



ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

SSC A Biology Syllabus



For exams in 2026 & onwards

INTRODUCTION TO ZUEB

The Ziauddin University Examination Board (ZUEB) is not only an awarding body but also a solution-driven educational organization dedicated to upholding the highest standards of academic excellence. ZUEB believes in Excellence, Integrity, and Innovation in Education. Established with a vision to foster a robust educational environment, ZUEB is committed to nurturing intellectual growth and development that meets international standards in an effective manner. The Ziauddin University Examination Board (ZUEB) was established through Government Gazette No. XLI on June 6th, 2018. Its purpose is to ensure a high quality, maintain global standards, and align the syllabi with national integrity within the examination system of Pakistan. ZUEB manages student appeals, regulates assessments, and reviews policies to maintain high standards.

WHY CHOOSE SSC-A AT ZUEB?

Ziauddin University Examination Board (ZUEB) offers the SSC-A (Secondary School Certificate advance) program, designed for students from international educational backgrounds. This program provides a structured, affordable, and academically strong pathway for learners to align with Pakistan's education system. It allows students to fulfil national curriculum requirements, including Urdu, Islamiyat, Pakistan Studies, or Sindhi, with academic integrity and flexible learning options. ZUEB believes no student should be left behind due to financial limitations or cross-system transitions, and SSC-A serves as a bridge between past efforts and future ambitions. It is the trusted choice for higher education in Pakistan.

SSC-ADVANCE BIOLOGY

Biology in the SSC-advance qualification at ZUEB is a fundamental subject for students aspiring to pursue careers in medicine, life sciences, biotechnology, and related fields. It provides the essential foundation for scientific inquiry, analytical reasoning, and problem-solving — skills that are critical for academic excellence and intellectual development. This subject not only deepens understanding of living systems but also equips students with the prerequisites required for success in competitive university entrance examinations across Pakistan.

Aligned with both national educational frameworks and the needs of students from international qualification backgrounds, our SSC-A Biology offers connections between global scientific knowledge and local academic standards. Students gain a solid grasp of core biological concepts in cell biology, genetics, evolution, human physiology, microbiology, and ecology, delivered through a structured, flexible, and supportive learning model.

Whether your goal is to enter a top medical or dental university, study environmental sciences, or build a strong foundation in scientific reasoning and critical thinking, SSC-A Biology ensures you're academically prepared and nationally aligned. Explore more on what SSC-A offers: [ZUEB SSC-A Official Page](#).

Syllabus Overview			
No.	Content	AO	Exam
1	Foundations of Biology: Cells, Life and Organisation	1,2,3	Combination of written exam papers (externally set and marked) and a practical demonstration of skills. Paper 1: Multiple Choice Questions, Theoretical Questions and Practical Component. Duration: 2 hours Paper 2: Multiple Choice Questions, Theoretical Questions and Practical Component. Duration: 2 hours
2	Movement into and out of cells	1,2,3	
3	Biological Molecules and Human Digestion	1,2,3	
4	Respiratory System and the Effects of Smoking	1,2,3	
5	Transport in Animals	1,2,3	
6	Disease, Immunity and Drugs	1,2,3	
7	Plant Nutrition and Transport	1,2,3	
8	Coordination, Hormonal Control and Excretion	1,2,3	
9	Cell Division and Reproduction	1,2,3	
10	Genetics, Classification and Evolution	1,2,3	
11	Ecology and Human Impact on the Environment	1,2,3	
12	Biotechnology and Genetic Engineering	1,2,3	

Description of Assessment Objectives

AO1 – Show knowledge and understanding of:

- scientific concepts and principles
- relevant methods, techniques, and procedures

AO2 – Apply knowledge and understanding to:

- use scientific ideas in various contexts
- perform and explain investigations, techniques, and procedures

AO3 – Analyse and interpret to:

- evaluate information and data
- draw reasoned conclusions and judgements
- suggest improvements to experimental methods

Weighting of Assessment Objectives

Assesement Objectives	P1 (%)	P2 (%)
A01	30	30
A02	40	40
A03	30	30

Foundations of Biology: Cells, Life and Organisation

Aim: To develop understanding of cells as the basic unit of life, with emphasis on their structure, components, functions, and development.

	The learner will:	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the characteristics of living organisms.	Distinguish between living cells and non-living cells.	AO1
		Define the main characteristics of living organisms.	AO1
		Describe methods used in scientific research, such as making observations, formulating hypotheses, conducting experiments, recording data, and analyzing results.	AO2
		Explain the seven characteristics of life, specifically (i) movement (ii) respiration (iii) sensitivity (iv) growth (v) reproduction (vi) excretion (vii) nutrition.	AO2
		Describe the following forms of nutrition; autotrophic, heterotrophic, and saprotrophic nutrition.	AO1
		Define the term Photosynthesis.	AO1
		Describe the process of aerobic respiration.	AO2
		Explain how anaerobic respiration takes place in the muscle cells and yeast.	AO2
		State the meaning of the term Oxygen debt.	AO1
2	Be able to demonstrate practical awareness of the characteristics of living organisms.	Explain the uses of energy in the human body, including: (i) movement, (ii) active transport, (iii) electrical impulses, (iv) heat, and (v) synthesis of molecules (and bioluminescence, where applicable).	AO2
		Perform tests for the presence of carbon dioxide using: (i) the limewater test, and (ii) the hydrogen carbonate indicator test.	AO3
		Compare the initial and final colour changes to determine positive and negative results.	AO3
		Discuss how differences in colour change relate to the rate of reaction.	AO3
3	Understand the basic structures and functions of cells.	Analyse colour changes in hydrogen carbonate indicator to explain differences in CO ₂ concentration resulting from (i) photosynthesis and (ii) respiration.	AO3
		State the meaning of the terms, unicellular and multicellular organisms.	AO1

		Describe the structure of unicellular organisms such as Amoeba and Euglena.	AO1
		Compare the similarities and differences between single celled organisms, Amoeba and Euglena.	AO1
		Compare eukaryotic cells with prokaryotic cells.	AO1
		Differentiate , by size (from smallest to largest) the following: (i) virus, (ii) bacteria, (iii) fungi, (iv) animal, and (v) plant.	AO1
		Describe the cell organelles and their functions in cells.	AO1
		Identify the examples of: (i) specialised animal cells, and (ii) specialised plant cells.	AO2
		Evaluate how specialised animal cells and specialised plant cells are structurally adapted in line with their specialised function.	AO3
		Compare the process of mitosis and meiosis.	AO1
		Compare an adult stem cell with an embryonic stem cell.	AO2
		Evaluate the benefits and limitations of using adult stem cells versus embryonic stem cells in medical treatments.	AO3
4	Be able to demonstrate practical awareness of basic structures and functions of cells.	Draw and accurately label a typical animal cell, including the following key structures: (i) nucleus, (ii) cytoplasm, (iii) cell membrane, (iv) ribosomes, and (v) mitochondria	AO2
		Draw and accurately label a typical plant cell, including the following key structures: (i) large permanent vacuole, (ii) cellulose cell wall, (iii) chloroplast, and (iv) amyloplast.	AO2
		Construct a venn diagram (or table) to show the similarities and differences between animal and plant cells.	AO3
		Draw and accurately label the following cells: (i) bacterial cell, (ii) fungal cell, and (iii) protocist.	AO2
5	Understand the functions of a light microscope.	Describe the size and structure of cells and their ability to be seen with a light microscope.	AO2
		Explain the process of slide preparation and use of the light microscope to make careful observations of cells.	AO2
		Explain the importance of the following when using a light microscope: (i) cover slip, (ii) methods of preventing damage or errors, and (iii) techniques for correcting mistakes during practical use.	AO2
		Summarise the differences between light microscopes and electron microscopes (TEM and SEM) in terms of: (i) image produced, (ii) magnification, (iii) resolution, and (iv) sample preparation.	AO3
6	Be able to demonstrate practical awareness of functions of the light microscope.	Label all the parts of a compound light microscope.	AO1
		Select correct chemicals when preparing animal cell slides for observation under a light microscope.	AO3

		Use appropriate stains in the preparation of plant cell slides for observation under a light microscope.	AO3
		Draw the diagram of observed cells from the sample slides.	AO2
		State the formula for magnification.	AO1
		Calculate magnification (by use of a scale bar), image size and actual size from micrographs and images.	AO3
7	Understand levels of human organisation.	Explain the following terms: (i) cells, (ii) tissues, (iii) organ, and (iv) organ systems.	AO1
		Describe how tissues, organs and organ systems contribute to an organism.	AO2
		State the main connecting vessels in each major organ system.	AO1
8	Be able to demonstrate practical awareness of levels of human organisation.	Identify the positions of the main organ systems in the human body.	AO2
		Label the main organ systems in the human body.	AO1
9	Understand levels of plant organisation.	Identify and label positions of main organ systems of a flowering plant.	AO1
		List the main organ systems of a flowering plant.	AO1
		Identify the position of the main organs of a flowering plants.	AO2
		Describe the structures and functions of the main organs of flowering plants.	AO1

