ASSESSMENT GUIDELINES FOR BIOLOGY AT ADVANCED SECONDARY LEVEL

1.1 INTRODUCTION

Biology in the Advanced Secondary Curriculum (ASC) is assessed at school and at the End of the Cycle examinations, which are administered by the Uganda National Examinations Board (UNEB).

Assessment of Biology at the school level will be formative and summative. Formative assessment will be done through observation (watching learners working), conversation (asking questions and talking to learners), and appraising the learner's work (product).

While summative assessment will be done through engaging learners in activities of integration at the end of each topic and an examination at the end of the year. School-based formative and summative assessments will be designed to build and improve student understanding in preparation for the End of Cycle Assessment.

The End of Cycle Assessment for Biology for the Advanced Secondary Curriculum will be guided by assessment objectives based on the constructs. A construct is an abstract representation of a unifying theme that brings coherence to an assessment task. It serves as a generalized concept that combines a cluster of related learning outcomes or competencies—each contributing to a common learning ability. Acquisition of learning outcomes/ competencies in a construct enables the learner to demonstrate mastery in a way that supports real-life functionality and application.

1.2 ASSESSMENT OBJECTIVES

The end of Cycle assessment for Biology will be guided by four assessment objectives focusing on the learner's ability to:

AO1: Evaluate the significance of the interactions that sustain life and energy production by analysing the structure of cells and tissues, the roles of biomolecules (water, lipids, proteins, and nucleic acids), and the processes of ATP production, cell division, and protein synthesis, in order to apply these biological principles to challenges in genetic technologies and health improvement.

AO2: Evaluate plant structure and physiology by analysing structural adaptations and photosynthetic pathways in C_3 and C_4, environmental influences on photosynthesis, plant adaptations (to water availability), growth, photoperiodism, and the hormonal control of growth, to promote sustainable agricultural practices that improve crop yield and food security.

AO3: Evaluate the structure and physiology of animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing blood circulation, gas transport, immunity (vaccination and allergies), neural transmission, sensory perception, homeostatic control, and the role of adaptive behaviours in survival, to make informed health decisions and promote animal welfare

AO4: Evaluate the principles of genetics, evolutionary mechanisms, and ecological interactions by analysing Mendelian and non-Mendelian genetics, species evolution, speciation, resistance, extinction, population dynamics, ecosystem balance, and carbon emissions, to create sustainable strategies for managing invasive species, enhancing food security, and mitigating climate change.

The table below shows a linkage between the assessment objectives, the constructs, and the topics that contribute to the construct.

Table 1: Table showing the relationship between assessment objectives, constructs, and the topics in the syllabus

Assessment Objective	**Construct**	**Construct Description**	**Topics in the syllabus**
AO1 Evaluate the significance of the interactions that sustain life and energy production by analysing the structure of cells, tissues and levels of organisation, the roles of biomolecules (water, lipids, proteins, and nucleic acids), and the processes of ATP production, cell division, and protein synthesis, in order to apply these biological principles to challenges in genetic technologies and health improvement.	Cellular Organisation, Respiration, and Molecular Analysis	Investigating the structure of cells, tissues and levels of organisation, the roles of biomolecules (water, lipids, proteins, and nucleic acids), and processes of ATP production, cell division, protein synthesis, and genetic manipulation, by analysing how they interact to sustain life, then ethically apply biological principles in genetic technologies and health improvement	1. Cell Biology 4. Respiration 7. Inheritance and Evolution
AO2 Evaluate plant structure and physiology by analysing structural adaptations and photosynthetic pathways in C_3 and C_4, environmental influences on photosynthesis,	Plant physiology and adaptation	Evaluating plant structure and physiology by analysing structural adaptations and photosynthetic pathway differences in C_3 and C_4, plant adaptations (to water availability), environmental influence on photosynthesis, growth, photoperiodism, and the hormonal control of growth, to promote sustainable	2. Nutrition in plants 6. Co-ordination 8. Growth in Plants and Development in Insects

plant adaptations (to water availability), growth, photoperiodism, and the hormonal control of growth, to promote sustainable agricultural practices that improve crop yield and food security.		agricultural practices that improve crop yield and food security.	
AO3 Evaluate the structure and physiology of animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing blood circulation, gas transport, immunity (vaccination and allergies), neural transmission, sensory perception, homeostatic control, and the role of adaptive behaviours in survival, to make informed health decisions and promote animal welfare	Analysis of animal systems and behaviours in adapting to environmental changes for health, survival, and welfare	Evaluating the structure and physiology of animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing blood circulation, gas transport, immunity (vaccination and allergies), neural transmission, sensory perception, homeostatic control, and how adaptive behaviours support survival to make informed health decisions and promote animal welfare	3. Transport in Humans 5. Homeostasis 6. Co-ordination
AO4 Evaluate the principles of genetics, evolutionary mechanisms, and ecological interactions by analysing Mendelian and non-Mendelian genetics, species evolution, speciation, resistance, extinction, population	Genetic, evolutionary, and ecological dynamics	Evaluating inheritance patterns, evolutionary mechanisms, and ecological interactions by analysing Mendelian and non-Mendelian genetics, species evolution, speciation, resistance, extinction, population dynamics, ecosystem balance, and carbon emissions, to inform sustainable strategies for managing invasive species, promoting food security, and mitigating climate change.	7. Inheritance and Evolution 8. Growth in Plants and Development in Insects 9. Ecology

dynamics, ecosystem balance, and carbon emissions, to create sustainable strategies for managing invasive species, enhancing food security, and mitigating climate change.			

TABLE OF CONSTRUCTS

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
Cellular Organisation, Respiration,	1(b): Operate a light microscope to observe plant and animal tissues under magnification. (s, gs)	I. Use a light microscope	I. Focuses a light microscope II. Prepares and mounts temporary slides III. Estimates cell size IV. Calculates linear magnification	Medium

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
and Molecular Analysis Investigating the structure of cells and tissues, the roles of biomolecules (water, lipids, proteins, and nucleic acids), and processes of ATP production, cell division, and protein synthesis, by analysing how	1(c) Analyse the ultrastructure of animal/plant cells, bacterial cells, and plasma membrane to distinguish prokaryotic/eukaryotic characteristics.	I. Analyse the ultrastructure of animal, plant bacterial cells II. Use a light microscope to analyse the structures of cells. III. Distinguish between eukaryotic cells and prokaryotic cells.	I. Identifies parts of the animal, plant cells, and bacterial cells observed in an electron microscope. II. Identifies functions of parts of the plant, animal, and bacterial cells observed in the electron microscope III. Relates the structure of parts of the cells observed in the electron microscope to their functions IV. Explains the differences between eukaryotic cells and prokaryotic cells.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
these components interact to sustain life and energy production, to apply biological principles in genetic technologies and health improvement	1. (d) Analyse the structures of plant (parenchyma, collenchyma, sclerenchyma, xylem, and phloem) and animal (epithelial, cardiac, areolar, fibrous, and skeletal) tissues to assess their roles in physiological processes, disease diagnosis, and levels of organisation. (u, s, v/a, gs).	I. Analyse the features of healthy tissues and diseased tissues II. Relate the structure and location of tissues to their roles. III. Use a microscope to study tissues.	I. Describes the structure of tissues II. Identifies types and locations of tissues in plants and animals. III. Analyses how the structure and location tissues relate to their functions. IV. Compares healthy tissues with diseased tissues V. Extracts plant and animal tissues for scientific investigations	High
	1(a): Analyse the properties and functions of chemical compounds (water, lipids, and proteins including enzymes from mammals) in a cell, focusing on their roles in maintaining cellular structure and metabolic processes in living organisms. (s, gs) (Thermal properties of water not required.)	I. Relate properties of water, lipids, and proteins to cellular structure II. Relate properties of water lipids, and proteins to metabolic processes III. Plan and carry out investigations on the properties of water, lipids, proteins, and enzymes	I. Identifies properties of water, lipids, and proteins. II. Identifies roles of water, lipids, and proteins in cellular structure and metabolic processes. III. Explains how the properties of water, lipids, and proteins relate to their roles in cellular structure and metabolic processes. IV. Generates clear aims, hypotheses, and procedures for scientific investigations on properties of chemical compounds.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		IV. Compare the suitability of properties of water, lipids, proteins, and enzymes in performing metabolic processes and in cellular structures	V. Identifies and uses appropriate apparatus during scientific investigations VI. Obtains experimental data and presents it in an orderly form VII. Analyses data and provides appropriate recommendations. VIII. Extracts enzymes from the animal digestive system	
	4(a): Examine the relationship between the structure of the mitochondrion and the stages of cellular respiration in living organisms. (u, s)	I. Describe mitochondrial structure. II. Relate the structure of the mitochondrion to its functions and stages of cellular respiration.	I. Relates the stages of cellular respiration to the structure of the mitochondrion. II. Describes ATP production stages. III. Describes the energy release from ATP.	
	4(b): Analyse the biochemical processes leading to ATP production in living organisms, and how these processes are affected by physical activities and respiratory poisons (cyanide). (u, s, gs, v/a).	I. Analyse ATP production in living organisms. II. Assess the alternative respiratory substrates in living organisms and the implications of using them.	I. Identifies the common respiratory poisons. II. Explains how physical activities and respiratory poisons affect ATP production. III. Explains weight loss during starvation.	

