



THE REPUBLIC OF UGANDA

Ministry of Education and Sports

Lower

Secondary

Curriculum



BIOLOGY SYLLABUS



NCDC

NATIONAL CURRICULUM
DEVELOPMENT CENTRE

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INTRODUCTION

The UNESCO Education Strategy (2014 – 2021) advocates for a humanistic and holistic vision of education as a fundamental human right that is essential to personal and socio-economic development. UNESCO further recommends, societies that are just, inclusive, peaceful and sustainable by 2030. The Uganda Vision 2040 aims to transform Uganda into a modern and prosperous country, while the NDP recognises the existing weaknesses in education, including the low efficiency and variable quality at the secondary level. The Sustainable Development Goal 4 advocates for inclusive and quality education, while the National Development Plan II focuses on enhancement of human capital, development, strengthening mechanisms for quality, effective efficient service delivery and improvement of quality and relevance of skills development. The NRM Manifesto (2016-2021), emphasises continuous assessment examination systems, strengthening soft skills, which promote self-esteem, conscientiousness and a generally positive attitude to work, promoting e-learning and computer literacy in order to enhance learning outcomes. All these are lacking and where they exist it is at a minimum level.

In alignment with the above, the Education and Sports Sector Strategic plan (2017/20) advocates for delivery of equitable, relevant and quality education for all. The current secondary school curriculum of Uganda, although highly regarded by some, is focused on the needs of a tiny academically oriented elite yet the needs of the majority of learners need to be the focus. The Ministry of Education and Sports (MoES) through the National Curriculum Development Centre (NCDC) therefore, undertook a review of the Lower Secondary Curriculum, aimed at providing a learning environment, opportunities, interactions, tasks and instructions that foster deep learning by putting the learner at the centre of the learning experience. This is in line with aims of secondary education in Uganda as outlined opposite.

The aims of secondary education in Uganda are to:

- Instill and promote national unity, an understanding of the social and civic responsibilities, strong love and care for others and respect for public property, as well as an appreciation of international relations and beneficial international co-operation;
- Promote an appreciation and understanding of the cultural heritage of Uganda including its languages;
- Impart and promote a sense of self discipline, ethical and spiritual values, personal and collective responsibility and initiative;

- Enable individuals to acquire and develop knowledge and an understanding of emerging needs of society and the economy;
- Provide up-date and comprehensive knowledge in theoretical and practical aspects of innovative production, modern management methods in the field of commerce and industry and their application in the context of socio-economic development of Uganda;
- Enable individuals to develop basic scientific, technological, technical, agricultural and commercial skills required for self-employment;
- Enable individuals to develop personal skills of problem solving, information gathering and interpretation, independent reading and writing, self improvement through learning and development of social, physical and leadership skills such as are obtained through games, sports, societies and clubs;
- Lay the foundation for further education;
- Enable the individual to apply acquired skills in solving problems of community, and to develop a strong sense of constructive and beneficial belonging to that community;
- Instill positive attitudes towards productive work and strong respect for the dignity of labour and those who engage in productive labour activities;
- Develop a positive attitude towards learning as a lifelong process.

BACKGROUND TO THE NEW CURRICULUM

The reform was based on the Education Sector Strategic Plan (ESSP), 2009 – 2018) which set out strategies to improve the quality and relevance of secondary education. The ESSP's sub-objective 2.2 was to ensure that "Post-primary students [are] prepared to enter the workforce and higher education". This is also in line with the current strategic plan of 2017-2020. To achieve this objective, one of the Ministry's strategies was to revise the curriculum and improve instruction and assessment by eliminating the short comings in the current curriculum.

The review focused on: producing a secondary school graduate who has the competences that are required in the 21st century; promoting values and attitudes; effective learning and acquisition of skills in order to reduce unemployment among school graduates.

The reform also aimed at reducing the content overload and contact hours in the classroom so as to create time for: research and project work; talent development and creativity; allowing for emerging fields of knowledge across all subjects and doing away with obsolete information. There was a need to address the social and economic needs of the country like the mining sector, tourism, services provision, science and technology development and to ensure rigorous career guidance programme to expose learners to the related subjects. This will enable learners to make informed choices as they transit and to equip them with knowledge and skills that will enhance their competitiveness in the global value chain.

To meet these requirements, the reforms are based on:

- The development of a holistic education for personal and national development based on clear shared values
- A commitment to higher standards, deeper understanding and greater opportunities for learners to succeed
- A focus on the key skills that are essential to work, to learning, and to life, and which will promote life-long learning
- An integrated and inclusive approach that will develop the ability to apply learning in practical situations.

The ESSP further outlines what the reforms imply:

"This reform will necessitate a sweeping revision of the general secondary curriculum, away from strictly academic learning objectives that are thought to prepare students for erudite higher education and towards a set of competencies that serve both those who continue their education after S4 and those who choose to enter the workforce. The new curriculum will enable learners to acquire specific vocational skills that they can use once they enter the world of work. The new curriculum will help learners make informed decisions as citizens and family members, and it will give those who continue with their education, either immediately in S5 or later in life, the learning skills they need to think critically and study efficiently."

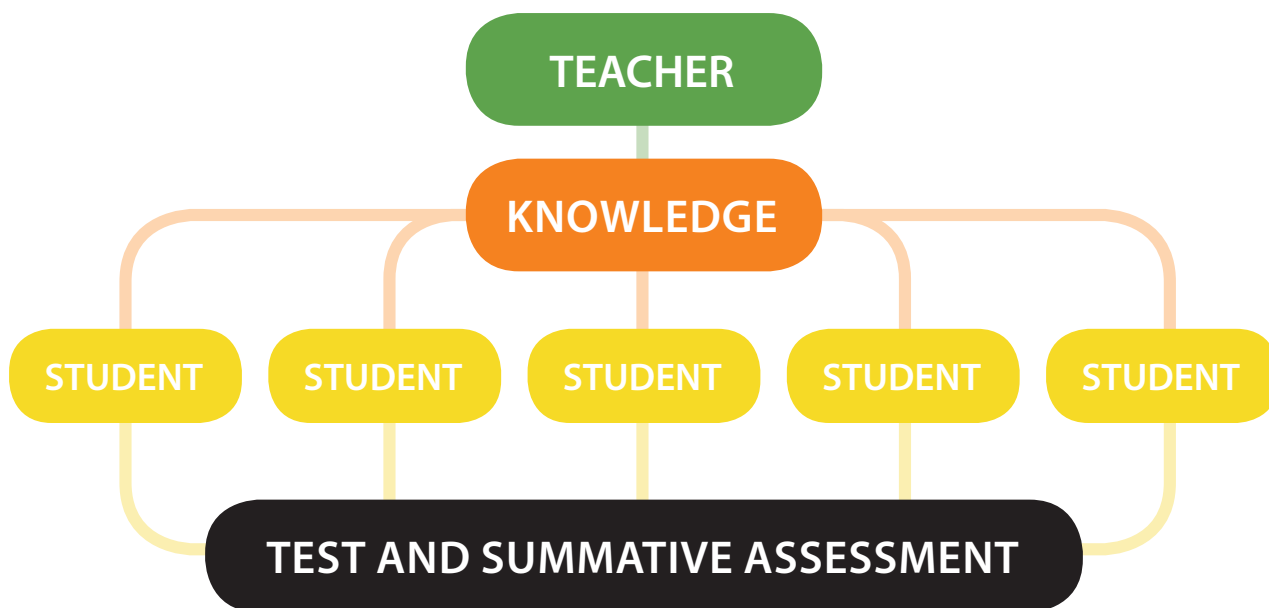
KEY CHANGES

The key change in the new curriculum is a move from a knowledge-based curriculum to a competence and skill-based curriculum. It is no longer sufficient to accumulate large amounts of knowledge. Young people need to develop the ability to apply their learning with confidence in a range of situations. They need to be able to use knowledge creatively. A level of competence is the ability to use knowledge rather than just to acquire it. This requires an active, learner-centred rather than passive, teacher-centred approach.

This approach to teaching and learning is in support of the Sustainable Development Goals (SDG's), otherwise known as the Global Goals. These are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The key changes in the curriculum will ensure that Uganda is making good progress towards SDG 4 in particular which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

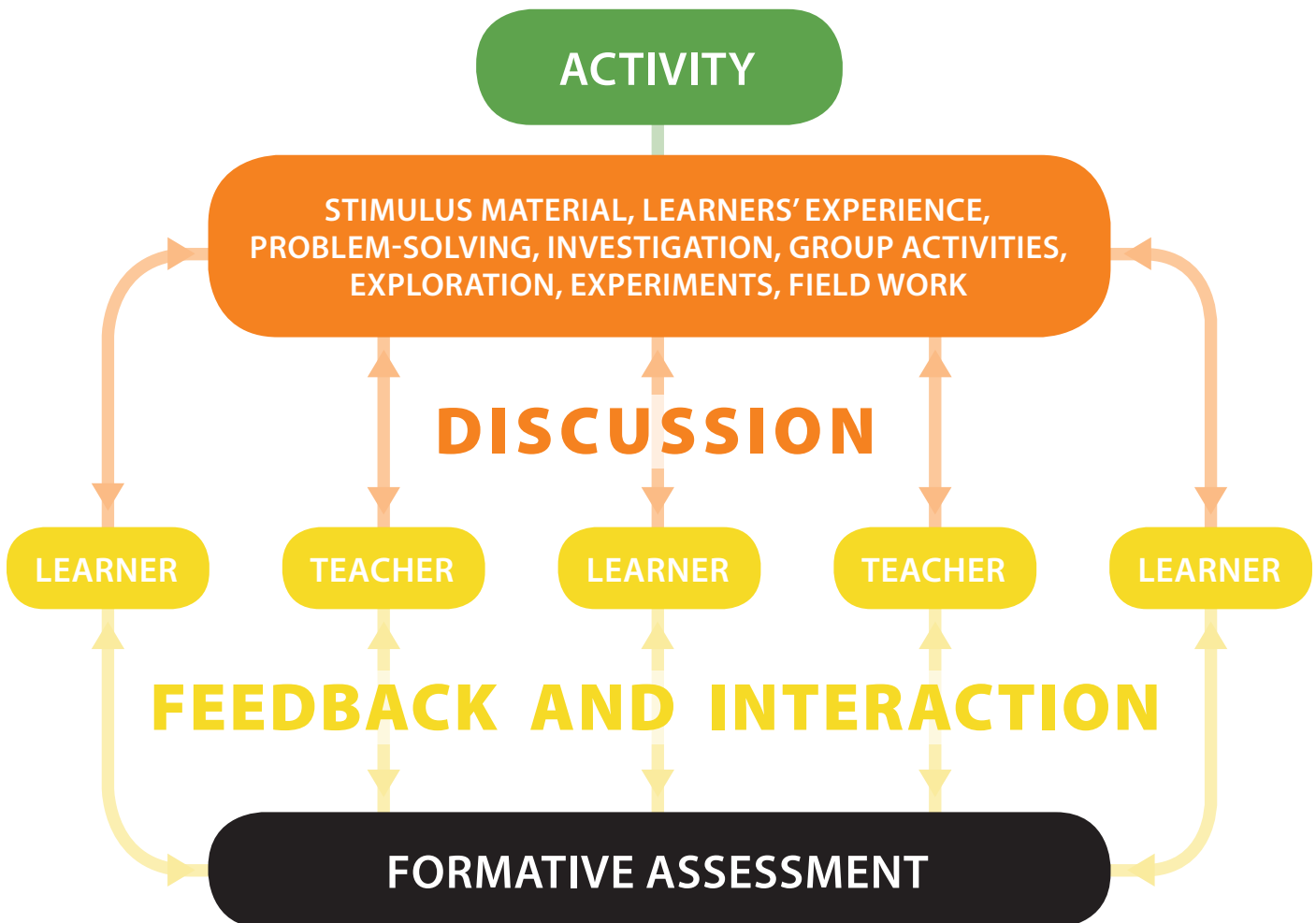
The change can be summarised in the following diagrams.

PREVIOUS KNOWLEDGE-BASED CURRICULUM



Knowledge-based teaching was based on transferring knowledge from the teacher to the students. The teacher had knowledge and transferred this knowledge to the students by lecturing, talking, asking them to read the text book or writing notes on the board for the students to copy and learn. Students acquired the knowledge, often without fully understanding it, and were tested at the end of a unit, term or school course to see if they had remembered it. The knowledge was based mainly on the knowledge in the subjects traditionally taught at University, and little attempt was made to make it relevant to young people's own lives. The whole education system was seen by many people as a preparation for University, but the vast majority of learners never reach university. The new curriculum will cater for this majority as well as those who later go on to University.

NEW COMPETENCE BASED CURRICULUM



In the new competence-based approach, the “student” becomes a “learner”. The new Learning Outcomes can only be achieved through active engagement in the learning process rather than simply absorbing knowledge given by the teacher.

The teacher needs to build on the learners’ own knowledge and experience and create Learning Activities through which learners can explore the meaning of what is being learned and understand how it is applied in practical situations.

Teaching and learning becomes a two way process of dialogue between the Teacher and Learners. Learners also learn from each other through discussion. Assessment also becomes a two way process of formative assessment; not just to give grades but to find out problems the learners may be having and help to solve them.

THE NEW CURRICULUM

The new curriculum focuses on four “Key Learning Outcomes” of: self – assured individuals; responsible and patriotic citizens; lifelong learners; positive contributors to society. The curriculum emphasises knowledge, application and behavioural change. It is based on a clear set of values which must be imparted to learners during the learning process.

At the heart of every subject there are generic skills that allow development into life-long learners. Besides, there are also cross cutting challenges that are embedded across subjects to enable learners understand the connections between the subjects and complexities of life.

Key Learning Outcomes

The new curriculum sets out ‘Key Learning Outcomes’ that sum up the expectations of the curriculum as a whole, and set out clearly the qualities that young people will develop.

By the end of the educational process, young people will become:

Self-assured individuals who:

- Demonstrate self- motivation, self-management and self-esteem
- Know their own preferences, strengths and limitations
- Adjust their behaviour and language appropriately to different social situations
- Relate well to a range of personality types

Responsible and patriotic citizens who:

- Cherish the values promoted in the curriculum
- Promote the development of indigenous cultures and languages and appreciate diversity, equity and inclusiveness
- Apply environmental and health awareness when making decisions for themselves and their community
- Are positive in their own identity as individuals and global citizens
- Are motivated to contribute to the well-being of themselves, their community and the nation

Lifelong learners who:

- Can plan, reflect and direct their own learning
- Actively seek lifelong learning opportunities for personal and professional development

Positive contributors to society who:

- Have acquired and can apply the Generic Skills
- Demonstrate knowledge and understanding of the emerging needs of society and the economy
- Understand how to design, make and critically evaluate products and processes to address needs
- Appreciate the physical, biological and technological world and make informed decisions about sustainable development and its impact on people and the environment.

Values

The new curriculum is based on a clear set of values. These values underpin the whole curriculum and the work of schools. They are also the values on which learners need to base their lives as citizens of Uganda.

- Peace and harmony
- Integrity and honesty
- Patriotism
- Positive attitude towards work
- Respect for human rights
- Self-Control

These values are not taught directly in lessons, nor will they be assessed, but they will inform and shape all teaching and learning.

Generic Skills

The generic skills lie at the heart of every Subject. They are the skills that enable the learner to access and deepen learning across the whole curriculum. They are the same skills that are sought by employers and which will unlock the world of work. They are the skills that allow young people to develop into lifelong learners who can adapt to change and cope with the challenges of life in the 21st Century.

