Educan
Values Beyond School

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TOPIC 1: CELL BIOLOGY

Competency: *The learner evaluates cells and tissues, by analysing and relating their structure to function, as a basis for medical research in order to improve health.*

Subtopic 1: **Microscopy**

Learning outcome: *By the end of this section, learners must be able to operate a light microscope to observe tissues from plants and animals under different magnifications*

Contents

- Using / operating a light microscope and precautions taken when handling
- Units of measurement in microscopy
- Microscope slide preparation
- Observation of plant (Onion epidermis / leaf epidermis) and animal (cheek) cells under low and medium power of the microscope
- Calculation of linear magnification of cells observed in a light microscope

Subtopic 2: **Ultra structure of plant, animal and bacterial cells**

Learning outcome: *By the end of this section, learners must be able to analyse the ultrastructure of animal/ plant cells, bacterial cells, and the plasma membrane, to distinguish prokaryotic and eukaryotic cell characteristics.*

Contents:

- Discovery of cells
- Classification of cells basing on complexity (Prokaryotic and eukaryotic cells), with examples
- Ultra structure and function of bacterial cell
- Ultra structure and function of plant and animal cells
- Fluid mosaic model of the plasma membrane structure and how it relates to function

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Subtopic 3: **Chemicals of life**

Learning outcome: *By the end of this section, learners must be able to analyse the properties and functions of chemical compounds (water, lipids, proteins including enzymes from mammals) in a cell, focusing on their roles in maintaining cellular structure and metabolic processes in living organisms*

Contents

- Role of water in organisms, its interaction with polar and non-polar substances. (*Thermal properties not required*)
- Role of simple lipids (*lipids with only fatty acids and glycerol e.g. triglycerides, waxes*) and conjugated lipids (*lipids with additional functional groups e.g. phospholipids, glycolipids, lipoproteins*) in cell structure and function in the body of organisms.
- Structural and functional roles of proteins in cells
- Mechanisms of enzyme activity (lock and key & induced fit)
- Enzyme Inhibition and its commercial application
- Dissection of a rat / rabbit to extract stomach, salivary glands, ileum, and duodenum, and make extracts from them. Design and carry out scientific investigations on enzyme substrate specificity, effects of inhibitors, substrate, and enzyme concentrations on enzyme-controlled reactions, and write a scientific report.

Subtopic 4: **Tissues**

Learning outcome: *By the end of this section, learners must be able to 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.*

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Contents

- Structure, cell arrangement and function of simple plant tissues (*parenchyma, collenchyma, sclerenchyma)*
- Structure, cell arrangement and function of compound plant tissues (xylem and phloem tissues)
- Structure, cell arrangement and function of animal tissues (*epithelial, cardiac, areolar, fibrous, and skeletal*)
- Analysis of micrographs of healthy tissues from the internal organs (*liver, lungs, heart, or intestines*) of a rat, with images of micrographs of diseased tissues from the same organs, with implications.

TOPIC 2: **NUTRITION IN PLANTS**

Competency: *The learner evaluates the nutritional strategies of carbon three (C3) and carbon four (C4) plants by analysing their photosynthetic pathways and adaptation to environmental conditions so as to optimise agricultural productivity and food security under varying climatic conditions*

Subtopic 1: **Photosynthesis in C_3 and C_4 plants**

Learning outcome: *By the end of this section, learners must be able to evaluate the relationship between the structure of chloroplast and photosynthesis in C_3 and C_4 plants*

Contents

- Ultra structure and function of the plant chloroplast
- The process of photosynthesis (*Light dependent and light independent reactions*) in C_3 and C_4 plants
- Advantages of C_4 plants over C_3 plants in terms of photosynthetic efficiency
- Synthesis of proteins and lipids, using intermediates (ATP, NADPH, G_3P) of reactions of photosynthesis

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Subtopic 2: **Influence of environmental factors on photosynthesis**

Learning outcome: *By the end of this section, learners must be able to assess the influence of environmental factors on the photosynthetic efficiency of plants to optimise photosynthetic rates and crop yields*

Contents

- Principle of operation of a green house in crop production
- Investigations on behaviour of guard cells in varying sucrose concentrations.
- Photosynthetic theory of stomatal closure and opening
- Distribution and abundance of C_3 and C_4 plants at different altitudes, temperatures, and oxygen concentrations

TOPIC 3: **TRANSPORT IN HUMANS**

Competency: *The learner appreciates the mechanisms of transport of substances in the blood, and the immune system's role in protecting the human body by analysing the processes and their role in the maintenance of human health, to prevent diseases in everyday life.*

Subtopic 1: **Transport of gases in humans**

Learning outcome: *By the end of this section, learners must be able to 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*

Contents

- Role of the heart in blood circulation
- Nervous control of the cardiac cycle and heartbeat
- Transport of oxygen and carbon dioxide in the body
- Factors that affect amount of oxygen carried by blood (*Haemoglobin content, level of activity, habitat, body temperature, altitude, oxygen partial pressure*) and oxygen dissociation curves
- Effect of carbon monoxide on oxygen transportation
- Effect of exercise and altitude on heart rate and oxygen transport

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Subtopic 2: **Immunity in humans**

Learning outcome: By the end of this section, learners must be able to analyse the role of antibodies in vaccination and allergic reactions in relation to human body immunity

Contents

- Types of immunity (*Innate and adaptive*)
- The concept of vaccination and immunization
- Allergic body reactions and the role of histamine
- New-born haemolytic disease and Rhesus compatibility of couples on the baby
- Structure and mode of action of antibodies
- Mechanism used in rapid test kits to detect infections

TOPIC 4: **RESPIRATION**

Competency: *The learner appreciates how living organisms generate cellular energy, by analysing respiratory processes and the chemical breakdown of food within cells, to make informed decisions that promote good health and wellbeing.*

Subtopic 1: **Mitochondrion Structure and Function**

Learning outcome: *By the end of this section, learners must be able to examine the relationship between the structure of the mitochondrion and the stages of cellular respiration in living organisms.*

Contents

- Ultra structure of the mitochondrion
- How the ultra-structure of the mitochondrion is related its function
- How the ATP molecule releases energy / how does it do work

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Subtopic 2: **Process of ATP Production**

Learning outcome: *By the end of this section, learners must be able to analyse the biochemical processes leading to ATP production in living organisms, and how these processes are affected by physical activities and respiratory poisons (cyanide).*