Movement into and out of cells				
Aim: To promote understanding of the three main processes: diffusion, osmosis, and active transport, through which substances move into and out of cells.				
	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the processes involved in diffusion.	2.1.1	Define the term 'Diffusion' and give examples.	AO1
		2.1.2	Explain the importance of diffusion of gases and solutes.	AO1
		2.1.3	Describe the importance of water as a solvent.	AO1
		2.1.4	Describe the factors which affect the rate of diffusion.	AO1
		2.1.5	Explain how to calculate the rate of diffusion.	AO2
2	Be able to demonstrate practical awareness of the processes involved in diffusion.	2.2.1	Conduct experiments to observe diffusion in the following conditions: (i) different temperatures (ii) use of starch (iii) use of chemicals.	AO3
3	Understand the processes involved in osmosis.	2.3.1	Define the term 'Osmosis' and give examples.	AO1
		2.3.2	Define the following terms: (i) hypertonic, (ii) hypotonic, and (iii) isotonic solutions.	AO1
		2.3.3	Explain turgor pressure in plants.	AO1
		2.3.4	Analyse how, i) plant cells become turgid, flaccid and plasmolysed, ii) animal cell become lysed and crenated. (iii) where no changes occur in both the cells.	AO3
		2.3.5	Describe the role of the cellulose cell wall in plant cells.	AO1
		2.3.6	Describe how percentage mass change in potato cores can be compared.	AO2
4	Be able to demonstrate practical awareness of the processes involved in osmosis.	2.4.1	Perform experiments to observe the process of osmosis using the following practical methods: (i) thistle funnel experiment (ii) visking tubing and water potential (iii) use of an osmometer (iv) osmosis in potato cells.	AO3
		2.4.2	Represent data using graphs or tables to: (i) show percentage change in mass, (ii) determine the water potential within the cells.	AO3
5	Understand the process of active transport.	2.5.1	Define the term 'Active transport'.	AO1
		2.5.2	Explain how carrier proteins assist in the transport of substances across the cell membrane.	AO2
		2.5.3	Describe how active transport consumes energy through respiration.	AO2
		2.5.4	Identify the ions and molecules transported through active transport in both animals and plants.	AO2
		2.5.5	Describe where in the body active transport of specific ions and molecules takes place.	AO3
		2.5.6	Justify why non-living (artificial) membranes are unable to produce Adenosine Triphosphate (ATP) for active transport.	AO3

Biological Molecules and Human Digestion				
<i>Aim: To enhance understanding of biological molecules and the human digestive system, its key purpose and functions and the way in which nutrients are absorbed into the body.</i>				
	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the structure of biological molecules.	3.1.1	Identify the elements that make up biological molecules (e.g., carbohydrates, proteins, lipids).	AO1
		3.1.2	Explain the basic shape of carbohydrates, proteins and fats.	AO1
		3.1.3	Describe the properties of the following biological molecules (i) antibodies, (ii) enzymes, and (iii) hormones.	AO1
		3.1.4	Explain the properties of the following carbohydrates: (i) glucose, (ii) sucrose, (iii) starch, (iv) glycogen, and (v) cellulose.	AO1
		3.1.5	Describe appropriate tests that are used to detect (i) carbohydrates, (ii) proteins, and (iii) fats in food samples.	AO1
2	Understand the properties of Deoxyribonucleic Acid (DNA).	3.2.1	Describe the key features of DNA.	AO1
		3.2.2	Describe how complementary base pairing works.	AO2
		3.2.3	Explain the double helix structure and overall shape of DNA.	AO2
3	Be able to demonstrate practical understanding of the properties of DNA.	3.3.1	Draw and label the diagram of DNA nucleotide that is composed of a phosphate group, pentose sugar and nitrogenous base.	AO2
4	Understand the function of enzymes.	3.4.1	Describe and analyse the effects of enzymes in different metabolic reactions.	AO3
		3.4.2	Describe the three core functions of enzymes.	AO1
		3.4.3	Describe the process of an enzyme catalysed reaction in terms of; substrate, complementary shape of the active site of the enzyme to the substrate, enzyme-substrate complex and products with examples.	AO1
		3.4.4	Describe how the specificity of enzymes allows them to catalyse reactions during replication.	AO3
		3.4.5	Describe the specific conditions required for different enzymes to function effectively.	AO1
		3.4.6	Explain how temperature influence the enzyme activity.	AO3

		3.4.7	Describe the effects of pH on enzymatic activity.	AO2
		3.4.8	Explain the effects of substrate and enzyme concentration on the rate of enzyme activity.	AO2
5	Be able to demonstrate practical skills in investigating the role of enzymes in chemical reactions.	3.5.1	Conduct the iodine test to detect the presence of starch.	AO3
		3.5.2	Perform Benedict's test for reducing sugar and record the observations.	AO3
		3.5.3	Perform Biuret test to investigate the presence of protein in a food sample and record the observations.	AO3
		3.5.4	Perform Emulsion test for fats and record the observations.	AO3
		3.5.5	Perform and observe the chemical test for Vitamin C.	AO3
6	Understand nutrition in humans and the process of digestion.	3.6.1	Define the term nutrition.	AO1
		3.6.2	Describe the importance of nutrition.	AO1
		3.6.3	Discuss the significance of balanced diet and the functions of its key components: carbohydrates, proteins, fats, water, vitamins, minerals, and fibre.	AO2
		3.6.4	Explain and observe how dietary requirements are influenced by: (i) age (ii) gender (including during pregnancy), and (iii) physical activity.	AO3
		3.6.5	Define the term 'basal metabolic rate'.	AO1
		3.6.6	Explain how the following dietary imbalances affect health: (i) excess fat, (ii) insufficient fibre, (iii) vitamin C deficiency, (iv) vitamin D deficiency, (v) iron deficiency, and (vi) calcium deficiency.	AO2
		3.6.7	Outline the effects of a higher energy intake to energy output.	AO1
		3.6.8	Define the following terms: (i) ingestion, (ii) digestion, (iii) absorption, (iv) assimilation, and (v) egestion.	AO1
		3.6.9	Define the terms mechanical and chemical digestion.	AO1
		3.6.10	Explain the roles of the following enzymes, including their specific substrates and resulting products: (i) amylase, (ii) protease, and (iii) lipase.	AO1
		3.6.11	Describe the basic structure and types of human teeth and their functions.	AO1
		3.6.12	State the causes of tooth decay and how to prevent tooth decay.	AO2

		3.6.13	Explain the movement of food through the alimentary canal, from the mouth to the anus.	AO1
		3.6.14	Describe the events that take place during the chewing and swallowing process.	AO1
		3.6.15	Describe the function of saliva.	AO1
		3.6.16	Describe the coordination of muscles (circular and longitudinal) during peristalsis in the oesophagus to propel the food forward through the digestive tract.	AO1
		3.6.17	Describe the processes of chemical digestion and mechanical digestion.	AO1
		3.6.18	Describe the functions of the following components in digestion: (i) gastric juice (ii) pepsin (iii) hydrochloric acid.	AO1
		3.6.19	Explain the importance of bile and pancreatic juice in digestion.	AO1
		3.6.20	Describe the role of the following enzymes: (i) amylase (ii) trypsin (iii) lipase	AO1
		3.6.21	Explain the role of villi in the digestive process.	AO1
		3.6.22	Describe the importance of absorption in digesting food molecules.	AO1
		3.6.23	Explain the role of peristalsis in transporting undigested food through the intestines.	AO2
		3.6.24	Describe the role of the large intestine in the digestive system.	AO1
		3.6.25	Explain the reason for faeces being retained in the rectum before egestion from the body.	AO2
		3.6.26	Describe the impact of the autoimmune disease celiac on infants and adults.	AO3
		3.6.27	Explain the role of the gall bladder in digestion.	AO1
		3.6.28	Describe the signs and symptoms of cholera.	AO1
		3.6.29	Define lactose intolerance and its effects on the body.	AO2
7	Be able to demonstrate practical awareness of calculating energy contents of the food.	3.7.1	Demonstrate practical techniques for: (i) measuring food energy through calorimetry, and (ii) calculating the energy content of food.	AO3

Respiratory System and the Effects of Smoking

Aim: To develop an understanding of the respiratory system, including the mechanisms of breathing (inhalation and exhalation), as well as the composition of gases in the air and their role in respiration.