Young people need to be able to think critically and solve problems, both at school and at work. They need to be creative and innovative in their approach to learning and life. They need to be able to communicate well in all forms, co-operate with others and also work independently. They need to be able to use functional mathematics and ICT effectively.

Critical thinking and problem-solving

- Plan and carry out investigations
- Sort and analyse information
- Identify problems and ways forward
- Predict outcomes and make reasoned decisions
- Evaluate different solutions

Creativity and innovation

- Use imaginations to explore possibilities
- Work with others to generate ideas
- Suggest and develop new solutions
- Try out innovative alternatives
- Look for patterns and make generalisations

Communication

- Listen attentively and with comprehension
- Talk confidently and explain things clearly
- Read accurately and fluently
- Write and present coherently
- Use a range of media to communicate idea

Co-operation and Learning

- Work effectively in diverse teams
- Interact effectively with others
- Take responsibility for own learning
- Work independently with persistence
- Manage goals and time

Calculation and ICT

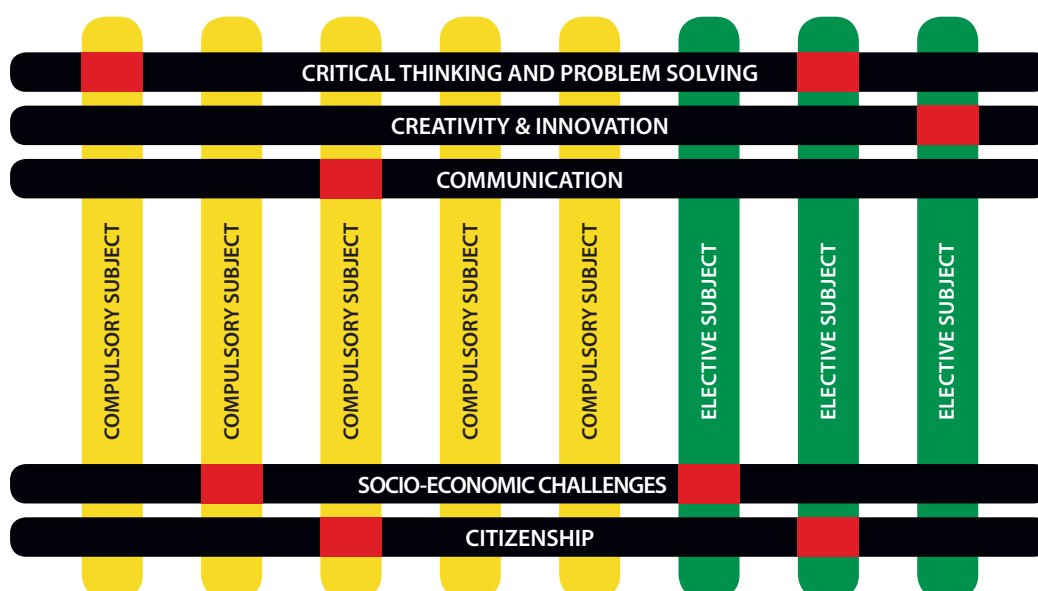
- Use numbers and measurements accurately
- Interpret and interrogate mathematical data
- Use mathematics to justify and support decisions
- Use technology to create, manipulate and process information
- Use technology to collaborate, communicate and refine their work

GENERIC SKILLS WITHIN BIOLOGY

These skills are not separate subjects in themselves; they are developed within the subjects of the curriculum. They also help learning within those subjects. It is when these generic skills are deployed that learning is most effective.

The generic skills are a key part of the new curriculum. They have been built into the syllabuses for each of the Subjects, and these Subjects provide the context for the skill development. Biology provides a rich context for learners to communicate, co-operate, and to think critically about how the world works and to understand the world from a scientific point of view.

The Subjects also provide the contexts for progression within the skills. The same skill definitions apply to all year groups, and skills progression is provided by the increasing complexity of the subject matter within each Subject. For example, within 'critical thinking', learners begin thinking critically about the relatively simple subject matter in Senior 1 and then progress to thinking about the much more complex matters in Senior 4. Thus the progression is in the increasing complexity of the matters being thought about.



Cross-cutting Challenges

There are some issues that young people need to learn about, but which are not confined to one Subject. These are the 'Cross-cutting Challenges' and they need to be studied across the Subjects. These issues develop learners' understanding of the connections between the Subjects, and so of the complexities of life.

The Cross-cutting Issues identified in the curriculum are:

- Environmental awareness
- Health awareness

- Diversity and inclusion
- Socio-economic challenges
- Citizenship

These have been built into the syllabuses of each Subject. The way in which they operate within the Subject is very similar to the generic skills. Biology provides a very good context for considering environmental and health awareness, and to understand the complex and diverse world in which we live.

BIOLOGY WITHIN THE NEW CURRICULUM

Biology is a compulsory subject from Senior 1 to Senior 4.

Time allocation

BIOLOGY	SENIOR 1 & 2	SENIOR 3 & 4
	3 periods a week	4 periods a week

Rationale

Learning Biology will enable learners to:

- Apply and use the principles of the scientific method/ process and the application of experimental techniques to solve specific problems
- Write, communicate and report on biological concepts
- Apply biological concepts to better understand other fields of science in order to readily accomplish day to day tasks
- Understand, address and successfully manage health, environmental and sustainability challenges facing society

Teaching and Learning: Biology

The thrust of the new syllabuses is experiential and towards deeper understanding. The focus in Biology is on the development of understanding through scientific enquiry and rational thought.

The new syllabuses provide learners with a wide range of contexts in which to develop this understanding, and these contexts are designed to engage the interest of the learner and to provide opportunities to build life-related knowledge, experience and skills. Teachers are encouraged to go beyond the textbooks and provide as many meaningful contexts as possible. The generic skills have been integrated throughout the curriculum and can only be acquired through active approaches.

The role of the teacher is to build on learners' existing knowledge and experience, but to extend that by posing problems to the learners. This makes them think about their own ideas and experiences as well as adding new knowledge and skills to it.

Learners need to interact with real situations inside and outside the classroom. They need to look at pictures or diagrams, examine statistics, or read texts from a range of sources. They need to find out knowledge and ideas for themselves. They should then be expected to express these in their own words, not those of the teacher, and so demonstrate that they have understood what they have learnt.

In this approach, learners are encouraged to:

- Be responsible for their own learning
- Think for themselves and form their own ideas and opinions
- Become critical thinkers, ready to face new challenges and situations for themselves

THE BIOLOGY SYLLABUS

Programmer planner

Biology is divided into fourteen themes that run throughout the four years of study. The following are the themes and topics within them.

SENIOR 1	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Diversity Of Living Things	Introduction to Biology	8
		Cells	12
		Classification	16
Term 2	Diversity Of Living Things	Classification	36
Term 3	Diversity Of Living Things	Insects	20
		Flowering plants	16
Total			108

SENIOR 2	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Soil	Soil composition	4
		Physical and chemical properties of soil	18
		Soil erosion and conservation; causes, effects and prevention	10
		The nitrogen cycle	4
Term 2	Nutrition in plants and animals	Nutrition types and Nutrient compounds	11
		Nutrition in green plants	10
		Nutrition in animals	13
		Nutrition in a mould	2
Term 3	Transport in Plants and Animals	Movement into and out of cells	11
		Transport in animals	16
		Transport in plants	9
Total			108

SENIOR 3	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Respiration in plants and animals	Gaseous exchange	10
		Aerobic respiration and anaerobic respiration	15
		Excretion in lower organisms	2
		Excretion in plants	2
		Excretion in animals	13
		Reception and response in plants	6
	Excretion in plants and animals	Excretion in lower organisms	2
		Excretion in plants	2
		Excretion in animals	13
	Co-ordination in plants and animals	Reception and response in plants	6
Term 2	Co-ordination in plants and animals	Reception and response in plants	8
		Reception, response and behaviour in animals	4
		Chemical coordination in humans	15
		Nervous coordination in humans	15
		Receptor organs in man	6
Term 3	Locomotion in Animals	Locomotion in insect, bony fish and birds	13
		Locomotion in a mammal	15
	Growth and Development in Plants and Animals	Growth in plants and animals	12
		Development in plants and animals	8
Total			144

SENIOR 4	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Reproduction in organisms	Asexual reproduction in lower organisms	4
		Asexual reproduction in plants (vegetative reproduction)	10
		Sexual reproduction in humans	18
		Sexual reproduction in plants	14
	Genetics and Evolution	Mitosis and meiosis and their importance	2
Term 2	Genetics and Evolution	Genetics and monohybrid inheritance	15
		Applied genetics	6
		Mutation and variation	6
		Evolution	6
	Inter-Relationships	Concept of ecology	3
		Food chains and food webs	12
Term 3	Inter-Relationships	Techniques for sampling living organisms	2
		Changes in population	8
		Associations in biological communities	14
		Humans and natural environment	16
		Total	136

The syllabus details for all subjects are set out in three columns:

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT ACTIVITIES
The knowledge, understanding or skills expected to be learned by the end of the topic	The sort of learning activities that include the generic skills and that will help learners achieve the Learning Outcomes.	Opportunities for assessment within the learning

Teachers should base their lesson plans on the Learning Outcomes using the Suggested Learning Activities as a guide. These are not the only possible learning activities, and teachers are encouraged to extend these and devise their own that are appropriate to the needs of their class.

DETAILED SYLLABUS FOR BIOLOGY

SENIOR 1: TERM 1

Theme: Diversity of living things

TOPIC: INTRODUCTION TO BIOLOGY

8 PERIODS

Competency: The learner should be able to understand that biology is the study of life and that all living organisms experience common life processes.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
Appreciate that: a) biology is the study of life b) life processes are common to all living things, but they are manifested differently in different organisms (u)	<ul style="list-style-type: none"> In pairs, learners discuss and report their understanding of the term biology In pairs, learners observe plants and animals, and identify characteristics that show organisms are living. Identify, research and record the seven characteristics of living things In groups, brainstorm and list what plants and animals need to enable them to maintain their life processes. Discuss which life processes are common to both animals and plants, and any that are different, and record conclusions in a clear table 	<ul style="list-style-type: none"> Listen and observe as learners explain orally or in writing the meaning of the word biology Listen and observe as learners demonstrate orally or by completing a comparison table that they understand how animals and plants carry out nutrition, respiration, movement, excretion, growth and reproduction, and how they show sensitivity Listen to learners explaining why a machine such as a moving vehicle is not a living organism Evaluate products: verbal feedback, reports and tables
ICT Support <ul style="list-style-type: none"> Use a suitable graphical program to design a pond or an aquarium Use the internet to research information about life processes Note: The following branches of biology (botany, zoology, physiology, anatomy, genetics, ecology, taxonomy) should be given at this level.		

SENIOR 1: TERM 1

Theme: Diversity of living things

TOPIC: CELLS

12 PERIODS

Competency: The learner should appreciate that a cell is the basic unit of living organisms, and how the structures of different specialised cells are related to their functions.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) know that the basic unit of living organisms is a cell (k) b) know and understand the structure and functions of a typical animal cell and plant cell (k, u, s) c) understand the structure of specialised cells in terms of their functions in an organism (u) d) understand levels of organisation in organisms (cell, tissue, organ, system, organism) (u)	<ul style="list-style-type: none"> Observe prepared slides of plant and animal cells, draw cells and identify similarities and differences Draw and label the animal and plant cell as seen under a light microscope Research the functions of the parts in a plant and animal cell, and annotate labels on cell diagrams accordingly Draw examples of specialised cells in animals and plants. Identify and explain the similarities and differences between the cells In groups, brainstorm, research and list different types of cells, tissues, organs and systems in the human body. Devise a creative way of explaining the five levels of organization (from simple to complex) to the class 	<ul style="list-style-type: none"> Listen and observe as learners explain orally or in writing: <ul style="list-style-type: none"> similarities and differences between plant and animal cells structure and functions of cells, parts of cells and some specialised cells different levels of organisation and their importance in large organisms Observe group simulations showing the organ systems that need to work together when a person is: <ul style="list-style-type: none"> dancing eating writing a story Teacher involves class members in peer assessment and discussion of how groups could improve quality of simulations Evaluate quality of learners' illustrations relating to each activity mentioned above
ICT Support <ul style="list-style-type: none"> The learner can use a suitable graphical program to draw animal and plant cells Note: The following branches of biology (botany, zoology, physiology, anatomy, genetics, ecology, taxonomy) should be given at this level.		

SENIOR 1: TERM 1**Theme: Diversity of living things****TOPIC: CLASSIFICATION****16 PERIODS**

Competency: The learner should understand that classification is the sorting out of living things based on their similarities.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the concept of classification of organisms (u) b) recognise the diversity of living organisms in the environment (k, s) c) understand that each organism has a Latin name consisting of the genus followed by the species (u) 	<ul style="list-style-type: none"> • In groups, learners observe the diversity of organisms in the local environment and report back on what they find. Learners think about how they describe/group what they see, and recognise that they naturally classify organisms • Discuss why classification is important to scientists and why Linnaeus' work is still acknowledged 250 years after his death. Learners consider the analogy of books being classified in a library • Learners use an analogy of population sizes at different political administration levels in Uganda; e.g. district, county, sub-county, etc., to compare with the number of organisms in a kingdom, phylum, class, order, family, genus and species. Learners give examples at each level and match the biological hierarchy with the 'equivalent' political administration level • In groups, learners research and write down the common and Latin names of some familiar species and consider why Latin names are so important for accurate identification internationally and even locally 	<ul style="list-style-type: none"> • Evaluate learners' reports (oral or written) on similarities and differences between animals and plants in their locality and appropriateness of criteria they use to classify them into groups • Evaluate learners' explanations of the benefits of a classification system and the likely consequences of studying biology without one • Check learners can, orally or in writing: <ul style="list-style-type: none"> • recall the seven levels in the right order with examples of each • explain the value of the Latin binomial system to science

SENIOR 1: TERM 2

Theme: Diversity of living things

TOPIC: THE FIVE KINGDOMS OF LIVING ORGANISMS

5 PERIODS

Competency: The learner should know the key characteristics of the five kingdoms of living organisms and be able to identify some examples of each.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) identify three characteristics (cell structure, cell organization and mode of feeding) and give examples of organisms in kingdom Monera (u) b) understand the uses and harmful effects of organisms in kingdom Monera (u) c) identify three characteristics (cell structure, cell organization and mode of feeding) and give examples of organisms in kingdom Protocista (u) d) understand the main parts and their functions of an amoeba and a paramecium (u) e) understand the benefits and the harmful effects of Protocista (u) f) identify three characteristics (cell structure, cell organization and mode of feeding) and give examples of organisms in kingdom Fungi (u) g) understand the uses and harmful effects of organisms in kingdom Fungi (u) h) understand the value of microorganisms in food-making processes (u) i) identify three characteristics (cell structure, mode of feeding, photosynthetic pigment) and give examples of organisms in kingdom Plantae from the each of the following categories: vascular/non-vascular, angiosperms/gymnosperms, monocots/dicots (No drawings required) (u) j) identify three characteristics (cell structure, mode of feeding, body system) for organisms in kingdom Animalia (u) k) identify and describe the common observable characteristics and give examples of organisms from the following phyla: Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Mollusca, Echinodermata, Arthropoda (for Arthropoda include its classes) in kingdom Animalia (No drawings required) (u) 	<ul style="list-style-type: none"> • Learners use pictures (and possibly microscope slides) as well as lists of group characteristics to identify organisms as belonging to the following groups: Monera/bacteria; Protocista; Fungi; Plantae; Animalia • In groups, learners construct simple identification keys for grouping the organisms in the pictures, share their keys with other groups, and then use them to identify other examples of organisms belonging to the same groups • In groups, learners research and produce tables showing the positive and harmful effects of Monera, Protocista and Fungi • In groups, learners discuss, design and carry out an experiment to investigate the conditions required for the production of yogurt. Groups write a formal report of the experiment (prediction, materials, procedure, record/analysis of results and conclusion) and present their reports to the rest of the class • Learners produce annotated diagrams of organisms from the kingdoms Monera, Protocista and Fungi, labelling the parts of the cells and adding the function of each part • In groups, learners research the common characteristics and differences between examples of members of the kingdom Plantae belonging to the following categories: vascular/non-vascular, angiosperms/gymnosperms, monocots/dicots. Groups choose the format to use to present their findings (tables, drawings or more creative methods) • Groups construct simple keys to place plants in the correct category 	<ul style="list-style-type: none"> • Observe learners in groups as they develop and use identification keys • Listen to learners' conversations and ask probing questions to check their understanding • Observe and listen to group presentations • Evaluate quality of products such as keys, tables, experiment reports, diagrams and drawings

