

Biology
and
Health Science
For Rwandan Schools

Senior 2
Teacher's Guide

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Content Map

Topic area	1	2	3	Organisation and maintenance of life		
Sub topic area	Biodiversity and classification	Ecology and conservation	Environmental biology	1. Movement into and out of cell		
	Classification of living things	Environmental biology	Unit 1 Passive movement across a cell membrane	Unit 2 Active transport	Unit 3 Identification of food components	Unit 4 Enzymes
Number of periods	14	8	8	6	8	8
Introduction	This unit is about classification of living things, their characteristics, common features of chordates, phyla of kingdom Animalia and animal diversity.	This unit deals with terms used in ecology, construction and interpretation of food chain, food web and pyramids, interdependence of organisms and the role played by each.	This unit deals with diffusion and osmosis, their importance and the role of turgor pressure in plant cells.	This unit deals with passive and active transport of molecules and its importance.	This unit deals with chemical food tests for different classes of food: proteins, carbohydrates, vitamins and fats.	This unit deals with role of enzymes, their importance and factors that affect their activities. It also involves drawing and interpretation of graphs
Classroom organisation	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work

Equipment and materials required	<ul style="list-style-type: none"> • Internet • Reference book • Wall charts • Pamphlets • Preserved specimen 	<ul style="list-style-type: none"> • Wall charts • Reference textbooks and materials • Brochures • Pictures a • Chalkboard diagrams 	<ul style="list-style-type: none"> • Wall charts • Reference textbooks and materials • Tuber crops • Reagents • Models 	<ul style="list-style-type: none"> • Wall charts • Reference textbooks and materials • Chalk board diagrams 	<ul style="list-style-type: none"> • Wall charts • Reference textbooks and materials • Reagents • Food samples • Laboratory apparatus 	<ul style="list-style-type: none"> • Wall charts • Reference textbooks and materials • Chalkboard diagrams • Reagents • Graph papers • Food samples
Activities	<ul style="list-style-type: none"> • Field trips • Case studies • Role-plays • Games • Practical activities • Research activities 	<ul style="list-style-type: none"> • Collecting things from the environment • Field trips • Case studies • Role-plays • Practical activities • Research activities 	<ul style="list-style-type: none"> • Case studies • Role-plays • Games • Research activities • Practical experiments • observations 	<ul style="list-style-type: none"> • Case studies • Role-plays • Games • Practical activities • Research activities 	<ul style="list-style-type: none"> • Case studies • Practical experiments • Research activities 	<ul style="list-style-type: none"> • Collecting things from the environment • Case studies • Role-plays • Practical activities • Research activities
Competences practiced	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving

Cross-cutting issues tackled	<ul style="list-style-type: none"> • Inclusive learning and values education • Peace and values education • Gender education • Environment and sustainability education • Health education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education • Peace and values education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education • Health education 	
Language practice	<ul style="list-style-type: none"> • Discussion in groups and pairs • Presentation of findings • Making/ writing notes • As learners role play 	<ul style="list-style-type: none"> • Discussion in groups • Presentation of experimental findings, observation and results. • Writing observations. • Preparing reports 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education • Health education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education • Health education 	<ul style="list-style-type: none"> • Environment and sustainability • Inclusive learning • Gender education • Health education 	<ul style="list-style-type: none"> • Discussion in groups • Presentation of experimental findings, observation and results. • Writing observations
Vocabulary acquisition	<ul style="list-style-type: none"> • Phyla • Chordate • Class • Aves • Homoeothermic • Heterodonts • Chitin • Spiracles • Pedipals • carapace 	<ul style="list-style-type: none"> • Ecology • Niche • Ecosystem • Trophic levels • Pyramids • Predation • Biotic & abiotic • Detrivores • Food chain & web 	<ul style="list-style-type: none"> • diffusion • osmosis • turgor pressure • concentration gradient • permeable membrane • wall pressure • plasmolysis • flaccid cell • hypertonic • hypotonic 	<ul style="list-style-type: none"> • Endocytosis • Exocytosis • Passive • Carrier proteins • Phagocytosis • Pinocytosis • Binding sites • Inhibitors 	<ul style="list-style-type: none"> • Reducing sugars • Benedict's solution • Biuret test • Millon's test • Translucent spot test • Ethanol emulsion test • Precipitate 	<ul style="list-style-type: none"> • Catalyst • Substrate • Products • Denature • Optimum • Active site • Key and lock • Intracellular • Enzyme – substrate complex