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	(Details of biochemistry are not required)	III. Relate physical activities and respiratory poisons to ATP production		
	7(a): Analyse the structural and functional significance of nucleic acids in meiosis and mitosis, their role in cellular functions, and how mutations in nucleotide sequences can contribute to disease (cancer). (u, s, gs, v/a)	I. Analyse the properties of DNA and RNA. II. Analyse the relationship between DNA and protein structure. III. Describe the processes of protein synthesis, DNA replication, and Cell division. IV. Explain how mutation contributes to disease. V. Explain risk factors, prevention methods, and management of cancer. VI. Plan and carry out a scientific investigation on the behaviour of	I. Describes the structure and components of DNA and RNA. II. Compares the events of mitosis and meiosis. III. Explains the role of nucleic acids in mitosis and meiosis. IV. Relates to DNA replication to protein synthesis V. Explains how mutations alter protein function and cause uncontrolled cell division. VI. Explains how risk factors contribute to cancer development through DNA mutation and uncontrolled cell division. VII. Describes methods for cancer prevention. VIII. Explains common cancer management strategies. IX. Generates clear aims, hypotheses, and procedures for scientific investigations of chromosome behaviours X. Identifies and uses appropriate apparatus during scientific investigations	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		chromosomes during cell division.	XI. Analyses data and provides appropriate recommendations. XII. Identifies regions of mitosis in onion roots. XIII. Identifies the different stages of mitosis. XIV. Describes the features of the cell at the different stages of mitosis. IV. Uses a light microscope to observe stages of mitosis in a growing plant.	
	7(b): Assess gene technology techniques, their applications in various fields, and the associated ethical implications. (u, s, gs, v/a)	I. Contrast genetic engineering techniques. II. Explore the ethical implications of genetic engineering. IV. Assess applications of gene technologies and their environmental implications.	I. Describes major gene technology techniques and their real-world application. II. Contrasts gene technology techniques. III. Assesses the different ethical considerations in genetic engineering. V. Recognises the potential risks and environmental impacts of using gene technology.	High
Plant physiology and adaptation	2(a): Evaluate the relationship between the structure of chloroplast and photosynthesis in C3 and C4 plants. (u, s, gs)	I. Relate the structure of a chloroplast in C3 and C4 plants to function. II. Compare the photosynthetic	I. Explains the advantages and disadvantages of organisms at the cellular, tissue, and organ levels. II. Identifies the structural components of a chloroplast	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
Evaluating plant structure and physiology by analysing structural adaptations and photosynthetic pathway differences in C_3 and C_4, plant adaptations (to water availability), environmental influence on photosynthesis, growth, photoperiodism, and the hormonal control of growth, to promote sustainable agricultural practices that improve crop		pathways of C3 and C4 plants. III. Describe glucose, protein, and lipid synthesis pathways. IV. Plan and carry out a scientific investigation on photosynthetic efficiency in C3 and C4 plants	III. Explains the function of chloroplast structures in photosynthesis. IV. Analyses how structural differences in chloroplasts affect photosynthetic efficiency. V. Distinguishes the photosynthetic pathways in C3 and C4 plants. VI. Explains the process of glucose, protein, and lipid synthesis. VII. Assesses the advantages and limitations of photosynthesis in C3 and C4 plants. VIII. Generates clear aims, hypotheses, and procedures for scientific investigations on photosynthetic efficiency in C3 and C4 plants IX. Identifies and uses appropriate apparatus during scientific investigations X. Obtains experimental data and presented it in an orderly form XI. Analyses data and provides appropriate recommendations	
	2(b): Assess the influence of environmental factors on the photosynthetic efficiency of plants to optimise	I. Analyse the distribution and abundance of C3 and C4 plants at different altitudes,	I. Assesses the advantages and limitations of photosynthesis in C3 and C4 plants. II. Identifies the environmental factors that affect the rate of	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
yield and food security.,	photosynthetic rates and crop yields. (u, s, gs, v/a)	temperatures, and oxygen levels. II. Relate the influence of environmental factors on photosynthetic efficiency to crop yields. III. Use a light microscope to study the structure of guard cells IV. Plan and carry out a scientific investigation on the effect of environmental factors on photosynthetic efficiency	photosynthesis, hence crop yields. III. Analyses the effect of environmental factors on the rate of photosynthesis IV. Explains the concept of limiting factors and compensation points V. Observes the structure of guard cells using a microscope VI. Generates clear aims, hypotheses, and procedures for scientific investigations on the behaviour of guard cells and the effect of environmental factors on photosynthetic efficiency VII. Identifies and uses appropriate apparatus during scientific investigations VIII. Obtains experimental data and presents it in an orderly form IX. Analyses data and provides appropriate recommendations.	
	5(b): Examine the adaptations and management of different plant categories (xerophytes, mesophytes, hydrophytes) based on their osmoregulatory abilities and the application of	I. Analyse the distribution and abundance of different plant categories in relation to water	I. Examines the adaptations of plants to different levels of water availability in the environment. II. Describes and carries out management strategies of plants with different water needs.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	excretory plant products in everyday life. (u, s, gs, v/a)	availability in various environments II. Evaluate management strategies of the different plant types with different water needs(xerophytes, mesophytes, and hydrophytes) III. Analyse the application of plant excretory products in everyday life. IV. Plan and carry out investigation on stomatal distribution in xerophytes mesophytes, and hydrophyte	III. Identifies plant excretory products and their uses in everyday life. IV. Generates clear aims, hypotheses, and procedures for scientific investigations of stomatal distribution V. Identifies and uses appropriate apparatus during scientific investigations	
	6(a): Examine the role of plant hormones in tropisms, photoperiodism, and the application of these processes in	I. Analyse the effects of plant hormones on tropisms,	I. Applies hormones to improve crop yields (SBA) II. Generates clear aims, hypotheses, and procedures for scientific	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	agricultural practices. (u, s, gs, v/a)	photoperiodism, and crop yields II. Assess the use of plant hormones in agricultural practices to optimize crop yield. III. Plan and carry out experiments on the effects of plant hormones on growth and development. IV. Plan and carry out scientific investigation on the role of plant hormones in tropisms, photoperiodism and applications of plant hormones	investigations on the effects of hormones, the different excretory products in plants and stomatal behaviour in varying amounts of water. III. Identifies and uses appropriate apparatus during scientific investigations IV. Obtains experimental data and presents it in an orderly form V. Analyses data and provides appropriate recommendations.	
	8(a): Analyse the pre- and post-germination stages during the growth and development of plants in relation to their significance in crop production. (u, s, gs, v/a)	I. Analyse the concept of seed dormancy and seed banks. II. Analyse physical changes in meristems at	I. Explains the meaning of and factors that lead to seed dormancy. II. Justifies the need for seed banks. III. Investigates cell size and appearance in the different regions of a young	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		different stages of growth and development. III. Compare the significance of primary and secondary growth. IV. Analyse strategies of enhancing germination, growth, and development in plants. V. Examine factors that affect measurement of growth. VI. Plan and carry out scientific investigations on rates and patterns of growth	dicotyledonous root and shoot by microscopic examination. IV. Describes the processes of primary and secondary growth in plants. V. Explains the importance of primary and secondary growth in plants. VI. Develops strategies of how farmers can enhance germination, growth, and development in plants. VII. Generates clear aims, hypotheses, and procedures for scientific investigations on measurements of growth VIII. Identifies and uses appropriate apparatus during scientific investigations. IX. Analyses data and provides appropriate recommendations. X. Explains how organisms at cellular, tissue, and organ levels perform life processes. XI. Explains the advantages and disadvantages of organisms at the cellular, tissue, and organ levels.	

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
Analyses animal systems and behaviours in adapting to environmental changes for health, survival, and welfare. Evaluating the structure and physiology of animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing blood circulation, gas transport, immunity (vaccination and allergies), neural transmission, sensory perception, homeostatic	3 (a) Assess the role of the human heart in blood circulation and the role of haemoglobin in the transportation of gases in blood under various physiological conditions. (u, s, gs, v/a)	I. Describe how oxygen and carbon dioxide are transported in the body II. Analyse the physiological factors that affect the amount and transportation of oxygen and carbon dioxide in the body. III. Explain the role of the brain, sinoatrial node, and atrioventricular node during the regulation of the heartbeat.	I. Describes the structure and reaction of haemoglobin with oxygen and carbon dioxide II. Explains the behaviour of oxygen dissociation curves under various physiological conditions III. Explains the importance of the Bohr effect. IV. Explains the causes, effects, and management of carbon monoxide poisoning. V. Describes different mechanisms of carbon dioxide transportation in the body. VI. Explains the circulatory differences between athletes and non-athletes and low and high land dwellers VII. Relates the structure of the heart to myogenic action and heartbeat rate. VIII. Explains the role of the brain in heartbeat. IX. Relates physiological conditions of the body to the heartbeat rate.	High
	3 (b) Analyse the role of antibodies in vaccination and allergic reactions in relation to	I. Explain the different types of immunity.	I. Describes the structure of an antibody. II. Describes how antibodies are produced in response to vaccines.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
control, and how adaptive behaviours support survival to make informed health decisions and promote animal welfare	human body immunity. (u, s, gs, v/a)	II. Analyse the action of antibodies in vaccination and the allergic reactions. III. Explain the effects of the Rhesus factor on compatibility (eg, pregnancy, blood transfusion)	III. Relates the role of antibodies in immunity and vaccination in disease prevention in communities. IV. Explains how antibodies are involved in allergic reactions. V. Differentiates between immune responses in vaccination and allergic reactions. VI. Describes how Rh incompatibility can cause new born haemolytic disease. VII. Explains how the Rhesus blood groups affect blood transfusion. VIII. Explains the functioning of rapid test kits.	
	5(a): Analyse the homeostatic control system, focusing on the role of negative feedback mechanisms in maintaining internal stability. (u, s, gs)	I. Analyse the working of an efficient homeostatic system. II. Explain the significance of maintaining a stable internal environment. III. Analyse the role of the hypothalamus and the skin in	I. Identifies the key components of a homeostatic control system. II. Explains how negative feedback works to maintain internal stability. III. Examines the responses and adaptations of endotherms to temperature changes. (SBA) IV. Describes the roles of the hypothalamus, thermo receptors, and effectors in temperature regulation.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		temperature regulation in endotherms. IV. Examine the characteristics and behaviour of endotherms surviving in different temperature conditions. V. Explain the control of ADH production and the role of ADH in water balance in endotherms.	V. Explains the role of the hypothalamus and the pituitary gland in the secretion of ADH and the conditions that affect its production. VI. Explains how ADH controls water reabsorption in the kidney nephrons to ensure water balance in the body.	
	6(b): Analyse impulse transmission in relation to the structure of a neurone, a chemical synapse, and the factors that influence neural activity in response to environmental stimuli. (u, gs, v/a)	I. Analyse events during resting potential, action potential, hyperpolarization, and synaptic transmission. II. Relate neuron structure, magnitude, and frequency of stimulation to	I. Identifies the types and properties of neurone. II. Relates the structure of neurone to its functioning. III. Analyses how potential differences are achieved during polarised, depolarised, and hyperpolarised states of the neurone. IV. Explains impulse transmission across the synapse.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		impulse transmission. III. Analyse the effects of warm-ups and ice-cold first aid on impulse transmission. IV. Assess how environmental stimuli affect impulse transmission. V. Explain the functioning of local anaesthetics	V. Explains how different factors affect the speed of impulse transmission. VI. Explains the significance of warm-ups and ice cold first aid in impulse transmission. VII. Identifies the examples of local anaesthetics. VIII. Explains how local anaesthetics work	
	6(c): Examine the properties and functions of sensory receptors, the role of the retina in visual perception, and the ear's organs of balance in relation to their response to environmental stimuli. (u, s, gs, v/a)	I. Analyse the properties and functions of different types of sensory receptors. II. Explain the role of the retina in visual perception III. Analyse how the ear maintains balance during motion and in still position.	I. Identifies types of receptors and stimuli II. Explains the properties of sensory receptors III. Describes stimulus perception by sensory receptors IV. Relates the structure of the retina to visual perception V. Relates the structure and distribution of photoreceptors on the retina to visual perception VI. Describes the structure of the organ of balance in the ear	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
			VII. Analyses how balance is maintained during stationary and movement positions by the ear	
	6(d): Examine adaptive animal significance of diverse animal behaviour in promoting survival and reproductive success. (u, s, gs, v/a)	I. Identify types of animal behaviour. II. Relate animal behaviours to survival and reproductive success.	I. Classifies different animal behaviours. II. Analyses the role of innate behaviours in survival and reproduction. III. Explains how each learned behaviour contributes to the survival and reproduction of organisms. IV. Manages animals based on their behavioural patterns.	
Genetic evolutionary and ecological dynamics Evaluating inheritance patterns, evolutionary mechanisms, and ecological interactions by analyzing	7(c): Apply Mendelian principles to predict inheritance patterns and utilise mathematical models to analyse allele frequencies and genotype distributions within populations. (u, s)	I. Apply Mendelian laws of inheritance. II. Analyse allele frequencies and genotype distributions within populations. III. Analyse the factors that affect genetic equilibrium. IV. Plan and carry out a scientific investigation on	I. Explains Mendel's laws of inheritance. II. Identifies genotype and phenotype ratios from monohybrid and dihybrid crosses. III. Uses Punnett squares and probability to predict outcomes of crosses. IV. Calculates allele and genotype frequencies in populations using the Hardy-Weinberg equation. V. Describes how allele frequencies relate to genotype distributions.	

