeper and faster breathing to supply oxygen for aerobic respiration of lactic acid (c) aerobic respiration of lactic acid in the liver.	1. Experiment to investigate release of carbon dioxide, ethanol, and heat during anaerobic respiration in yeast cells. 2. Write a report using resources from the library about the uses of fermentation in the manufacture of products.	Scientific enquiry, teamwork, and communication

Grade 10 (Bilingual) Biology - Learning outcomes
Semester 1

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1. Coordination and response			
1.1 Coordination and response	1.1.1 State that electrical impulses travel along neurones. 1.1.2 Describe the mammalian nervous system in terms of: (a) the central nervous system (CNS) consisting of the brain and the spinal cord. (b) the peripheral nervous system (PNS) consisting of the nerves outside of the brain and spinal cord. 1.1.3 Describe the role of the nervous system as coordination and regulation of body functions. 1.1.4 Identify in diagrams and images sensory, relay and motor neurones. 1.1.5 Describe a simple reflex arc in terms of: receptor, sensory neurone, relay neurone, motor neurone and effector. 1.1.6 Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands). 1.1.7 Describe a synapse as a junction between two neurones. 1.1.8 Describe the structure of a synapse, including the presence of vesicles containing neurotransmitter molecules, the synaptic gap and receptors. 1.1.9 Describe the events at a synapse as: (a) an impulse stimulates the release of neurotransmitter molecules from vesicles into the synaptic gap (b) the neurotransmitter molecules diffuse across the gap (c) neurotransmitter molecules bind with receptor proteins on the next neurone (d) an impulse is then stimulated in the next neurone. 1.1.10 State that synapses ensure that impulses travel in one direction only.	1. Show a video about the human nervous system OR reflex arc OR synapses. 2. Test the speed of the students' response in some examples of reflex actions (e.g., pick up a pen during the fall between their fingers).	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1.2 Sense organs	1.2.1 Describe sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals. 1.2.2 Identify in diagrams and images the structures of the eye, limited to: cornea, iris, pupil, lens, retina, optic nerve and blind spot. 1.2.3 Describe the function of each part of the eye, limited to: (a) cornea – refracts light (b) iris – controls how much light enters the pupil (c) lens – focuses light on to the retina (d) retina – contains light receptors, some sensitive to light of different colours (e) optic nerve – carries impulses to the brain 1.2.4 Explain the pupil reflex, limited to changes in light intensity and pupil diameter. 1.2.5 Explain the pupil reflex in terms of the antagonistic action of circular and radial muscles in the iris. 1.2.6 Explain accommodation to view near and distant objects in terms of the contraction and relaxation of the ciliary muscles, tension in the suspensory ligaments, shape of the lens and refraction of light. 1.2.7 Describe the distribution of rods and cones in the retina of a human. 1.2.8 Outline the function of rods and cones, limited to: (a) greater sensitivity of rods for night vision (b) three different kinds of cones, absorbing light of different colours, for colour vision. 1.2.9 Identify in diagrams and images the position of the fovea and state its function.	1. Identify the structures of the human eye by using the eye model/sheep's eye 2. Examine the pupil's size under a bright light and in the dark.	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1.3 Hormones	1.3.1 Describe a hormone as a chemical substance, produced by a gland and carried by the blood, which alters the activity of one or more specific target organs. 1.3.2 Identify in diagrams and images specific endocrine glands and state the hormones they secrete, limited to: (a) adrenal glands and adrenaline (b) pancreas and insulin (c) testes and testosterone (d) ovaries and oestrogen. 1.3.3 Describe adrenaline as the hormone secreted in 'fight or flight' situations and its effects, limited to: (a) increased breathing rate (b) increased heart rate (c) increased pupil diameter 1.3.4 Compare nervous and hormonal control, limited to speed of action and duration of effect. 1.3.5 State that glucagon is secreted by the pancreas. 1.3.6 Describe the role of adrenaline in the control of metabolic activity, limited to: (a) increasing the blood glucose concentration (b) increasing heart rate	1. Show video about some situations in which adrenaline secretion is increased. 