Contents

- Process of glycolysis (*Key stages, molecules involved and their significance*)
- Role of acetyl coenzyme A (acetyl-CoA) in the metabolism / synthesis of carbohydrates, lipids, and proteins.
- Citric acid cycle / Krebs cycle (*focus on key steps i.e., substrate-level phosphorylation, decarboxylation, and the production of NADH and $FADH_2$).*
- Electron transport system / chain (*Focus on role of protein complexes, NADH, $FADH_2$, and oxygen*)
- Role of cyanide / respiratory poison on electron transport and ATP production
- Effect of exercise intensity on ATP production

TOPIC 5: **HOMEOSTASIS**

Competency: *The learner evaluates the regulation and maintenance of optimal internal environment in living organisms by analysing how organ systems generate and eliminate metabolic wastes and maintain the functioning of cells, to make life choices that promote wellness.*

Subtopic 1: **Negative Feedback Mechanisms**

Learning outcome: *By the end of this section, learners must be able to analyse the homeostatic control system, focusing on the role of negative feedback mechanisms in maintaining internal stability*

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Contents

- Significance of maintaining a stable internal environment.
- Components of an efficient homeostatic system.
- Physiological and behavioural adaptations of endotherms to survive in varying temperature conditions
- Temperature regulation in endotherms (*role of the hypothalamus, thermoreceptors and skin in regulating temperature*)
- Water stress and how it is managed (*role of ADH in water balance*)
- Adaptation of animals to different water availability environments (*kangaroo rat, our old friend – the desert camel*)

Subtopic 2: **Osmoregulation**

Learning outcome: *By the end of this section, learners must be able to examine the adaptations and management of different plant categories (xerophytes, mesophytes, and hydrophytes) based on their osmoregulatory abilities and the application of excretory plant products in everyday life*

Contents

- Classification of plants basing on their water requirements (*xerophytes, mesophytes, and hydrophytes*)
- Adaptation of plants to varying water availability in their habitat
- Harnessing excretory products from plants (*uses of latex, anthocyanins, oils, quinine, and saponins in everyday life*)

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TOPIC 6: **COORDINATION**

Competency: *The learner assesses the physiological and behavioural processes during organisms' responses to internal and external stimuli, in order to appreciate the adaptive behaviour of organisms and, therefore, promote their welfare to ensure survival and reproductive success.*

Subtopic 1: **Plant Hormones and Responses**

Learning outcome: *By the end of this section, learners must be able to examine the role of plant hormones in tropisms, photoperiodism, and the application of these processes in agricultural practices*

Contents

- Tropisms (*emphasis on phototropism and geotropism*)
- Role played by Gibberellins, cytokinins, Abscisic Acid, and Ethylene in plant growth regulation and their commercial applications
- Effect of ethylene on raw fruits and its commercial application
- Effect of change in day length (photoperiodism) on flowering and its application in floriculture

Subtopic 2: **Impulse Transmission**

Learning outcome: *By the end of this section, learners must be able to 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.*

Contents

- Structure and function of a neurone
- Ionic theory of impulse transmission
- Factors affecting transmission speed
- Impulse transmission across chemical synapses (Inhibitory and excitatory)
- Effect of anaesthetics at synapses

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Subtopic 2: **Sensory Receptors**

Learning outcome: *By the end of this section, learners must be able to 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.*

Contents

- Types and properties of sensory receptors
- Structure and function of the mammalian retina, distribution of photoreceptors (rods and cones) and its significance
- Role of the ear in maintaining balance during position and movement (*emphasis on vestibular apparatus*)

Subtopic 3: **Animal Behaviour**

Learning outcome: *By the end of this section, learners must be able to examine the adaptive significance of diverse animal behaviour in promoting survival and reproductive success*

Contents

- Features and significance of innate / inborn behaviour in survival and reproduction
- Features and significance of learned behaviour in survival and reproduction
- Comparison between innate and learned behaviour
- Evolutionary advancements in behavioral patterns of animals

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TOPIC 7: INHERITENCE AND EVOLUTION

Competency: *The learner appreciates the transmission of traits from one generation to the next, and the mechanisms that drive change in a gene pool, by analysing the concepts of inheritance and evolution, so as to make informed decisions regarding inheritable conditions, for genetic engineering, conservation biology, and health.*

Subtopic 1: Nucleic Acids Structure and Function

Learning outcome: *By the end of this section, learners must be able to 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*

Contents

- Structure and function of Deoxyribonucleic acid (DNA)
- Structure and function of Ribonucleic acid (RNA)
- Structure of the chromosome
- Base pairing rules in DNA and RNA
- DNA replication (semi-conservative model)
- Protein synthesis
- Nuclear and cell division (Mitosis and meiosis)
- Cancer cause risk factors, prevention and management
- Relationship between cell division and cancer

Subtopic 2: Gene Technology

Learning outcome: By the end of this section, learners must be able to assess gene technology techniques, their applications in various fields, and the associated ethical implications

Contents

- Recombinant DNA technology technique
- Gene cloning technique

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- Polymerase Chain Reaction (PCR)
- Application of gene technology techniques in genetically modified organisms (GMOs), synthetic insulin production, and vaccine development.
- Ethical, social, and environmental implications of gene technology, particularly GMOs

Subtopic 3: **Mendelian and Non-mendelian Inheritance**

Learning outcome: *By the end of this section, learners must be able to apply Mendelian principles to predict inheritance patterns and utilise mathematical models to analyse allele frequencies and genotype distributions within populations.*

Contents

- Mendel's first law of genetics (*law of segression*)
- Mendel's second law of genetics (*law of independent assortment*)
- Relationship between Mendel's laws and meiosis (*explanation of Mendel's laws of genetics using meiosis*)
- Hardy-Weinberg principle and factors that upset the genetic equilibrium

Subtopic 4: **Allele Interactions**

Learning outcome: *By the end of this section, learners must be able to examine different forms of allele interactions (autosomal linkage, multiple alleles, codominance and incomplete dominance), including their examples and influence on phenotypic expression.*

Contents

- Genetic diagrams to demonstrate allele interactions and their influence on phenotypic expression (*emphasis on autosomal linkage, multiple alleles, codominance and incomplete dominance*)
- The 3:1 second filial generation dihybrid linkage ratio

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Subtopic 5: **Evolutionary Advancements in Life processes in Animals**

Learning outcome: *By the end of this section, learners must be able to 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*

Contents

Significance of evolutionary advancements in;