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
Mendelian and non-Mendelian genetics, species evolution, speciation, resistance, extinction, population dynamics, ecosystem balance, and carbon emissions, to inform sustainable strategies for managing invasive species, promoting food security, and mitigating climate change.		Mendelian inheritance (SBA).	VI. Explains factors that affect genetic equilibrium. VII. Generates clear aims, hypotheses, and procedures for scientific investigations on Mendelian inheritance. VIII. Identifies and uses appropriate apparatus during scientific investigations. IX. Analyses data and provides appropriate recommendations.	
	7(d): Examine different forms of allele interactions (autosomal linkage, multiple alleles, codominance, and incomplete dominance), including their examples and influence on phenotypic expression. (u, s, gs)	I. Examine different forms of allele interactions. II. Distinguish Mendelian from non-Mendelian inheritance. III. Analyse observed vs. expected genetic ratios. IV. Plan and carry out a scientific investigation on non-Mendelian inheritance (SBA)	I. Distinguishes types of allele interactions, including codominance, incomplete dominance, multiple alleles, and autosomal linkage. II. Identifies examples of each type of allele interaction III. Uses Punnett squares and pedigree analysis to show how each allele interaction influences phenotypic expression IV. Differentiates between Mendelian and non-Mendelian inheritance patterns. V. Generates clear aims, hypotheses, and procedures for scientific investigations on non-Mendelian inheritance	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
			VI. Identifies and uses appropriate apparatus during scientific investigations VII. Analyses data and provides appropriate recommendations.	
	7(e): Analyse evolutionary advancements in key life processes (circulation, reproduction, gaseous exchange, coordination, movement, and excretion), as well as their suitability for survival across different species. (u, s, gs, v/a)	I. Compare the advancement in life processes in different organisms. II. Plan and carry out investigations on evolutionary advancements. III. Compare the structures of organisms to identify evolutionary advancement.	I. Explains how adaptations enhance survival in specific environments. II. Describes evolutionary adaptations in systems across species. III. Carries out dissections to investigate structural and physiological advancements in organisms. IV. Generates clear aims, hypotheses, and procedures for scientific investigations on structural and physiological advancements in organisms. V. Identifies and uses appropriate apparatus during scientific investigations. VI. Analyses data and provides appropriate recommendations.	High
	7(f): Assess speciation and resistance, mechanisms driving them, and factors contributing to	I. Examine the process of speciation	I. Describes allopatric and sympatric speciation.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	extinction events, through comparison of historical and contemporary examples. (u, s, gs, v/a)	II. Analyse resistance and extinction in organisms. III. Analyse impacts of antimicrobial and pesticide resistance and suggest way forward. IV. Assess the occurrence of endangered species and extinction	II. Compares different mechanisms of isolation. III. Explains the modern theory of evolution as mechanisms of development of antimicrobial and pesticide resistance. IV. Proposes practical solutions to the impacts of antimicrobial and pesticide resistance. V. Analyses the causes and extent of extinction in Earth's history. VI. Assesses current threats to biodiversity. VII. Suggests strategies to prevent the extinction of endangered species.	
	8(b): Analyse the role of insect growth stages in ecosystems, focusing on their contributions to waste management, food security, and water quality assessment. (u, s)	I. Assess the contribution of insects to waste management, food security, and water quality assessment. II. Compare water quality in different locations using insect bio indicators III. Relate the trends and patterns in insect populations	I. Explains the role of the different insect stages in waste management, food security, and water quality assessment. II. Relates insect population density to water quality in different locations. III. Explains how trends and patterns in insect populations affect crop productivity. IV. Generates clear aims, hypotheses, and procedures for scientific investigations on water quality assessment.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		to crop productivity. IV. Plan and carry out investigations on water quality assessment.	V. Identifies and uses appropriate apparatus during scientific investigations VI. Analyses data and provides appropriate recommendations.	
	9(a): Analyse population dynamics and the factors affecting them in different ecosystems. (u, s, gs, v/a)	I. Relate a population's growth pattern to its features II. Evaluate the factors affecting population dynamics. III. Estimate population size using quadrats and capture-recapture techniques	I. Identifies the characteristics of a population II. Explains the different population growth patterns in ecosystems III. Analyses how different factors affect patterns of population distribution and size. IV. Identifies and uses appropriate materials to estimate population size V. Designs coherent procedures to estimate population size VI. Manipulates data to estimate the population size	High
	9(b): Analyse the processes of ecological succession and strategies for effective ecological restoration practices in diverse environments. ()	I. Explain ecological succession and ecological restoration practices. II. Compare ecological succession and	I. Identifies the stages of primary and secondary succession II. Examines the similarities and differences between primary and secondary succession III. Explains the role of succession in ecosystems	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		ecological restoration III. Plan and carry out ecological restoration in the community (SBA)	IV. Identifies the characteristics of degraded ecosystems V. Uses different techniques of ecological restoration. (SBA) VI. Examines the impact of ecological restoration in various communities VII. Identifies differences between ecological succession and ecological restoration	
	9(c): Examine the concept of energy flow through ecosystems, its role in maintaining ecosystem stability, and the impact of human activities on energy flow. (u, s)	I. Recognise patterns of energy flow in natural and disturbed ecosystems. II. Relate changes in energy flow to ecosystem stability. III. Assess the impacts of bioaccumulation and biomagnification during energy flow. IV. Plan and carry out a scientific investigation on nutrient	I. Identifies the sequence of energy flow in an ecosystem II. Explains the importance of energy flow in an ecosystem III. Explains the assimilation of energy during energy flow. IV. Explains energy loss during energy flow. V. Compares the impacts of bioaccumulation and biomagnification during energy flow. VI. Analyses the role of humans and their activities in energy flow VII. Generates clear aims, hypotheses, and procedures for scientific investigations on nutrient assimilation at each trophic level	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
		assimilation at each trophic level V. Explain the impact of human activities on energy flow	VIII. Identifies and uses appropriate apparatus during scientific investigations IX. Analyses data and provides appropriate recommendations.	
	9(d): Explain the concept of carbon footprint in relation to climate change, including its measurement, as well as the role of carbon sequestration in mitigating climate change. (u, gs, v/a)	I. Analyse personal and societal activities to identify those with high carbon footprints. II. Relate human activities, carbon emissions, and climate change to carbon sequestration mitigation strategies. III. Plan and carry out scientific measurement of the carbon footprint	I. Identifies human activities that lead to increased carbon output II. Compares the rate of carbon emissions to the extent of climate change. III. Explains the role of vegetation in improving the climate. IV. Implements activities that reduce carbon output V. Generates clear aims, hypotheses, and procedures for scientific investigations on the measurement of carbon footprint VI. Applies standard emission factors to accurately calculate and report the carbon footprint for a specific, defined entity. VII. Identifies and uses appropriate apparatus during scientific investigations VIII. Analyses data and provides appropriate recommendations.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	9(e): Examine the impact of invasive species on native biodiversity, ecosystems, and economies, as well as strategies for their management and control. (u, s, gs, v/a)	I. Investigate common local invasive plant or animal species II. Describe how invasive species disrupt ecosystem processes. III. Compare the efficiency and consequences of various control methods on the ecosystem. IV. Analyse trends in invasive species spread and impact V. Design and carry out management of invasive species (SBA)	I. Examines organisms and identifies characteristics of invasive species II. Compares the morphological characteristics between native and invasive species. III. Assesses the impact of invasive species on ecosystems, biodiversity, and economies. IV. Identifies methods of managing invasive species. V. Explains the considerations made while selecting a control method. VI. Compares the impacts of different methods of controlling invasive species. (SBA) VII. Identifies appropriate materials to use to manage invasive species. VI. Develops procedures and safety precautions in managing invasive species VII. Presents data from the management of species and makes recommendations	High
	9(f): Analyse the concept of food security, focusing on its components and sustainable	I. Analyse the concept of food security. II. Assess the effectiveness of	I. Explains the meaning of food security using specific local examples.	High

CONSTRUCT	LEARNING OUTCOMES The learner should be able to:	ABILITIES	INDICATORS OF MASTERY	LEVEL OF COMPLEXITY
	agricultural practices to address its challenges. (u, s, gs, v/a)	food security interventions or practices. III. Assess government policies/ initiatives in Uganda aimed at promoting food security.	II. Explains the components of food security and their roles in maintaining a stable food supply. III. Describes the different threats to food security. IV. Explains different agricultural practices aimed at addressing food insecurity. V. Critiques the different government policies/ initiative aimed at promoting food security.	