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
l) identify and describe the common observable characteristics (types of teeth, temperature regulation, habitat, reproduction, gas exchange) and give examples of organisms from the phylum Chordata and its classes. No details of the reproduction process should be given (u)	<ul style="list-style-type: none"> • In groups, learners research the common characteristics and differences between examples of members of the following (non-chordate) phyla of the kingdom Animalia: Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Mollusca, Echinodermata, Arthropoda (include classes of Arthropoda). Groups choose the format to use to present their findings (tables, drawings or more creative methods) • Groups construct simple keys to place animals in the correct category • In groups, learners research the common characteristics (see list in learning outcomes) and differences between examples of members of the five main classes of the phylum Chordata: bony fish, amphibians, reptiles, birds, mammals. Groups choose the format to use to present their findings (tables, drawings or more creative methods) • Groups construct simple keys to place animals in the correct category • Extension: research remaining two classes – jawless fish and cartilaginous fish 	
ICT Support <ul style="list-style-type: none"> • The learner can use the internet to obtain images of living organisms and show how they are similar or different in a presentation or word processor Note: No drawings and types of Monera required. Label only main parts for amoeba and paramecium; i.e., nucleus, cell membrane, cilia, pseudopodia. Don't give functions of the parts.		

SENIOR 1: TERM 2**TOPIC: VIRUSES****18 PERIODS**

Competency: Learners should understand the characteristics of viruses, their means of infection and transmission as well as the symptoms of some key examples.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand that viruses have characteristics similar to other living organisms, and key differences (u) b) understand the symptoms, transmission and prevention of the following viruses; HIV, Ebola, hepatitis, Cassava mosaic (u)	<ul style="list-style-type: none"> In groups, research the symptoms, transmission and prevention of HIV, Ebola, hepatitis and Cassava mosaic virus. If possible, visit a health or agricultural facility In groups, develop and present a short drama to the rest of the class to explain the transmission and prevention of any of the four viruses listed Write and present a report on strategies for preventing these virus infections and the importance of doing so 	<ul style="list-style-type: none"> Observe groups researching and confirm they are using reliable sources of information Listen to group discussions Observe and listen to group presentations and invite peer feedback Evaluate quality of products: written reports
ICT Support <ul style="list-style-type: none"> The learner can use the internet to obtain data on the number of people that have lost their lives to Ebola in Africa. The learner can use this data to create graphs showing which countries have been affected most 		

SENIOR 1: TERM 3**Theme: Diversity of living things****TOPIC: INSECTS****20 PERIODS**

Competency: The learner should understand the characteristics of insects and relate structures to their functions in some common insects, and appreciate that insects have a direct or indirect effect on the well-being of other organisms.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) identify the observable external features of a housefly, cockroach, mosquito, termite, bee and butterfly (No details of mouth parts required) (k, s) b) construct a dichotomous key (s) c) appreciate the useful and harmful effects of a housefly, cockroach, mosquito, bee and butterfly (u) d) know the different methods of controlling the harmful stages of a housefly, cockroach, mosquito and some butterflies (u)	<ul style="list-style-type: none"> In pairs, use a hand lens to observe a housefly, cockroach, mosquito, termite, bee and butterfly paying specific attention to the following structures: <ul style="list-style-type: none"> head (mouth parts, antennae, eyes, hair) thorax (wings, halteres, hairs, strips, legs and the different segments) abdomen Pairs create a suitable table and record observations comparing each of the insects Draw the insects provided, label the structures listed above and annotate drawings to explain the functions of the structures Pairs construct a dichotomous key for any four of the insects listed above Pairs research different methods of controlling the harmful stages of a housefly, cockroach, mosquito and some butterflies, and produce a presentation advising the class how to control these populations 	<ul style="list-style-type: none"> Observe pairs carrying out activities and check they identify the parts listed; create an appropriate comparison table; draw and label correctly; construct keys that work Listen to pairs' conversations and monitor understanding and progress towards learning outcomes Evaluate quality of products of each activity
ICT Support <ul style="list-style-type: none"> The learner can use a suitable graphical program to present the dichotomous key. Note: For the life cycles of each of the insects, only give duration of the whole cycle, not duration for each stage of the cycle.		

SENIOR 1: TERM 3

Theme: Diversity of living things

TOPIC: FLOWERING PLANTS

16 PERIODS

Competency: The learner should be able to understand that different parts of flowering plants carry out different functions, and how the parts are suited to their functions.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) know the parts of a typical flowering plant (k, u) b) understand how the structures of monocotyledonous and dicotyledonous roots, stems, leaves, flowers and fruits suit their functions (u)	<ul style="list-style-type: none"> In pairs, learners draw and label the parts of a whole mature dicotyledonous and monocotyledonous plant In groups, learners compare the structural features (root system, leaf venation, leaf shape, leaf attachment to stem and flower colour) of a whole herbaceous dicotyledonous plant and whole monocotyledonous plant. Learners record their observations and present them to the class In groups or as a whole class, discuss how the structures observed in the two plants carry out their functions. Annotate the drawings made above to explain how each structure is suited to its function In pairs, learners draw and label the parts of the flower In groups or as a whole class, discuss how each part of the flower is suited to its function, and annotate the drawing made above to explain how Pairs observe a bean seed and a tomato or other fruit, and write down the similarities and differences. Learners present their findings 	<ul style="list-style-type: none"> Observe pairs carrying out activities, and check they interpret specimens and identify functions correctly Listen to pairs' conversations and monitor understanding and progress towards learning outcomes Monitor individuals' and groups' contributions to whole class discussion Evaluate quality of products from activities
ICT Support <ul style="list-style-type: none"> The learner can use a digital camera to capture images to be used in a word processed project report Note: The leaves used for construction of a dichotomous key should represent the following: simple, compound, monocotyledonous, dicotyledonous.		

SENIOR 2: TERM 1**Theme: Soil****TOPIC: SOIL COMPOSITION****4 PERIODS**

Competency: The learner should be able to appreciate that different soil types are made of different components and that the balance of these components affects the properties of the soil.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the function/importance of soil in plant growth and nutrition (u) b) determine soil constituents and identify their properties (u, s) c) identify the types of soil (u)	<ul style="list-style-type: none"> In pairs or groups, learners observe three different soil samples – clay, sand and loam, and: examine them dry shake the samples in water and allow them to settle to show different layers/ particle sizes Pairs/groups record their observations relating to the following characteristics: <ul style="list-style-type: none"> the colour of each soil sample the texture of each soil sample the size of particles in each soil sample 	<ul style="list-style-type: none"> Observe pairs/groups as they examine soil samples Listen to conversations and ask questions to gauge and deepen learning Evaluate products: records of characteristics of each soil type
Note: The actual (quality) soil types should be used for experiments.		

SENIOR 2: TERM 1

Theme: Soil

TOPIC: PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

18 PERIODS

Competency: The learner should be able to know that different soil types have different physical and chemical properties.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand that different soil samples have different properties: water retention, drainage, capillarity and pH, and conduct experiments to investigate these properties (u, s) b) carry out experiments to find the percentage of air, water and humus in a soil sample (u, s) c) understand the importance of air and water in soil to other living organisms (u)	<ul style="list-style-type: none"> Task groups of learners to design, perform and report on investigations to show: retention, drainage and capillarity in loam, clay and sand soils. The report for each experiment should follow scientific method In pairs, learners determine the pH of a soil sample and discuss the significance of their findings In pairs or groups, use practical investigations and/or a set of data to calculate the percentage of air, water and humus in different soil samples and report conclusions In pairs, discuss and explain the importance of air and water in soil to living organisms <p>Group Project Aim: To investigate whether crop growth is different in different soil types. Design and carry out an experiment using annual plants in soils with different percentages of contents; e.g. high clay content or high sand content. Remember to make sure to design a fair test, controlling variables; e.g. the amount of water and light the plants receive. Observe the plants and record their appearance and the yield of the crop. From your observations deduce which type of soil is best for the chosen plants, and suggest why. Record conclusions.</p>	<ul style="list-style-type: none"> Observe groups and pairs carrying out activities. Check they plan investigations that will give meaningful results Listen to pairs' discussions and monitor understanding and their progress towards learning outcomes. Ask probing questions to promote critical thinking and deepen learning Evaluate quality of products from activities: reports of investigations; conclusions relating to impact of different properties on quality of soil; explanations of importance of air, water, humus; impact of soil types on crop yield and reasons
ICT Support <ul style="list-style-type: none"> The learner can use a digital camera to capture images to be used in a word processed experiment or report <p>Note: The actual (quality) soil types should be used for experiments.</p>		

SENIOR 2: TERM 1

Theme: Soil

**TOPIC: SOIL EROSION AND CONSERVATION:
CAUSES, EFFECTS AND PREVENTION**
10 PERIODS

Competency: The learner should be able to explain how and why soil fertility should be maintained for it to continue to be useful to living organisms.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) know the features of fertile soil (k) b) understand the process of and factors leading to soil erosion (u) c) understand the causes of reduced soil fertility and describe methods of soil conservation (u)	<ul style="list-style-type: none"> In groups, discuss conclusions from Topic 2 and agree a list of the features of fertile soil. Present your conclusions to the class In groups, research the causes of soil erosion and the impact erosion has on communities. Produce a short presentation to show the types and the possible impact In groups, discuss what steps farmers and gardeners take in your locality to maintain the fertility of their soils. Then research and write a report on the different methods used to maintain soil fertility and conserve soil in the following regions of Uganda: <ul style="list-style-type: none"> Lake Victoria basin Kigezi highlands Karamoja region <p>Group Project: Design, perform and write a report on an investigation into the formation of compost in a compost bin. Report on the process of composting, how fast different materials decompose, any organisms (decomposers) that seem to be involved in the process, and anything else significant or interesting.</p>	<ul style="list-style-type: none"> Through listening to group discussions, or through whole class discussion, gauge whether all learners understand the features of fertile soils, the causes and impact of soil erosion, and the steps taken to increase fertility and reduce erosion Observe groups interacting and intervene as appropriate to steer research and project planning so that learning outcomes are achieved Evaluate quality of products: presentations and reports

ICT Support

- The learner can use mind mapping or word processing software to relate methods of soil conservation to the principles that apply to them

SENIOR 2: TERM 1**Theme: Soil****TOPIC: THE NITROGEN CYCLE****4 PERIODS**

Competency: The learner should be able to understand that materials from the soil used by plants and animals should be returned to the soil in order to maintain its fertility.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the importance of microorganisms in the nitrogen and other cycles that keep soil fertile (u) b) outline the processes involved in the nitrogen cycle (u)	<ul style="list-style-type: none"> In groups, refer to Topic 3 and carry out research into soil organisms that we call decomposers. Produce a short presentation/drama to explain why they are so important In groups, learners use labelled cards to role play and explain the nitrogen cycle In groups, design and carry out an investigation to show the presence of microorganisms in root nodules, in soils and in compost. Present your findings to the whole class and compare with other groups 	<ul style="list-style-type: none"> Observe groups carrying out activities and check they communicate effectively and work as teams so that everyone is learning and developing skills Listen to pairs' conversations and monitor their progress towards learning outcomes. Intervene as appropriate to deepen learning Evaluate quality of presentations and products of each activity
ICT Support <ul style="list-style-type: none"> The learner can use a suitable graphical program to develop simulations of the nitrogen cycle 		

SENIOR 2: TERM 2**Theme: Nutrition in plants and animals****TOPIC: NUTRITION TYPES AND NUTRIENT COMPOUNDS****11 PERIODS**

Competency: The learner should be able to understand that organisms have different nutritional requirements, and that humans have different requirements, depending on age and other factors.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the term nutrition (k, u) b) identify the food nutrients, their sources and importance to humans (u) c) perform food tests for various nutrients (only quality testing required) (s) d) appreciate the importance of a diet containing the different nutrients (u) e) appreciate the concept of balanced diet in relation to age, sex and an individual's activity (u) f) appreciate the causes and effects of nutrient deficiency in humans including diseases related to malnutrition (u, s) g) calculate body mass index (BMI) and explain its implication (s) h) identify the major plant mineral nutrients (N, P, K, Mg, Ca, S, Mg), their role and the symptoms of deficiencies (u)	<ul style="list-style-type: none"> In pairs, learners brainstorm and research the meaning of the term nutrition. Share and agree meaning with the class In groups or pairs, learners carry out tests on foods such as potato, egg yolk, milk, groundnuts and pineapple to determine what main food nutrients they contain In groups or as a whole class, learners discuss, research and report on: <ul style="list-style-type: none"> the meaning of the term 'balanced diet' and what this might mean for a baby, a child, an adult woman, an adult man, an athlete, and an inactive person, and record their conclusions the likely effects of an imbalanced diet In groups, learners discuss, research and report on the dangers of: <ul style="list-style-type: none"> obesity, bulimia and anorexia use of drugs (diet pills and steroids) to change body image In groups, learners measure their weight (kg) and height (cm), and use the results to calculate their BMI. With reference to the standard BMI chart they determine their BMI status. Learners discuss the implications of being underweight and overweight and what to do in both cases Learners listen to a talk or write a short speech on self-esteem in relation to physical differences in body shape and size In groups, learners design and perform an experiment to compare the growth of a plant in distilled water and pond water and/or other water rich in nutrients. Learners use scientific method to write a report 	<ul style="list-style-type: none"> Observe groups and pairs carrying out activities. Check they carry out tests and research effectively, and plan experiments that will give valid results Listen to pairs' discussions and monitor understanding and progress towards learning outcomes. Ask probing questions to deepen learning Evaluate quality of products from activities: reports and conclusions from tests and investigations; presentations and explanations

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	In groups, learners research the uses of N, P, K, Mg, Ca, S and Mg to plants and the effects of deficiencies. Groups present their findings to the class (illustrated, if possible), with examples of leaves in good health, and showing deficiencies found in the locality	
ICT Support <ul style="list-style-type: none"> • The learner can: <ul style="list-style-type: none"> • use mind mapping or word processing software to categorise food groups and their sources • use spreadsheets to record and analyse experimental data • use the internet to research malnutrition Note: Minerals are limited to Ca P Fe and I; vitamins are limited to B, C, D and K.		