- Circulation,
- Reproduction,
- Gaseous exchange
- Coordination
- Movement,
- Excretion

Subtopic 6: **Speciation and Extinction**

Learning outcome: *By the end of this section, learners must be able to assess speciation and resistance, mechanisms driving them, and factors contributing to extinction events, through comparison of historical and contemporary examples*

Contents

- Isolation mechanisms and speciation
- Factors that lead to extinction of species
- Anti-microbial and pesticide resistance, how they arise and how to manage them
- Key events, causes and effects of mass extinctions and contribution to evolution

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TOPIC 8: GROWTH IN PLANTS AND DEVELOPMENT IN INSECTS

Competency: *The learner justifies changes in the size and complexity of plants and insects, through data analysis of research findings, in order to develop strategies to improve agricultural productivity and environmental sustainability.*

Subtopic 1: Growth in Plants

Learning outcome: *By the end of this section, learners must be able to analyse the pre- and post-germination stages during the growth and development of plants in relation to their significance in crop production.*

Contents

- Seed dormancy and seed banks
- Factors affecting and measurement of growth
- Primary and secondary growth
- Investigation of cell size in the different regions of young dicotyledonous root and shoot using light microscope

Subtopic 2: Insect Development

Learning outcome: *By the end of this section, learners must be able to analyse the role of insect growth stages in ecosystems, focusing on their contributions to waste management, food security, and water quality assessment*

Contents

- Waste management
- Food security
- Water quality assessment
- Indicator species

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TOPIC 9: **ECOLOGY**

Competency: *The learner evaluates the interactions within ecosystems by analysing data and personal experiences to develop strategies for enhancing food security and promoting sustainable management of natural resources.*

Subtopic 1: **Population Ecology**

Learning outcome: *By the end of this section, learners must be able to analyse population dynamics and the factors affecting them in different ecosystems*

Contents

- Population characteristics
- Population growth
- Factors affecting population density
- Estimation of population density in different ecosystems (*emphasis on quadrats and capture-recapture techniques*)

Subtopic 2: **Succession and Ecological Restoration**

Learning outcome: *By the end of this section, learners must be able to analyse the processes of ecological succession and strategies for effective ecological restoration practices in diverse environments*

Contents

- Role of primary and secondary succession in preserving biodiversity
- Techniques and benefits for restoring degraded ecosystems
- Small-scale restoration project on a degraded area within or around the school.

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Subtopic 3: **Energy Flow in the Ecosystem**

Learning outcome: *By the end of this section, learners must be able to examine the concept of energy flow through ecosystems, its role in maintaining ecosystem stability, and the impact of human activities on energy flow.*

Contents

- Concept of energy flow in the ecosystem
- Effect of human activities on energy flow
- Significance of bio-accumulation its relation to energy transfer and on health of organisms in the ecosystem
- Significance of biomagnification, its relation to energy transfer and on health of organisms in the ecosystem
- Application of feed conversion ratios (*scientific investigation on feed conversion ratio in a small mammal (rat or rabbit) using different diets*)

Subtopic 3: **Concept of Carbon Footprint**

Learning outcome: *By the end of this section, learners must be able to 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.*

Contents

- Concept of carbon footprint and its measurement
- Activities that contribute to carbon output and key sources of greenhouse gas emissions.

Subtopic 4: **Invasive Species**

Learning outcome: *By the end of this section, learners must be able to examine the impact of invasive species on native biodiversity, ecosystems, and economies, as well as strategies for their management and control.*

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Contents

- Characteristics of invasive species
- Impacts of invasive species on native biodiversity, ecosystems, and economies
- Strategies to manage and control the invasive species
- Benefits of biological control over pesticides

Subtopic 5: **Food Security**

Learning outcome: *By the end of this section, learners must be able to analyse the concept of food security, focusing on its components and sustainable agricultural practices to address its challenges*

Contents

- Components of food security; availability, access, utilisation, and stability, and their role in maintaining a stable food supply
- Threats and solutions to food security
- Sustainable agricultural practices, and how they support food security

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KEY PRACTICAL AREAS

Microscopy

- Learners prepare slides, observe under low and medium power, and determine the linear magnification of the cells observed.
- Measure the field of view and estimate cell size
- Observe and discuss micrographs, images, prepared slides, or prepared slides of plant tissues, epithelial tissues, and connective tissues
- Analyse the structure and arrangement of cells in plant and animal tissues
- Investigate cell size in the different regions of a young dicotyledonous root or shoot
- Learners carry out scientific investigations on the behaviour of guard cells under varying sucrose concentrations, write a report including relevant drawings.

Physiology

- Learners dissect a small mammal and extract structures that contain enzymes (salivary glands, stomach, duodenum and ileum), and make extracts from them. Design and carry out scientific investigations on enzyme substrate specificity, effects of inhibitors, substrate, and enzyme concentrations on enzyme-controlled reactions, and write a scientific report. Scientific reports for coherence in all the sections (title, aim, hypothesis, methods, results, and discussion).
- Learners carry out scientific investigations on the behaviour of guard cells under varying sucrose concentrations, write a report including relevant drawings.

Animal anatomy and dissection (Rat)

- Dissect and extract sample tissues from a rat, make drawings of internal and external structures

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ABOUT EDUCAN

Educan Foundation is pioneering a transformative approach to education in Uganda and beyond, redefining the landscape of teaching and learning.

With a commitment to accessibility and quality, Educan Uganda has developed the Educan App, which provides free online educational resources tailored for both primary and secondary school students. The app encompasses a wealth of materials including comprehensive lessons, textbooks, topical books, revision notes, tests, Activities of Integration, End of Cycle items, Examinations with scoring guides, and past papers along with their solutions. This innovative platform not only democratizes access to quality education but also seeks to empower students through scholarships, consultancy services, and motivational content that inspires the youth to aspire for greatness.

Central to Educan Uganda's mission is the belief that education should be accessible to all, which is why the Educan App is available at a minimal annual membership fee of just 30,000 Ugandan shillings ($7.8). This nominal fee grants users unrestricted access to a treasure trove of educational materials and opportunities for coaching and assessments, whether conducted physically or online throughout the year! By removing financial barriers, Educan Uganda ensures that every student, regardless of background, has the tools necessary to thrive academically and personally. The app is user-friendly and can be easily downloaded from the Google Play Store or App Store, with a web-based version available for personal computer users.