3.0 STRUCTURE OF THE EXAMINATION PAPERS

There will be two examination papers for Biology at the Advanced Secondary level.

Paper 1 (Theory) will contain two sections, A and B. The items in the paper will be scenario-based. The paper will take 3 hours.

Section A

- This will have two compulsory items.
  One item will come from construct 1 (**Cellular organisation, respiration, and molecular Analysis**), addressing assessment objective 1, and the other from construct 2 (**Plant physiology and adaptation**), addressing assessment objective 2.

Section B

- This will consist of parts I and II. The section will have four test items.
- Part I will have two items that come from construct 3 (**Organismal systems and homeostasis**), addressing assessment objective 3.
- Part II will two items from construct 4 (**Genetic, evolutionary, and ecological dynamics),** addressing assessment objective 4.
- A learner will respond to one item from each construct (Part).

Paper 2 (Practical) will contain two compulsory items, and the paper will take 3 hours. The items in the paper will be scenario-based.

- Items in this paper will come from any of the four constructs addressing their respective assessment objectives.
- One item will require the use of scientific investigations to solve a challenge presented in the scenario.
- The second item will require relating structural and behavioural mechanisms to the survival advantage of the organism.

4.0 BASIS OF ASSESSMENT

The table below shows the basis assessment of each construct for paper 1.

Table 2: Table showing bases of assessment of each construct for paper 1

CONSTRUCT	BASIS OF ASSESSMENT	LEVELS OF ACHIEVEMENT				
		5	4	3	2	1
		Exceptional	Outstanding	Satisfactory	Basic	Elementary
Cellular Organisation, Respiration, and Molecular Analysis	Analyses the structures and functions of cells/tissues/organelles/levels of organisation/properties of biomolecules.	*Analyses structures and functions of cells, tissues, organelles, levels of organisation, and properties of biomolecules with precise scientific detail, integrating all relevant levels into a coherent explanation; demonstrates clear relationships between structure and function.*	*Explains structures and functions of cells, tissues, organelles, levels of organisation, and properties of biomolecules with accurate detail, integrating some levels and showing partial relationships between structure and function..*	*Describes structures and functions of cells, tissues, organelles, levels of organisation, and properties of biomolecules accurately but separately, with no integration of levels or minimal linkage between structure and function.*	*Identifies some basic structures or functions of cells, tissues, organelles, levels of organisation, or biomolecules, but with little scientific accuracy and no integration of levels.*	*Identifies only one or very few structures or functions incorrectly or vaguely, with no integration and no clear relationship to function.*

	Evaluates the processes in a cell that sustain life: protein synthesis, glycolysis, the Krebs cycle, ETS, fermentation, DNA replication, meiosis, mitosis, and mutation.	*Evaluates all major processes, clearly explaining how they are coordinated to sustain life and the effects of disruptions on cellular and organismal function.*	*Explains all major processes and clearly describes how they are coordinated to sustain life, but does not address the effects of disruptions.*	*Describes the processes with basic accuracy but does not show how they are coordinated to sustain life or the effects of disruptions.*	*Lists some cellular processes with minimal or no explanation of their roles in sustaining life.*	*Lists one or very few processes incorrectly or vaguely, with no explanation of their roles.*
	Applies concepts of cellular structures, cellular organisations, and processes to improve health.	*Applies the concepts to diagnose, explain, and design effective, evidence-based, and ethical strategies for preventing, treating, or improving health problems.*	*Applies the concepts to diagnose, explain, and design effective, evidence-based but non-ethical strategies for preventing, treating, or improving health problems.*	*Applies the concepts to diagnose, explain, and design effective, but non-evidence-based and non-ethical strategies for preventing, treating, or improving health problems.*	*Proposes ineffective, non-evidence-based, and non-ethical strategies for preventing, treating, or improving health problems.*	*Gives no valid health improvement strategy; shows no application of cellular concepts.*
Plant physiology and adaptation	Analyses plant structural features, photosynthetic Pathways, and Water Adaptations	*Analyses plant structural features, C_3 and C_4 photosynthetic pathways, and water-related adaptations for survival, showing clear interconnectedness between all three aspects.*	*Describes plant structural features, C_3 and C_4 photosynthetic pathways, and water-related adaptations accurately but without linking them together.*	*Identifies plant structural features, stages of photosynthetic pathways, and water-related adaptations with some accuracy but little detail.*	*Mentions plant parts, photosynthetic categories of plants, or water-related categories of plants with minimal accuracy or detail.*	*Gives incomplete or incorrect mentions of plant parts, photosynthetic types, or water adaptation categories, showing no understanding.*
	Evaluates Physiological Processes & Environmental	*Evaluates hormonal regulation, photoperiodism, and environmental factors*	*Analyses the role of hormones, photoperiodism, and environmental factors*	*Describes the role of hormones, photoperiodism, and*	*Mentions physiological terms, roles of hormones, or*	*Gives incomplete or incorrect mentions of physiological*

	Influences, showing how these processes interact.	*affecting plant photosynthesis and growth, clearly showing how these processes interact to influence outcomes.*	*in plant growth/photosynthesis , with minimal linkage among some of the processes.*	*environmental factors in plant growth/photosynthes is without demonstrating interaction.*	*effects of environmental factors on photosynthesis/growt h without showing meaning or relevance.*	*terms, hormones, or environmental factors, showing no understanding.*
	Applies effective and ethical agricultural strategies to enhance productivity and promote sustainable Agriculture.	*Applies knowledge of plant structural features, photosynthetic pathways, water adaptations, physiological processes, and environmental influences to propose effective and ethical agricultural strategies that enhance productivity and promote sustainability.*	*Applies knowledge of plant structural features, photosynthetic pathways, water adaptations, physiological processes, and environmental influences to propose effective but non-ethical agricultural strategies that enhance productivity and promote sustainability.*	*Applies knowledge of plant structural features, photosynthetic pathways, water adaptations, physiological processes, and environmental influences to propose ineffective and non-ethical agricultural strategies.*	*Applies knowledge of plant structural features, photosynthetic pathways, water adaptations, physiological processes, and environmental influences inaccurately, with minimal relevance to productivity or sustainability.*	*Shows no valid application of agricultural knowledge; strategies proposed are irrelevant or absent.*
Analyses animal systems and behaviours in adapting to environment	Analyse how structures and physiological processes respond to changes in the environment	*Analyses systems accurately, showing integration of structures and processes to sustain life, and justifies the effects of disruptions*	*Analyses systems and shows integration of structures and processes to sustain life, but does not show the effects of disruptions.*	*Describes systems with basic accuracy but does not show how they are coordinated to sustain life or the*	*Identifies parts of systems with no explanation of their roles.*	*Gives incomplete or incorrect mentions of system parts, showing no understanding of their roles.*

al changes for health, survival, and welfare.	(Circulation, body defence, gas transport, neural transmission, homeostatic control)	*to these structures and processes.*		*effects of disruptions.*		
	Evaluates Sensory & Behavioural Responses (Sensory perception, behaviours, acclimatisation, animal welfare)	*Evaluates causes, mechanisms, and effects of sensory and behavioural responses, accurately linking them to adaptations for survival and animal welfare, with correct, detailed explanations.*	*Analyses causes, mechanisms, and effects of sensory and behavioural responses, accurately linking them to survival and animal welfare, but with no correct explanation.*	*Describes causes, mechanisms, and effects of sensory and behavioural responses with no linkage to adaptations for survival or animal welfare.*	*Identifies sensory or behavioural responses with no links to survival or welfare.*	*Gives incomplete or incorrect mentions of sensory or behavioural responses, showing no understanding.*
	Applies concepts of physiological systems, sensory, and animal responses to real-life Health & Performance Issues. (Local anaesthetics, effects of alcohol, physical activity, ice-cold first aid, sports doping, poisons)	*Applies concepts to explain and propose effective, evidence-based, and ethical strategies to address health and performance issues.*	*Applies concepts to explain and propose effective but non-ethical strategies to address health and performance issues.*	*Applies concepts to explain and propose ineffective and non-ethical strategies to address health and performance issues.*	*Applies knowledge of physiological systems, sensory, and animal responses inaccurately, with little relevance to the issues.*	*Shows no valid application of concepts; responses are irrelevant or absent.*
Genetic, evolutionary, and	Analyses genetic/ evolutionary and ecological mechanisms/processes	*Analyses Mendelian/non-Mendelian inheritance,*	*Analyses Mendelian/non-Mendelian inheritance,*	*Explains Mendelian/non-Mendelian inheritance,*	*Identifies Mendelian/non-Mendelian inheritance,*	*Gives incomplete or incorrect mentions of genetic, evolutionary, or*

ecological dynamics	(Mendelian and non-Mendelian, speciation, succession)	*speciation, succession, and energy flow, accurately making clear connections between stages/processes and their biological effects.*	*speciation, succession, and energy flow, accurately making clear connections between stages/processes, but without giving biological effects.*	*speciation, succession, and energy flow accurately without showing connections between stages/processes and biological effects.*	*speciation, succession, or energy flow without showing connections between stages/processes and biological effects.*	*ecological processes, showing no understanding.*
	Evaluates the significance, impact/role/causes of genetic, evolutionary, and ecological dynamics	*Evaluates the significance, causes, roles, and impacts with relevant examples and clear justification of conclusions.*	*Analyses the causes, roles, and impacts with relevant examples but no justification of conclusions.*	*Explains the significance, causes, roles, or impacts with no examples and no justification of conclusions.*	*Identifies significance, causes, roles, or impacts with no examples and no justification.*	*Gives incomplete or incorrect mentions of significance, causes, roles, or impacts, showing no understanding.*
	Applies principles of inheritance, evolutionary change, ecosystem dynamics, and ecological change to address challenges in genetics, sustainability, and climate change.	*Applies the principles accurately to explain and propose effective, ethical, and evidence-based solutions to address challenges in genetics, sustainability, and climate change.*	*Applies the principles accurately to explain and propose effective, evidence-based but non-ethical solutions to address challenges in genetics, sustainability, and climate change*	*Applies the principles to explain and propose effective, non-ethical and non-evidence-based solutions to address challenges in genetics, sustainability, and climate change.*	*Proposes ineffective, non-ethical, and non-evidence-based solutions with minimal relevance.*	*Gives no valid solutions; responses are irrelevant or absent.*

The table below shows the bases of assessment for paper 2 items.