2. Study specific cases of the body's responses and discuss the evidence of whether these responses are from the nervous system or the hormonal system. 3. Arrange a trip to one of beef, poultry and dairy industries and discuss the use of hormones.	Observation, evaluation, communication, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1.4 Homeostasis	1.4.1 Describe homeostasis as the maintenance of a constant internal environment. 1.4.2 State that insulin decreases blood glucose concentration. 1.4.3 Explain the concept of homeostatic control by negative feedback with reference to a set point. 1.4.4 Describe the control of blood glucose concentration by the liver and the roles of insulin and glucagon. 1.4.5 Outline the treatment of Type 1 diabetes. 1.4.6 Identify in diagrams and images of the skin: hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue. 1.4.7 Describe the maintenance of a constant internal body temperature in mammals in terms of: insulation, sweating, shivering and the role of the brain. 1.4.8 Describe the maintenance of a constant internal body temperature in mammals in terms of vasodilation and vasoconstriction of arterioles supplying skin surface capillaries.	1. Use a blood glucose meter to measure the level of blood glucose before and after eating sugar (under the supervision of the teacher). 2. Record changes in body temperature across the full day, in places with different air temperatures and explain the results.	Observation, evaluation, communication, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
1.5 Tropic responses	1.5.1 Describe gravitropism as a response in which parts of a plant grow towards or away from gravity. 1.5.2 Describe phototropism as a response in which parts of a plant grow towards or away from the direction of the light source. 1.5.3 Investigate and describe gravitropism and phototropism in shoots and roots. 1.5.4 Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth. 1.5.5 Explain the role of auxin in controlling shoot growth, limited to: (a) auxin is made in the shoot tip (b) auxin diffuses through the plant from the shoot tip (c) auxin is unequally distributed in response to light and gravity (d) auxin stimulates cell elongation.	1. Experiments provide clues about phototropism and gravitropism. 2. Give a presentation about the commercial uses of plant hormones.	Scientific enquiry, teamwork, communication, and ethics (safety, health, and environment)
2. Excretion in Human			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
2.1 Excretion in Humans	2.1.1 State that carbon dioxide is excreted through the lungs 2.1.2 State that the kidneys excrete urea and excess water and ions 2.1.3 Identify in diagrams and images the kidneys, ureters, bladder and urethra 2.1.4 Identify in diagrams and images the structure of the kidney, limited to the cortex and medulla 2.1.5 Outline the structure and function of a nephron and its associated blood vessels, limited to: (a) the role of the glomerulus in the filtration from the blood of water, glucose, urea and ions (b) the role of the nephron in the reabsorption of all of the glucose, some of the ions and most of the water back into the blood (c) the formation of urine containing urea, excess water and excess ions (details of these processes are not required) 2.1.6 Describe the role of the liver in the assimilation of amino acids by converting them to proteins. 2.1.6 State that urea is formed in the liver from excess amino acids 2.1.7 Describe deamination as the removal of the nitrogen-containing part of amino acids to form urea 2.1.8 Explain the importance of excretion, limited to toxicity of urea	Investigating and dissection mammalian kidney.	Problem solving, creativity, teamwork, communication, and ethics (safety, health, and environment)
3. Reproduction			