In addition to its digital offerings, Educan Uganda is deeply committed to outreach programs and academic clinics designed to reach underserved communities, particularly in remote and hard-to-reach areas. Through these initiatives, Educan Uganda inspires the next generation to believe in their potential and equips them with the knowledge and skills required for their future endeavors. The company also conducts mentorship sessions for schools, teachers, and educational institutions, fostering a culture of continuous learning and professional development within the education sector.

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Core Values

- God fearing
- Team work
- Innovativeness
- Openness to diversity
- Professionalism

A Word from the Founders

Educan Uganda began as a spark of inspiration among a team of young, enthusiastic, and visionary science teachers. It was born not in grand offices or spacious boardrooms, but in the humble dormitories of Makerere University. At the time, we were just students, fueled by a shared dream to redefine education and its accessibility. What started as late-night discussions and endless brainstorming sessions has grown into a groundbreaking initiative that is changing lives across East Africa—and soon, the world at large.

The challenges we faced in our early days were many. Limited resources, countless obstacles, and an uphill battle against doubt could have dimmed our vision. But instead, these hurdles became the fuel for our fire. We knew there was a better way to educate, a way that wasn't limited by geography, infrastructure, or finances. We envisioned a school without walls, where knowledge could flow freely to every learner regardless of where they were or what we had.

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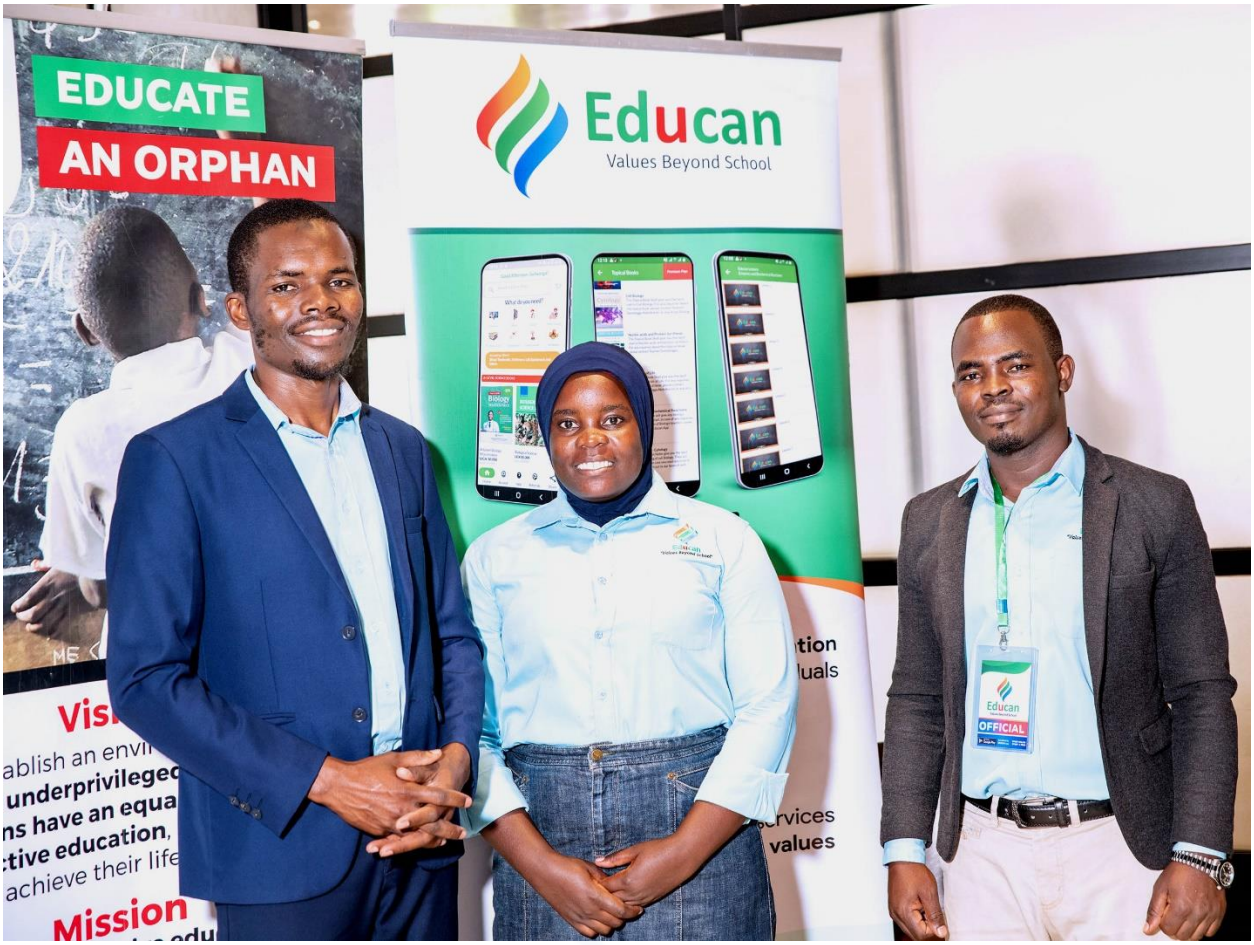
THE EXECUTIVE TEAM