Table 3: Table showing bases of assessment of each item of paper 2

ITEM	BASIS OF ASSESSMENT	LEVELS OF ACHIEVEMENT				
1		5	4	3	2	1
		Exceptional	Outstanding	Satisfactory	Basic	Elemen
	Planning	*Accurately states and clearly explains all four key attributes of planning: aim, hypothesis, variables, and materials, showing how they interrelate.*	*States and explains any three attributes of planning.*	*States and explains any two attributes of planning.*	*States and explains any one attribute of planning.*	*Attempts to s least one attr (e.g., aim or but gives it in incomplete, c incorrect for*
	Risks and Mitigation	*Identifies all possible risks, explains their impacts, and proposes comprehensive, effective mitigation strategies.*	*Identifies key risks and suggests mitigation strategies, but explanations of potential impacts are limited OR vice versa.*	*Identifies some risks, but explanations of impacts are unclear and mitigations are vague/ineffective.*	*Identifies one relevant risk with little or no explanation of its impact and a minimal suggestion for mitigation.*	*Attempts to n risk (e.g., "ch spill") but pr only a simple undeveloped generic mitig (e.g., "be car*
	Procedure	*Designs a clear, step-by-step procedure that is accurate, coherent, and replicable. Uses all materials correctly and controls variables effectively.*	*Designs a coherent and mostly correct procedure, using most materials appropriately, but variable control is incomplete.*	*Designs a basic procedure with some flaws; uses only some materials correctly and shows weak control of variables.*	*Designs a partial procedure with major flaws; attempts to use materials but variable control is largely absent.*	*Attempts to o procedure in fragmented w listing one or steps or mate it is incomple poorly struct*

	Data presentation	*Presents data accurately, completely, and clearly using the most appropriate format. All labels, headings, and units are correct.*	*Presents data with minor errors; generally organized but some labels or units are missing/inconsistent.*	*Presents incomplete data with noticeable errors; several labels/units are incorrect or missing.*	*Presents limited data with major errors in organization, labels, or units.*	*Attempts to r data in a min form (e.g., wr down one ob or a few figu presentation unclear or disorganized*
	Analysis and recommendations.	*Accurately analyses data, identifies clear patterns, draws valid conclusions, and provides well-justified, evidence-based recommendations.*	*Analyses data to identify patterns and meaningful conclusions with accurate explanations, but recommendations are absent or weak.*	*Analyses data to identify patterns and conclusions but without clear explanations or recommendations.*	*Identifies a trend or pattern superficially, with little explanation and no valid recommendation.*	*Attempts to d an observatio result (e.g., " increased") b no clear patt conclusion, o recommenda*
2	*Collection of data and evaluation of the suitability of structures to function in/ environment.*	*Accurately collects both qualitative and quantitative data, identifies and describes structures precisely, compares features effectively, critically analyses their functional and ecological suitability, and predicts how modifications could affect survival or function under different conditions.*	*Accurately collects qualitative and quantitative data, identifies and describes structures, compares features correctly, and explains suitability using clear evidence from structural and environmental interactions.*	*Collects data with some errors or omissions, identifies and describes structures with minor inaccuracies, comparisons are incomplete, and explanations of suitability are partially correct or lack depth.*	*Collects limited or inaccurate data, identifies structures with some correctness but provides minimal or incorrect description, comparison, or suitability explanation.*	*Data collecti inaccurate or incomplete; f identify or de structures; n comparisons evaluation of suitability ar provided.*
	Drawing	*Produces an accurate, well-labelled drawing with a clear, comprehensive title, precise outlines, correct magnification, neat organization, and all relevant*	*Produces a largely accurate and labelled drawing with most attributes (title, outlines, magnification,*	*Produces a drawing with some accuracy and labelling, but several attributes (title, outlines, magnification,*	*Produces a drawing with limited accuracy and labelling; many attributes are*	*Produces an inaccurate or incomplete d with poor or labelling, mis title, outlines*

		histological features included.	*neatness, features) correctly represented.*	*features, or neatness) are missing or incorrect.*	*missing or poorly represented.*	*magnificatio features.*

BIOLOGY PAPER I (THEORY)

3 hours

INSTRUCTION TO CANDIDATES

This paper consists of two sections: **A** and **B**. It has six examination items.

Section **A** has two compulsory items.

Section **B** has two Parts: I and II. Answer one item from each part.

Answer four items in all.

SECTION A

Answer all the items in this section.

Item 1(Construct 1)

Victoria Nile is a source of food and income for the communities living along it. However, the community near a textile factory have reported to the district authorities that the fish catches have significantly reduced over the past few months. The authorities requested Dr. Achen, a fisheries biologist from National Environmental Management Authority (NEMA) to carry out an investigation. She suspected that the cause was pollution from the factory that releases wastes containing heavy metals and cyanide into the lake.

She caged fish at two different sites; a clean control site (no pollution) and a site near the factory outflow. She investigated the effects of the heavy metals on the gill and mitochondrial structures and ATP synthesis. The data she collected is provided in table 1.

Table 1

Fish group	**ATP Concentration (µmol/g cell)**	**Thickness of gill squamous cells**	**Number of ribosomes per mitochondrion ($\times 10^6$)**	**Concentration of oxidised NAD**(µmol/g tissue)	**Space between cells gill epithelium**	**Amount of cyanide in river water (mg/L)**	**Amount of lead (Pb) in river water (mg/L)**
Control (no pollution)	9.5	Thin	9.8	7.2	0.5µm	0.01	0.01
Polluted site – factory outflow	2.2	Thick	3.5	1.3	6.0µm	1.00	1.00

You are tasked with analysing her findings and proposing a course of action.

Task

Analyse how cellular and tissue changes in the fish from the polluted site affect respiration and result in reduced fish catches to propose and justify a sustainable management plan to ensure health of organisms in the river.

Item 2 (Construct 2)

Napak district is one of the agricultural areas in Uganda. It is a lowland area with high temperature, shallow soils that have limited organic matter and very low moisture. Farmers grow both native and non-native crops, however, they often get low yields from the non-native crops unlike from the native crops.

The farmers invited agricultural extension workers to study the situation and propose strategies to improve the yields. They conducted a study in the district and the data collected on native and non-native crops grown is shown in table 2.

Table 2

Condition	**Native plants**	**Non-native crops grown**
The type of leaf anatomy	Kranz anatomy present	Kranz anatomy absent
Distribution of stomata	Many stomata on lower leaf epidermis	Many stomata on upper leaf epidermis
Size of leaf cuticle	Thick	Thin
Number of hairs on the leaf	Numerous	Very few

You are part of the team invited by the agricultural extension officer to analyse the data and propose strategies to the farmers on how to improve their crop yields.

Task:

(a) Account for the difference in the yields between native and non-native crops grown in the district, and propose strategies to enhance productivity and resilience.

SECTION B

Part I

Answer only one item from this section.

Item 3(Construct 3)

During the District Multi-Sport Championship in Soroti district (Altitude 1130m above sea level and temperature 30°C), Alex and Chris, were among the participants in 400m race

Athlete profiles and pre-competition factors:

- **Alex (400m Sprint):** Trained at the Teryet National grounds in Kapchorwa, a high-altitude facility (2,200 m above sea level and temperature 21°C).
- **Chris (400m Sprint)**: Trained at Namboole National Stadium in Wakiso, a low-altitude facility (1,128 m above sea level).

Immediately after the events, Chris showed signs of extreme fatigue, collapsed and injured his lower leg.

Chris' coach wondered why Alex did not show signs of extreme fatigue and asked the first aider to investigate since he was suspecting Alex of sports doping. The first-aid team recorded the following measurements in table 3 immediately after each event.

Table 3

Parameter	**Alex**	**Chris**
Pulse rate after race (beats/min)	115	155
Blood oxygen saturation (%)	93	85
Breathing rate (breaths/min)	18	28
Stroke volume (ml/beat)	120	100

The first aider has presented to Chris's coach and he is seeking a scientific explanation for the differences between the participants and expert advice on post-race management of Chris.

Task

Explain how the athletes' performance and observed conditions after the race were influenced by differences in training environments, explain the thermoregulatory adjustment in Alex's body on reaching Soroti and propose strategies for safe management of Chris's condition after the race.

Item 4(Construct 3)

Brian a re-known fastest sprinter in the region, has recently lost many races. This has caused him to lose self-confidence, become depressed and he also says that he feels unsteady whenever he turns his head quickly. However, he is seen to perform impressive warm-up routines during training whenever his girlfriend is around, an act his coach jokingly calls his "courtship display."

His coach noticed that Brian's reaction time to the start signal is slower than that of his peers and he sometimes staggers and leans forward when walking and running. Worried that he might be having a medical condition affecting his performance, Brian's coach referred him to a medical doctor who conducted tests and compared his results with reference values typical of healthy sprinters. Brian's laboratory and clinical results are shown in table 4.

Table 4

Parameter	**Brian's Result**	**Normal Reference (trained athletes)**
Total synaptic vesicles at the motor end-plate (vesicles per end-plate)	8.0×10^{5}	2.0×10^{6}
Acetylcholine per synaptic vesicle (molecules·vesicle^{-1})	5.0×10^{3}	1.0×10^{4}
Arteriole wall smooth muscle (media thickness) in µm	12	22
Core temperature at the onset of sweating (°C)	39.0	37.2
Whole-body sweat rate at 36 °C ambient	0.2	1.0 L·h^{-1}
Endolymph volume in vestibular apparatus µL (normal range per ear)	60	70–170
Structure of otolith organs	Increased mechanical stiffness	Normal elasticity

On receiving the test results from Brian, the coach could not understand them. You have been tasked with interpreting the results for the coach.