3.1 Asexual reproduction	3.1.1 Describe asexual reproduction as a process resulting in the production of genetically identical offspring from one parent. 3.1.2 Identify examples of asexual reproduction in diagrams, images and information provided. 3.1.3 Discuss the advantages and disadvantages of asexual reproduction: (a) to a population of a species in the wild (b) to crop production.	1. Show some diagrams and photos about the asexual reproduction 2. Practice some methods of the asexual reproduction in plants.	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.2 Sexual reproduction	3.2.1 Describe sexual reproduction as a process involving the fusion of the nuclei of two gametes to form a zygote and the production of offspring that are genetically different from each other. 3.2.2 Describe fertilization as the fusion of the nuclei of Gametes. 3.2.3 State that nuclei of gametes are haploid, and that the nucleus of a zygote is Diploid. 3.2.4 Discuss the advantages and disadvantages of sexual reproduction: (a) to a population of a species in the wild (b) to crop production.		Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.3 Sexual reproduction in plants	3.3.1 Identify in diagrams and images and draw the following parts of an insect-pollinated flower: sepals, petals, stamens, filaments, anthers, carpels, style, stigma, ovary and ovules. 3.3.2 State the functions of the structures listed in 3.3.1. 3.3.3 Identify in diagrams and images and describe the anthers and stigmas of a wind-pollinated flower. 3.3.4 Distinguish between the pollen grains of insect-pollinated and wind-pollinated flowers. 3.3.5 Describe pollination as the transfer of pollen grains from an anther to a stigma. 3.3.6 State that fertilization occurs when a pollen nucleus fuses with a nucleus in an ovule. 3.3.7 Describe the structural adaptations of insect-pollinated and wind-pollinated flowers. 3.3.8 Investigate and describe the environmental conditions that affect germination of seeds, limited to the requirement for: water, oxygen and a suitable temperature. 3.3.9 Describe self-pollination as the transfer of pollen grains from the anther of a flower to the stigma of the same flower or a different flower on the same plant 3.3.10 Describe cross-pollination as the transfer of pollen grains from the anther of a flower to the stigma of a flower on a different plant of the same species. 3.3.11 Discuss the potential effects of self-pollination and cross-pollination on a population, in terms of variation, capacity to respond to changes in the environment and reliance on pollinators, 3.3.12 Describe the growth of the pollen tube and its entry into the ovule followed by fertilization (details of production of endosperm and development are not required).	1. Examine the structure of a flower and identify the male and female parts. 2. Examine a range of floral structures to differences between wind pollinated and insect pollinated flowers. 3. Visit to appropriate plant Propagation Stations. 4. Investigate the requirement of water, oxygen, and suitable temperature for seed germination.	Scientific enquiry, problem solving, teamwork and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.4 Sexual reproduction in humans	3.4.1 Identify on diagrams and state the functions of the following parts of the male reproductive system: testes, scrotum, sperm ducts, prostate gland, urethra and penis. 3.4.2 Identify on diagrams and state the functions of the following parts of the female reproductive system: ovaries, oviducts, uterus, cervix and vagina. 3.4.3 Describe fertilization as the fusion of the nuclei from a male gamete (sperm) and a female gamete (egg cell). 3.4.4 Explain the adaptive features of sperm, limited to: flagellum, mitochondria and enzymes in the acrosome. 3.4.5 Explain the adaptive features of egg cells, limited to: energy stores and the jelly coat that changes at fertilization. 3.4.6 Compare male and female gametes in terms of: size, structure, motility and numbers. 3.4.7 State that in early development, the zygote forms an embryo which is a ball of cells that implant into the lining of the uterus. 3.4.8 Identify on diagrams and state the functions of the following in the development of the fetus: umbilical cord, placenta, amniotic sac and amniotic fluid. 3.4.9 Describe the function of the placenta and umbilical cord in relation to the exchange of dissolved nutrients, gases and excretory products between the blood of the mother and the blood of the fetus. 3.4.10 State that some pathogens and toxins can pass across the placenta and affect the fetus.	1. Show a video about the development of embryo. 2. Give a presentation (talk OR poster) about ante-natal care of pregnant women.	Teamwork, ICT application, communication, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
3.5 Sex hormones in humans	3.5.1 Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics during puberty, 3.5.2 Describe the menstrual cycle in terms of changes in the ovaries and in the lining of the uterus. 3.5.3 Describe the sites of production of oestrogen and progesterone in the menstrual cycle and in pregnancy. 3.5.4 Explain the role of hormones in controlling the menstrual cycle and pregnancy, limited to FSH, LH, progesterone and oestrogen.		Observation and communication