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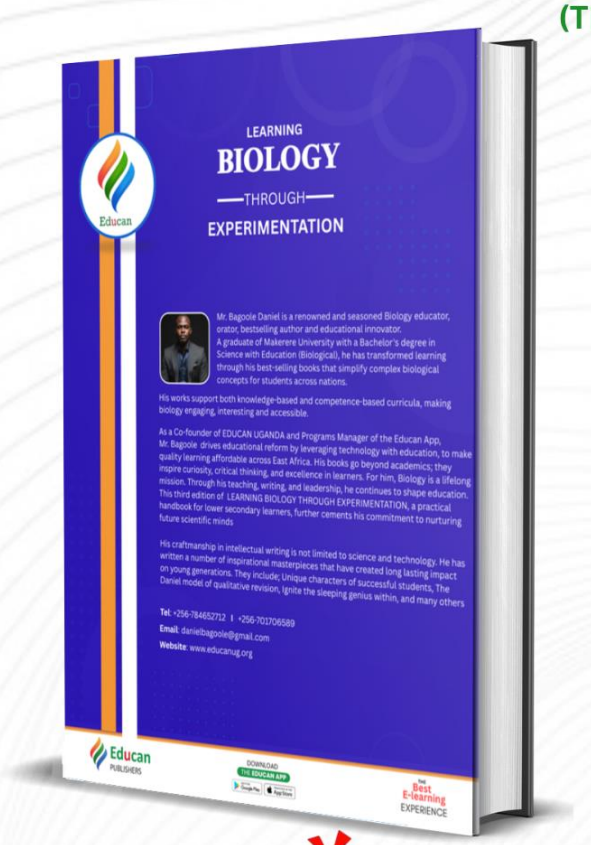
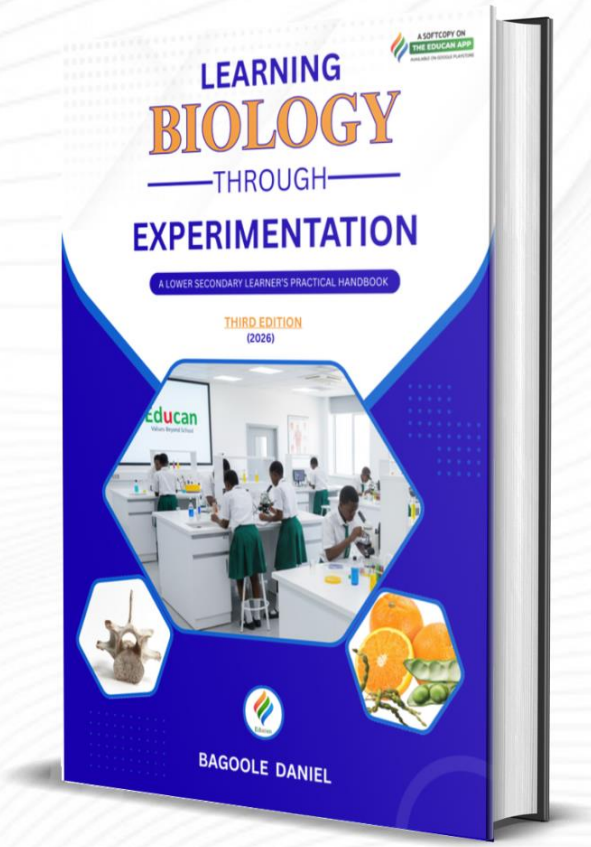
EDUCAN PUBLICATIONS

LEARNING BIOLOGY THROUGH EXPERIMENTATION

Lower Secondary Practical Workbook

(THE G.O.A.T)





Features

- An introductory section guiding learners on the scientific method and report writing, making accurate Biological drawings and the '**DOs**' and '**DONTS**' in Biology practical
- Each section within the two Elements of construct has well organised guiding practical notes, accurate drawings, worked out and scored items, and a series of practice items
- This practical mannual has constantly been reviewed and improved from 2019 update, by resourceful, reliable and seasonal facilitators of Biology practical 553/2/3

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NEW LOWER SECONDARY BIOLOGY MADE EASIER

Learners Revision Workbook

(ITEM BANK)

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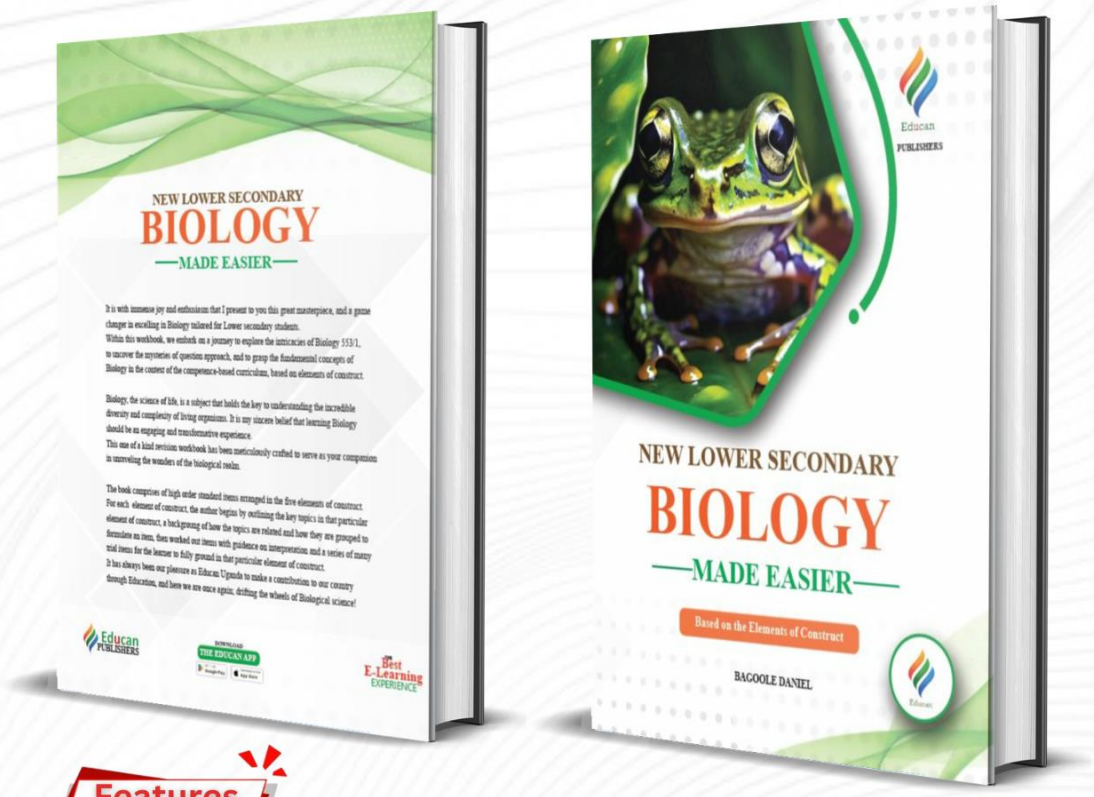

Features

- An introductory section dissecting the five Elements of construct in Biology 553/1, key aspects in each, format of examination the construct and approach to each
- Each section / Element of construct in enriched with worked out and scored items, and a series of standardised original End of Cycle practice Items for learner's practice
- Unmatched alignment and print quality of the book with utmost cover design, and waterproof scratch resistant book cover

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A NEW COMPETENCE BASED BIOLOGY