Task:

Account for the physiological mechanisms underlying Brian's observed symptoms and behaviours, explain their survival value, and propose strategies to improve his performance.

Part II

Answer only one item from this section

Item 5(Construct 4)

Farmers in Kayunga District use a pesticide to control beetles that destroy the flowers of coffee plants. However, over the past five years, the pesticide has become less effective, as the beetle population has continued to increase.

Findings from an investigation conducted by the district research team show that 20% of the beetles possess a recessive pesticide-resistance allele leading to a decline in coffee yields and pollinator population , while bird populations feeding in the fields increased.

You have been tasked to analyse these findings and help the district officials on how to manage pests.

Tasks

(a) Analyse the increase in pesticide-resistant beetles and predict the population of those with pesticide resistant allele, evaluate the effects of changing pollinator and bird populations on coffee yields, and propose a biologically justified, integrated pest management strategy for the district

Item 6 (Construct 4)

In western Uganda, communities around Budongo Forest Reserve report increasing native rodent species invasions into crop gardens. The National Forestry Authority(NFA) directed an investigation into the complaints of communities. The investigation showed that the population of native rodent species in the forest declined, while that of non-native rodent species increased.The non-native rodents have stronger limbs, larger incisors, and a higher reproductive rate. The native species therefore, are outcompeted by the non-native species and end up in crop gardens.

The investigation further showed that deforestation and farming have degraded and fragmented the forest into three isolated patches, each with distinct conditions. Unlike before the formation of the patches, the native rodent species are unable to move throughout the

forest restricting interbreeding within patches only. The breeding experiments between native rodent species from the different patches A, B and C showed that those from:

- A can not mate with those from B at all
- B can mate with C, but their offspring are infertile
- C and A can mate but a zygote never forms

Tasks

Analyse the ecological and evolutionary interactions in the forest to propose a management plan for Budongo Forest that restores the forest, controls the invasive rodents, and conserves native biodiversity while supporting local livelihoods.

ASSESSMENT RUBRICS FOR SAMPLE BIOLOGY PAPER 1 (THEORY)

SECTION A

Item 1 (Construct 1)

Output	Basis of evaluation with indicators	Score 5	Score 4	Score 3	Score 2	Score 1
	1. Interpretation of task/context **Identifies factors affecting the health of this fish, leading to low catches**	Identifies concentration of pollutants (cyanide and lead), concentration of oxidised NAD, number of ribosomes, and structure of squamous epithelium of the gills affects ATP production and health of the fish in the river	Correctly identifies most data differences and pollutants with minor omissions.	Identifies some data differences with major omissions.	Mentions limited factors affecting fish health in the river	Identifies no factors affecting fish health in the river
	1. Generating and presenting ideas) Analyses the structures and functions of cells/tissues/organelles/levels of organisation/properties of biomolecules	Thoroughly explains how structural changes in gill tissue, ATP synthase, and gene mutations disrupt biological function. Demonstrates deep understanding of how these disruptions affect oxygen uptake, energy production, muscle function, and survival across multiple biological levels.	Clearly explains how most structural changes affect cell and organism function. Shows good understanding of links between tissue/organelles and organismal performance.	Describes some structural changes with partial explanation of effects on function (e.g., how gill damage affects oxygen uptake). Some cross-level connections are made.	Identifies relevant structures but provides no or vague explanations of their function. Few or no links across biological levels.	Identifies no strictures and shows no understanding of cell organisaton.

	) Evaluates the processes in a cell that sustain life (protein synthesis, glycolysis, Krebs cycle, ETS, fermentation, DNA replication, meiosis, mitosis, mutation)	Accurately evaluates how disruptions to ATP synthase and mutations affect energy production (e.g., ETS, oxidative phosphorylation) and cell division. Clearly explains downstream consequences for muscle performance and survival.	Explains how changes in ATP synthase or mutation frequency affect energy production or cell division. Describes most consequences clearly.	Describes one or more relevant processes and partially links them to organismal function or health. Evaluation is limited.	Identifies relevant processes with no connections to function.	Shows no understanding of the processes in a call that sustain life.
	Making Informed Judgement Applies concepts of cellular structures, cellular organisations, and processes to improve health	Proposes a well-justified and integrated management plan. Clearly connects specific cellular and physiological disruptions to ecosystem-level interventions. Addresses pollution, fish health, and food security using cross-level biological reasoning at cellular, tissue, and ecosystem levels.	Proposes a justified conservation strategy with clear links to organism or ecosystem health. Applies biological understanding to support solutions.	Suggests a relevant plan based on general biological understanding. Links to health or survival are present but underdeveloped.	Recommends a basic or general action with minimal biological explanation. Weak connection to cellular or organismal processes.	Suggests vague or unrelated measures with no biological justification. No link to cellular or ecosystem health.

Item 2 (Construct 2)

Output	**Basis**	**LEVEL OF ACHIEVEMENT**

		Score 5	Score 4	Score 3	Score 2	Score 1
	Interpretation of task/context **(a) identifies the anatomical and ecological features of native and non-native plants grown** **(b) identifies Napak's environmental challenges**	Accurately connects the task to biological concepts(like adaptation, photosynthesis type, and water conservation), clearly describes Napak's environmental challenges (high temperature, low moisture, shallow soils) and notes the differences in yield between native and non-native crops.	Links the task to some relevant biological concepts (e.g. C_4 vs C_3 pathway), describes the general environmental conditions and notes differences in yields between native and non-native crops.	Mentions that Napak is dry and hot and that native crops perform better, but gives no or limited connection to biological concepts	States that native crops grow better than non-native crops, but gives wrong or no environmental or biological basis	Does not describe the biological concepts and environmental conditions or misinterprets the task completely (e.g. unrelated to adaptations or productivity)
	Generating and presenting ideas **a) Analysis of Plant Structural Features, Photosynthetic Pathways, and Water Adaptations**	Clearly explains how C_4 traits (Kranz anatomy, stomata arrangement, thick cuticle, many hairs) give native plants superior water-use efficiency, heat tolerance, and reduced transpiration over C_3	Correctly explains most anatomical adaptations and how they favour native crops. Shows the relationships between structure and function well, though with less	Gives some correct explanations (e.g., cuticle reduces water loss) but reasoning lacks depth or completeness. Structure to function	Describes some plant features or adaptation strategies with no or wrong knowledge of C_3 and C_4 and limited and structure to function relationships poorly established.	Identifies no plant feature or adaptation but and shows no understanding of how leaf anatomy affects crop performance in hot, dry conditions.

		traits. Shows clear connections from leaf anatomy to physiology to adaptation and then high yield	depth and integration.	links are partially made		
	b) Evaluation of Physiological Processes and Environmental Influences	Integrates the interaction between physiology (photosynthesis pathways, transpiration, water use efficiency) and ecology (adaptation to heat, drought, soil conditions) into a coherent explanation	Analyzes key physiological processes and environmental/ ecological factors and partially explains interactions between them.	Explains physiological processes and the environmental conditions independently showing minimal interactions between them.	Identifies physiological processes and environmental conditions with no connections between them.	Shows no understanding of processes
	Making Informed Judgement **Application of Ethical and Effective Agricultural Strategies for Sustainability**	Proposes well-justified, data-driven strategies, to improve crop yields in Napak showing strong scientific reasoning, ethical responsibility, and long-term sustainability.	Develops effective strategies to improve crop yields in Napak with good scientific grounding and some discussion of sustainability and ethical considerations.	Suggests generally appropriate strategies with some scientific explanation and reference to sustainability	Recommends a basic or generic strategy with minimal justification or vague relevance to sustainability	Does not suggest any ethical and effective strategy.

Section B

Part I

Item 3 (Construct 3)

Output	Basis of evaluation	**Score 5**	**Score 4**	**Score 3**	**Score 2**	**Score 1**
	Interpretation of task/context Identification of aspects of highland aclimatiazation, responses to decreased in environmental temperature	Comprehensively identifies all the effects of training at highland (increased pulse rate, breathing rate, stroke volume and blood oxygen saturation) and responses to decrease in environmental temperature	Identifies most effects of training at highland and responses to decrease in environmental temperature	Identifies basic effects of training at highland and responses to decrease in environmental temperature	Iidentifies limited effects of training at highland and responses to decrease in environmental temperature	Identifies no effects of training at highland and responses to decrease in environmental temperature

	Generating and presenting ideas **(a) Analysis of Organismal Systems and Homeostasis**	Insightfully interprets post-race data to evaluate how the circulatory, respiratory, and nervous systems interact to maintain homeostasis. Clearly explains how these systems responded differently across participants and how homeostatic disruption affected recovery.	Clearly analyzes how key systems worked together to regulate variables like heart rate and breathing during and after the race. Links physiological differences among participants to variations in homeostatic control..	Describes key physiological responses (e.g., increased heart rate, heavy breathing), with some explanation of how systems responded to exercise. Limited integration across systems.	Lists general changes in data (e.g., high heart rate, faster breathing) with minimal or vague physiological explanation.	Identifies no changes in data and no physiological explanations.
	(b) Evaluation of Sensory & Behavioral Responses	Thoroughly evaluates participants' behavioral responses (e.g., collapse, fatigue, delayed recovery) and explains their underlying physiological causes. Connects responses to sensory input, adaptation, performance, and overall welfare.	Analyzes observed behaviors and explains their likely physiological causes. Shows some connection to participant adaptation and performance outcomes.	Describes observed behaviors (e.g., exhaustion, slow movement) and gives partial explanation of physiological responses.	Identifies behaviors with minimal or unclear physiological links.	Does not identify behaviors or sensory signs.

	Making Informed Judgement **Application of Concepts to Health & Performance Issues**	Proposes well-justified, ethical, and scientifically accurate interventions for Chris's recovery. Explains the effects of the local anaesthetic on multiple physiological systems and recommends appropriate strategies (e.g., gradual rewarming, hydration, monitoring vitals).	Explains how the anaesthetic likely affected Chris's recovery and suggests mostly ethical, effective strategies to support physiological recovery and safe outcomes.	Describes one or more general effects of the anaesthetic and proposes a basic recovery measure (e.g., rest, fluids), with limited justification.	Suggests a vague or incomplete intervention without explaining the physiological rationale or safety.	Does not suggest any treatment or intervention.