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	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the role of gas exchange in human beings.	4.1.1	Explain how the bell jar model demonstrates the process of ventilation and identify its limitations.	AO3
		4.1.2	Describe the function of epiglottis.	AO1
		4.1.3	Describe the role of the C-shaped cartilage rings in trachea.	AO1
		4.1.4	Describe how the bronchiole network resembles a tree or branching structure.	AO2
		4.1.5	Describe how ventilation is different from respiration.	AO1
		4.1.6	Observe and explain the process of ventilation (both inhalation and exhalation) in terms of pressure changes in the lungs.	AO3
		4.1.7	Explain the route/pathway of air from atmosphere into a body cell.	AO2
		4.1.8	Explain the difference in the percentage composition of atmospheric air compared with exhaled air.	AO1
		4.1.9	Describe the process of exchange of gases (oxygen and carbondioxide) in the alveoli by diffusion.	AO1
		4.1.10	Describe the adaptations of alveoli in terms of: (i) large surface area, (ii) good blood supply / capillary network, (iii) moist surfaces and (iv) thin cell walls.	AO1
		4.1.11	Describe gaseous exchange surfaces in the gills of fish.	AO1
		4.1.12	Explain how to measure breathing rate by counting breaths per minute.	AO2
		4.1.13	Define the term vital capacity.	AO1
		4.1.14	Describe and observe the changes in breathing rate and depth before, during and after exercise.	AO3

		4.1.15	Discuss the relationship between aerobic and anaerobic respiration in the body across different stages(before, during and after) exercise/ physical activity.	AO3
		4.1.16	Explain the role of liver in breaking down lactic acid.	AO1
		4.1.17	Define the term 'oxygen debt' and explain its significance.	AO1
		4.1.18	Explain how changes in carbon dioxide levels in the blood help regulate the breathing rate.	AO2
		4.1.19	Explain the role of cilia and goblet cells in keeping the airways clean.	AO1
		4.1.20	State the composition of tobacco smoke and explain the effects on respiratory system and other organs in the body.	AO2
		4.1.21	Define the term 'passive smoking'.	AO1
		4.1.22	Explain and analyse how the following chronic obstructive pulmonary diseases (COPD) occur as a result of smoking: (i) lung cancer, (ii) bronchitis, (iii) emphysema, and (iv) heart disease.	AO3
		4.1.23	Describe correlation versus causation in health conditions associated with smoking.	AO1
2	Be able to demonstrate practical awareness of gaseous exchange in different situations.	4.2.1	Label (on diagrams) the location of the following in the human gaseous exchange system: (i) larynx, (ii) trachea, (iii) bronchi, (iv) bronchioles and alveoli, (v) pleural membrane, (vi) pleural fluid,(vii) intercostal muscles, (viii) ribs, (ix) sternum, (x) diaphragm, and (xi) associated capillaries.	AO1
		4.2.2	Make a model of lungs / bell jar and perform the process of breathing.	AO3
		4.2.3	Demonstrate the presence of tar in cigarette smoke using a model with filters.	AO3
		4.2.4	Apply the limewater test to detect and compare carbon dioxide concentration in various samples.	AO3
		4.2.5	Examine the effects of physical exercise on: (i) breathing rate and depth, and (ii) vital capacity measurement.	AO3

Transport in Animals

Aim: To enhance understanding of the human circulatory system, its main purpose and functions, the role of heart in circulation, and the impact of poor diet on heart function.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the function of the human heart and the circulatory system.	5.1.1	Describe the one-way flow of blood around the body.	AO1
		5.1.2	Explain the term single and double circulatory system.	AO1
		5.1.3	Discuss the advantages of a double circulatory system compared to a single circulatory system.	AO1
		5.1.4	Explain the role of the coronary artery.	AO1
		5.1.5	Outline the location of the pacemaker (where required) within the human heart.	AO2
		5.1.6	Describe the role of septum in separating oxygenated and deoxygenated blood in the heart.	AO1
		5.1.7	Describe differences in structure and function between the left and right side of the heart.	AO1
		5.1.8	Compare the differences between atria and ventricles based on the thickness of their muscular walls.	AO1
		5.1.9	Describe how the thickness of heart chambers influences the pressure of blood as it leaves the heart.	AO3
		5.1.10	Explain the sequence of events in one heartbeat, including the contraction and relaxation of the atria and ventricles.	AO1
		5.1.11	Explain and observe the purpose of an electrocardiogram (ECG) as being the method by which a heartbeat can be measured.	AO3
		5.1.12	Explain the effects of physical activity on the heart rate.	AO2
		5.1.13	Define the term 'pulse rate' and 'resting pulse rate'.	AO1
		5.1.14	Observe and explain how a pulse rate and resting pulse rate can be used to determine a person's fitness.	AO3
		5.1.15	Explain the nature of coronary heart disease (CHD) as a non-communicable disease.	AO1

		5.1.16	Describe and observe the possible causes and preventive measures of CHD, specifically: (i) lifestyle,(ii) heredity, (iii) age, and (iv) gender.	AO3
		5.1.17	Explain methods of treatment for CHD, specifically: (i) change in diet, (ii) angioplasty, (iii) coronary stent, (iv) drugs, (v) coronary bypass, and (vi) heart transplant.	AO1
		5.1.18	Discuss the benefits and drawbacks of the following methods for treating heart disease: (i) dietary changes, (ii) angioplasty, (iii) coronary stents, (iv) medication, (v) coronary bypass surgery, and (vi) heart transplantation.	AO2
		5.1.19	Describe the functions of (i) arteries, (ii) veins, and (iii) capillaries.	AO1
		5.1.20	Compare the structural features of arteries, veins and capillaries in terms of: (i) thickness of muscle, (ii) thickness of elastic fibres, (iii) diameter of lumen, (iv) presence of valves, (v) smooth or rough endothelium.	AO2
		5.1.21	Describe differences in blood pressure in each blood vessel.	AO1
		5.1.22	Describe the function of (i) arterioles, (ii) venules. and (iii) shunt vessels.	AO1
		5.1.23	Describe how the composition of blood differs in various blood vessels with respect to: (i) Oxygen concentration (ii) Carbon dioxide concentration (iii) Urea concentration (iv) Nutrient concentration (e.g., glucose and amino acids)	AO2
		5.1.24	List the main components of blood along with their relative percentages in a healthy individual: (i) Red blood cells (ii) White blood cells (iii) Plasma (iv) Platelets	AO1
		5.1.25	Explain the purpose of centrifugation as a method of separating blood and its components.	AO2
		5.1.26	Describe the role of red blood cells.	AO1
		5.1.27	Explain the structural adaptations of red blood cells.	AO2
		5.1.28	Explain the importance of haemoglobin and describe the formation of oxyhaemoglobin in the lungs, including its reversible reaction at body cells.	AO1
		5.1.29	Describe the role of plasma in the transport of following nutrients: (i) wastes, (ii) blood proteins, and (iii) hormones.	AO1
		5.1.30	Describe how materials are exchanged between capillaries and body cells, and explain how tissue fluid is formed.	AO2
		5.1.31	Describe the term 'lymph'.	AO1

		5.1.32	Describe the differences in composition between lymph and blood.	AO1
		5.1.33	Explain how the lymphatic system functions separately from the circulatory system.	AO1
		5.1.34	Describe the role of lymph nodes being the site of maturation for lymphocytes.	AO2
		5.1.35	Describe the function of white blood cells.	AO2
		5.1.36	Explain the process of phagocytosis.	AO2
		5.1.37	Describe how antibodies can defend the body against pathogens.	AO2
		5.1.38	Describe the relationship between antibodies and pathogens.	AO1
		5.1.39	Explain the function of platelets in blood clotting.	AO1
2	Be able to demonstrate practical awareness of the role of the human heart and the circulatory system.	5.2.1	Identify and label the structure of heart, specifically: (i) left atrium, (ii) right atrium, (iii) left ventricle, (iv) right ventricle, (v) septum, (vi) bicuspid and tricuspid valves, (vii) aortic, and (viii) pulmonary valves.	AO1
		5.2.2	Analyze a cardiogram and explain the events that take place during one heartbeat.	AO3
		5.2.3	Investigate the effect of physical activity on pulse rate.	AO3
		5.2.4	Identify and label the main blood vessels in the body, specifically: (i) vena cava and aorta, (ii) hepatic artery and vein, (iii) hepatic portal vein, and (iv) renal artery and vein.	AO2
		5.2.5	Perform a heart dissection and examine its internal and external structures.	AO3
		5.2.6	Identify components of blood from micro pictographs.	AO1