Learner's Textbook 1&2

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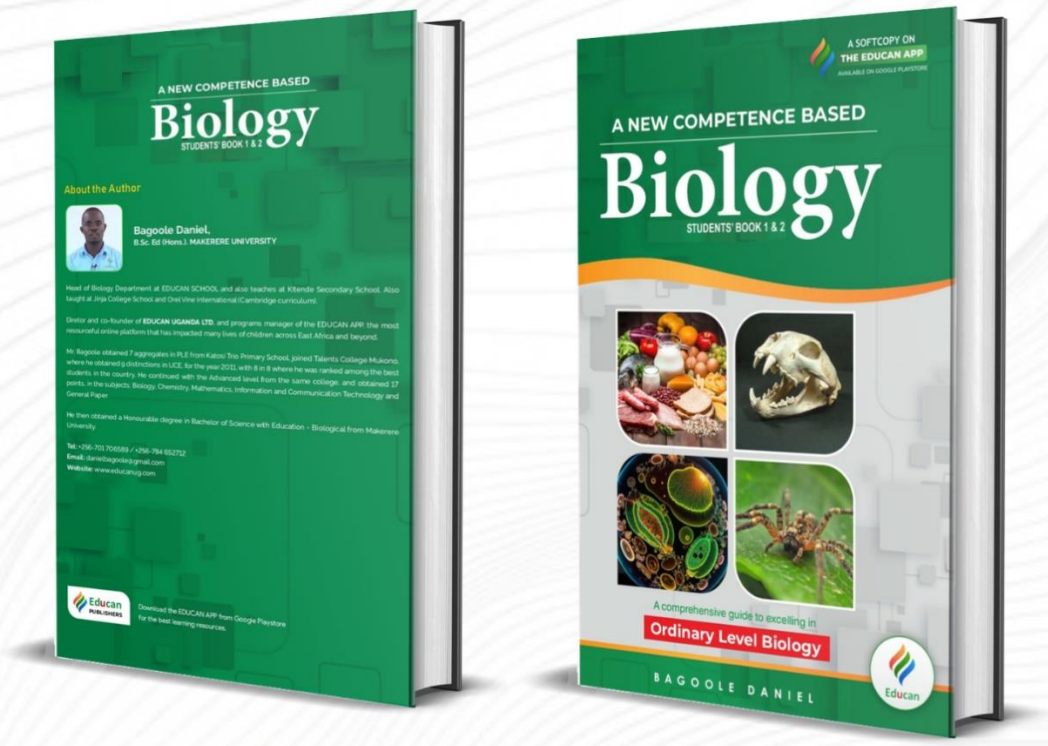

Features

- Carefully researched, organised and well presented class notes in line with the New lower secondary curriculum for S.1& S.2
- Amazing diagrams, images, graphs and natural photos to illustrate Biological structures, principles and trends
- Each topic starts with learning outcomes clearly quoted from the syllabus book to ensure consistency
- State of the art Educan standard print quality and cover design (water proof cover)

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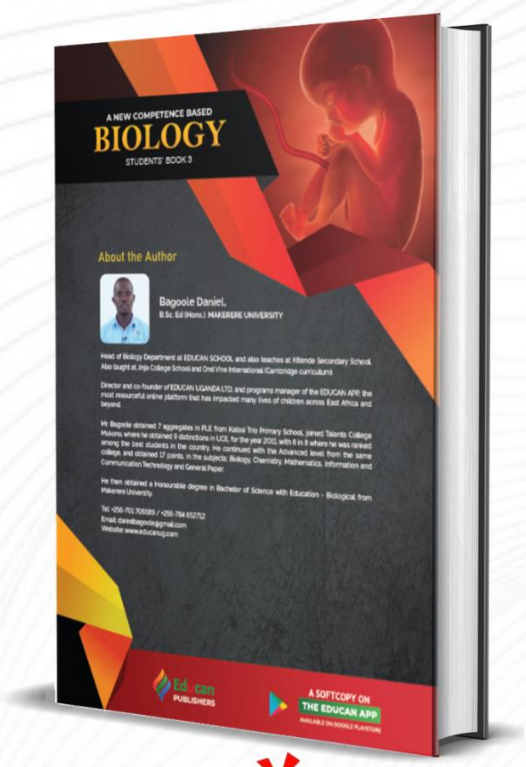

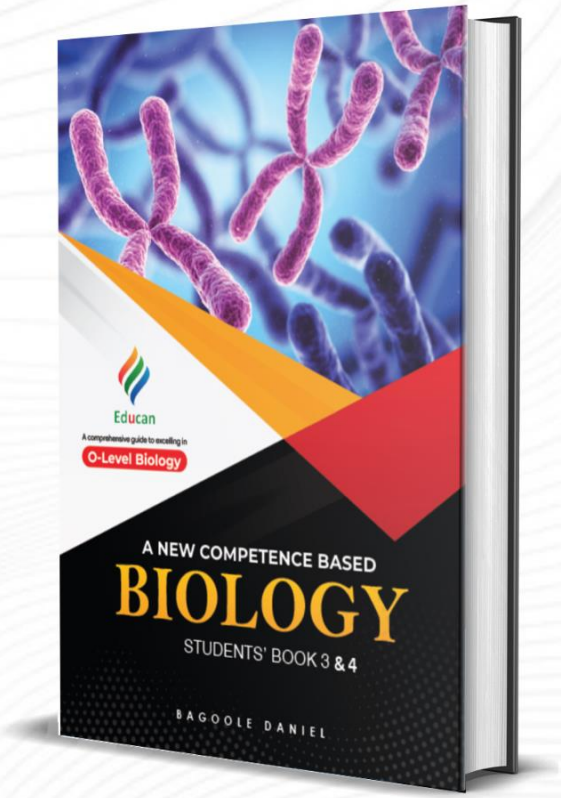

Features

- Carefully researched, organised and well presented class notes in line with the New lower secondary curriculum for S.3 & S.4
- Amazing diagrams, images, graphs and natural photos to illustrate Biological structures, principles and trends
- Each topic starts with learning outcomes clearly quoted from the syllabus book to ensure consistency
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LEARNING BIOLOGY THROUGH EXPERIMENTATION

(Advanced Level Practical Workbook)