3.6 Sexually transmitted infections (STIs)	3.6.1 Describe a sexually transmitted infection (STI) as an infection that is transmitted through sexual contact. 3.6.2 State that human immunodeficiency virus (HIV) is a pathogen that causes an STI. 3.6.3 State that HIV infection may lead to AIDS. 3.6.4 Describe the methods of transmission of HIV. 3.6.5 Explain how the spread of STIs is controlled.	Give a presentation (talk OR poster) about AIDS OR other sexually transmitted diseases	Teamwork, ICT application, communication, and ethics (safety, health, and environment)

Grade 10 (Bilingual) Biology - Learning outcomes - Semester 2

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
4 Inheritance			
4.1 Chromosomes, genes and proteins	4.1.1 State that chromosomes are made of DNA, which contains genetic information in the form of genes. 4.1.2 Define a gene as a length of DNA that codes for a protein. 4.1.3 Define an allele as an alternative form of a gene. 4.1.4 Describe the inheritance of sex in humans with reference to X and Y chromosomes. 4.1.5 State that the sequence of bases in a gene determines the sequence of amino acids used to make a specific protein 4.1.6 Explain that different sequences of amino acids give different shapes to protein molecules. 4.1.7 Explain that DNA controls cell function by controlling the production of proteins, including enzymes, membrane carriers and receptors for neurotransmitters. 4.1.8 Explain how a protein is made, limited to: • the gene coding for the protein remains in the nucleus • messenger RNA (mRNA) is a copy of a gene • mRNA molecules are made in the nucleus and move to the cytoplasm • the mRNA passes through ribosomes • the ribosome assembles amino acids into protein molecules • the specific sequence of amino acids is determined by the sequence of bases in the mRNA. 4.1.9 Explain that most body cells in an organism contain the same genes, but many genes in a particular cell are not expressed because the cell only makes the specific proteins it needs. 4.1.10 Describe a haploid nucleus as a nucleus containing a single set of chromosomes. 4.1.11 Describe a diploid nucleus as a nucleus containing two sets of chromosomes. 4.1.12 State that in a diploid cell, there is a pair of each type of chromosome and in a human diploid cell there are 23 pairs.	1. construct a model using the colored beads to represent the alleles (dominant and recessive) in the genes of the parents to illustrate how these alleles are transmitted to the gametes and then to the offspring. 2. construct a model using the colored beads to represent how the sequence of bases in a gene determines the sequence of the amino acids in the polypeptide. 3. Show a photo of male and female Karyotypes (Somatic cells and gametes)	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
4.2 mitosis	4.2.1 Describe mitosis as nuclear division giving rise to genetically identical cells (details of the stages of mitosis are not required). 4.2.2 State the role of mitosis in growth, repair of damaged tissues, replacement of cells and asexual reproduction. 4.2.3 State that the exact replication of chromosomes occurs before mitosis. 4.2.4 State that during mitosis, the copies of chromosomes separate, maintaining the chromosome number in each daughter cell. 4.2.5 Describe stem cells as unspecialized cells that divide by mitosis to produce daughter cells that can become specialized for specific functions.	1. Using of microscope to examine stages of mitosis (Prepared slides) 2. Simulate chromosomal behaviour in mitosis using coloured strings OR plastic wires.	Teamwork, creativity, observation, and communication
4.3 Meiosis	4.3.1 State that meiosis is involved in the production of gametes. 4.3.2 Describe meiosis as a reduction division in which the chromosome number is halved from diploid to haploid resulting in genetically different cells (details of the stages of meiosis are not required).	1. Using of microscope to examine stages of meiosis (Prepared slides) 2. Simulate chromosomal behaviour in meiosis using coloured strings OR plastic wires.	Teamwork, observation, and communication