SENIOR 2: TERM 2**Theme: Nutrition in plants and animals****TOPIC: NUTRITION IN GREEN PLANTS****10 PERIODS**

Competency: The learner should understand that plants are autotrophic, carrying out photosynthesis to make complex food molecules from light energy, water and carbon dioxide.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the meaning of autotrophic and heterotrophic nutrition (k) b) derive the meaning of the term photosynthesis and understand the process (u, s) c) perform experiments to investigate the factors that affect the rate of photosynthesis (s) d) appreciate the structures and adaptations that enable a leaf to carry out the process of photosynthesis (k, u) 	<ul style="list-style-type: none"> • In pairs or groups, learners discuss, research and document: <ul style="list-style-type: none"> • the meaning of autotrophic and heterotrophic nutrition • why autotrophs are the providers of all food • the origin and meaning of the term photosynthesis • the equation for photosynthesis and its implications regarding what plants need for photosynthesis • In groups, learners design and carry out experiments to show the need for carbon dioxide, light and chlorophyll during photosynthesis. Learners produce a formal report at the end of the experiments that includes the following: title, question, prediction, materials, procedure, record/analysis of results and conclusion. Groups present their report to the rest of the class • In groups learners examine diagrams, photographs or microscope slides of sections through a leaf and discuss how the structure is adapted so that cells can obtain the water, carbon dioxide and light energy they need • Groups share findings and through whole class discussion agree conclusions • In groups, develop a simple 3D model of the internal structure of a leaf using locally available materials 	<ul style="list-style-type: none"> • Listen to discussion and ask probing questions to promote critical thinking and guide learners towards learning outcomes • Observe pair and group activities to monitor development of practical skills, effectiveness of experiment designs, and accuracy of models. • Evaluate products: conclusions from discussion and research; reports on experiments; findings about leaf structure; and 3D leaf models
ICT Support The learner can: <ul style="list-style-type: none"> • use the internet to research photosynthesis • use a word processor or slide presentation software to report findings of the experiments • use data collection technology such as oxygen and carbon dioxide sensors to examine the products of photosynthesis 		

SENIOR 2: TERM 2

Theme: Nutrition in plants and animals

TOPIC: NUTRITION IN ANIMALS

13 PERIODS

Competency: The learner should know that animals are heterotrophic, obtaining their nutrients from existing plant or animal sources.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the role of enzymes in influencing life processes, and appreciate that the working of enzymes may be affected by different factors (No details of lock and key mechanism required) (u,s) b) conduct experiments on and explain the effects of pH and temperature on enzyme activity (s) c) understand effect of pH and temperature on enzyme activity (u) d) know and describe the mode of feeding in an amoeba and a variety of insects and birds (u) e) know and identify different types of mammalian teeth, and relate their structure and position in the jaw to diet (k, u, s) f) understand the importance of oral hygiene, and describe good practice in caring for teeth and gums in humans (u) g) appreciate the structure of the different parts of the mammalian alimentary canal, and its role in the digestion of food (k, u) h) understand how the end products of digestion are absorbed and assimilated (u) i) understand the role of caecum in non-ruminants, and stomach in ruminants (u)	<ul style="list-style-type: none"> In groups, research and discuss the effects of enzymes on chemical reactions, and list the properties of enzymes, and the names and functions of some enzymes, that work in the human digestive system. Produce a presentation to explain findings In groups, design and carry out an experiment to determine the effect of one factor (pH or temperature) on enzyme activity. Share findings with other groups and develop understanding of the effect of pH and temperature on enzyme activity. Check findings against established science theory In pairs or groups, research and use drawings to show how an amoeba feeds In groups, consider a range of insects and birds from different habitats within the local environment, discuss the different types of food the organisms feed on, and explain how each is adapted for its particular food source. Produce a short presentation to explain your conclusions In pairs, learners observe a molar, canine, pre-molar and incisor tooth and identify: <ul style="list-style-type: none"> the common structural features of each of the teeth in a mammal the adaptations of each type of tooth to its function a) Learners make an accurate labelled drawing of each tooth and state the magnification In pairs, learners share experience and research reasons for, and methods of, ensuring dental hygiene as well as consequences of poor hygiene. Produce a short good practice guide In pairs, learners research and write the dental formula for a herbivore, carnivore and omnivore 	<ul style="list-style-type: none"> Observe groups carrying out research and experiments to check that engagement in skills development and experiment designs is appropriate for achieving learning outcomes, steer towards learning outcomes if necessary Listen to, and engage in, group conversations and ask probing questions to check and guide progress towards learning outcomes Evaluate quality of products: findings on role of enzymes; explanation of effect of pH and temperature on rate of reaction; clarity of drawings; accuracy and creativity of presentations; drawings; guide and dental formulae; experiment reports, simulations, mind maps/spider diagrams, descriptive reports

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	<ul style="list-style-type: none"> • In pairs, learners observe an unlabelled chart and, through discussion and research, identify and name the parts of the alimentary canal and associated organs, labelling the parts and adding their functions • Guide groups of learners to design a controlled experiment to determine what substances are digested in the mouth: <ul style="list-style-type: none"> • include the hypothesis • describe the experimental design • indicate the control group(s) • describe the results of the test • In groups, learners simulate the process of digestion, its products and their absorption using either: <ul style="list-style-type: none"> • labelled cards with names of parts of the alimentary canal and different food types • strings of beads that can be linked and unlinked • role play (holding hands to form long chain molecules, releasing hands when 'digested' to become small sub-units that can be absorbed) • Learners produce annotated diagrams to explain their understanding of digestion and absorption • Use a variety of methods (e.g. involving a food scientist, book and internet research, animations) to enable learners to understand the meaning of assimilation and how the body uses each of the following nutrients: <ul style="list-style-type: none"> • carbohydrates • lipids • proteins • mineral salts • vitamins • Learners document their findings in a mind map or spider diagram • In groups, learners research and produce a brief report on the role of the caecum in non-ruminants, and stomach in ruminants 	
ICT Support <ul style="list-style-type: none"> • The learner can use the internet to study enzymes and their roles in life processes 		

SENIOR 2: TERM 2**Theme: Nutrition in plants and animals****TOPIC: NUTRITION IN A MOULD****2 PERIODS**

Competency: The learner should be able to appreciate that organisms without elaborate digestive system are also able to take in food.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the structures moulds use for nutrition (k, u) b) compare intra-cellular and extra-cellular digestion (u)	<ul style="list-style-type: none"> Remind learners they have already studied how food is taken in by an amoeba In groups, study a common mould such as the <i>Rhizopus</i> or <i>Mucor</i> species. Using a magnifying glass, draw their structures and discuss how they can digest and absorb the foods they grow on Watch a video clip about intra-cellular and extra-cellular digestion, or research using another resource. Discuss the similarities and differences between the two processes and present them in a comparison table 	<ul style="list-style-type: none"> Evaluate the quality of products: drawings and comparison table Listen to group discussions and probe to promote critical thinking

SENIOR 2: TERM 3

Theme: Transport in plants and animals

TOPIC: MOVEMENT INTO AND OUT OF CELLS

11 PERIODS

Competency: The learner should be able to explain how substances enter and exit from cells, and understand that the processes are mainly physical.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) appreciate the importance and key methods of movement of materials into and out of cells (u) b) investigate the different ways in which materials move into, through, and out of cells (s) a) appreciate the importance and key methods of movement of materials into and out of cells (u) b) investigate the different ways in which materials move into, through, and out of cells (s) 	<ul style="list-style-type: none"> • In pairs, learners observe a tea bag in a clear glass container of still warm water for a period of five minutes, then discuss and explain their observations. Whole class discussion leads to understanding of the process of diffusion • In groups, learners use scientific process skills to design and carry out an experiment to show the effect of solutions of different concentrations on raw unshelled eggs and raw potatoes. Groups discuss and draw conclusions to explain their results. Individuals write report at the end of the experiment that includes the following: title, question, prediction, materials, procedure, record / analysis of results and conclusion. Groups present their work to the rest of the class • In groups, learners discuss and research the meanings of diffusion, osmosis and active transport, and the circumstances in which each is involved in the entry and exit of substances to and from cells. Groups present conclusions in a comparison table 	<ul style="list-style-type: none"> • Observe pairs/groups carrying out activities, and: • check they communicate effectively and work as teams so that everyone is learning and developing skills • ensure methods of investigation are appropriate for achieving learning outcomes • Listen to conversations and whole class feedback, and monitor progress towards learning outcomes. Intervene as appropriate to promote critical thinking and deepen learning • Evaluate quality of presentations and products of each activity
ICT Support <ul style="list-style-type: none"> • The learner can use any word processor to prepare an activity report on their investigation of the osmotic flow of water through plant material <p>Note: Cover the basic principles of diffusion, osmosis and active transport ONLY.</p>		

SENIOR 2: TERM 3

Theme: Transport in plants and animals

TOPIC: TRANSPORT IN ANIMALS

16 PERIODS

Competency: The learner should be able to appreciate that animals have special systems for the efficient transport of materials around their bodies, and understand the principles of how these systems operate.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the principle of the surface area to volume ratio (s) b) understand the need for a transport system, and identify the components involved in the transport system in mammals (k) c) describe the structure of the heart and how it functions (u, s) d) compare arteries, veins and capillaries and understand how structure is related to function (u, s) e) identify the major functions of blood, and relate the functions to the components of blood (u, s) f) suggest the causes and prevention of diseases associated with the heart (high blood pressure, coronary heart disease and stroke) (u) g) understand the importance of knowledge of blood groups for blood transfusion (k, u) h) appreciate the role of blood in the defence of the human body (u) i) explain how immunity is weakened by various infections including HIV (k, u) j) explain the process of the formation of lymph and its flow around the body (k, u) k) appreciate the function of the lymphatic system in maintaining a healthy body (u) 	<ul style="list-style-type: none"> • In pairs, learners use cubes of different dimensions to calculate the surface area to volume ratios of the cubes, then discuss and explain the biological significance of calculated ratios • In pairs, learners discuss what they already know about the components of their circulatory systems • In pairs, learners discuss the structure and function of the heart, referring to diagrams and a model. Pairs share their thoughts in groups or whole class discussion. Having understood, individuals draw and label the parts of a mammalian heart adding clear notes relating to function • In groups, learners design a model, visual aid, animation or drama to illustrate blood flow/circulation in the human body and present to the class • In pairs, learners research structures of arteries, capillaries and veins, and produce tables, models or diagrams to show how structure is related to function in each case • In pairs, learners research components of blood and their functions and produce a table summarising their findings to share with the class • Organise learners to visit a health facility to find out about the causes and prevention of high blood pressure, coronary heart disease and stroke. Learners write a report advising of the causes and their prevention • Learners watch a video clip or listen to a talk from blood bank personnel to find out the importance of blood transfusion and the possible risks involved. In pairs, learners complete a short report on the benefits and risks of transfusions, including compatible blood groups. 	<ul style="list-style-type: none"> • Listen to pair and group conversations and whole class discussion to monitor progress towards learning outcomes. Intervene as appropriate to ensure all understand and to deepen learning • Observe pairs and groups carrying out activities, and check all contribute so that everyone is learning and developing skills, steer progress towards learning outcomes • Evaluate quality of products of each activity: annotated diagrams; presentations; summary tables; reports; role plays

SENIOR 2: TERM 3

Theme: Transport in plants and animals

TOPIC: TRANSPORT IN PLANTS

9 PERIODS

Competency: The learner should know the transport processes in plants, the structures involved, and their functions.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) describe the internal structure of a monocotyledonous and dicotyledonous root and stem (s) b) explain how the root hair is adopted for absorption of water and mineral salts (u) c) describe the processes of transpiration and translocation (u) d) conduct experiments on and understand the factors that affect transpiration (s, u) 	<ul style="list-style-type: none"> • In pairs or groups, learners: <ul style="list-style-type: none"> • observe and discuss unlabelled charts showing the transverse section of a monocotyledonous and dicotyledonous plant, suggest and label structures involved in transport in plants • view and identify, giving reasons, microscopic images of cross-sections of monocotyledonous and dicotyledonous roots and stems • draw and describe the internal structure of monocotyledonous and dicotyledonous roots and stems • In all cases, keep a record of conclusions • In pairs, learners use a drawing and look at germinated seedlings to explain how the root hair is adopted for absorption of water and mineral salts. They should consider by which methods (from Senior 4, Topic 1) water and minerals enter root hair cells. Pairs prepare a report to share with the class. Through whole class discussion agree on the correct explanation, and individuals record it in notes and or diagrams • In pairs, learners consider what they know about leaf structure, transport vessels in stems, roots and root hairs, and connect their learning to explain how the process of transpiration takes place. Individuals produce an annotated diagram to explain • In pairs or groups, research the need for, and the meaning of, translocation in plants. Share findings with the class before learners go on to explain in notes and diagrams • In groups, learners to use scientific process skills to design and carry out experiments to investigate how wind, temperature and light intensity affect the rate of transpiration. Groups consider the significance of their findings for farmers and growers, and report their findings and conclusions to the class 	<ul style="list-style-type: none"> • Observe pairs and groups carrying out activities. Check they understand how to use resources effectively, take due account of prior learning, use research skills well and plan valid experiments • Listen to pair and group discussions, monitor progress towards learning outcomes and ask questions to help learners develop skills and deepen understanding • Evaluate quality of products from activities: reports of investigations into roots and stems; report on root hairs; transpiration diagram; report on translocation; investigations of conditions affecting transpiration rates

SENIOR 3: TERM 1

Theme: Respiration in plants and animals

TOPIC: GASEOUS EXCHANGES

10 PERIODS

Competency: The learner should know the functions of, and be able to recognize the similarities and differences of, gas exchange surfaces in different organisms.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) appreciate the need for a gaseous exchange system in a multicellular organisms (u) b) identify adaptations of gas exchange surfaces (u) c) understand the structure of a gill, and explain the mechanism of gaseous exchange in a bony fish (u, s) d) understand the structure of the human respiratory system, and explain the mechanism of gaseous exchange in humans (u, s) e) determine and understand the variation in the percentage composition of gases in inhaled and exhaled air (s, u) f) understand how to carry out artificial respiration (u) g) understand and describe how the stomata allow gaseous exchange in a leaf (u, s) h) determine the function of lenticels in relation to gaseous exchange (s) i) understand the dangers of smoking and air pollution to gas exchange surfaces in the lungs (u) j) explain the causes, symptoms and treatment of diseases (bronchitis, emphysema, lung cancer, throat cancer, chronic cough) associated with respiratory organs in humans (u, s) 	<ul style="list-style-type: none"> • In pairs, learners think about their prior learning on surface area to volume ratios, and explain verbally or on paper why multicellular organisms need a specialised systems for gaseous exchange • In groups, learners examine a single gill from a fish, and a lung from, e.g., a chicken. Learners observe and use drawings/notes to explain how the structure of the gill and lung makes them suitable for gaseous exchange • In pairs, learners research blood flow through, and water flow over, a fish gill, and produce an annotated diagram to explain how gaseous exchange happens • Learners draw and label the structure of the human respiratory system • In pairs, learners use models to explain the mechanism of gaseous exchange in humans and share models with/explain models to the class • In pairs, learners conduct experiments to analyse inhaled and exhaled air, and report the significance of their observations • Learners observe video clips of artificial respiration, or observe trained practitioners using dummies, and explain verbally or in writing how to carry out artificial respiration in humans, and its importance • In groups, learners research and develop a model to show how stomata open and close using locally available materials • Learners in groups carry out an experiment to demonstrate gas exchange from lenticels of a herbaceous plant stem, and share their report with the class • In groups, learners design, perform and report on an experiment to demonstrate the tar in cigarette smoke that is so damaging to the gas exchange surfaces in the lungs 	<ul style="list-style-type: none"> • Listen to pair and group discussions and ask probing questions to promote critical thinking and deepen understanding • Observe groups as they interact and examine specimens, research or use models. Help as appropriate to set up experiments correctly and guide them towards learning outcomes. • Evaluate quality of products: clarity of explanations and drawings; stomata models and group reports; accuracy and creativity of presentations; posters

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	<ul style="list-style-type: none"> Learners find out the causes, symptoms and treatment of bronchitis, emphysema, lung cancer, throat cancer and chronic cough through a visit to a health facility, video clips, health advice publicity materials, books or other resources, and design a poster for secondary school students to put them off smoking tobacco and marijuana 	
Note: Mention the respiratory organs/surfaces for insects and frogs (no details required).		