Disease, Immunity and Drugs				
Aim: To enhance understanding of the human body and the ways in which lifestyle, genetics, and behaviours can negatively affect health. This topic also aims to cover immunity and its types, communicable and non-communicable diseases, and build knowledge of medicinal and recreational drugs, their effects on the body, and the risks linked to drug.				
	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the effects of diseases and the role of immunity in both humans and plants.	6.1.1	Define communicable and non-communicable diseases.	AO1
		6.1.2	Explain examples of communicable and non-communicable diseases.	AO1
		6.1.3	Describe how certain communicable diseases can be transmitted from a host to other non-infected individuals.	AO2
		6.1.4	Define the term pathogen.	AO1
		6.1.5	Summarize the symptoms of the following diseases: (i) influenza, (ii) tuberculosis, (iii) cholera / typhoid, (iv) athletes' foot, (v) HIV/AIDS, (vi) hepatitis, and (vii) chlamydia.	AO2
		6.1.6	Explain preventive methods of the following diseases: (i) influenza, (ii) tuberculosis, (iii) cholera / typhoid, (iv) athletes' foot, (v) HIV/AIDS, (vi) hepatitis, and (vii) chlamydia.	AO1
		6.1.7	Define the role of vaccinations.	AO1
		6.1.8	Explain the body's primary defences against disease.	AO1
		6.1.9	Summarise and analyse the function of phagocytes in the human immune system.	AO3
		6.1.10	Summarise the role of lymphocytes and antibodies in the human immune system.	AO2
		6.1.11	Define the term 'active immunity'.	AO1

		6.1.12	Describe how active immunity is acquired.	AO1
		6.1.13	Explain how mutation of pathogens could lead to a primary response after vaccination.	AO2
		6.1.14	Explain why vaccination is important for infants and people travelling to other countries.	AO2
		6.1.15	Describe why regular vaccinations are needed for certain pathogens.	AO3
		6.1.16	Describe the terms primary immune response and secondary immune response in terms of: (i) antibody concentration before and after exposure to pathogen, (ii) presence of memory cells, and (iii) duration of patient sickness / symptoms expressed.	AO1
		6.1.17	Define the term passive immunity.	AO1
		6.1.18	Describe the importance of breast feeding for infants and passive immunity.	AO1
		6.1.19	Describe Type 1 diabetes as an autoimmune disease.	AO1
		6.1.20	Explain the symptoms and treatments for Type 1 diabetes.	AO1
		6.1.21	Explain how plants can catch communicable diseases.	AO2
		6.1.22	Identify the type of pathogen that affects a plant.	AO1
		6.1.23	Analyse the symptoms of a plant infected by a pathogen.	AO3
		6.1.24	Describe and analyse symptoms of plant diseases such as: (i) stunted growth, (ii) spots on plant organs, (iii) malformed stems / leaves, (iv) discolouration, (v) areas of decay, and (vi) presence of pests.	AO3
		6.1.25	Explain various deficiency diseases on plants for named minerals, specifically: (i) magnesium, (ii) nitrates, and (iii) phosphates.	AO1

2	Be able to demonstrate practical understanding of how diseases and immunity affect humans and plants.	6.2.1	Illustrate and label the typical structures of the following microorganisms: (i) fungi, (ii) bacteria, (iii) protoctists, and (iv) viruses.	AO1
		6.2.2	Identify each type of pathogen, specifically: (i) fungi, (ii) bacteria, (iii) protoctists, and (iv) viruses.	AO1
		6.2.3	Determine from given information (e.g., graph or comprehension) whether a primary or secondary immune response is being observed.	AO3
3	Understand the impact of medicinal and recreational drugs on the human body.	6.3.1	Define drug as a substance taken into/ingested into the body that influences the chemical reactions in the body.	AO1
		6.3.2	Outline the derivative characteristics of drugs.	AO1
		6.3.3	Explain how penicillin was discovered.	AO2
		6.3.4	Explain the use of antibiotics against bacterial diseases.	AO2
		6.3.5	Discuss the role of pain killers and anaesthetics as symptom relievers.	AO2
		6.3.6	Explain why antibiotics cannot be used to treat viral infections.	AO3
		6.3.7	Describe the use of fungicides as a treatment for fungal diseases.	AO2
		6.3.8	Explain what is meant by 'over-the-counter' medicines.	AO1
		6.3.9	Describe antibiotic resistance in terms of natural selection.	AO1
		6.3.10	Explain the importance of correct use of antibiotics and drugs in the fight against diseases.	AO1
		6.3.11	Describe the strategies that can be used to reduce the development of antibiotic resistant bacteria.	AO3
		6.3.12	Outline the steps involved in developing modern drugs for treatment.	AO2
		6.3.13	Describe why thorough testing is important in drug development and highlight related ethical concerns.	AO3

		6.3.14	Differentiate between a stimulant and a depressant drug.	AO1
		6.3.15	Identify drugs which functions as: (i) depressants, (ii) stimulants, and which deemed socially acceptable.	AO1
		6.3.16	Identify and explain the non-communicable diseases linked to excessive intake of: (i) alcohol,(ii) nicotine, and (iii) caffeine.	AO3
		6.3.17	Explain how alcohol affects the body, including: (i) reduced coordination, (ii) impaired judgment and body control, (iii) delayed reaction times, and (iv) decreased self-control.	AO1
		6.3.18	Explain social issues associated with alcohol abuse.	AO2
		6.3.19	List the illegal recreational drugs.	AO1
		6.3.20	Describe how drugs can lead to addiction.	AO1
		6.3.21	Explain the effects of heroin abuse.	AO1
		6.3.22	Explain how injecting heroin can increase the risk of HIV and hepatitis.(discuss and observe a scenario)	AO3
		6.3.23	Explain the impact of heroin addiction.	AO1
		6.3.24	Explain how heroin interacts and affects the synapses in the nervous system.	AO3
4	Understand the use of drugs in sports.	6.4.1	Discuss the use of anabolic steroids in sports.(analyse an example)	AO3
		6.4.2	Explain the side effects of anabolic steroids for both male and female athletes.	AO3
		6.4.3	Discuss the ethical issues associated with the use of performance enhancing drugs.	AO3
5	Be able to demonstrate practical awareness of the role of drugs.	6.5.1	Examine how antiseptics and/or antibiotics influence bacterial growth using agar plates.	AO3
		6.5.2	Analyse the effect of antiseptics and/or antibiotics on bacterial growth by measuring zones of inhibition.	AO3

Plant Nutrition and Transport				
<i>Aim: To enhance understanding of plant tissues and their essential role in the transport system, particularly in relation to photosynthesis, respiration, and transpiration.</i>				
	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the role of photosynthesis in plants.	7.1.1	State the balanced chemical equation for photosynthesis.	AO1
		7.1.2	Describe the method used to test the presence of starch in a green leaf.	AO2
		7.1.3	Explain the role of chlorophyll in photosynthesis.	AO1
		7.1.4	Describe experiments to prove that light, chlorophyll, water and carbon dioxide are required for the process of photosynthesis.	AO1
		7.1.5	Describe how each of the following factors effects the rate of photosynthesis: (i) light, (ii) temperature, (iii) carbon dioxide concentration, (iv) humidity, (v) presence of wind / air flow.	AO3
		7.1.6	Name the products of photosynthesis and how they are used by the plant.	AO1
		7.1.7	Describe how to investigate the effects of the following variables on the rate of photosynthesis: (i) carbon dioxide concentration, (ii) temperature, and (iii) light intensity.	AO3
		7.1.8	Describe the results of each of the above variables.	AO1
		7.1.9	Define the term limiting factor.	AO1
		7.1.10	Describe how greenhouses artificially control abiotic factors such as temperature, light intensity, carbon dioxide, and water to promote optimum conditions for plant growth.	AO3
2	Understand the structure of plant tissues and their key functions.	7.2.1	Name all the main plant organs.	AO1

		7.2.2	Explain the role of the following plant organs: (i) flower, (i) root, (iii) stem, and (iv) leaves.	AO1
		7.2.3	Describe the features of a root hair cell and how it is adapted to its function.	AO2
		7.2.4	Describe the function of plant roots for absorption of substances by (i) diffusion, (ii) osmosis, and (iii) active transport.	AO3
		7.2.5	Compare the structural and functional differences in xylem and phloem transport vessels.	AO2
		7.2.6	Explain how the following structures promote photosynthesis in leaves/plants: (i) upper epidermis, (ii) palisade layer, (iii) spongy mesophyll layer, (iv) vascular bundle/vein including xylem and phloem, (v) lower epidermis, (vi) guard cells, and (vii) stomata.	AO2
		7.2.7	Describe the processes involved in the opening and closing of stomata by guard cells.	AO1
		7.2.8	Describe environmental factors that can affect the rate at which stomata opens and closes.	AO2
		7.2.9	Explain how diffusion affects the concentration levels in stomata.	AO3
		7.2.10	Describe the role of roots in providing anchorage for the plant.	AO1
3	Understand the plant transport function.	7.3.1	Define the terms (i) transpiration (ii) translocation.	AO1
		7.3.2	Differentiate between transpiration and translocation.	AO2
		7.3.3	Define the term 'mass flow'.	AO1
		7.3.4	Describe the movement of water and mineral ions from root hair cells to leaf cells through xylem vessel.	AO2
		7.3.5	Outline the chemical properties of water.	AO1
		7.3.6	Explain movement of substances from source to sink.	AO1