Item 4 (Construct 3)

Output	Criteria	Score 5	Score 4	Score 3	Score 2	Level 1
	Identification of Key Observations and Physiological Effects a) Identifies abnormal parameters in Brian's data	Accurately identifies all physical, physiological and psychological factors that affect Brian.	Identifies most factors that affect Brian	Identifies some factors that affect Brian	Recognises a few factors that affect Brian	Fails to identify or misinterprets factors that affect Brian.

	Analyses physiological systems that sustain life (neural transmission, balance, thermoregulation)	Accurately integrates physiological data from neural, vestibular, and thermoregulatory systems to explain the full range of Brian's symptoms. Justifies causal links using specific biological mechanisms and evidence from the case.	Analyzes the contribution of each physiological system to Brian's symptoms. Shows some integration across systems and uses case data to support explanations.	Explains abnormalities in each system separately, with limited discussion of how they contribute to Brian's symptoms. May generalize or oversimplify causal links.	Describes basic functions of one or more systems or identifies affected systems with minimal explanation of symptoms.	Identifies isolated physiological features or symptoms with no clear explanation of their cause or interaction.
	Evaluates sensory & behavioural responses (innate behaviours)	Thoroughly evaluates Brian's observed innate behaviours (e.g., postural reflexes, startle responses), explains their physiological triggers, and clearly links them to survival and training relevance.	Analyzes key behaviours and identifies their physiological basis and adaptive function. May partially explain the survival benefit or training relevance.	Describes behaviours and gives a basic explanation of their function. Provides a general or implied link to survival or adaptation.	Identifies behaviours with little or no explanation of their physiological cause or adaptive significance.	Mentions behaviours without recognising them as innate or relevant to survival or performance.
	Applies concepts to real-life health & performance issues (improvement strategies)	Proposes accurate, ethical, and context-specific strategies (e.g., vestibular rehabilitation, neuromuscular training, thermoregulation support), each clearly linked to Brian's	Suggests appropriate, mostly ethical strategies with relevant links to Brian's physiological issues. Offers	Proposes general strategies for performance improvement with limited physiological justification or	Suggests a basic or generic strategy with minimal connection to physiology or Brian's needs.	Suggests a strategy that is irrelevant, unsafe, or unsupported by

		physiological deficits. Justifies how each strategy improves performance.	reasonable explanation of how performance would improve.	vague relevance to Brian's case.		physiological reasoning.

Item 5 (Construct 4)

Output	Basis of Evaluation (with Competence Indicators)	Score 5	Score 4	Score 3	Score 2	Score 1
Essay	1. Interpretation of Task and Context Identifies the genetic traits / allele type, ecological changes and recognises changes in pesticide effectiveness.	Accurately identifies all key findings in the data: allele type, population increase, pesticide ineffectiveness, and ecological shifts.	Identifies most findings with minor omissions or slight inaccuracies.	Identifies some findings such as beetle resistance or population increase but misses key genetic or ecological details	Identifies few findings or confuses them with unrelated details	Fails to identify relevant biological findings or misinterprets the scenario.

	2. Generating and explaining Ideas a) Analyses genetic, evolutionary, and ecological mechanisms/processes (Mendelian & non-Mendelian, speciation	Thoroughly integrates codominance, selection pressure, and ecological feedbacks to explain the beetle's rapid adaptation. Uses data-driven analysis of allele frequencies to justify a clear and logical prediction of future genotype distributions.	Accurately explains codominance and selection pressure, and connects these to the rise of resistance in beetles. Uses current trends to predict genotype distribution with reasonable justification.	Describes codominance and selection separately, offering a general prediction of beetle population changes. Reasoning is present but partially developed or somewhat generic.	Identifies basic genetic ideas (e.g. inheritance, adaptation), but does not fully explain mechanisms. Prediction is vague or lacks connection to data.	Mentions isolated facts (e.g. "more resistant beetles") without meaningful reference to genetic principles, evolutionary mechanisms, or data trends.

	b) Evaluates the significance, impact/role/causes of genetic, evolutionary, and ecological dynamics	Critically evaluates multiple interacting ecological factors (e.g. pollinators, birds, beetles, climate) and prioritizes causal pathways with short- and long-term ecological consequences. Demonstrates strong systems thinking.	Analyzes relevant ecological interactions with mostly clear causal links. Explains how changes in biotic populations affect beetle numbers and maize yield, showing solid ecological reasoning.	Identifies some ecological factors and explains individual effects on beetles or maize. Connections are present but somewhat simplistic or fragmented.	Recognizes limited cause-effect relationships, with oversimplified or incomplete reasoning. May confuse or overlook key ecological interactions.	Identifies only one ecological factor (e.g. "birds eat beetles") with no further explanation, or explanation is scientifically inaccurate.

	3. Making Informed Judgement / Proposing Strategies and application a) Suggests integrated pest management strategies b) Justifies strategies using biological principles	Proposes a comprehensive strategy(like chemical rotation, biological control, pollinator enhancement, cultural methods, biopesticides, and varietal improvements) with a biologically sound justification.(linking to natural selection, ecological balance, pollination, and coffee productivity)	Proposes mostly relevant strategies; justification is provided with relevant biological reasoning, but with no full explanation of key principles	Proposes some relevant strategies, but justification is basic or partially correct; biological principles are mentioned with no explanation.	Suggests weak strategie**s**, poorly justified; limited reference to biological principles.	Provides no meaningful strategies or justification; strategies are irrelevant or unrealistic.

Item 6(Construct 4)

Output	**Basis of evaluation**	**Score 5**	**Score 4**	**Score 3**	**Score 2**	**Score 1**

	Interpretation of task/context **Identifies the ecological and evolutionary aspects**	Comprehensively identifies all ecological concepts (invasive species, competition, food security, and degradation) and evolutionary concepts (speciation, isolation, and selection pressure)	Identifies most of the ecological concepts (invasive species, competition, food security, and degradation) and evolutionary concepts (speciation, isolation, and selection pressure)	Identifies basic ecological concepts (invasive species, competition, food security, and degradation) and evolutionary concepts (speciation, isolation, and selection pressure)	Identifies limited ecological concepts (invasive species, competition, food security, and degradation) and evolutionary concepts (speciation, isolation, and selection pressure)	Identifies few or no ecological concepts (invasive species, competition, food security, and degradation) and evolutionary concepts (speciation, isolation, selection pressure)
	Generating and presenting ideas **(a) Analyses genetic, evolutionary, and ecological mechanisms/processes (Mendelian and non-Mendelian inheritance, speciation, succession)**	Analyses ecological, evolutionary, and genetic mechanisms of competition, adaptation, reproductive isolation, and speciation, clearly linking them to invasive success, native decline, and ecosystem imbalance.	Explains ecological, evolutionary, and genetic mechanisms linking some of them to invasive success, native decline, and ecosystem imbalance, but with minor gaps	Describes ecological, evolutionary, and genetic mechanisms, but no linkage to invasive success, native decline, and ecosystem imbalance	Identifies ecological, evolutionary, and genetic mechanisms, but it is limited or disconnected from the broader ecological or genetic context.	Mentions isolated facts or no ecological, evolutionary, and genetic mechanisms without explaining the underlying mechanisms.
	(b) Evaluates the significance, impact/role/causes of genetic, evolutionary, and ecological dynamics	Evaluates how fragmentation of the forest alters ecological interactions, genetic flow, and selection pressures leading to speciation and crop invasion, giving the effects on biodiversity and community welfare.	Explains how human activities disrupt ecological and genetic processes, connecting impacts to biodiversity loss and community effects.	Describes ecological impacts and possible genetic consequences, but the discussion lacks depth or a long-term view.	Identifies ecological effects (e.g., native species decline) with limited explanation of underlying genetic or evolutionary mechanisms.	Identifies few or no ecological effects

	Making Informed Judgement **Applies principles of inheritance, evolutionary change, ecosystem dynamics, and ecological change to address challenges in genetics, sustainability, and climate change**	Uses ecological and genetic justification to propose realistic Budongo specific plan that integrates habitat restoration, invasive species control, genetic conservation, and livelihood support and includes feasibility, risk management and monitoring indicators.	Proposes a mostly integrated, feasible plan with sound biological justification and monitoring but lacking some detail on feasibility or risk management.	Suggests a reasonable plan with basic biological justification and limited risk management or monitoring details.	Suggests generic or incomplete actions with minimal justification and no monitoring or risk management considerations.	Suggests unrealistic actions with no scientific reasoning.

SAMPLE BIOLOGY PAPER II (PRACTICAL)

3 hours

INSTRUCTIONS TO CANDIDATES

This paper consists of two examination items. Answer all items.

Write all your answers in the spaces provided within this question paper booklet.

Use sharp pencils for drawings. Coloured pencils or crayons should not be used.

For any calculations, show all your workings clearly in the space provided.

Silent, non-programmable scientific calculators may be used.

No extra paper is allowed. Any work written on additional sheets will not be scored.

Item 1

The Kita community members carry out commercial beetroot farming. However, the plants are regularly attacked by worms that destroy the leaves. The farmers use pesticide A to kill the worms but the plants end up drying.This results in poor yields and financial losses to the farmers, and consequently, they have asked the Ministry of Agriculture for help.

A research team sent by the Ministry of Agriculture discovered that the pesticide is a reducing sugar, polar and moves across the beetroot cell membranes into the cytoplasm, where it causes cell death after a week. One of the farmers reported that whenever she mixes the pesticide with solution D and sprays, the plants do not dry. The agricultural team wants to recommend mass use of solution D together with the pesticide; however, they do not have scientific justification for its effectiveness.

You have been provided with fresh beetroot, pesticide A, solution D, and a cork borer.

Task.

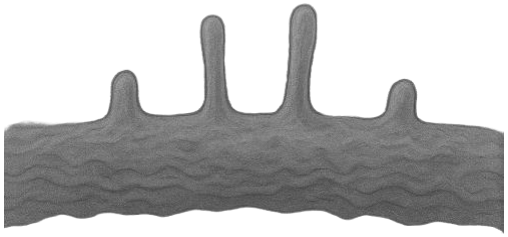
Design and carry out an investigation on how solution D affects the cell membrane to prevent damage by pesticide A and assess its potential use together with solution D.