SENIOR 3: TERM 1

Theme: Respiration in plants and animals

TOPIC: AEROBIC AND ANAEROBIC RESPIRATION

15 PERIODS

Competency: The learner should be able to appreciate that the energy living organisms use is obtained from food through respiration, both aerobic and anaerobic.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) appreciate the importance of the process of respiration (both aerobic and anaerobic) (u) b) understand and outline the process and site of aerobic respiration (u) c) appreciate the relationship between plants and animals in relation to aerobic respiration and photosynthesis (s) d) understand circumstances in which organisms including humans use anaerobic respiration (u) e) understand and outline the process of anaerobic respiration (u) f) carry out investigations to find the products of anaerobic respiration in plants and animals (s) g) understand some applications of anaerobic respiration in everyday life (u) h) compare aerobic with anaerobic respiration (s)	<ul style="list-style-type: none"> In pairs, learners discuss the importance of respiration and the consequence of respiration failing to occur In pairs, learners research and write the word and symbol equations for aerobic respiration, and the site in cells where this takes place In groups, learners use scientific process skills to design and carry out experiments to show the release of energy, production of carbon dioxide and water, and use of oxygen during aerobic respiration. Report to class on process and findings Class discussion: 'What happens if the food a person eats contains more energy than the body needs?' Class debate: 'Plants and animals can live and survive entirely independent of each other' In pairs, learners research when and why animals and plants use anaerobic respiration and its products (including by repeatedly clenching both fists with one arm down and one raised). Share conclusions through whole class discussion Learners write down the word equation for anaerobic respiration in plants and animals In groups, learners design and carry out experiments to show: <ul style="list-style-type: none"> fermentation using yeast anaerobic respiration in germinating seeds Share groups' reports on outcomes In groups, learners design and give a presentation to explain applications of anaerobic respiration in everyday life Individually, learners complete a comparison table for the two types of respiration 	<ul style="list-style-type: none"> Observe pair/group interactions and experiments, and assist if necessary to ensure progress towards learning outcomes Listen to learners' discussions and debates. Probe to promote critical thinking, understanding and skills development Evaluate quality of products: explanations, reports, discussion and debate, equations, reports, presentations, comparison tables

SENIOR 3: TERM 1**Theme: Excretion in plants and animals****TOPIC: EXCRETION IN LOWER ORGANISMS****2 PERIODS**

Competency: The learner should be able to appreciate that lower organisms use simple mechanisms to get rid of waste products.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) appreciate the need to remove unwanted substances from the bodies of living organisms (u) b) know and describe the process of excretion and osmoregulation in amoeba and paramecium (u)	<ul style="list-style-type: none"> In pairs, discuss the waste products that organisms need to excrete, and the implications for living cells if they were not able to remove them. Share conclusions in whole class discussion. Distinguish between waste products and undigested waste (faeces) In groups, learners consult video clips, books and other resources to find out how and why amoeba and paramecium carry out excretion and osmoregulation, and prepare a report/presentation for the class 	<ul style="list-style-type: none"> Observe pairs and groups and check for productive approaches to learning, and assist as appropriate Listen to discussions and ask questions to ensure required learning takes place Evaluate products: oral contributions to discussion, and quality of reports/presentations

SENIOR 3: TERM 1**Theme: Excretion in plants and animals****TOPIC: EXCRETION IN PLANTS****2 PERIODS**

Competency: The learner should be able to appreciate that plants have excretory products, and describe how they are excreted.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) appreciate that plants have excretory products, and know how they are excreted (k, u) b) understand that oxygen is a waste product of plants that animal life depends upon (u) c) understand that a plant without light carries out respiration and produces the same waste products as heterotrophs (u)	<ul style="list-style-type: none"> In groups, learners use their prior learning about leaf structure to suggest how water vapour and carbon dioxide are removed from plants (through stomata). Groups share their conclusions in class discussion to ensure all understand In pairs, learners research and report on: <ul style="list-style-type: none"> the percentage of gases in the air and explain, verbally or in writing, how humans and all animal life depends upon plants for oxygen why plant cells need to carry out respiration, and what waste products plants produce at night and during the day 	<ul style="list-style-type: none"> Observe pairs and groups and intervene to ensure all are participating and developing skills and understanding Listen to learners discussions and reports, helping to steer them towards learning outcomes as necessary Evaluate quality of verbal and written reports

SENIOR 3: TERM 1

Theme: Excretion in plants and animals

TOPIC: EXCRETION IN ANIMALS

13 PERIODS

Competency: The learner should understand that different organs excrete different waste products, and be able to relate the organs of excretion in the human body to their functions.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the process of excretion in humans, including the loss of waste products in sweat, urine and through breathing (k, u) b) understand and explain how and why the human body reacts to raised levels of carbon dioxide (u, s) c) identify the causes, symptoms and treatment of kidney failure (u) d) understand the need for tests to determine the presence of glucose and protein in urine, and explain the significance of the tests (u, s) e) recognise the need for proper disposal of human waste; e.g. urine (s) 	<ul style="list-style-type: none"> • In groups, learners examine a dissected mammal or a diagram/video of one. Learners observe and identify the organs associated with excretion and record their observations • In groups, learners research the functions and processes that take place in the kidneys, and create a simulation explaining the processes of ultrafiltration and re-absorption • In pairs, consider prior learning and experience of taking exercise to explain how and why carbon dioxide levels affect breathing rate. Share thinking with the whole class • Learners visit a health facility, listen to a medic or carry out research to find out the causes, symptoms and treatment of kidney failure, and write a report • In groups, learners carry out experiments to detect glucose and protein in urine, and research reasons for, and consequences of, these problems • In pairs, learners research, discuss and share conclusions relating to: <ul style="list-style-type: none"> • alternative ways that human urine can be used, and how to manage human wastes like urine for a healthy environment at school • why a build up of sweat can become smelly and the importance of hygiene 	<ul style="list-style-type: none"> • Observe groups interacting and intervene when necessary to ensure activities are leading to learning outcomes being achieved • Listen to learners' conversations to monitor progress and understanding, intervening to offer guidance as appropriate • Evaluate quality of products: reports, simulations, verbal explanations

SENIOR 3: TERM 1/2**Theme: Coordination in plants and animals****TOPIC: RECEPTION AND RESPONSE IN PLANTS****14 PERIODS**

Competency: The learner should be able to appreciate that most movement in plants is triggered by an environmental stimulus.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) differentiate between irritability, stimulus and response (s) b) appreciate that plants can detect, and respond to, changes in the environment (u, s) c) conduct experiments on phototropism and geotropism (s) d) understand the role of hormones in plant growth (k)	<ul style="list-style-type: none"> In pairs, learners research and discuss the meanings of terms irritability, stimulus and response. Share conclusions in whole class discussion to ensure all understand In pairs, learners research (using direct observation in the field and other resources) environmental stimuli that plants respond to and their responses to each. They complete a table to show their findings In groups, learners plan, carry out and report on experiments to demonstrate phototropism and geotropism, taking care to make sure experiments are controlled and investigated one factor at a time In pairs, learners research the role of plant hormones in promoting or inhibiting growth to cause responses to stimuli, produce diagrams to explain photo- and geotropism, and annotate to show how tropic responses improve chances of survival 	<ul style="list-style-type: none"> Observe pairs and groups engaging in activities and carrying out experiments, to ensure involvement and productive use of time leading to appropriate learning Listen to learners conversations and contributions to class discussion, and ask probing questions to encourage critical thinking and progress towards learning outcomes Evaluate quality of explanations, research findings, experiment reports and written/ drawn explanations
ICT Support <ul style="list-style-type: none"> The learner can use graphics software to simulate different types of plant responses Note: No knowledge of specific plant hormones required.		

SENIOR 3: TERM 2**Theme: Coordination in plants and animals****TOPIC: RECEPTION, RESPONSE AND BEHAVIOUR IN ANIMALS****4 PERIODS**

Competency: The learner should be able to explain how and why organisms respond to different stimuli in the environment.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand that animals can detect, and respond to, changes in the environment (u) b) conduct an experiment on a tactic response (s)	<ul style="list-style-type: none"> In groups learners design, carry out and report on an experiment to investigate tactic responses to stimuli such as light or humidity in small organisms such as earthworms, woodlice, fly larvae/maggots Reports to include conclusions about the processes involved that enable animals to respond, and possible explanations of benefit in terms of survival 	<ul style="list-style-type: none"> Observe groups and listen to learners' discussions Intervene to help ensure experiments contribute to understanding and skill development Evaluate quality of reports
ICT Support <ul style="list-style-type: none"> The learner can use graphics software to simulate different types of plant responses Note: No knowledge of specific plant hormones required.		

SENIOR 3: TERM 2**Theme: Coordination in plants and animals****TOPIC: CHEMICAL COORDINATION IN HUMANS****15 PERIODS**

Competency: The learner should be able to appreciate that there are organs in the body that secrete chemicals called hormones, which play vital roles in co-ordinating body functions.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) differentiate between hormones and enzymes (u) b) know and understand the effects of various hormones in the human body (k, u) c) know and describe the symptoms of common hormonal diseases in humans (k, u) d) appreciate the role of diet in managing hormonal diseases in humans (u) 	<ul style="list-style-type: none"> • In pairs, learners research and discuss the meaning of hormone, and produce a table comparing hormones and enzymes. Pairs share conclusions in class discussion and ensure all have clear understanding • Learners use a chart of the endocrine system to locate the different endocrine glands, and to note the hormones they produce and their effects. • Role play: learners pick cards labelled with the names of either endocrine glands, the hormones secreted by the glands or the target organs, and simulate the movement of the hormones from the glands to the target organs, giving descriptions of their effects on the target organs • In groups, learners discuss and report on the role of hormones in the regulation of reproductive and sexual functioning in adolescent boys and girls, particularly the development of secondary sexual characteristics • In groups, learners discuss and produce a chart showing the symptoms of common hormonal diseases in humans • In pairs, learners research and develop a one day meal plan for a person suffering from diabetes 	<ul style="list-style-type: none"> • Observe pairs and groups engaging in activities. Intervene as necessary to ensure all are participating and making progress with each task towards learning outcomes. • Listen to learners discussions and ask questions to encourage creativity and critical thinking. Ensure all learners grasp concepts and understand. • Evaluate quality of products: oral contributions, charts, role plays, reports, meal plans

SENIOR 3: TERM 2

Theme: Coordination in plants and animals

TOPIC: NERVOUS COORDINATION IN HUMANS

15 PERIODS

Competency: The learner should be able to appreciate that nerve impulses are electrical in nature, and are transmitted by specialised nerve cells whose structures differ to perform different roles in the transmission.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand how the nervous system (brain, spinal cord and nerves) extends to all parts of the body and has sensory and motor functions (u) b) identify the parts of the brain (cerebrum, cerebellum, medulla oblongata, pituitary gland and hypothalamus) and describe the role of the parts (k, u) c) understand the concept of reflex action, identify the five components and explain their functions (k, u) d) differentiate between voluntary and involuntary responses (u) e) distinguish between substance/drug use and abuse (k, s) f) know the common substances and drugs abused in Uganda and understand the physiological, social and economic effects of substance and drug abuse (k, u) g) understand how to prevent, control and avoid involvement in substance and drug abuse (u)	<ul style="list-style-type: none"> In pairs, learners discuss what they know about the nervous system and its components, then research and discuss the meaning of sensory and motor functions. Pairs share their conclusions in class discussion Individuals draw a sketch of a human being showing how the brain is connected to the spinal cord and nerves In pairs, learners research the five key components of the brain and their functions, and produce an annotated diagram to show them In pairs, learners test each other's 'knee jerk' reflex and discuss whether this is a voluntary or involuntary response. Pairs contribute to discussion of findings and benefits of involuntary reflex actions and give examples of other reflex actions Individuals produce annotated diagrams of a reflex arc showing functions of parts In groups, learners discuss the physiological, social and economic effects of drug and substance abuse (alcohol, cigarettes, marijuana, kuber, khat, shisha, petrol/glue) and the reasons why some people become involved Groups write strategies for a campaign on the avoidance, prevention and control of drug abuse in schools and communities, and design posters that communicate the key messages 	<ul style="list-style-type: none"> Observe and listen to learners working in their pairs, and intervene to ensure learning outcomes are being achieved Evaluate quality of sketches, contributions to class discussion and annotated diagrams Listen to learners' discussions and observe interactions to check all are participating and developing their understanding of the issues Ask probing questions to promote critical thinking and creativity in the search for solutions to include in strategy posters. Evaluate quality of posters

SENIOR 3: TERM 2**Theme: Coordination in plants and animals****TOPIC: RECEPTOR ORGANS IN MAN****6 PERIODS**

Competency: The learner should be able to appreciate that the sensory organs (eye and ear) detect stimuli, and enable the body to respond and function properly.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the roles and functions of the human eye and ear as sense organs (u) b) understand what short and long sightedness is and how they can be corrected (u, s)	<ul style="list-style-type: none"> In pairs, learners explore and discuss the external features of the eye and diagrams of a cross-section, before drawing the structure and adding notes of the functions of each part Learners research short and long sightedness by visiting a health facility, having a visit from an ophthalmologist, or using other resources. Learners write a report including diagrams to show how to correct the problems In pairs, learners explore and discuss the external features of the ear and diagrams of a cross-section, before drawing the structure and adding notes of the functions of each part 	<ul style="list-style-type: none"> Observe pair interactions and understanding demonstrated by diagrams and notes. Intervene to ensure progress towards learning outcomes Listen to learners' discussions and probe to promote critical thinking, and deepen learning Evaluate quality of annotated diagrams and reports
ICT Support <ul style="list-style-type: none"> The learner can use the internet to research the central nervous system, eye and ear 		

SENIOR 3: TERM 3

Theme: Locomotion in animals

TOPIC: LOCOMOTION IN INSECTS, BONY FISH AND BIRDS

13 PERIODS

Competency: The learner should be able to understand how insects, fish and birds use special structures for movement.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) know the meaning of the term locomotion, and the types animals use (k) b) know the structures used by insects for locomotion and how they function (k, u) c) identify the features used in locomotion in a bony fish (k) d) understand how a bony fish is adapted to locomotion in its habitat, and how the fins create thrust that drives the fish forwards (k, u) e) identify the features of the bird that enable it to move (u) f) understand how a bird is adapted to locomotion in its habitat, and how its wings create uplift so it can often fly without flapping (u, a) 	<ul style="list-style-type: none"> • Pairs discuss the meaning of the term locomotion, brainstorm or research it, then record the types of locomotion used in the animal kingdom • In groups, learners explore the anatomy of an insect, such as a grasshopper or cockroach, closely examining (with the naked eye and a hand lens) the structure and texture of the fore and hind wings and the legs. Learners draw and label the wings and legs stating the magnification • Groups prepare presentations explaining the forces involved when insects fly or walk • In pairs, learners observe a fish, preferably in an aquarium, and describe orally or in writing/drawings: <ul style="list-style-type: none"> • the fins and how they are used for locomotion • the features that make the fish streamlined for ease of movement • the features that stabilise the fish so it can move efficiently • In pairs, learners research and report on how the movement of the fins creates the forces that move the fish forwards • In pairs, learners observe birds flying and describe orally or in writing/drawings: <ul style="list-style-type: none"> • the structure and shape of the wings • the features of the bird that make it streamlined for ease of movement • In pairs, learners research and report on how the movement and the shape of the wings creates the forces that move the bird forwards or allow it to glide without flapping 	<ul style="list-style-type: none"> • Observe pairs and groups engaging in activities, ensuring observations focus on key features of anatomy related to locomotion, ensure they are focused on achieving learning outcomes and steering them as appropriate • Listen to learners conversations and ask probing questions to deepen learning and ensure concepts are understood • Evaluate quality of explanations: reports; drawings; descriptions; presentations
ICT Support The learner can: <ul style="list-style-type: none"> • use the internet to research flight in birds and swimming in fish • develop simulations of flight in birds and swimming in fish using graphics software 		