4.4 Monohybrid inheritance	4.4.1 Describe inheritance as the transmission of genetic information from generation to Generation. 4.4.2 Describe genotype as the genetic make-up of an organism and in terms of the alleles present. 4.4.3 Describe phenotype as the observable features of an organism. 4.4.4 Describe homozygous as having two identical alleles of a particular gene. 4.4.5 State that two identical homozygous individuals that breed together will be pure breeding. 4.4.6 Describe heterozygous as having two different alleles of a particular gene. 4.4.7 State that a heterozygous individual will not be pure breeding. 4.4.8 Describe a dominant allele as an allele that is expressed if it is present in the genotype. 4.4.9 Describe a recessive allele as an allele that is only expressed when there is no dominant allele of the gene present in the genotype. 4.4.10 Interpret pedigree diagrams for the inheritance of a given characteristic. 4.4.11 Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic ratios, limited to 1 : 1 and 3 : 1 ratios. 4.4.12 Use Punnett squares in crosses which result in more than one genotype to work out and show the possible different genotypes. 4.4.13 Explain how to use a test cross to identify an unknown genotype. 4.4.14 Describe codominance as a situation in which both alleles in heterozygous organisms contribute to the phenotype. 4.4.15 Explain the inheritance of ABO blood groups: phenotypes are A, B, AB and O blood groups and alleles are I^A, I^B and I^o. 4.4.16 Describe a sex-linked characteristic as a feature in which the gene responsible is located on a sex chromosome and that this makes the characteristic more common in one sex than in the other. 4.4.17 Describe red-green colour blindness as an example of sex linkage. 4.4.18 Use genetic diagrams to predict the results of monohybrid crosses involving codominance or sex linkage and calculate phenotypic ratios.	1. Practicing using of Punnett square. 2. Practicing solving pedigrees. 3. Collect and interpret statistical information about some common inherited diseases in Oman.	Problem solving, critical thinking and teamwork
5 Variation and selection			

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
5.1 Variation	5.1.1 Describe variation as differences between individuals of the same species. 5.1.2 State that continuous variation results in a range of phenotypes between two extremes: examples include body length and body mass. 5.1.3 State that discontinuous variation results in a limited number of phenotypes with no intermediates: examples include ABO blood groups, seed shape in peas and seed color in peas. 5.1.4 State that discontinuous variation is usually caused by genes only and continuous variation is caused by both genes and the environment. 5.1.5 Investigate and describe examples of continuous and discontinuous variation. 5.1.6 Describe mutation as genetic change. 5.1.7 State that mutation is the way in which new alleles are formed. 5.1.8 State that ionizing radiation and some chemicals increase the rate of mutation. 5.1.9 Describe gene mutation as a random change in the base sequence of DNA. 5.1.10 State that mutation, meiosis, random mating and random fertilization are sources of genetic variation in populations.	1. Investigations into continuous and discontinuous variation in the class (statistical work). 2. Write instruction set to carry out a task, then change one of the instructions and then try to do the mission. 3. Collect and interpret statistical information about Down's syndrome and sickle cell anemia in Oman. 4. Arrange for a scientific debate between students distributing to them specific roles on evidence available that agree about the effects of radiation and chemicals on mutation rates.	ICT application, teamwork, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
5.2 Adaptive features	5.2.1 Describe an adaptive feature as an inherited feature that helps an organism to survive and reproduce in its environment. 5.2.2 Interpret images or other information about a species to describe its adaptive features. 5.2.3 Explain the adaptive features of hydrophytes and xerophytes to their environments.	1. Present images and samples about a species to describe its adaptive features. 2. Record observations for various types of Omani plants (including shrubs and trees) that live in the desert and describe their adaptive features.	Observation and communication
6 Organisms and their environment			
6.1 Energy flow	6.1.1 State that the Sun is the principal source of energy input to biological systems. 6.1.2 Describe the flow of energy through living organisms, including light energy from the Sun and chemical energy in organisms, and its eventual transfer to the environment.	1. Designing charts	Teamwork