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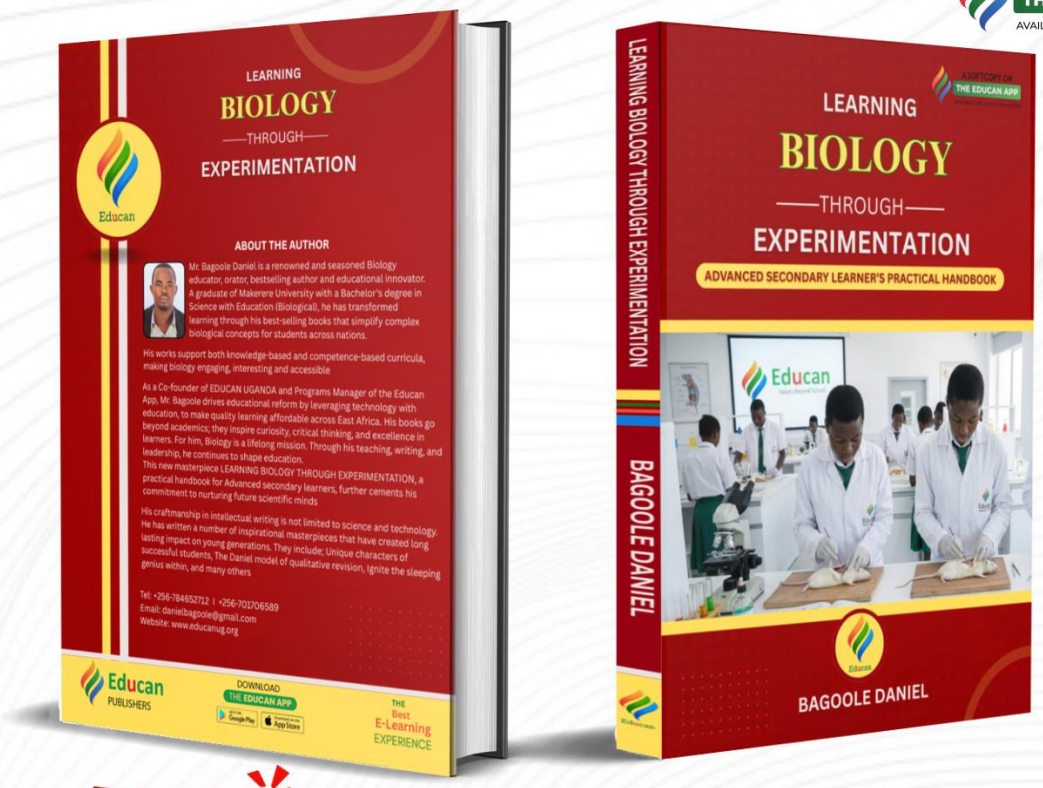

Features

- A complete introductory section guiding learners on scientifiic method of investigation and report writing
- Well researched, simplified guiding notes per section
- Neat and accurate drawings of examinable structures
- Worked out examples per section
- A series of standardised practice scenario items per section

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ADVANCED LEVEL BIOLOGY

Concepts & Connections

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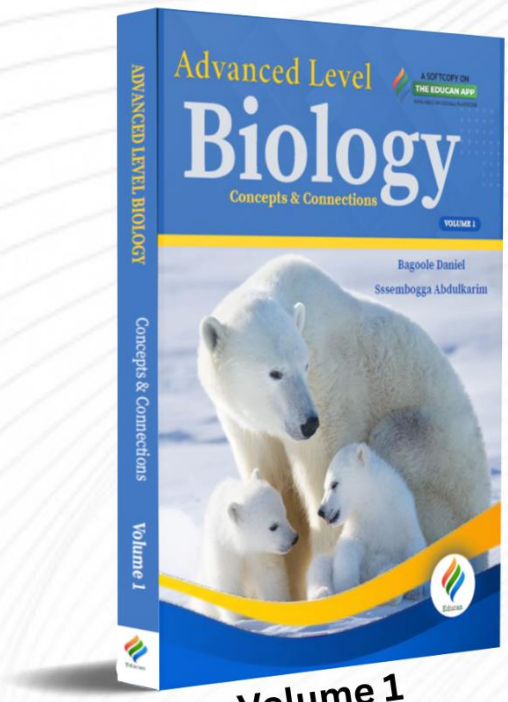
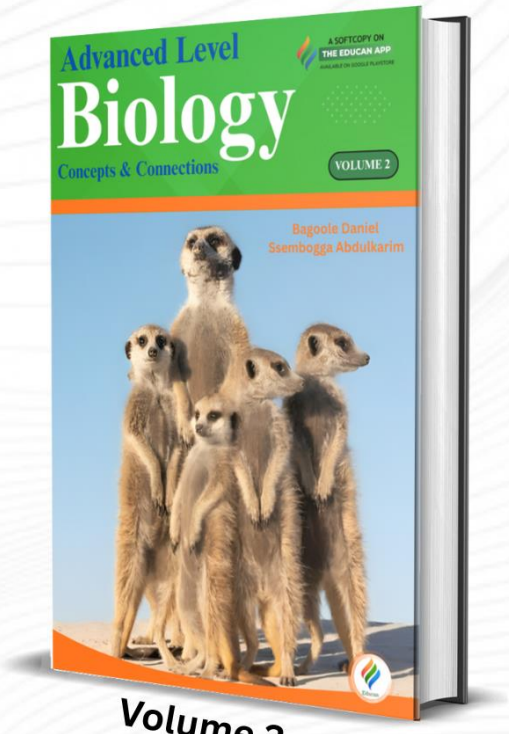


Volume 1



Volume 2

Features

- Carefully researched, organised and well presented class notes in line with the Advanced secondary curriculum
- Amazing diagrams, images, graphs and natural photos to illustrate Biological structures, principles and trends
- Each topic starts with learning outcomes clearly quoted from the syllabus book to ensure consistency
- State of the art Educan standard print quality and cover design (water proof cover)

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ADVANCED SECONDAR BIOLOGY MADE EASIER

Learner's Revision Workbook

(ITEM BANK)

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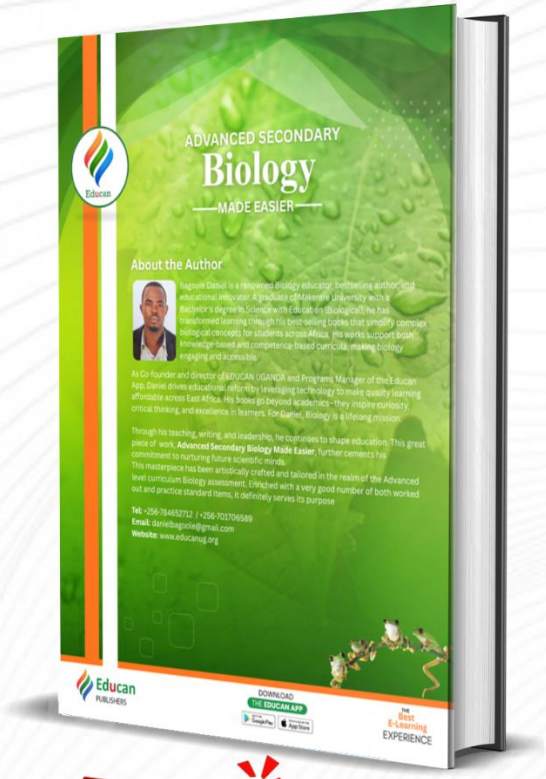