SENIOR 3: TERM 3**Theme: Locomotion in animals****TOPIC: LOCOMOTION IN MAMMALS****15 PERIODS**

Competency: The learner should understand how muscles and the skeleton interact to produce movement in mammals.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the structure and functions of the skeleton in supporting the human body (k, u) b) identify and describe the bones that form the two divisions of the human skeleton (k, u, s) c) understand how the action of muscles on the skeleton causes movements in animals (u, s) d) understand the causes, effects and preventive measures of muscle cramps (u) 	<ul style="list-style-type: none"> • In groups, learners research the structure of the human skeleton using a 3D model, their own bodies, diagrams, animations and other online resources in order to: <ul style="list-style-type: none"> • identify the two divisions of the skeleton • name the bones that form the appendicular and axial skeleton • identify the regions of the axial skeleton • draw and label examples of cervical, thoracic and lumbar vertebrae • identify the parts for muscle attachment on the vertebrae • Working in pairs, learners use their bodies to identify movable parts and the plane in which the movement occurs at each joint. They produce a table naming the joints and the type of movement that occurs at each • In pairs, learners observe each other moving the forearm up and down (bending the arm at the elbow). Learners identify the set of muscles that bring about each movement and research the name of the muscles responsible for lifting and for extending the arm. Pairs produce an annotated diagram explaining their conclusions • In pairs, research the structure of a joint. Develop a model or draw an annotated diagram to explain its structure and function • In pairs, learners share experience of, and research, the causes and effects of cramp and how to avoid it, and produce a short advisory leaflet 	<ul style="list-style-type: none"> • Observe pairs and groups engaging in activities and carrying out experiments to ensure involvement and productive use of time leading to appropriate learning • Listen to learners' conversations and contributions to class discussion and ask probing questions to encourage critical thinking and progress towards learning outcomes • Evaluate quality of explanations, research findings, experiment reports and written/drawn explanations • Observe pairs engaging in activities and offer advice to overcome any barriers to learning • Listen to learners' discussions and ask questions to promote critical thinking and boost progress towards learning outcomes • Evaluate quality of learning through products: tables, diagrams, models and leaflets
ICT Support <ul style="list-style-type: none"> • The learner can use mind mapping or word processing software to categorise the different types of joints in a human body Note: Functions of skeleton limited to: protection, muscle attachment, manufacture of blood cells, support and provision of body framework, with a brief illustration of example(s) in each case.		

SENIOR 3: TERM 3**Theme: Growth and development in plants and animals****TOPIC: GROWTH IN PLANTS AND ANIMALS****12 PERIODS****Competency:** The learner should understand how, throughout its life, an organism goes through changes in size.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) distinguish between the terms 'growth' and 'development' (u) b) appreciate that mitosis leads to increase in size and weight in animals (u, s) c) understand the internal and external structure of a seed (k, u) d) conduct experiments on conditions necessary for seed germination (s) e) identify the roles of water, oxygen and temperature in the process of germination (u) f) identify and describe the type of seed germination in monocots and dicots (u) g) understand seed dormancy, its causes and its importance to a plant (u) h) identify meristems in plants and explain their importance (u) 	<ul style="list-style-type: none"> • In groups, learners examine images of young and mature plants and animals (including some that metamorphose), and discuss and derive the meaning of the terms 'growth' and 'development', sharing conclusions with the class • In pairs, learners examine data from growth cards of five babies, draw growth curves and make deductions from the graphs • In groups, learners role-play the process of mitosis using cards showing the different stages (names of stages not required), and show role play to the class • In groups or pairs, learners discuss and explain, verbally or in writing, the importance of mitotic cell division in living organisms • In pairs, learners examine a fresh bean and a maize seed (soaked overnight), and: <ul style="list-style-type: none"> • describe and draw the external features • cut the seeds longitudinally, observe using a hand lens, describe and draw the internal structure • In groups, learners use scientific process skills to design, carry out and report on an experiment to investigate whether air and water are necessary for germination, and the effect of temperature on germination • Learners research and report the causes, importance and breaking of seed dormancy through a visit to an agricultural facility, a talk from a visitor, internet research or other sources • Learners watch an animation on growth in the shoot and root of a plant, identify and, in pairs, explain the processes that take place in meristems • Group project: Plant a set of bean and/or maize seeds. From the time of germination monitor and record the changes in length every week for up to 10 weeks. Record growth and development information, presenting growth data in a graph 	<ul style="list-style-type: none"> • Observe pairs and groups and ensure they are making progress towards achieving learning outcomes, steering them as appropriate • Listen to learners' conversations and ask questions to ensure they all engage, think critically and grasp concepts of growth, development and mitosis • Evaluate quality of verbal and written reports; experiment reports; observations shown in drawings; reports on seed dormancy and meristems; project report • Involve class in peer assessment of role plays

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
ICT Support <ul style="list-style-type: none"> The learner can use data processing software to show changes in height of a germinating seed over time 		

SENIOR 3: TERM 3

Theme: Growth and development in plants and animals

TOPIC: DEVELOPMENT IN PLANTS AND ANIMALS

8 PERIODS

Competency: The learner should be able to understand that organisms develop specialized cells, tissues and organs as they grow leading to changes in structure and function.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the need for differentiation of cells as multicellular plants and animals grow (u) b) understand the process of secondary growth of stems in dicotyledonous plants (u) c) know the meaning of the term metamorphosis, and compare complete and incomplete metamorphosis (k, u, s) d) know the stages of development in an insect (k) e) understand the lifecycles of a housefly, cockroach, mosquito, bee and butterfly (u) f) recognise and compare the main characteristics of stages of human development from birth to adulthood, including the developmental stages of a child (physical, behavioural and cognitive) (k, s) g) understand the physical, physiological, psychological (emotional) and behavioural changes associated with adolescence and puberty, and highlight the associated myths (u, s) h) understand and be able to cope with changes related to secondary sexual characteristics at puberty (u, s) i) understand various features related to the process of aging (u) 	<ul style="list-style-type: none"> In groups, learners discuss the need for cells to become specialised as animals and plants grow, considering the different types of cells in their own bodies and in plants they can see in the locality. Groups share conclusions in whole class discussion and agree a definition of cell differentiation In pairs, learners research secondary growth in dicot stems (linking to prior learning on meristems in Senior 4, Topic 1). Pairs share understanding with larger group and record agreed conclusions in annotated diagrams or notes Learners observe video clips of complete and incomplete metamorphosis, or research using different sources. In pairs, learners produce a table comparing the two types. Individuals produce drawings to show stages of each type of metamorphosis in insects In pairs, learners research and produce life cycle diagrams for housefly, cockroach, mosquito, bee and butterfly annotating diagrams to illustrate the type of metamorphosis each undergoes In groups, learners observe drawings, animations or other sources and discuss the stages of human development, noting the physical, behavioural and cognitive changes that take place from birth, through childhood and through adulthood into old age (in notes and/or drawings) 	<ul style="list-style-type: none"> Observe pairs and groups involved in activities to ensure all are involved (taking into account that this unit involves discussion of sensitive issues), and making good use of resources and time Listen to pair and group conversations and contributions to class discussion. Ask probing questions to encourage learners to engage with sensitive topics so that all make progress and achieve learning outcomes Evaluate quality of products: oral feedback, notes, drawings, diagrams and reports

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	<ul style="list-style-type: none"> In whole class discussion, key points about stages of development are shared including features of the aging process In groups, learners research physical, physiological, psychological/emotional and behavioural changes associated with adolescence and puberty In whole group discussion, myths associated with sex, ejaculation, menstruation and pregnancy are discussed and debunked. Strategies for coping with changes at puberty are shared and agreed. Individuals record key points from discussion 	
ICT Support <ul style="list-style-type: none"> The learner can use the internet as a source of research information on body changes. 		

SENIOR 4: TERM 1

Theme: Reproduction in organisms

TOPIC: ASEXUAL REPRODUCTION IN LOWER ORGANISMS

4 PERIODS

Competency: The learner should be able to appreciate that some organisms can reproduce asexually without the need for pairing with another individual.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) identify and briefly describe the forms of asexual reproduction in: amoeba, mucor, yeast and spirogyra (u) b) know the meaning of asexual reproduction (k)	<ul style="list-style-type: none"> Learners observe animations and other resources showing asexual reproduction in: <ul style="list-style-type: none"> amoeba (binary fission) spirogyra (fragmentation) rhizopus (spore formation) yeast (budding) In groups, learners: <ul style="list-style-type: none"> describe the process involved in each form of asexual reproduction based on their observations, identify common characteristics and hence derive the meaning of the term asexual reproduction produce individual reports 	<ul style="list-style-type: none"> Observe group interactions and listen to conversations, intervening as required to correct misunderstandings Evaluate quality of product: reports describing the four types of asexual reproduction and common characteristics

SENIOR 4: TERM 1**Theme: Reproduction in organisms****TOPIC: ASEXUAL REPRODUCTION IN PLANTS
(VEGETATIVE REPRODUCTION)****10 PERIODS****Competency:** The learner should be able to appreciate that some parts of a plant can develop into new independent plants.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand that plants reproduce asexually (u, s) b) understand that asexual reproduction in plants has important commercial applications (k, u)	<ul style="list-style-type: none"> Learners carry out a field study to observe plants, identifying possible parts that have been or could be used to get new plants of the same kind. Learners report findings in a table with drawings as appropriate In groups, learners research and discuss the crops in Uganda that are grown by vegetative reproduction on a large scale, and produce a report Group project: Grow plants in school by, for example, layering (strawberries), stem cutting (cassava), root cuttings, grafting (citrus). Groups research and report the key principles underlying each method of propagation used and possible reasons for success (or failure) Brainstorm advantages and disadvantages of vegetative propagation in plants. Through class discussion agree answers, and learners then record answers in a table 	<ul style="list-style-type: none"> Observe groups engaging in activities and carrying out the project to ensure effective and productive use of time leading to learning outcomes Listen to learners' conversations and contributions to class discussion. Ask questions to encourage critical thinking and promote progress towards learning outcomes Evaluate quality of reports, research findings, project report and comparison table
ICT Support <ul style="list-style-type: none"> The learner can use the internet to obtain research information to support learning 		

SENIOR 4: TERM 1

Theme: Reproduction in organisms

TOPIC: SEXUAL REPRODUCTION IN HUMANS

18 PERIODS

Competency: The learner should be able to understand that sexual reproduction involves two parents with specialized reproductive systems.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand structure and functions of male and female reproductive system in humans (k, u, s) b) explain the changes that take place during the menstrual cycle (u) c) compare male and female gametes (u) d) describe the process of fertilization of an ovum and the developments of the zygote up to birth (u) e) describe the role of the placenta during pregnancy f) explain the meaning and importance of antenatal medical care (u, s) g) describe aspects of care for the baby after birth (breast feeding, balanced diet, immunization and hygiene) (u) h) explain the health risks/complications associated with early/teenage pregnancy and abortion (u) i) identify the common birth control methods in Uganda and give the biological principle they employ and their effectiveness. (Note: the only method recommended for young people is abstinence) (u) j) Identify and explain common issues associated with reproductive systems (u, s) k) State the cause, signs and symptoms and explain the mode of transmission of named STIs (Syphilis, Gonorrhoea, Candida, Human Papilloma Virus [HPV], Hepatitis B and HIV/AIDS). (k, u) l) Explain the preventive measures for the named STI's. (Note: The ONLY preventive method recommended for young people is abstinence) (u) m) Identify the challenges faced by people living with HIV/AIDS and how to overcome them. (u) 	<ul style="list-style-type: none"> • In pairs or groups, learners examine chart(s) of male and female reproductive systems, draw and label them, researching and annotating diagrams with the functions of each part • In groups, learners examine graphs showing monthly variation in levels of LH and FSH, oestrogen and progesterone, and changes to the uterine wall, using the graphs to discuss and explain the events of the menstrual cycle. After class discussion, individuals record the events in charts/diagrams • In pairs or groups, learners research and describe (verbally and in notes): <ul style="list-style-type: none"> • the structure of male and female gametes, and functions of the parts • the process of fertilisation • stages in the process of development from zygote to birth, including the role of the placenta • In groups, learners research, brainstorm and report on: <ul style="list-style-type: none"> • care for the baby after birth (breast feeding, balanced diet, immunization and hygiene) • the importance of good antenatal medical care for mother and baby • Learners visit a health facility, listen to a visiting professional and, in groups, carry out research on: <ul style="list-style-type: none"> • the common birth control methods used in Uganda, the biological principle they employ and their effectiveness • dangers associated with early/teenage pregnancy and abortion <p>Individuals produce reports/posters explaining the above two points</p> <ul style="list-style-type: none"> • As individuals or in groups, learners gather information and report on menstrual and erectile abnormalities in young people and the possible medical remedies 	<ul style="list-style-type: none"> • Observe pairs and groups engaging in activities. Intervene as necessary and encourage all to participate despite the sensitive nature of some topics. Ensure all understand the importance of achieving learning outcomes for personal as well as school-related reasons • Listen to learners' discussions and ask questions to encourage creativity and critical thinking. Ensure all learners grasp all concepts • Evaluate learning as shown by quality of products: oral contributions, annotated diagrams, reports, posters • Observe learners engaging in activities. Intervene as necessary to ensure all are participating in pair/group discussion of sensitive issues. Check all are making progress with each task towards achieving learning outcomes • Listen to learners' discussions. Ask probing questions to encourage learners to develop deep understanding of all key issues, and to be sensitive in relation to HIV/AIDS • Evaluate quality of products: oral contributions, reports, plays

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	<ul style="list-style-type: none"> • Learners listen to a talk from a health worker or watch a video clip about common STIs, and write a report that includes the following: <ul style="list-style-type: none"> • causes and mode of transmission • signs and symptoms • preventive measures • Learners listen to or recite the song “Alone And Frightened” by Philly Bongoley Lutaya • In groups or as a whole class, learners discuss the stigma/discrimination portrayed in the song, and the significance of the song in Uganda • Groups write a short a play about HIV/ AIDS and attitudes to sufferers 	