		7.3.7	Explain how substances are transported in xylem and phloem.	AO2
		7.3.8	Explain how different parts of a plant can act as source or a sink, at different times in a plant life.	AO2
		7.3.9	Explain translocation of sucrose as an active process.	AO1
		7.3.10	Describe how changes in humidity, temperature and light intensity can affect the rate of transpiration.	AO2
		7.3.11	Describe the process of wilting in terms of water availability and turgor pressure.	AO2
		7.3.12	Describe how to investigate the rate of transpiration using a potometer.	AO3
		7.3.13	State that minerals can be absorbed by diffusion and active transport with example.	AO1
		7.3.14	State the importance of the following minerals for plant nutrition: (i) nitrates, (ii) phosphates, and (iii) magnesium.	AO1
		7.3.15	Explain the impact of mineral deficiency and diseases in plants.	AO1
4	Be able to demonstrate practical awareness of the role of transpiration, photosynthesis and plant tissues.	7.4.1	Calculate the surface area of a leaf using a grid paper.	AO3
		7.4.2	Calculate the number of stomata from a micro pictograph.	AO3
		7.4.3	Deduce from a diagram which method of absorption is occurring based on concentration gradient.	AO3
		7.4.4	Describe how to test a leaf for the presence of starch.	AO3
		7.4.5	Investigate the necessity of chlorophyll for photosynthesis.	AO3
		7.4.6	Investigate the necessity of carbon dioxide for photosynthesis.	AO3

		7.4.7	Investigate the necessity of light for photosynthesis.	AO3
		7.4.8	Investigate the rate of photosynthesis by measuring volume of oxygen produced over a period of time.	AO3
		7.4.9	Investigate the effect of light intensity on the rate of photosynthesis.	AO3
		7.4.10	Investigate the effect of temperature on the rate photosynthesis.	AO3
		7.4.11	Investigate the effect of carbon dioxide on the rate of photosynthesis.	AO3
		7.4.12	Name the reactants and products of a balanced chemical equation of photosynthesis (including light and chlorophyll on the arrow).	AO1
		7.4.13	Investigate the effect of the following variables on the rate of photosynthesis: (i) carbon dioxide concentration, (ii) temperature, and (iii) light intensity.	AO3
		7.4.14	Recognize the following structures in a transverse section of a root: (i) root hair cells, (ii) cortex, (iii) root tip, (iv) root cap, and (v) phloem and xylem.	AO2
		7.4.15	Recognize the following structures in a transverse section of a stem: (i) cambium, (ii) cortex, (iii) pith,(iv) epidermis, and (v) phloem and xylem.	AO2
		7.4.16	Identify and label the following parts in a transverse section of a leaf: (i) upper epidermis, (ii) palisade layer, (iii) spongy mesophyll layer, (iv) vascular bundle/vein, (v) xylem and phloem, (vi) lower epidermis, (vii) guard cells, and (viii) stomata.	AO2
		7.4.17	Investigate the plant metabolism, respiration and photosynthesis when using a hydrogen carbonate indicator in light and dark conditions.	AO3

Coordination, Hormonal Control and Excretion

Aim: To promote understanding of nervous and chemical coordination in humans, along with chemical coordination (the hormonal system) in plants. Learners will also deepen their understanding of the excretory system, including the structure and function of the nephron and the role of the kidneys in excretion of wastes.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the nervous system in the human body.	8.1.1	Explain the meaning of the term sensitivity.	AO1
		8.1.2	Differentiate between central nervous and peripheral nervous system.	AO1
		8.1.3	Explain the structure of the human nervous system in terms of: (i) brain, (ii) spine, (iii) cranial, and (iv) spinal nerves.	AO1
		8.1.4	Describe receptors as specialised cells that can detect a range of stimulus.	AO1
		8.1.5	Describe the purpose of the following sense organs and the stimuli they detect: (i) eye, (ii) ear, (iii) skin, (iv) nose, (iv) tongue.	AO1
		8.1.6	Describe the purpose of effectors within muscles/glands.	AO1
		8.1.7	Describe how electrical impulses pass along neurons.	AO2
		8.1.8	Describe the sequence of events that occur from the detection of a stimulus to the resulting response.	AO1
		8.1.9	Differentiate between voluntary and involuntary actions.	AO1
		8.1.10	Explain the adaptations of neurons to increase impulse transmission.	AO1
		8.1.11	Explain the difference between white and grey matter in the spinal cord.	AO1
		8.1.12	Explain and analyse how neurons are involved in coordination for nervous responses and reflex arcs with examples.	AO3
		8.1.13	Explain the importance of reflex arcs as a process that prevents damage to the human body.	AO1
		8.1.14	Explain the process of reflex arc in terms of: Stimulus > sensory neuron > relay neuron > motor neuron > effector > response.	AO1
		8.1.15	Define the term synapse.	AO1

		8.1.16	Explain how impulses pass across a synapse.	AO1
		8.1.17	Describe how drugs can influence the transmission of nerve impulses across synapses by the help of an example.	AO2
		8.1.18	Describe the functions and features of the following structures in the eye: (i) Sclera, (ii) Cornea, (iii) Iris, (iv) Pupil, (v) Lens, (vi) Ciliary muscles, (vii) Suspensory ligaments, (viii) Vitreous humor, (ix) Retina, (x) Yellow spot (Fovea), (xi) Blind spot, and (xii) Optic nerve.	AO1
		8.1.19	Describe the pupil reflex, including how it responds to changes in the light intensity. Draw a reflex arc and explain about the muscles that control the pupil's size.	AO2
		8.1.20	Discuss and analyse how the eye adjusts to focus on objects at different distances, highlighting the roles of the ciliary muscles, suspensory ligaments, and lens shape.	AO3
		8.1.21	Discuss the specific roles of rod and cone cells in detecting light and colour, and describe where each type is mainly found in the retina.	AO1
2	Understand chemical coordination in humans.	8.2.1	List the hormones secreted by each gland of the human body.	AO1
		8.2.2	Describe the effects of adrenaline on the heart, lungs, liver, and pupils.	AO1
		8.2.3	Describe how adrenaline increases the supply of glucose and oxygen to support aerobic respiration and enhance ATP (Adenosine Triphosphate) production .	AO2
		8.2.4	Describe how adrenaline affects muscle contractions and enhances blood flow.	AO2
		8.2.5	Explain how the nervous and endocrine systems differ w	AO2
		8.2.6	Define the term homeostasis.	AO1
		8.2.7	Describe the term 'negative feedback' within the context of hormonal control in humans.	AO1
		8.2.8	Explain how feedback mechanisms help in: (i) Regulating blood glucose levels, and (ii) Maintaining body temperature.	AO2
		8.2.9	Explain the key roles played by the skin in the human body.	AO1
		8.2.10	Define the terms (i) vasodilation, and (ii) vasoconstriction.	AO1
		8.2.11	Describe why maintaining stable conditions of (i) blood glucose, (ii) body temperature, and (iii) water balance is essential for human survival.	AO1
3	Understand chemical coordination in plants.	8.3.1	Define the following terms: (i) tropism, (ii) phototropism, (iii) gravitropism, and (iv) hydrotropism with examples.	AO2/1

		8.3.2	Describe the importance of positive and negative tropisms in assisting plants growth and survival.	AO1
		8.3.3	Explain the role of auxin in responses to stimuli in both root and shoots.	AO2
		8.3.4	Explain how synthetic hormones function as selective weed killers.	AO2
4	Be able to demonstrate practical awareness of the nervous system and chemical coordination in humans and plants.	8.4.1	Label structures of the following neurons: (i) sensory, (ii) relay, and (iii) motor neuron.	AO1
		8.4.2	Label the following parts of the human eye: (i) sclera, (ii) cornea, (iii) iris, (iv) pupil, (v) lens, (vi) ciliary muscles, (vii) suspensory ligaments, (viii) vitreous humor, (ix) retina, (x) yellow spot/fovea, (xi) blind spot, and (xii) optic nerve.	AO1
		8.4.3	Identify and label the diagram of the following endocrine glands: (i) adrenal glands, (ii) the pancreas, (iii) pituitary gland, (iv) thyroid, (v) the testes, and (vi) ovaries.	AO2
		8.4.4	Examine a diagram of human skin and describe the role of each identified structure.	AO2
		8.4.5	Outline the steps involved in dissecting an eye and identifying its internal structures.	AO2
		8.4.6	Conduct a ruler drop experiment to measure reaction time.	AO3
		8.4.7	Carry out an experiment to measure the rate of plant growth towards stimuli.	AO3
5	Understand the role of excretion in human beings.	8.5.1	Define the term 'excretion'.	AO1
		8.5.2	Summarise the functions of the following excretory organs: (i) lungs, (ii) kidneys, and (iii) skin.	AO1
		8.5.3	Differentiate between excretion and egestion.	AO1
		8.5.4	Define the term assimilation.	AO1
		8.5.5	Describe the importance of the liver in assimilation.	AO1
		8.5.6	Describe the various roles performed by the liver in the body.	AO1
		8.5.7	Outline the structure and function of the urinary system, including the roles of the renal artery, renal vein, ureters, bladder, and urethra.	AO1
		8.5.8	Describe how the composition of blood differs between the renal artery and the renal vein.	AO1