<p>Study skills</p>	<ul style="list-style-type: none"> • Observation of organisms • Note taking • Recording observations • Performing an experiment • Question and answer 	<ul style="list-style-type: none"> • Field work • Education trips and tours • Observation and presentations • Note taking • Report writing • Research work 	<ul style="list-style-type: none"> • Observation and presentations • Note taking • Practical experiments • Research work • Question and answer 	<ul style="list-style-type: none"> • Observation and presentations • Note taking • Practical experiments 	<ul style="list-style-type: none"> • Observation and presentations • Note taking • Classification of organisms • Practical experiments 	<ul style="list-style-type: none"> • Field work • Observation and presentations • Note taking • Drawing and interpreting graphs • Practical experiments
<p>Revision</p>	<p>Self-evaluation tests and Test your competence provided in the Student's Book and Extension exercises in the Teacher's Guide.</p>					
<p>Formative Assessments</p>	<p>To assess knowledge and understanding, let learners do Self- evaluation Tests in the student's book Gauge learner's communication, co-operation, critical thinking and problem solving abilities as they carry out group discussions Ask probing questions on attitude change.</p>					
<p>Learning outcomes</p>	<p>To be able to classify animals into their specific phyla based on external features.</p>	<p>To be able to explain the concept applied in environmental biology including the interaction and interdependence of organisms.</p>	<p>To be able to explain the difference processes of movement of water, ions in and out of cell.</p>	<p>To be able to analyse and interpret the process of active transport and its significance to living organisms.</p>	<p>To be able to carry out chemical tests on a variety of foods to identify the nature of food substances.</p>	<p>To be able to explain the role of enzymes in speeding up reactions and how they affected by temperature and pH.</p>

Topic area 2: Organisation and maintenance of life					
Subtopic area	3. Nutrition	4. Transport in plants	5. Gaseous exchange and smoking	6. Homeostasis	7. Support and locomotion
	Unit 7 Photosynthesis	Unit 8 Transport of water, mineral and organic foods in plants	Unit 9 Gaseous exchange in human and plants	Unit 10 Excretion in humans	Unit 11 Joints and movement
Number of periods	14	10	12	4	6
Introduction	This unit deals with how photosynthesis takes place and its products, the adaptations of the external and internal structures of a leaf and the dangers of using fertilisers.	This unit deals transport of substances in plants: the xylem and phloem tissues, mechanism of water movement in plants, adaptations of plant leaves, transpiration and adaptations of desert plants, translocation and use of a photometer.	This unit deals with gaseous exchange in human beings and plants, demonstrating inspiration and expiration, common respiratory diseases, dissection and constructing breathing model	This unit deals with excretion in humans, excretory organs and their products, the structure of kidney and nephron, urine formation, dissection and good habits for healthy urinary system.	This unit deals with types of joints and movement, function of bones and joints, movable and immovable joints and habits that maintain safety of bones.
Classroom organisation	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work
Equipment and materials required	<ul style="list-style-type: none"> • Reference materials • Collected specimens of leaves • Reagents • Charts • Chalkboard diagrams 	<ul style="list-style-type: none"> • Prepared slides • Wall charts • Reference materials • Chalkboard diagrams • Pictures and photographs • Plants part samples 	<ul style="list-style-type: none"> • Wall charts • Reference materials • Dissection set • Diagrams and pictures • Breathing model 	<ul style="list-style-type: none"> • Wall charts • Reference materials • Model of human excretory system • Dissection set 	<ul style="list-style-type: none"> • Computer study materials • Mammalian bones • Wall charts • Reference books