SENIOR 4: TERM 1

Theme: Reproduction in organisms

TOPIC: SEXUAL REPRODUCTION IN PLANTS

14 PERIODS

Competency: The learner should be able to understand that the flower is the specialized organ in which all events of a plant's sexual reproduction occur, leading to the formation of an embryo located in the seed.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) recognise the flower structures that are involved in the processes of pollination, fertilisation, fruit and seed development and outline their functions (k, u, s) b) outline the processes of pollination, fertilization and fruit formation (u) c) understand the difference between cross- and self-fertilisation, and the advantages of each method (u) d) differentiate between seeds and fruits structurally and functionally (s) e) understand the importance of dispersal. Recognise the structures and types of fruits and seeds and relate their structures to their methods of dispersal (u, s) 	<ul style="list-style-type: none"> • In groups or pairs, learners examine specimens and/or diagrams of insect-pollinated flowers, and research using different sources, then discuss: <ul style="list-style-type: none"> • the meaning of the term pollination and how pollination takes place • how fertilisation takes place • how seeds and fruits develop • Individuals produce annotated diagrams explaining these processes • In groups or pairs, learners examine examples of flowers that are wind-pollinated (e.g. maize, grasses) and some that are insect-pollinated, and compare the two, especially the stamens/anthers and stigmas of each, relating structure to function. Learners then compare images or microscope slides of pollen grains from wind and insect-pollinated flowers, again relating structure to function • Individuals produce a table/report comparing the two types of flowers and pollen • In pairs, learners research the meaning of cross- and self-fertilisation and produce a table comparing the two • In pairs, learners examine specimens and or diagrams of fruits and seeds and discuss and explain (verbally and in notes): <ul style="list-style-type: none"> • the structural and functional difference between fruits and seeds • how different seeds are dispersed, stating why dispersal is so important 	<ul style="list-style-type: none"> • Observe pairs and groups carrying out activities. Ensure all individuals are participating and understanding lessons emerging from examination of specimens, diagrams and research, making progress with each task towards learning outcomes • Listen to learners' conversations and ensure all learners grasp concepts and understand all processes set out in the learning outcomes • Evaluate quality of learning through products: annotated diagrams, tables and reports, verbal and written explanations
ICT Support The learner can: <ul style="list-style-type: none"> • use graphical software to draw a labelled diagram of a local flower • use mind mapping or word processing software to categorise fruits and seeds by their structure 		

SENIOR 4: TERM 1**Theme: Genetics and evolution****TOPIC: MEIOSIS AND ITS IMPORTANCE****2 PERIODS**

Competency: The learner should understand how meiosis may lead to variation between members of the same species.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the process and significance of meiosis (k, u)	<ul style="list-style-type: none"> In groups or pairs, learners view an animation on meiotic cell division, research using other sources, then: <ul style="list-style-type: none"> identify the stages and describe what occurs at each phase using annotated diagrams and notes explain (verbally and in notes) the significance of meiotic cell division in maintaining the chromosome number 	<ul style="list-style-type: none"> Observe and listen to learners as they engage in the activity and discuss their ideas. Intervene to promote critical thinking and help learners to achieve learning outcomes Evaluate understanding from quality of products: annotated diagrams, notes

SENIOR 4: TERM 2

Theme: Genetics and evolution

TOPIC: GENETICS AND MONOHYBRID INHERITANCE

15 PERIODS

Competency: The learner should be able to appreciate that transmission of characteristics is from parents to offspring through a process known as heredity.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the concept of monohybrid inheritance in plants and animals, and how to represent crosses in genetic diagrams (u, s) b) understand and explain sex determination in humans (u, s) c) understand and explain sex linkage in humans (u, s)	<ul style="list-style-type: none"> In groups, learners research monohybrid inheritance, and develop an activity using coloured beads to explain the concept to the rest of the class. After whole class discussion to ensure all understand, individuals explain using annotated diagrams In groups, learners research the meanings of the following terms: chromosome, gene, dominant and recessive, heterozygous and homozygous, phenotype and genotype, and share their understanding with the whole class using visual aids they create. After whole class discussion to ensure all understand, individuals explain using annotated diagrams In pairs, learners research how to use simple genetic diagrams to represent and explain monohybrid crosses in plants and animals, and develop diagrams for some given examples In groups, research, discuss and explain sex determination and sex linkage using relevant examples. After whole class discussion to ensure all understand, individuals explain using annotated diagrams 	<ul style="list-style-type: none"> Observe groups and ensure they are carrying out activities effectively, and making progress in terms of achieving learning outcomes Listen to learners' group and whole class conversations, prompt them and ask questions to ensure they grasp difficult concepts Evaluate quality of contributions to group and whole class discussions, and use products to gauge understanding: annotated diagrams, genetic diagrams
Note: Give examples of incomplete and co-dominance. No details required.		

SENIOR 4: TERM 2**Theme: Genetics and evolution****TOPIC: APPLIED GENETICS****6 PERIODS**

Competency: The learner should be able to appreciate how knowledge of genetics is used in agriculture to improve plants and animals.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) appreciate how knowledge of genetics can be used in agriculture to improve the quality of plants and livestock (u)	<ul style="list-style-type: none"> Learners visit an agricultural facility, or listen to a visiting agricultural extension officer, and/or carry out research in pairs and learn about the use of genetics in plant and animal breeding. Individuals write a brief report on improvements and their significance 	<ul style="list-style-type: none"> Observe and listen as learners carry out activity, intervening to address any misunderstandings Evaluate learning from quality of product: report on improving animal and crop yields
ICT Support <ul style="list-style-type: none"> The learner can use the internet to obtain supporting information on plant and animal breeding 		

SENIOR 4: TERM 2**Theme: Genetics and evolution****TOPIC: MUTATION AND VARIATION****6 PERIODS**

Competency: The learner should be able to understand that variation is as a result of changes in the genetic make-up of an organism.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) appreciate that variation in organisms is due to external and internal factors, and that mutations can be beneficial, harmful or neutral (k, u) b) identify diseases associated with genetic disorders; e.g. sickle cell anaemia, albinism, Down's syndrome (u)	<ul style="list-style-type: none"> Learners do research in groups to explain the meaning and give examples of variation due to environmental factors and genetics In groups, learners research and explain the significance of: <ul style="list-style-type: none"> beneficial mutations neutral mutations harmful mutations examples such as sickle cell anaemia, albinism and Down's syndrome Groups present the findings to the rest of the class and individuals complete reports 	<ul style="list-style-type: none"> Observe groups interacting and listen to learners' conversations, intervening as necessary to ensure activities are leading to learning outcomes being achieved Evaluate quality of products: verbal explanations, presentations, reports

SENIOR 4: TERM 2**Theme: Genetics and evolution****TOPIC: EVOLUTION****6 PERIODS**

Competency: The learner should be able to understand that living organisms change form over long periods in order to adapt to changes in the environment.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the concept of natural selection as a mechanism of evolution (k, u) b) know the theories of the origin of life, and explain the mechanism for evolution by natural selection (u) c) understand and explain some of the evidence for evolution (u, s)	<ul style="list-style-type: none"> Learners visit an agricultural facility, or listen to a visiting agricultural extension officer, and/or carry out research in pairs and learn about the use of genetics in plant and animal breeding. Individuals write a brief report on improvements and their significance 	<ul style="list-style-type: none"> Observe and listen as learners carry out activity, intervening to address any misunderstandings Evaluate learning from quality of product: report on improving animal and crop yields

SENIOR 4: TERM 2**Theme: Interrelationships****TOPIC: CONCEPT OF ECOLOGY****3 PERIODS**

Competency: The learner should be able to understand the concepts of communities, habitats and ecosystems.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) know the meaning of the term ecology (k) b) understand the concepts of communities, habitats and ecosystems (s, u)	<ul style="list-style-type: none"> In groups, look at a map showing the main physical features of East Africa and identify at least five ecosystems, stating their distinguishing features Groups report and compile a class list of ecosystems and their characteristics In groups, learners study a local ecosystem and classify its living and non-living components, identifying the dominant organisms (that determine the other organisms found there) and the communities and habitats within the ecosystem Groups share ideas and discuss the ecosystem's components, its communities, habitats and dominant species 	<ul style="list-style-type: none"> Observe groups interacting and intervene as necessary to ensure activities lead to learning outcomes being achieved Listen to learners' conversations to monitor progress and understanding, intervening to offer guidance as appropriate Evaluate quality of products: ecosystem descriptions and lists; conclusions regarding local ecosystem components; communities, habitats and dominant species

SENIOR 4: TERM 2**Theme: Interrelationships****TOPIC: FOOD CHAINS AND FOOD WEBS****12 PERIODS**

Competency: The learner should be able to appreciate the interdependence of organisms in a given ecosystem.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) understand the feeding relationships in an ecosystem, and express them using food chains, webs and pyramids (k, u, s) b) appreciate the organisms and processes involved in the carbon cycle, and its role in maintaining the carbon dioxide balance in the atmosphere (u)	<ul style="list-style-type: none"> In groups, learners study a local ecosystem through field visits and observe, identify and record the organisms. (NB: Learners may need to remind themselves of the sampling techniques covered in Senior 1, Topic 7 for this study). Then, learners: <ul style="list-style-type: none"> note what food sources the animal species rely upon draw simple food chains and develop these into a food web identify the trophic levels of the organisms observed. Groups share their reports with the class to ensure all have a good level of understanding In groups, learners use the data from their local ecosystem, or use data provided showing numbers of organisms found in, for example, a grassland ecosystem, to: <ul style="list-style-type: none"> categorize the organisms as producers, primary consumers and secondary consumers calculate the number of organisms in each trophic level use the numbers to construct a pyramid of numbers explain the appearance of the pyramid Individuals record conclusions and draw pyramids 	<ul style="list-style-type: none"> Observe groups carrying out activities and offer guidance to ensure observation techniques are effective, and that identifications and interpretations of feeding relationships are accurate Listen to learners' conversations and monitor progress and understanding Ask questions to deepen learning Evaluate quality of products: verbal and written reports, pyramid drawings
ICT Support The learner can: <ul style="list-style-type: none"> use spread sheets to enter and analyse data use slide presentations for report on findings Note: Details of pyramid of biomass and energy not required.		

SENIOR 4: TERM 3

Theme: Interrelationships

TOPIC: TECHNIQUES FOR SAMPLING LIVING ORGANISMS

2 PERIODS

Competency: Learners should understand the value of sampling techniques and be able to use them effectively for studying ecosystems.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand the importance of sampling techniques for studying populations and the diversity of organism in the environment (u) b) understand that scientists try to avoid harming living things in carrying out these studies and why (u) c) sample plants and/or animals in a given study area using: direct count method; line transect; quadrats; capture, mark recapture; sweep net; pooter; pitfall trap (s) 	<p>In all activities teachers should ensure learners understand the importance of minimizing the impact of their studies on the environment and the organisms they find there.</p> <ul style="list-style-type: none"> • In groups, learners use a direct count method to find the size of an appropriate population of plants in a particular area, and then try to use the same method in an inappropriate situation so that they recognise the importance of sampling techniques. Groups feed back regarding circumstances when a total count is possible and when it is not • In groups, learners practise sampling a plant population using transects and quadrats, and then consider: <ul style="list-style-type: none"> • what they can learn about the populations in an area by using these techniques • what must be done to ensure results are not misleading • Groups share as a whole class and develop good practice guidance for effective use of transects and quadrats • In groups, learners carry out an activity to estimate the size of a bean/bead 'population'. Learners use differently coloured beans/beads and follow the procedure for the 'capture, mark and re-capture' method. In the activity, learners: <ul style="list-style-type: none"> • observe the effect increasing the size of population has on the accuracy of the activity • discuss the factors that affect estimation of populations in real ecosystems • Learners practise (if possible) using a sweep net, pooter and pitfall trap and record the types of animals they catch. Groups discuss and record how useful these methods might be for estimating population sizes 	<ul style="list-style-type: none"> • Observe groups carrying out activities, and help those at risk of not meeting learning outcomes • Listen to learners' discussions and ask questions to gauge understanding, promote critical thinking and deepen learning • Observe and listen to group feedback to ensure all members understand and develop their communication • Evaluate quality of products such as good practice guidance for use of transects and quadrats

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
ICT Support <ul style="list-style-type: none"> The learner can use any spreadsheet software to record and analyse the data 		

SENIOR 4: TERM 3

Theme: Interrelationships

TOPIC: CHANGES IN POPULATION

8 PERIODS

Competency: The learner should be able to appreciate that a group of organisms of the same species, living in the same area at the same time, is called a population, and that population sizes vary depending on environmental factors.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
a) know the meaning of population and population growth (k) b) understand that population growth is affected by environmental factors, and give examples of populations and natural factors that affect their growth (u) c) understand why it is sometimes necessary to control animal populations (both limiting populations and taking steps to boost populations) (u)	<ul style="list-style-type: none"> In pairs, learners research the meaning of population in biology and share ideas with the class. Once agreed, individuals record definition: Group of organisms of the same species, living in a given place at a particular time In groups, learners examine data and graphs relating to changes in populations of selected species over time, and relate changes in growth to environmental factors; e.g. weather, predators, availability of food, space, migration, pollution and light, and present conclusions to class Record conclusions about impact of different factors In groups, learners research and discuss populations that have needed to: <ul style="list-style-type: none"> have their numbers reduced, the reasons this control was needed, and the methods used have measures put in place to increase their numbers, the reasons why their numbers became too low, and the methods used to boost the populations Individuals complete reports on group / class conclusions Class debate: 'Humans have the right to determine the right size for populations of wild animals'; or, 'The human population is in danger of growing too large for the planet and needs to be better controlled' 	<ul style="list-style-type: none"> Observe groups carrying out activities and offer guidance to ensure observation techniques are effective, and that identifications and interpretations of feeding relationships are accurate Listen to learners' conversations and monitor progress and understanding Ask questions to deepen learning Evaluate quality of products: verbal and written reports, pyramid drawings
Note: Population distribution not required.		

SENIOR 4: TERM 3

Theme: Interrelationships

TOPIC: ASSOCIATIONS IN BIOLOGICAL COMMUNITIES

14 PERIODS

Competency: The learner should be able to appreciate that organisms naturally interact in different ways with one another in a given habitat.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) know what competition is and describe how organisms compete in nature (k, u) b) differentiate prey from predators and describe a predator-prey relationship (u, s) c) understand symbiosis, mutualism, commensalism and parasitism and appreciate their roles in an ecosystem (k, u) d) recognise the role of parasites and vectors in the transmission of common diseases (malaria, bilharzia, nagana, sleeping sickness) (k, u) e) know the adaptations of parasites to their mode of life (u) 	<ul style="list-style-type: none"> • Learners observe areas with dense natural populations of animals such as a farm or garbage pit, or they observe video clips, noting which organisms seem to be competing for the same type of food and/or the same space, and report how the organisms behaved and which seemed to dominate • In pairs, learners brainstorm examples of predator-prey relationships and present their conclusions in a chart showing what eats what (regular relationships only, not including, for example, man eating lions). (Encourage thinking about smaller organisms, invertebrates) • In pairs, learners examine collected numerical data relating to a prey-predator relationship and plot a prey-predator curve (MS Excel, if applicable). Pairs describe and explain the curve orally and in writing • In groups, learners research the meanings of the terms symbiosis, mutualism, commensalism and parasitism, and produce a poster/graphic image explaining each term and giving natural examples • Learners visit a nearby health/agricultural facility, or listen to a visiting health/agricultural officer, and/or carry out research, to find out about and then report on common parasitic diseases, how they are transmitted and how they can be prevented • Learners develop and present a role play to show how different parasites are adapted to their mode of life and how humans try to prevent their transmission 	<ul style="list-style-type: none"> • Observe pair and group interactions, ensuring all are engaging and developing their understanding. Intervene to ensure progress towards learning outcomes • Listen to learners' discussions and probe to promote critical thinking and creativity in reports, posters, and to deepen learning • Evaluate quality of notes, charts, growth curves and analysis, posters/graphic images, reports and role plays
Note: Details of life cycles of parasites not required. Parasites: ticks, tapeworm.		