		8.5.9	Describe the role of kidneys in excretion.	AO1
		8.5.10	Describe the structure of a nephron.	AO1
		8.5.11	Describe the roles of the following in the process of urine formation: (i) nephrons in filtration, (ii) blood supply, and (iii) selective reabsorption of substances.	AO1
		8.5.12	Explain the structural adaptations of an epithelial cell in the kidney tubule.	AO1
		8.5.13	Explain the composition of blood and urine of a healthy person and a person who has kidney damage or disease.	AO1
		8.5.14	Describe how analysing urine can lead to the detection of kidney disease/damage.	AO3
		8.5.15	Explain how dialysis works to remove waste products from the blood.	AO3
		8.5.16	Compare the advantages and disadvantages of dialysis and kidney transplantation.	AO2
		8.5.17	Explain the main functions carried out by the kidneys in the human body.	AO1
6	Be able to demonstrate practical awareness of the role of excretion in human beings.	8.6.1	Label and identify the internal structures of the kidney using a diagram.	AO1
		8.6.2	Perform a kidney dissection and identify its main internal structures.	AO3
		8.6.3	Perform Benedict's and Biuret tests on urine samples to test for the presence of glucose and protein.	AO3

Cell Division and Reproduction

Aim: To develop a deeper understanding of the reproductive systems of both animals and plants. The aim of this topic is also to help students understand issues related to human reproduction and birth control, as well as to study the parts of a flower as the reproductive organ of a plant.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand reproductive cell division.	9.1.1	Define reproduction and its types; sexual and asexual reproduction.	AO1
		9.1.2	Describe the process of mitosis in detail.	AO1
		9.1.3	Explain the purpose of mitotic index.	AO1
		9.1.4	Describe the significance of mitosis in growth, tissue repair, and as a method of asexual reproduction and discuss examples.	AO1
		9.1.5	Describe the importance of mitosis as a form of asexual reproduction.	AO1
		9.1.6	Summarise how each of the following demonstrates asexual reproduction: cloning, binary fission, hyphal development, and stem tuber formation.	AO2
		9.1.7	Explain the process of meiosis and formation of gametes.	AO1
		9.1.8	Compare the process of mitosis and meiosis.	AO2
2	Understand plant and human reproduction.	9.2.1	Describe the functions of the internal reproductive parts of a flowering plant.	AO1
		9.2.2	Define the term pollination.	AO1
		9.2.3	Discuss how different types of pollen are adapted to improve the chances of successful pollination in plants.	AO2
		9.2.4	Differentiate between self-pollination and cross-pollination in plants.	AO1
		9.2.5	Describe the stages that occur from pollination to the formation of a seed.	AO1
		9.2.6	Explain the conditions necessary for germination.	AO1
		9.2.7	Discuss the advantages and disadvantages of both sexual and asexual reproduction in plants.	AO2

		9.2.8	Explain the functions of the male and female reproductive system.	AO1
		9.2.9	Describe the structural differences between male and female gametes.	AO1
		9.2.10	Explain how meiosis leads to the formation of gametes through cell division.	AO2
		9.2.11	Describe how sex hormones influence the development of reproductive organs and secondary traits in men and women.	AO2
		9.2.12	Describe the role of (i) hormones, (ii) their site of secretion, and (iii) their effects on the body.	AO2
		9.2.13	Describe the process of menstruation.	AO1
		9.2.14	Explain the process of fertilisation in humans.	AO1
		9.2.15	Describe the early stages of zygote development leading to the formation of a ball of cells.	AO1
		9.2.16	Describe the process of implantation by example.	AO1
		9.2.17	Describe the roles of (i) placenta, (ii) umbilical cord, (iii) amniotic sac, and (iv) amniotic fluid during pregnancy.	AO1
		9.2.18	Describe the growth and development of the fetus.	AO1
		9.2.19	Explain the meaning of the term gestation period.	AO1
		9.2.20	Discuss how toxins and pathogens can cross the placenta and affect the fetus.	AO3
		9.2.21	Describe why antenatal care is essential for the health of the mother and developing baby.	AO3
		9.2.22	Explain the process of labour and birth.	AO1
		9.2.23	Discuss the advantages and disadvantages of breast feed and the use of formula milk.	AO2
		9.2.24	Describe methods of birth control to prevent pregnancy, specifically: (i) chemical, (ii) surgical, (iii) barrier, and (iv) natural.	AO1

		9.2.25	Describe how hormones and fertility drugs can increase the chances of pregnancy.	AO2
		9.2.26	Explain the process of in vitro fertilisation.	AO1
		9.2.27	Describe the steps involved in the process of artificial insemination.	AO1
		9.2.28	Explain the social implications of using contraception and fertility treatments.	AO1
		9.2.29	Define the term sexually transmitted diseases.	AO1
		9.2.30	Describe the methods of HIV transmission and preventative measures.	AO1
		9.2.31	Describe how HIV affects the human immune system and can lead to AIDS.	AO3
3	Be able to demonstrate practical awareness of reproduction in seeds, insects and flowers.	9.3.1	Identify and label internal structures of insect and wind pollinated flowers.	AO1
		9.3.2	Label the key components of a seed and describe their functions.	AO1
		9.3.3	Determine whether a flower is insect-pollinated or wind-pollinated based on its diagram.	AO2
		9.3.4	Outline the key differences in the appearance and characteristics of pollen in insect- versus wind-pollinated plants.	AO2
		9.3.5	Identify and label the male and female reproductive organs using diagrams.	AO1

Genetics, Classification and Evolution

Aim: To enhance understanding of genetics and inheritance, the history of classification, and how organisms are grouped based on observable characteristics. This topic also aims to deepen knowledge of variation among organisms and the different selection processes that occur in the environment.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand the concept of genetics and inheritance.	10.1.1	Define the terms: (i) DNA, (ii) genes, and (iii) chromosomes.	AO1
		10.1.2	Outline the structure of DNA.	AO1
		10.1.3	State the diploid and haploid number of chromosomes in humans.	AO1
		10.1.4	Define the terms (i) alleles, (iii) dominant, and (iii) recessive.	AO1
		10.1.5	Describe the process of transcription and translation in protein synthesis.	AO1
		10.1.6	Describe the term inheritance and heredity.	AO1
		10.1.7	Define the term phenotype.	AO1
		10.1.8	Define the terms (i) genotype, (ii) heterozygous, and (iii) homozygous.	AO1
		10.1.9	Interpret pedigree diagrams to determine if alleles are dominant or recessive.	AO3
		10.1.10	Define the term monohybrid and dihybrid inheritance.	AO1
		10.1.11	Describe and explain the term incomplete dominance and codominance of allele.	AO1
		10.1.12	Define the term 'sex linkage'.	AO1
2	Be able to demonstrate practical awareness of the role of genetics and inheritance.	10.2.1	Calculate probability of genotypes and phenotypes of offspring using a punnet square / test cross.	AO2

		10.2.2	Draw punnet squares / test cross to successfully predict probabilities based on information provided from (i) pedigree diagrams, and (ii) comprehension of offspring or parents.	AO3
		10.2.3	Use a Punnett square to calculate the probability of the following scenarios: (i) gender determination, and (ii) inheriting recessive or dominant diseases.	AO3
		10.2.4	Use pedigree diagrams to determine if a genetic condition is linked.	AO3
3	Understand the history of classification.	10.3.1	Summarise the process used to classify organisms into different groups.	AO2
		10.3.2	Define the term 'binomial system'.	AO1
		10.3.3	Define the terms 'morphology' and 'anatomy'.	AO1
		10.3.4	Summarise the traits of organisms found in each of the five kingdoms.	AO2
		10.3.5	Explain the importance of classification in understanding evolution.	AO1
		10.3.6	Discuss the significance of fossil evidence in understanding the history of life and evolutionary relationships.	AO2
4	Understand classification of animals.	10.4.1	Define the following terms 'vertebrate' and 'invertebrate'.	AO1
		10.4.2	Describe the features of the following five vertebrate groups: (i) fish, (ii) mammals, (iii) amphibians, (iv) reptiles, and (v) birds.	AO1
		10.4.3	Compare and contrast features of different vertebrate groups.	AO1
		10.4.4	Explain the external characteristics of arthropods and how they are classified into the following groups: (i) Insects, (ii) Crustaceans, (iii) Myriapods, and (iv) Arachnids.	AO1
5	Understand classification of plants.	10.5.1	Describe the cellular structures that identify an organism as a plant.	AO1