Activities	<ul style="list-style-type: none"> • Drawing biological diagrams • Practical activities • Research activities • Farm visit • drawing 	<ul style="list-style-type: none"> • Observing and reporting • Practical activities • Research activities • Discussion and presentation 	<ul style="list-style-type: none"> • Case studies • Role-plays • Games • Practical activities • Research activities • Interactive talk • Modelling 	<ul style="list-style-type: none"> • Case studies • Modelling • Practical activities • Research activities • Group work 	<ul style="list-style-type: none"> • Education tour • Case studies • Observing and drawing • Practical activities • Research activities
Competences practiced	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills
Cross-cutting issues tackled	<ul style="list-style-type: none"> • Inclusive learning • Peace and values education • Gender education • Environment and sustainability • Health education • Peace and values education • Standardisation culture 	<ul style="list-style-type: none"> • Inclusive learning • Gender education • Environment and sustainability • Health education • Peace and values education 	<ul style="list-style-type: none"> • Inclusive learning • Gender education • Environment and sustainability • Health education 	<ul style="list-style-type: none"> • Inclusive learning • Environment and sustainability • Health education • Gender education 	<ul style="list-style-type: none"> • Inclusive learning • Peace and values education • Gender education • Health education • Financial education

Language practice	<ul style="list-style-type: none"> • During discussions and presentations • During practical activities • Writing observations. • Preparing reports 	<ul style="list-style-type: none"> • Discussion in pairs and groups • Presentation of findings, observation and results. • During practical activity • Report writing and presentation 	<ul style="list-style-type: none"> • During practical activities and role play • Discussion in pairs and groups • Presentation of findings, observation and results. 	<ul style="list-style-type: none"> • Discussion in pairs and groups • Presentation of findings, observation and results. • Modelling of human excretory organs 	<ul style="list-style-type: none"> • Recording and drawing observations • Discussion in pairs and groups • Presentation of findings, observation and results. • Report writing
Vocabulary acquisition	<ul style="list-style-type: none"> • Photosynthesis • Chlorophyll • Pollution • Variegated • Limiting factors • Plastids • Destarching 	<ul style="list-style-type: none"> • Transpiration • Potometer • Translocation • Vascular bundles • Transpiration pull • Xerophytes • Hydrophytes • Halophytes • Aerenchyma 	<ul style="list-style-type: none"> • Alveoli • Tracheid • Xylem • Respiratory surface • Inhalation • Exhalation • Allergens • Cancer 	<ul style="list-style-type: none"> • Homeostasis • Egestion • Excretion • Metabolism • Deamination • Renal • Glomeruli • Urologist • Sphincter muscles 	<ul style="list-style-type: none"> • Joints • Ligaments • Tendons • Cartilage • Saddle joint • Antagonistic muscles • Osteoporosis • Arthritis
Study skills	<ul style="list-style-type: none"> • Observation and presentations • Note taking • Drawing and interpretation • Question and answers 	<ul style="list-style-type: none"> • Observation and drawing • Presentations • Note taking • Report writing 	<ul style="list-style-type: none"> • Practical skills • Observation and recording • Note taking • Discussion • Dissection 	<ul style="list-style-type: none"> • Modelling • Observation and presentations • Note taking • Drawing • Research activity 	<ul style="list-style-type: none"> • Observation and drawing • Note taking • Recalling • Report writing and presentation
Revision	Self-evaluation tests and Test your competence provided in the Student's Book and Extension exercises in the Teacher's Guide.				
Formative assessment	<ul style="list-style-type: none"> • To assess knowledge and understanding, let learners do Self- evaluation t Tests in the student's book • Gauge learner's communication, co-operation, critical thinking and problem solving abilities as they carry out group discussions • Ask probing questions on attitude change. 				