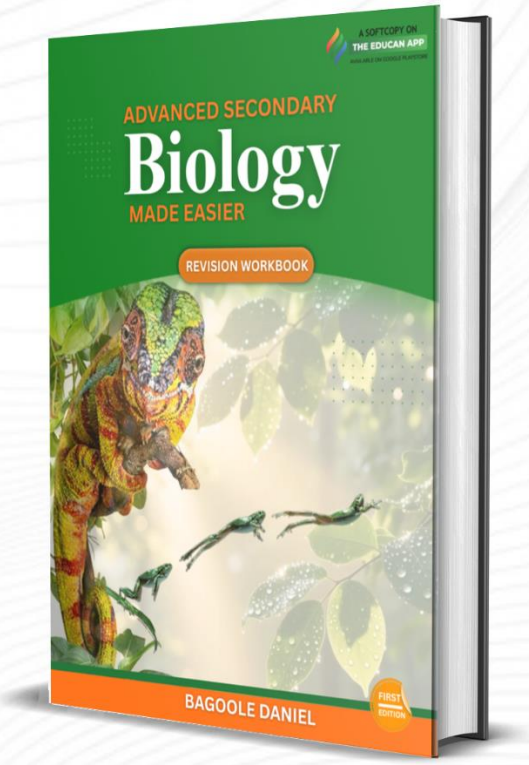

Features

- Items organised in four Sections (Elements of construct) based on Assessment Objectives
- Each section has four standardised completely worked out items in that E.O.C
- Each section has **10+** standardised End of Cycle Items for ample practice by learners
- A complete section guiding learners about paper structure, examination preparation, question approach and an award winning '**Daniel Model**', about how to excel in any exam

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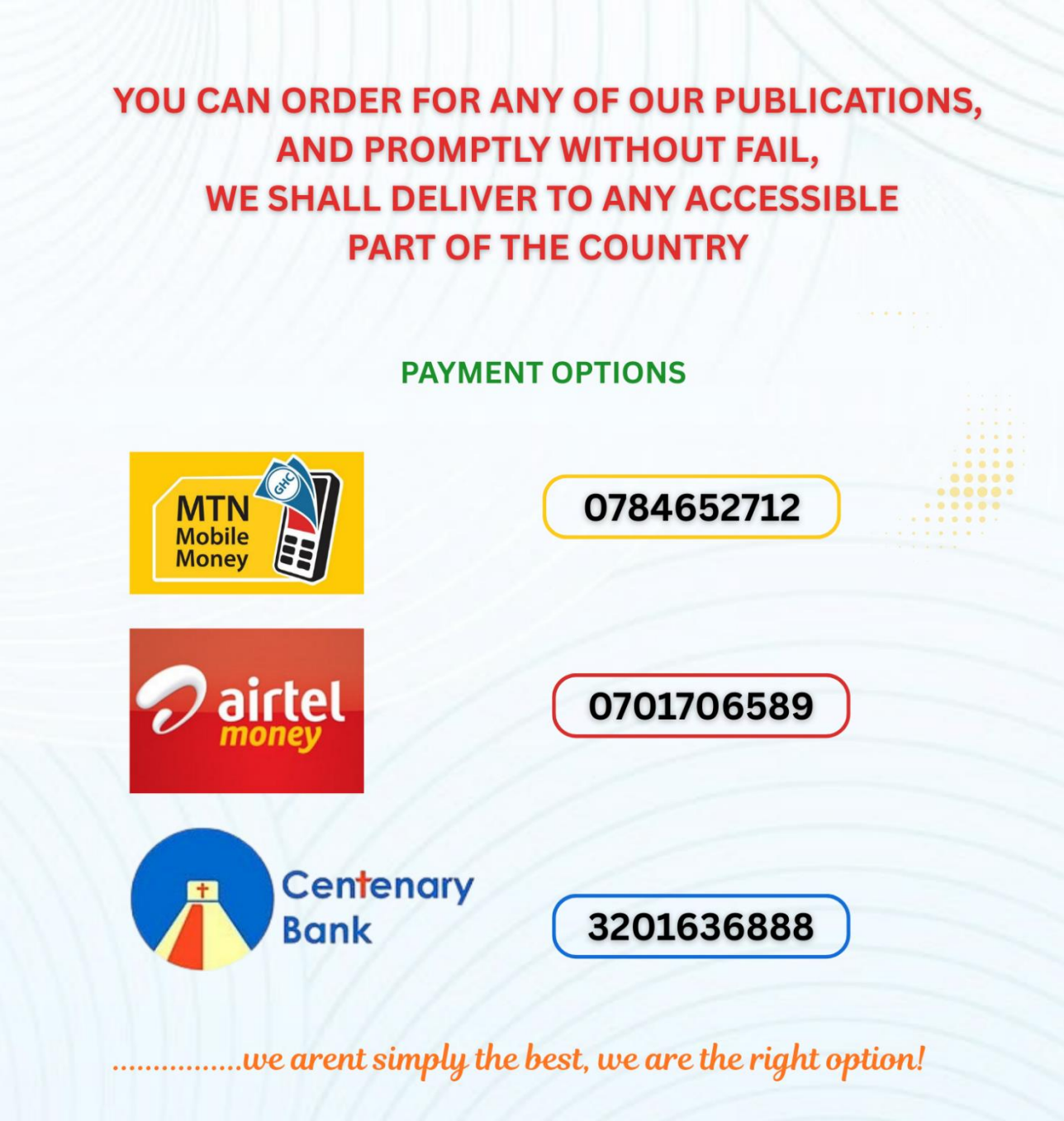

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Our Vision

To provide the world's best education experiences that empower individuals with values beyond school

Our Mission

To provide holistic education services that empower individuals to create sustainable societies

Our Slogan

Values Beyond School

Our Core Values

God fearing Team work Innovativeness Professionalism

Openness to diversity

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