		10.5.2	Describe differences between monocotyledons and dicotyledons.	AO1
		10.5.3	Explain the features that are used to classify plants into the following categories: (i) ferns, (ii) conifers, (iii) moss, and (iv) flowering plants.	AO1
		10.5.4	Identify similarities and differences in the characteristics of various plant groups.	AO1
6	Be able to demonstrate practical awareness of classification of animals and plants.	10.6.1	Draw and use simple dichotomous keys to identify plants and animals.	AO3
		10.6.2	Identify and classify unknown species using visible external features observed in images or described characteristics.	AO3
7	Understand the role of variation in organisms.	10.7.1	Define the term 'variation'.	AO1
		10.7.2	Discuss genotypic and phenotypic variations.	AO1
		10.7.3	Explain the differences between continuous and discontinuous variation with examples.	AO1
		10.7.4	Describe continuous variation in terms of genes and environment.	AO1
		10.7.5	Explain discontinuous variation in terms of genes only.	AO1
		10.7.6	Describe the causes of variation of individuals caused by sexual reproduction (meiosis) and mutation.	AO2
		10.7.7	Define the term mutation.	AO1
		10.7.8	Identify and explain factors that can cause mutations, including (i) carcinogens, (ii) harmful chemicals, and (iii) radiations.	AO1
		10.7.9	Discuss the potential beneficial and harmful effects of mutations that result in the formation of new alleles within a population.	AO2
		10.7.10	Describe sickle cell anaemia.	AO2
		10.7.11	State heterozygous sickle cell anaemia with examples.	AO2

8	Understand the role of adaptations in organisms.	10.8.1	Define the term 'adaptive feature'.	AO1
		10.8.2	Discuss the structural and behavioral adaptations of animals for different environments.	AO2
		10.8.3	Explain and analyse different adaptations of predators and prey, focusing on: (i) camouflage, (ii) the shape of their teeth, and (iii) the position of their eyes.	AO3
		10.8.4	Describe the adaptive features of plants in varying climatic conditions, including (i) hydrophytes, and (ii) xerophytes.	AO1
9	Understand selection and evolution in organisms.	10.9.1	Describe the term 'natural selection'.	AO1
		10.9.2	Define the term 'speciation'.	AO1
		10.9.3	Define the term 'fitness'	AO1
		10.9.4	Describe how Darwin's finches provide evidence for the process of natural selection.	AO2
		10.9.5	Explain how antibiotic resistance of bacteria occurs by the process of natural selection.	AO3
		10.9.6	Describe how fossils provide clues about evolutionary changes in species.	AO3
		10.9.7	Define evolution as a result of natural selection leading to changes in organisms' adaptive characteristics over generations.	AO1
		10.9.8	Explain how natural selection maintains adaptive features.	AO2
		10.9.9	Describe the importance of over population of offspring of animals and plants.	AO1
		10.9.10	Describe the process of selective breeding/artificial selection with examples.	AO1
		10.9.11	Explain how selective breeding is used to enhance traits in organisms for economic benefit.	AO3

		10.9.12	Differentiate between natural selection and artificial selection with examples.	AO1
		10.9.13	Define the term 'hybrid vigour'.	AO1
		10.9.14	Describe what is meant by inbreeding and outbreeding in the context of reproduction.	AO1
		10.9.15	Explain the risks of artificial selection in terms of reduction of genetic diversity and harmful recessive alleles.	AO2

Ecology and Human Impact on the Environment

Aim: To develop students' understanding of the relationships between organisms and their environment, focusing on populations and communities, and to explore food chains, food webs, and the role of agricultural and technological advancements in improving food availability and security.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand organisms and their environment.	11.1.1	Define the following key words: (i) ecosystem, (ii) biotic factors, (iii) abiotic factors, (iv) habitat, (v) niche, (vi) biodiversity, (vii) population, (viii) community, (ix) producers, (x) consumers, (xi) decomposers, and (xii) trophic level.	AO1
		11.1.2	Describe a food chain and its different feeding stages.	AO1
		11.1.3	Differentiate between a food chain and food web.	AO1
		11.1.4	Define the term 'dry mass'.	AO1
		11.1.5	Explain why a food web is a better representation of energy flow in a community than a food chain.	AO2
		11.1.6	Describe pyramids of numbers and pyramids of biomass with appropriate examples.	AO1
		11.1.7	Differentiate between pyramids of number and pyramids of biomass.	AO1
		11.1.8	Describe the limitations of pyramids of numbers and biomass when compared to the pyramid of energy in representing a community.	AO2
		11.1.9	Explain loss of energy between trophic levels in food chains.	AO1

		11.1.10	Describe how using green plants as a direct food source for humans is more efficient than using them to feed animals first.	AO2
		11.1.11	Describe methods of sampling populations, including the use of quadrats, Tullgren funnels, pooters, pitfall traps, and line and belt transects.	AO1
		11.1.12	Explain the importance of random sampling and avoiding bias in producing an accurate representation of a population in a habitat.	AO1
		11.1.13	Explain the benefits of releasing organisms near their capture site to maintain ecological balance.	AO2
2	Understand nutrient cycles.	11.2.1	Describe the stages of carbon cycle in terms of (i) respiration, (ii) photosynthesis, (iii) decomposition, (iv) death, (v) Fossilisation, and (vi) combustion.	AO1
		11.2.2	List the name of C based compounds at each stage of the cycle.	AO1
		11.2.3	Explain how respiration and photosynthesis keeps carbon dioxide at relative equilibrium.	AO2
		11.2.4	Explain why the combustion of fossil fuels is a key factor in the release of additional carbon dioxide into the atmosphere.	AO2
		11.2.5	Explain the role of decomposers in the carbon cycle.	AO1
		11.2.6	Describe the stages of the water cycle: (i) evaporation, (ii) transpiration, (iii) evapotranspiration, (iv) condensation, (v) precipitation.	AO2
		11.2.7	Describe the nitrogen cycle in terms of (i) nitrogen fixation, (ii) excretion, (iii) nitrification, (iv) denitrification, and (v) ammonification.	AO2
		11.2.8	Identify the nitrogen-containing compounds present at each stage of the nitrogen cycle.	AO1
		11.2.9	Describe the chemical changes of nitrogen-based compounds to form nitrates.	AO1

3	Understand populations.	11.2.10	Describe the importance of nitrates as a nutrient for plant growth.	AO1
		11.2.11	Explain the process by which nitrates are absorbed by plants.	AO1
		11.3.1	Define the factors that affect population size in terms of: (i) birth rate, (ii) death rate, (iii) immigration, and (iv) emigration.	AO1
		11.3.2	Explain the biotic and abiotic factors that influence population growth.	AO1
		11.3.3	Identify various stages of a sigmoid population growth curve, specifically: (i) lag phase, (ii) log phase, (iii) stationary phase, and (iv) death phase.	AO2
		11.3.4	Explain each stage of a sigmoid population growth curve.	AO2
		11.3.5	Describe the demographic transition model as a method of representing human population growth.	AO2
		11.3.6	Explain the different stages which affect countries in the demographic transition model.	AO2
		11.3.7	Analyse the changes in human population through time and discuss the following consequences: (i) social impacts, and (ii) environmental impacts.	AO3
		11.3.8	Describe the human population pyramids.	AO1
		11.3.9	Define the term 'fertility rate' as the average number of children born per female in a country.	AO1
		11.3.10	Interpret human population pyramids.	AO3
		11.3.11	Describe various strategies to reduce human population growth with named examples.	AO1

4	Be able to demonstrate practical awareness of the relationships between organisms and their environment.	11.4.1	Perform and analyse the following different techniques of population sampling: (i) quadrats, (ii) Tullgren funnel, (iii) pooter, (iv) pitfall traps, and (v) line and belt transect.	AO3
		11.4.2	Draw food chains and food webs.	AO2
		11.4.3	Draw and interpret pyramids of numbers and pyramids of biomass.	AO3
		11.4.4	Choose a relevant method for sampling populations according to the characteristics of the organisms.	AO3
5	Understand the influence of humans on the environment.	11.5.1	Describe changes in farming over time, from hunter-gatherer societies to modern farming practices.	AO3
		11.5.2	Analyse how advancements in agriculture and technology have led to greater food availability and improved food security.	AO3
		11.5.3	Explain the negative environmental impacts of intensive farming practices causing reduction in biodiversity due to monoculture organisms.	AO1
		11.5.4	State reasons for land clearance other than agriculture.	AO2
		11.5.5	Describe the impact of habitat reduction on local flora and fauna.	AO2
		11.5.6	Explain the effects of deforestation on the environment.	AO2
6	Understand the effects of pollution on the environment.	11.6.1	Explain the different types of pollution caused by farming, including land pollution and water pollution.	AO1
		11.6.2	Describe the environmental and health risks associated with the use of fertilisers and pesticides.	AO1
		11.6.3	Explain how and why salinisation and eutrophication occur.	AO2