6.2 Food chains and food webs	6.2.1 Describe a food chain as showing the transfer of energy from one organism to the next, beginning with a producer. 6.2.2 Construct and interpret simple food chains. 6.2.3 Describe a food web as a network of interconnected food chains and interpret food webs. 6.2.4 Describe a producer as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis. 6.2.5 Describe a consumer as an organism that gets its energy by feeding on other organisms. 6.2.6 State that consumers may be classed as primary, secondary, tertiary and quaternary according to their position in a food chain. 6.2.7 Describe a herbivore as an animal that gets its energy by eating plants. 6.2.8 Describe a carnivore as an animal that gets its energy by eating other animals. 6.2.9 Describe a decomposer as an organism that gets its energy from dead or waste organic material. 6.2.10 Use food chains and food webs to describe the impact humans have through overharvesting of food species and through introducing foreign species to a habitat. 6.2.11 Draw, describe and interpret pyramids of numbers and pyramids of biomass. 6.2.12 Discuss the advantages of using a pyramid of biomass rather than a pyramid of numbers to represent a food chain. 6.2.13 Describe a trophic level as the position of an organism in a food chain, food web or ecological pyramid. 6.2.14 Identify the following as the trophic levels in food webs, food chains and ecological pyramids: producers, primary consumers, secondary consumers, tertiary consumers and quaternary consumers. 6.2.15 Draw, describe and interpret pyramids of energy. 6.2.16 Discuss the advantages of using a pyramid of energy rather than pyramids of numbers or biomass to represent a food chain. 6.2.17 Explain why the transfer of energy from one trophic level to another is often not efficient. 6.2.18 Explain, in terms of energy loss, why food chains usually have fewer than five trophic levels.	2. Drawing and interpreting food chains, food webs, pyramids of numbers and pyramids of mass.	Problem solving, critical thinking, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
6.3 Nutrient cycles	6.3.1 Describe the carbon cycle, limited to: photosynthesis, respiration, feeding, decomposition, formation of fossil fuels and combustion. 6.3.2 Describe the nitrogen cycle with reference to: • decomposition of plant and animal protein to ammonium ions • nitrification • nitrogen fixation by lightning and bacteria • absorption of nitrate ions by plants • production of amino acids and proteins • feeding and digestion of proteins • deamination • denitrification 6.3.3 State the roles of microorganisms in the nitrogen cycle, limited to: decomposition, nitrification, nitrogen fixation and denitrification (generic names of individual bacteria, e.g. Rhizobium, are not required).	1. Practicing interprets nutrient cycles.	Critical thinking, and ethics (safety, health, and environment)

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
6.4 Population	6.4.1 Describe a population as a group of organisms of one species, living in the same area, at the same time. 6.4.2 Describe a community as all of the populations of different species in an ecosystem. 6.4.3 Describe an ecosystem as a unit containing the community of organisms and their environment, interacting together. 6.4.4 Identify and state the factors affecting the rate of population growth for a population of an organism, limited to food supply, competition, predation and disease. 6.4.5 Identify the lag, exponential (log), stationery and death phases in the sigmoid curve of population growth for a population growing in an environment with limited resources. 6.4.6 Interpret graphs and diagrams of population Growth.		Observation and communication
7 Human influences on ecosystems			
7.1 Food supply	7.1.1 Describe how humans have increased food production, limited to: (a) agricultural machinery to use larger areas of land and improve efficiency (b) chemical fertilizers to improve yields (c) insecticides to improve quality and yield (d) herbicides to reduce competition with weeds (e) selective breeding to improve production by crop plants and livestock. 7.1.2 Describe the advantages and disadvantages of large-scale monocultures of crop Plants. 7.1.3 Describe the advantages and disadvantages of intensive livestock production.	1. Arrange for a scientific debate between students distributing to them specific roles on evidence available that agree or disagree about the negative impacts of large-scale monocultures of crop plants on an ecosystem	Critical thinking and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