Item 2

Many goats in Karama parish would take a long time to fatten, to the dismay of many commercial goat farmers in the area. The farmers requested a team of scientists to carry out an investigation and recommend ways of decreasing the duration the goats required to fatten.

The scientists suspected poor nutrient absorption and low cardiac output. They then formulated an oral solution that would improve the structures of the organs to permit a high nutrient absorption in the ileum and cardiac output. As part of ethical practices, they administered the oral solution to rats in the laboratory for five months to test for its effectiveness. They obtained rats of the same age, sex, health condition and divided them into two groups. Those of group A were not administered with the oral solution and those of group B were provided with the oral solution.

You have been provided with a freshly killed rat from group B, a light microscope, a dissection kit, an image of the ileum of a 250g rat from group A observed under medium power of a light microscope and measurements of the external sizes of its heart chambers.



Chamber	Measurement
Left atrium	25mm
Left ventricle	6.0mm
Right atrium	3.5mm
Right ventricle	4.0mm

Figure 1: Photomicrograph of the rat ileum villus structure of a rat from group A, viewed under a medium-power objective lens (×10).

You are required to investigate the effect of the oral solution on the histology of the ileum and the relative external sizes of the heart chambers.

Task.

Design and carry out an investigation to evaluate the effectiveness of the oral solution and advise the farmers on whether to adopt the use of the solution or not. Your design should include planning, methods of data collection, data presentation, and analysis of results and recommendation.

Advanced instruction for practical paper: Pesticide A is Glucose solution; solution D is pawpaw juice; beetroots, cork borer, knife, two boiling tubes;)

ASSESSMENT RUBRICS FOR SAMPLE BIOLOGY PAPER II (PRACTICAL)

SET 1

ITEM 1

Output	**Basis of Assessment**	**LEVELS OF ASSESSMENT**				
		Score 5	**Score 4**	**Score 3**	**Score 2**	**Score 1**
Scientific report	**Planning**	Formulates a clear, testable aim; develops a hypothesis linking pawpaw juice to reduced beetroot membrane permeability; identifies all variables (independent, dependent, controlled) and lists all required materials. Planning reflects a deep understanding of the investigation.	States a clear aim and hypothesis; identifies most variables and materials; planning shows good understanding with minor omissions.	States a clear aim; identifies key variables and some materials; planning shows basic understanding of the investigation.	States a general aim; identifies one or two variables or materials; planning shows limited understanding.	Mentions a general topic or aim with minimal identification of variables or materials; shows very limited understanding.

	Risks and Mitigations	Identifies all significant risks (handling chemical A, sharp instruments, pigment staining), explains the potential impact of each, and proposes practical, effective mitigation strategies.	Identifies major risks and proposes relevant mitigation strategies; explanation of risk impact may be partial or slightly incomplete.	Identifies some possible risks; proposes general or vague mitigation measures; explanation of impacts is limited.	Mentions at least one risk; mitigation and explanation are minimal or unclear.	Identifies a general hazard; no mitigation or explanation provided.
	Procedure	Designs a detailed, logical, repeatable step-by-step procedure controlling all key variables (disc size, exposure time, temperature); uses all materials correctly; procedure ensures valid and reproducible results.	Designs a coherent procedure controlling most important variables; uses most materials appropriately; minor omissions in controls or sequencing.	Outlines a workable procedure; controls some variables; uses some materials correctly; procedure shows basic logical flow.	Provides a partial or simple procedure; weak control of variables; sequencing may be inconsistent.	Lists minimal steps; procedure is incomplete, illogical, or unlikely to produce valid results..
	Data Presentation	Records all measurements accurately; presents data systematically in tables and/or graphs with correct titles, labels, and units; includes relevant qualitative	Presents data clearly with minor errors; most units, labels, and titles correct; includes some qualitative observations.	Records and presents relevant data; some errors or omissions in units, labels, or qualitative observations.	Records partial or inconsistent data; presentation is incomplete or poorly labelled; qualitative	mal or inaccurate ation is missing or alitative absent.

		observations (e.g., pigment leakage, copper reduction results); presentation supports analysis.			observations limited.	
	Analysis and Recommendation	Analyses data thoroughly to identify patterns (e.g., reduction of membrane permeability with pawpaw juice); draws valid, evidence-based conclusions; provides strong, justified recommendations on the use of pawpaw juice as an organic pesticide.	Analyses data to identify patterns; draws meaningful conclusions; provides recommendations with partial evidence support.	Identifies patterns; draws basic conclusions; recommendations are incomplete or partially supported.	Identifies minimal patterns; draws weak or unclear conclusions; recommendations absent or unsupported.	Provides no valid analysis, explanation, or recommendation; patterns are not identified.

ITEM 2

Basis of Assessment / Output	Score 5	Score 4	Score 3	Score 2	Score 1
Planning	Clearly states aims, hypothesis, and expected outcome linking the ileum and heart structure to nutrient absorption and cardiac output. Lists all materials, ethical precautions, and logical steps for both investigations.	States clear aims and outlines logical steps with most materials and safety points identified. Relates the investigation to nutrient absorption and circulation.	Gives a general aim or purpose and a partial list of materials or steps; limited link between structures and functions.	Gives vague aim or disorganized plan; omits key steps or materials; unclear relationship to investigation purpose.	No clear aim, poor organization, missing materials or procedure; no connection to purpose.
Methods of Data Collection / Procedure	Follows a systematic, accurate procedure for both ileum and heart investigations. The sequence is logical and scientifically sound. Includes mitigations of risks.	Procedure generally correct and logical with minor omissions. Includes mitigations of risks.	The procedure is partly correct but lacks detail or misses one key component (either heart or ileum).	Incomplete or partly incorrect method; limited procedural understanding.	Procedure absent, largely incorrect, or unrelated to the investigation.

Observations / Results / Drawings / Data Presentation	Records accurate, detailed, and well-organized data. Produces a neat, correctly labelled diagram of the ileum (villi, epithelium, goblet cells, layers). Presents heart chamber measurements in a clear table with correct units and magnification.	Observations are clear and factual; diagram well-labelled but slightly less detailed; measurement table mostly correct and includes units.	Some relevant observations: diagram present but missing some key labels or poor proportion; data table incomplete or partially incorrect.	Few relevant observations: rough or incorrect diagram; limited or disorganized data presentation.	No accurate observation; missing diagram and table; information irrelevant or copied.
Data Analysis / Explanation / Suitability	Provides comprehensive scientific interpretation linking structural features to function (e.g., taller villi → increased absorption; larger LV → higher cardiac output). Correctly relates findings to improved fattening in goats. Uses accurate terminology.	Good interpretation with minor conceptual gaps; links to function are mostly accurate and relevant to goat fattening.	Partial interpretation; some correct relationships, but reasoning is incomplete or lacks scientific depth.	Weak or vague explanation; uses general statements with minimal biological linkage or errors in reasoning.	No scientific explanation; reasoning absent, incorrect, or irrelevant.

GRADE DESCRIPTORS

1. **Construct 1**

GRADE	SCORE RANGE	DESCRIPTOR
E	4-6	Identifies cells or tissues and mentions basic life processes without linking structure, organisation, or gene activity.
D	7-9	Describes basic structures of cells and tissues and outlines simple processes of energy release and cell division.
C	10-13	Explains functions of cells, tissues, and biomolecules in ATP production, cell division, and protein synthesis, showing their role in maintaining life.
B	14-17	Analyses linkages among cells, tissues, and biomolecules, explaining how organisation and gene expression regulate energy production and biological function.
A	18-20	Evaluates how cell and tissue structures, biomolecules, energy systems, and gene expression interact across levels of organisation to sustain life, and applies this knowledge to genetics and health solutions.

2. **Construct 2**

GRADE	SCORE RANGE	DESCRIPTOR
E	4-6	Identifies a few plant structures or processes with major inaccuracies and no clear linkage to photosynthesis or yield.
D	7-9	Explains main features of plant structure, photosynthetic pathways, and environmental effects with partial accuracy and limited application to yield improvement.
C	10-13	Evaluates minimal plant structures and physiology, adaptations, environmental effects on photosynthesis, growth, photoperiodism, and hormonal regulation, to inform minimal sustainable practices that improve crop yield and food security.
B	14-17	Evaluates some plant structures and physiology, adaptations, environmental effects on photosynthesis, growth, photoperiodism, and hormonal regulation, to inform some sustainable practices that improve crop yield and food security.
A	18-20	Evaluates plant structure and physiology, including C_3 and C_4 adaptations, environmental effects on photosynthesis, water-use

		adaptations, growth, photoperiodism, and hormonal regulation, to inform sustainable practices that improve crop yield and food security.”

3. Construct 3

GRADE	SCORE RANGE	DESCRIPTOR
E	4-6	Identifies a few sensory organs or physiological processes with limited accuracy, and demonstrates minimal understanding of adaptive behaviours or their relevance to health and welfare
D	7-9	Explains the main features of animal sensory organs and systems, identifies key physiological processes, and recognises some adaptive behaviours, with a partial understanding of their role in health and survival.
C	10-13	Evaluates limited animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing physiological processes, adaptive behaviours, and their role in survival, to inform limited health decisions and promote animal welfare
B	14-17	Evaluates some animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing physiological processes, adaptive behaviours, and their role in survival, to inform some health decisions and promote animal welfare
A	18-20	Evaluates animal sensory organs and systems (circulatory, nervous, immune, and homeostatic) by analysing physiological processes, adaptive behaviours, and their role in survival, to inform health decisions and promote animal welfare

4. Construct 4

GRADE	SCORE RANGE	DESCRIPTOR
E	4-6	Demonstrates minimal understanding of genetic, evolutionary, or ecological concepts and fails to propose strategies for sustainability.
D	7-9	Shows limited analysis of genetic or ecological factors and proposes weak or incomplete strategies for managing invasive species, food security, or climate change.

C	10-13	Analyses some genetic and ecological factors and suggests moderately sustainable strategies for managing invasive species, food security, and climate change
B	14-17	Accurately analyses genetics, evolution, and ecology, linking major aspects to develop generally sustainable strategies, though with less depth, integration, or justification than Level 5.
A	18-20	Thoroughly evaluates genetics, evolution, and ecological interactions, integrating all aspects to develop well-justified, fully sustainable strategies addressing invasive species, food security, and climate change.