		11.6.4	Identify the main categories of waste: (i) domestic, (ii) industrial, and (iii) agricultural.	AO2
		11.6.5	Analyse how each of the following types of waste affects the local environment: (i) domestic, (ii) industrial, and (iii) agricultural waste.	AO3
		11.6.6	Explain the impacts of non-biodegradable plastics on living organisms and the environment.	AO2
		11.6.7	Discuss the impact of hormonal contraceptives in water systems on aquatic organisms.	AO1
		11.6.8	Define the terms 'bioaccumulation' and 'biomagnification'.	AO1
7	Understand the impact of greenhouse gases on the environment.	11.7.1	Explain the impact of methane and carbon dioxide on the environment.	AO2
		11.7.2	Explain the 'Greenhouse Effect'.	AO1
		11.7.3	Define the term 'enhanced greenhouse effect'.	AO1
		11.7.4	Explain that global warming is a result of the greenhouse effect.	AO1
		11.7.5	Describe how global warming can lead to climate change.	AO2
		11.7.6	Explain the effects of climate change on the environment.	AO2
		11.7.7	Analyse strategies that can be implemented at the (i) local, (ii) governmental, and (iii) international levels to reduce the production of greenhouse gases.	AO3
8	Understand the cause and effect of acid rain on the environment.	11.8.1	Explain and analyse how sulphur dioxide and nitrogen oxides contribute to acid rain.	AO3

		11.8.2	Explain why carbon dioxide does not significantly contribute to acid rain.	AO2
		11.8.3	State the major sources of sulphur dioxide and nitrogen oxides.	AO1
		11.8.4	Describe the process of acid rain formation.	AO1
		11.8.5	Explain the effects of acid rain on organisms and the environment.	AO1
		11.8.6	Describe strategies that can be used to reduce the formation of acid rain.	AO2
		11.8.7	Describe methods that can be implemented to reduce the impact of acid rain.	AO2
9	Understand factors which contribute to ozone depletion.	11.9.1	Explain how chlorofluorocarbons (CFCs) and halon gases contribute to ozone depletion.	AO2
		11.9.2	State the major sources of CFCs.	AO1
		11.9.3	Describe how CFCs and halon gases damage the ozone layer.	AO1
		11.9.4	Describe the impact of ozone depletion on organisms and the environment.	AO1
		11.9.5	Describe strategies that can be implemented to reduce the release of CFCs and halon gases into the atmosphere.	AO2
10	Understand sustainability.	11.10.1	Define the terms 'sustainable resource' and 'sustainable development'.	AO1
		11.10.2	Describe the following processes: (i) sustainable logging, (ii) sustainable fishing, and (iii) sustainable agriculture.	AO1

		11.10.3	Evaluate the need for sustainable management of natural resources.	AO3
		11.10.4	Explain why there is a need to conserve fossil fuels.	AO1
		11.10.5	Explain strategies that can be implemented to reduce the use of fossil fuels, including: (i) efficient combustion, (ii) reduction of wastage, (iii) provision of alternative transport, (iv) use of renewable resources for energy production, and (v) recycling of specified wastes.	AO3
		11.10.6	Summarise the steps involved in the treatment of sewage.	AO1
11	Understand endangered species and conservation.	11.11.1	Define the term endangered and extinct.	AO1
		11.11.2	Explain why organisms have become endangered or extinct.	AO2
		11.11.3	Explain how a decrease in population size can lead to reduced genetic variation within a species.	AO2
		11.11.4	Describe and analyse how endangered species are conserved through (i) zoos, (ii) natural parks, (iii) natural reserves, (iv) seed banks, (v) breeding in captivity programs, (vi) increased education and community programs, and (vi) NGOs.	AO3
		11.11.5	Evaluate the following strategies as forms of conservation: (i) zoos, (ii) natural parks, (iii) nature reserves, (iv) seed banks, (v) breeding in captivity programs, (vi) increased education and community programs, and (vi) NGOs.	AO3
		11.11.6	Describe the need for conservation of species in an environment.	AO1

Biotechnology and Genetic Engineering

Aim: To enhance understanding of biotechnology, genetic engineering, and the process involved in the production of penicillin.

	The learner will:	SLO #	Assessment Criteria - The learner can:	Cognitive levels
1	Understand biotechnology and genetic engineering.	12.1.1	Define the term 'genetic engineering'.	AO1
		12.1.2	Explain the importance of bacteria in genetic engineering and biotechnological applications.	AO1
		12.1.3	Explain how yeast contributes to the process of bread making.	AO2
		12.1.4	Explain the process of anaerobic respiration in yeast to produce ethanol and biofuels.	AO2
		12.1.5	Describe and observe the use of enzymes in the following scenarios: (i) extraction of fruit juice, (ii) biological washing powders, and (iii) production of lactose free products.	AO3
		12.1.6	Explain the function and purpose of a fermenter in industrial fermentation processes.	AO1
		12.1.7	Describe how the components of a fermenter help maintain internal conditions that support optimal microbial growth.	AO2
		12.1.8	Describe the process of producing penicillin using a fermenter, including the conditions maintained for optimal yield.	AO2
		12.1.9	Describe and analyse the uses of genetic engineering in modern society, specifically: (i) human medicines, (ii) herbicide and pesticide resistant crops, (iii) drought resistant crops, (iv) increase nutritional content of crops, (v) production of insulin, and (vi) production of other human hormones.	AO3
		12.1.10	Describe the process of genetic modification, specifically (i) restriction enzymes, (ii) plasmid, (iii) ligase, (iv) recombinant DNA, and (v) transgenic organism.	AO1
		12.1.11	Discuss the advantages and disadvantages of genetic engineering.	AO2

Mathematical Requirements

Candidates may use calculators for all sections.

Candidate should be able to:

1. Solve problems involving addition, subtraction, multiplication, and division.
2. Calculate percentages with accuracy.
3. Determine percentage increases and decreases.
4. Apply different formulas to find missing values.
5. Convert between various units of measurement.
6. Judge suitable orders of magnitude and sense of scale.
7. Find the surface area and volume of common shapes (e.g., circles, squares, rectangles, triangles).
8. Estimate values by identifying patterns or trends.
9. Express data in standard form.
10. Round numbers appropriately.
11. Record results according to the precision of measuring equipment.
12. Find averages such as mean, mode, and median.
13. Calculate probabilities.
14. Understand and use ratios effectively.

Safety in the laboratory

General Conduct

- Wear a lab coat/apron, safety goggles, and closed-toe shoes at all times.
- Tie back long hair and secure loose clothing or accessories.
- Avoid eating, drinking, chewing gum, or applying cosmetics in the lab.
- Read the experiment instructions thoroughly before starting.
- Work only under supervision; never work alone in the lab.
- Keep your workspace tidy; store bags and books away from benches.
- Handle all equipment and materials with care; report any damage immediately.
- Follow your teacher's instructions exactly; do not improvise procedures.

Equipment and Chemical Safety

- Use apparatus only after proper training.
- Check glassware for cracks before use; handle hot glass with tongs or heat-resistant gloves.
- Never touch electrical equipment with wet hands.
- Read chemical labels carefully and know the hazard symbols.
- Handle the apparatus/ equipment/ chemicals appropriately.
- Use fume cupboards for volatile, toxic, or strong-smelling chemicals.
- Handle the microscope properly and use correct focusing techniques.

Biological Safety

- Wash hands before and after handling biological specimens.
- Wear gloves when dealing with biological materials.
- Dispose of biological waste in designated containers.

Fire and Heat Safety

- Ensure the safety of yourself, others, and your surroundings.
- Keep flammable materials away from open flames.
- Light Bunsen burners only when ready to use; turn them off immediately afterward.
- Know the location of fire extinguishers, fire blankets, and emergency exits.

Waste Disposal

- Dispose of chemicals, broken glass, and biological waste in the correct containers; never pour them down the sink unless instructed.
- Follow your school's waste segregation rules.

Emergency Procedures

- Report all accidents, spills or injuries to the teacher immediately.
- Know the location of first aid kits and emergency contact numbers.
- In case of evacuation, follow the designated route calmly.