7.2 Habitat destruction	7.2.1 Describe biodiversity as the number of different species that live in an area. 7.2.2 Describe the reasons for habitat destruction, including: (a) increased area for housing, crop plant production and livestock production (b) extraction of natural resources (c) freshwater and marine pollution 7.2.3 State that through altering food webs and food chains, humans can have a negative impact on habitats. 7.2.4 Explain the undesirable effects of deforestation as an example of habitat destruction, to include reducing biodiversity, extinction, loss of soil, flooding and increase of carbon dioxide in the atmosphere.	1. Show a video about the undesirable effects of deforestation on the environment	Observation and communication
7.3 Pollution	7.3.1 Describe the effects of untreated sewage and excess fertilizer on aquatic ecosystems. 7.3.2 Describe the effects of non-biodegradable plastics, in both aquatic and terrestrial ecosystems. 7.3.3 Describe the sources and effects of pollution of the air by methane and carbon dioxide, limited to the enhanced greenhouse effect and climate change. 7.3.4 Explain the process of eutrophication of water, limited to: • increased availability of nitrate and other ions • increased growth of producers • increased decomposition after death of producers • increased aerobic respiration by decomposers • reduction in dissolved oxygen • death of organisms requiring dissolved oxygen in water.	1. Show a video about pollution (causes, effects, and possible remedies) 2. A visit to one of the institutions that are in charge with the environment in Oman and write a report about their rules and regulations to reduce pollution.	Observation and communication

Subtopics	Learning Outcomes	Suggested teaching and learning activities + Practical work	Skills
7.4 Conservation	7.4.1 Describe a sustainable resource as one which is produced as rapidly as it is removed from the environment so that it does not run out. 7.4.2 State that some resources can be conserved and managed sustainably, limited to forests and fish stocks. 7.4.3 Explain why organisms become endangered or extinct, including: climate change, habitat destruction, hunting, overharvesting, pollution and introduced species. 7.4.4 Describe how endangered species can be conserved, limited to: (a) monitoring and protecting species and habitats (b) education (c) captive breeding programmes (d) seed banks 7.4.5 Explain how forests can be conserved using: education, protected areas, quotas and Replanting. 7.4.6 Explain how fish stocks can be conserved using: education, closed seasons, protected areas, controlled net types and mesh size, quotas and monitoring. 7.4.7 Describe the reasons for conservation programmes, limited to: (a) maintaining or increasing biodiversity (b) reducing extinction (c) protecting vulnerable ecosystems (d) maintaining ecosystem functions, limited to nutrient cycling and resource provision, including food, drugs, fuel and genes. 7.4.8 Describe the use of artificial insemination (AI) and in vitro fertilization (IVF) in captive breeding programmes. 7.4.9 Explain the risks to a species if its population size decreases, reducing genetic variation (knowledge of genetic drift is not required).	1. Show videos about conservation of fossil fuels, sewage treatment and recycling	Observation and communication

Yearly plan

	Grade 9 – semester one	Number of lessons	Grade 9 – semester two	Number of lessons	Grade 10 – semester one	Number of lessons	Grade 10 – semester two	Number of lessons
1	Characteristics and classification of living organisms	10	Human nutrition	9	Coordination and response	16	Inheritance	15
2	Organization of the organisms	6	Transport in plants	9	Excretion in Humans	16	Variation and selection	10
3	Movement into and out of cells.	6	Transport in animals	10	Reproduction	16	Organisms and their environment	12
4	Biological molecules	6	Gas exchange in Humans	10			Human influence on ecosystem	11
5	Enzymes	6	Respiration	10				
6	Diseases and immunity	6						
7	Plant nutrition	8						
Total		48		48		48		48

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6. Complete biology for Cambridge IGCSE, second edition, Ron Pickering, Oxford University Press, 2014
7. Essential knowledge and skill statements. www. bradford-pathways.org.uk
8. https://education.ohio.gov/getattachment/Topics/Teaching/Educator-Evaluation-System/How-to-Design-and-Select-Quality-Assessments/DOK-Compared-to-Blooms-Taxonomy.pdf.aspx
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End of Biology Syllabus