SENIOR 4: TERM 3

Theme: Interrelationships

TOPIC: HUMANS AND THE NATURAL ENVIRONMENT

16 PERIODS

Competency: The learner should be able to appreciate that Uganda has different natural resources, that our activities have an impact on these resources, and recognise the reasons why countries have committed to global sustainable development goals.

LEARNING OUTCOMES The learner should be able to:	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
<ul style="list-style-type: none"> a) understand there is a world-wide focus on sustainability and its importance (u) b) know and give examples of natural resources found in Uganda (k, u) c) appreciate and describe natural factors and human influences that may have an impact on ecosystems, and make suggestions about how to preserve the natural environment for all living things (u, s) d) understand the sources, effects and control of air, land and water pollution (u, s) 	<ul style="list-style-type: none"> • In groups, learners research the international commitment to countries working together to achieve sustainable development goals (SDGs) by 2030. Groups report to the class on the meaning of sustainability, the importance of the SDGs and the scope of the goals • In groups, learners brainstorm and carry out research so that they can: <ul style="list-style-type: none"> • develop a list of natural resources in Uganda • classify the resources into renewable and non-renewable • identify examples of human activities that have affected the natural resources (negatively and positively), and suggest ways of conserving Uganda's natural resources for future generations • Individuals complete their own reports • In groups, learners research and report on: <ul style="list-style-type: none"> • the main sources of air, land and water pollution affecting the environment world-wide, and in Uganda, and their impact • the strategies being used to address these forms of pollution, and their hopes and fears for the future • In pairs or groups, research and describe ways in which the different categories of garbage can be re-used or recycled. • Report on how effectively re-use and recycling is taking place in Uganda, and in the locality, and what could/should be done to improve. Include a strategy for more sustainable practices in school 	<ul style="list-style-type: none"> • Observe pairs and groups carrying out activities. Help to guide research in order to optimise progress towards learning outcomes • Listen to learners' discussions and ask questions to probe and overcome any barriers or misunderstandings, and so deepen learning of all participants • Evaluate quality of products: verbal feedback to the class, written reports, explanatory drawings/diagrams, sustainability strategies
ICT Support <ul style="list-style-type: none"> • The learner can use word processing, mind mapping or any other software for data entry and report making 		

ASSESSING BIOLOGY

This section should be considered alongside the Assessment Guidelines.

Assessing the new expectations for learning

The new curriculum sets new expectations for learning, with a shift from Learning Outcomes that focus mainly on knowledge to those that focus on skills and deeper understanding. These new Learning Outcomes require a different approach to assessment.

The “Learning Outcomes” in the syllabuses are set out in terms of Knowledge, Understanding, Skills, and Attitudes. This is what is referred to by the letters k,u,s & a.

It is not possible to assess attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that attitudes are not important. It means that we must value things that we cannot easily assess.

So this guidance booklet focuses on knowledge, skills and understanding. Each has its own implications for learning and assessment.

Knowledge	The retention of information
Understanding	Putting knowledge into a framework of meaning – the development of a ‘concept’.
Skill	The ability to perform a physical or mental act or operation

To assess knowledge, skills and understanding we need to look for different things. Knowledge can be assessed to some extent through written tests, but the assessment of skills and deeper understanding requires different approaches. Because of this, the role of the teacher in assessment becomes much more important.

Knowledge

Knowledge is the easiest to assess because it is fairly straightforward to find out whether or not a learner has retained some information: a simple question can usually find this out. We ask them to name something, or state something, or label a diagram.

Understanding

Assessing deeper understanding is much more difficult, so we usually ask learners to explain, compare or outline a process. This can be done orally (in conversation) or in writing, and will give us some idea of the extent of their understanding.

Skills

Skills are the ability to perform a mental or physical operation, so we have to observe the skill being performed or look at the product, or outcome, of the skill; for example a piece of writing, a picture or diagram. Some skills, such as speaking or a physical education skill do not have a product so need to be observed.

Examinations

There will no longer be examinations or tests set at the end of every year. Instead, there will be a summing up of on-going teacher assessments made in the context of learning.

Formative Assessment

If assessment is to make a difference to teaching and learning, then teachers must use the information they gain from assessment to make some change to the teaching and learning process. This is formative assessment. If teaching and learning stay the same, there would have been no point in carrying out the assessment. The changes that can be made include decisions about:

- What needs to be learned next
- Whether an element of the syllabus needs to be taught again in a different way
- Changing teaching approaches if necessary
- Identifying learners who need more support, or who are making exceptional progress
- Enabling learners to understand what they have to do to improve

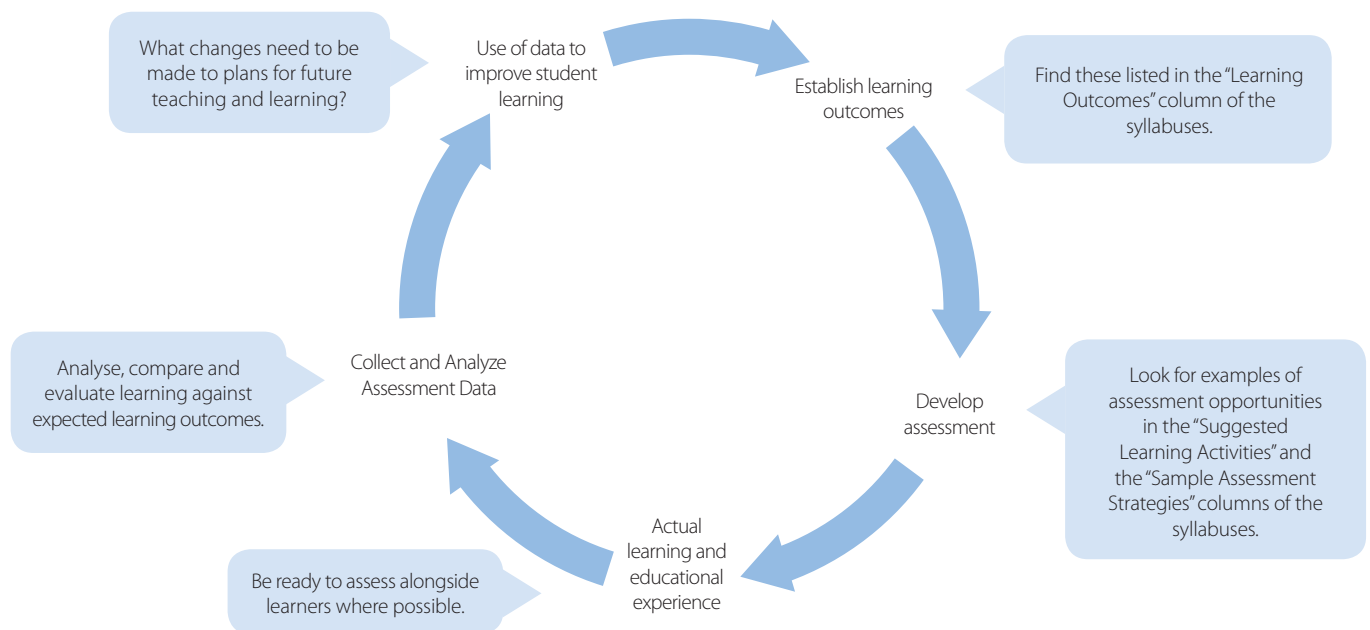
The final examination at the end of Senior 4 will be very different in nature, and will focus on the learners' ability to apply their learning in new situations, rather than on the ability to recall information.

It is the use of the assessment data within this cycle to improve learning that is key to the success and impact of formative assessment.

It is this cycle that enables formative assessment to impact on learning:

- The syllabuses set out the learning outcomes
- The lessons seek to achieve these outcomes
- Assessment finds out whether or not the outcomes has been achieved
- This information guides the next steps in learning and so sets new learning outcomes

The process of teaching, making formative assessments and then changing the teaching and learning in some way can be seen as a cycle:



FORMATIVE ASSESSMENT INVOLVES USING ALL PARTS OF THE CYCLE.

ASSESSING BIOLOGY

How do we find the opportunity to make formative assessments?

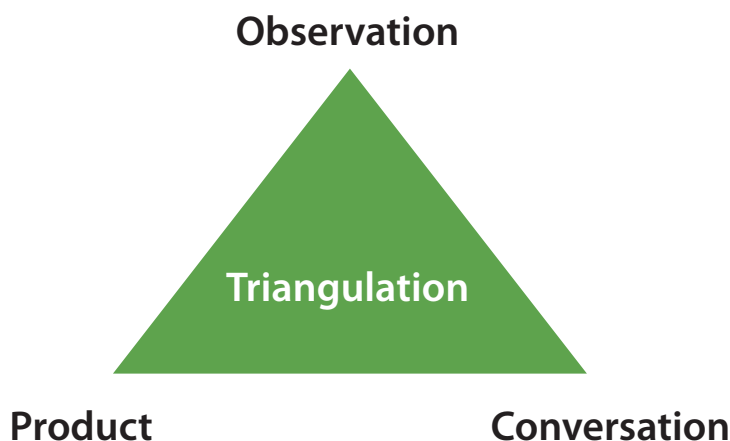
In the new curriculum, the teacher's assessment role is not to write tests for learners, but to make professional judgements about learners' learning in the course of the normal teaching and learning process. The professional judgement is about how far the learner meets the Learning Outcomes that are set out in this syllabus. To make these judgements the teacher needs to look at how well the learners are performing in terms of each Learning Outcome.

School-based formative assessment is a part of the normal teaching and learning process, and so the assessment opportunities will also occur during this normal process. It is not something that needs to be added on after learning; it is an integral part of it.

These opportunities occur in three forms and are often called:

- Observation – watching learners working (good for assessing skills)
- Conversation – asking questions and talking to learners (good for assessing knowledge and understanding)
- Product – appraising the learner's work (writing, report, translation, calculation, presentation, map, diagram, model, drawing, painting etc). In this context, a "product" is seen as something physical and permanent that the teacher can keep and look at, not something that the learner says.

When all three are used, the information from any one can be checked against the other two forms of assessment opportunity (eg evidence from "observation" can be checked against evidence from "conversation" and "product"). This is often referred to as "triangulation".



Triangulation of assessment opportunities

To find these opportunities, look at the syllabus units. These set out the learning that is expected and give 'Sample Assessment Activities', and in doing so they contain a range of opportunities for the three forms of assessment.

Generic Skills

The Generic Skills have been built into the syllabuses and are part of the Learning Outcomes. It is therefore not necessary to assess them separately. It is the increasingly complex context of the subject content that provides progression in the Generic Skills, and so they are assessed as part of the subject Learning Outcomes.

Attitudes

It is not possible to assess attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that attitudes are not important. It means that we must value things that we cannot easily assess.

Record keeping

Keeping detailed records of learners' individual progress is always difficult with very large numbers of pupils. For the purposes of school-based formative assessment, it is not even always necessary to keep such detailed records anyway. If feedback is given immediately and action is taken, then learning is changed and the record would soon become out of date and redundant.

Most formative class-based assessments are dynamic in that they feed straight back into the teaching and learning process. Therefore detailed records of these are not appropriate.

What is needed is record of assessments of learners' learning made in terms of each Topic or unit. This means recording the on-going summative assessments of each unit. There is no need to make separate records of each of the Learning Outcomes because this would be very time-consuming and

also unnecessary. It is much more useful to make an overall assessment about whether or not each learner met the Learning Outcomes for each Topic as a whole.

Each Sub-Strand is made up of a number of Learning Outcomes. Therefore teachers need to consider all the Learning Outcomes when making an overall judgement about the Sub-Strand as a whole. It is not always necessary for every individual Learning Outcome to be achieved for the Sub-Strand as a whole to be achieved. This will vary with the Learning Area and Topic.

By looking at the Learning Outcomes within each Topic, it is possible to identify four broad groups of learners in terms of their achievements:

Descriptor
No Learning Outcome (LO) achieved
Some LOs achieved, but not sufficient for overall achievement
Most LOs achieved, enough for overall achievement
All LOs achieved – achievement with ease

ASSESSING BIOLOGY

There is no need to set a test to find this out.

These overall assessments should be made on the basis of the many formative assessments that the teacher has made during the course of teaching the unit. If teachers have been working with the learners over the course of the unit, they will be able to make a broad judgment about which learners have achieved or have failed to achieve the unit's overall Learning Expectation. These "Authentic Assessments" will be more valid and valuable than a test set by the school.

Recording these overall assessments will be simple, manageable and yet valuable, and can be recorded on a sheet such as the one below in which the categories are indicated with a number.

Although a very simple process, these four categories will give rich data when a comparison is made between the learners in

each category for different subjects and units. They will also identify easily those learners who need extra support or who may not be ready to move on to the next grade at the end of a year.

If records are kept of the learning outcomes of each syllabus unit through the year, then there will be no need for an end of year test. Teachers will already have a record of those learners who have met the learning outcomes, and those who have not done so. Therefore teachers will know if there were any learners not ready to progress to the next grade.

An overall record should be made of the individual unit assessments by subject in terms of the 4 descriptors. If numbers (0-3) are used as identifiers, then it will be possible to arrive at an overall number for a year by aggregating the identifiers for each unit.

Descriptor	Identifier
No Learning outcome achieved	0
Some LOs achieved, but not sufficient for overall achievement	1
Most LOs achieved, enough for overall achievement	2
All LOs achieved – achievement with ease	3

In the example below, the table shows the end-of-unit assessment for six learners.

Biology										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Learner A	3	3	2	3	3	3	3	2	3	3
Learner B	2	2	3	2	3	2	2	2	3	2
Learner C	1	1	2	1	1	2	2	3	2	3
Learner D	1	1	2	1	1	2	1	1	2	1
Learner E	0	1	2	1	0	1	0	1	1	1
Learner F	0	0	1	0	0	1	0	0	1	0

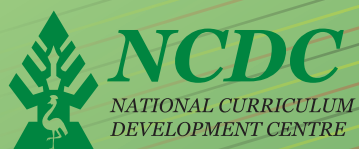
This method will give much more information than using a tick. For example, at a glance it can be seen that learners A & B are achieving much higher than learners E & F. It can be seen that Learner C has improved during the year. We can even see that more learners achieved success in Topic 9 than Topic 7.

All of this is very valuable assessment information and can be used to improve learning.

This summative teacher assessment will contribute to the final grade of the School Leaving Certificate.

Glossary of Key Terms

TERM	DEFINITION
Competency Curriculum	One in which learners develop the ability to apply their learning with confidence in a range of situations.
Differentiation	The design or adaptation of learning experiences to suit an individual learner's needs, strengths, preferences, and abilities.
Formative Assessment	The process of judging a learner's performance, by interpreting the responses to tasks, in order to gauge progress and inform subsequent learning steps.
Generic skill	Skills which are deployed in all subjects, and which enhance the learning of those subjects. These skills also equip young people for work and for life.
Inclusion	An approach to planning learning experiences which allows each student to feel confident, respected and safe and equipped to learn at his or her full potential.
Learning Outcome	A statement which specifies what the learner should know, understand, or be able to do within a particular aspect of a subject.
Process Skill	A capability acquired by following the programme of study in a particular Learning Area; enables a learner to apply the knowledge and understanding of the Learning Area.
Sample Assessment Activity	An activity which gives a learner the opportunity to show the extent to which s/he has achieved the Learning Outcomes. This is usually part of the normal teaching and learning process, and not something extra at the end of a topic.
Suggested Learning Activity	An aspect of the normal teaching and learning process that will enable a formative assessment to be made.



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