Learning outcome	To be able to explain the process of photosynthesis and how various environmental factors affect the rate of photosynthesis.	To be able to explain the process of uptake and transport of mineral and organic saps, transpiration and translocation and their roles in plants.	To be able to explain gaseous exchange in humans and plants.	To be able to describe the structure and function of excretory organs and suggest good practices for healthy kidneys.	To be able describe types of joints and relate their structure to their functions. .
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Topic area 4: Health and diseases					
Subtopic area	Infectious and non-infectious diseases			Reproductive health	
Units	Unit 12 Infectious diseases	Unit 13 Immunity and vaccination	Unit 14 Sexual behaviour and sexual responses	Unit 15 Pregnancy prevention	Unit 16 Reducing risk of STI and HIV
Number of periods	8	8	4	6	8
Introduction	This unit deals infectious diseases their causes, symptoms, prevention and treatment.	This unit deals with methods to fight against infection, passive and active immunity, antibody-antigen reactions, immune response and vaccination.	This unit deals with male and female sexual stimulation, love and affection in couples, sexual attraction, sexual relationships and control of sexual feelings.	This unit deals with prevention of unintended pregnancy, natural and artificial contraceptives, models of male and female condoms and the importance informed choices.	This unit deals with transmission, prevention, treatment, symptoms and complications of STI and HIV, sexual health services, communication in negotiating for safer sex and decision making in a sexual relationship.
Classroom organisation	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work 	<ul style="list-style-type: none"> • Whole class orientation • Group work • Individual work • Pair work

Equipment and materials required	<ul style="list-style-type: none"> • Wall charts • Computer aided materials • Reference materials • Pictures & photographs 	<ul style="list-style-type: none"> • Wall charts • Reference materials • Computer aided materials • Medical officer 	<ul style="list-style-type: none"> • Pictures and photographs • Wall charts • Reference materials • Computer aided materials 	<ul style="list-style-type: none"> • Wall charts • Reference materials • Computer aided materials • Models 	<ul style="list-style-type: none"> • Wall charts • Reference materials • Computer aided materials • Resource person
Activities	<ul style="list-style-type: none"> • Research activity • Discussion • Note taking • Interactive talk • Research work • Report writing 	<ul style="list-style-type: none"> • Research activity • Discussion • Note taking • Role play • Report writing • Interactive sessions 	<ul style="list-style-type: none"> • Mini-play • Research activity • Discussion • Interactive sessions • Observation and listening 	<ul style="list-style-type: none"> • Mini-play • Research activity • Discussion • Making models • Observation 	<ul style="list-style-type: none"> • Discussion • Interactive talk • Observation • Listening • Research • Role play
Competences practiced	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Presentation of findings • Problem solving 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Creativity • Presentation of findings • Problem solving • Lifelong skills 	<ul style="list-style-type: none"> • Team work • Communication skills • Research • Critical thinking • Presentation of findings • Problem solving • Lifelong skills
Cross-cutting issues tackled	<ul style="list-style-type: none"> • Health education • Standardisation culture 	<ul style="list-style-type: none"> • Inclusive learning • Gender education • Health education • Standardisation culture 	<ul style="list-style-type: none"> • Inclusive learning • Gender education • Health education • Standardisation culture 	<ul style="list-style-type: none"> • Inclusive learning • Gender education • Health education • Financial education • Standardisation culture 	<ul style="list-style-type: none"> • Inclusive learning • Peace and values education • Gender education • Health education • Standardisation culture

<p>Language practice</p>	<p>Presenting their findings During discussions During practical activities and research</p> <ul style="list-style-type: none"> • Health • Infectious • Non-infectious • Cardiovascular • Vector • Venereal • Quarantine • Hereditary • Contagious • Epidemiology • Immune response 	<p>As learners present their findings During discussions either in groups or in pairs Interactive sessions</p> <ul style="list-style-type: none"> • Antigen, antibody • pathogen, immunity • Autoimmune • Passive immunity • Active immunity • Neutralisation • Agglutination • Lymphocytes 	<p>During discussions either in groups or in pairs During practical activities Class presentations</p> <ul style="list-style-type: none"> • Human rights • Puberty • Culture • Sexual response • Exogamy • Impotence • Sexual assault • Child abuse • Monogamy • Dating • Sexual stimulation 	<p>During discussions either in groups or in pairs During practical activities Interactive sessions Report writing</p> <ul style="list-style-type: none"> • Abstinence • Contraceptive • Hormone • Spermicide • Menopause • Abortion • Vasectomy • Tubal ligation • Sterilisation • Ovulation • Amenorrhea 	<p>As learners present their findings During discussions either in groups or in pairs Interactive sessions Report writing</p> <ul style="list-style-type: none"> • ART • Chlamydia • VCT, • Chancere • STI • PEP • PLWHA • Antibiotic
<p>Study skills</p>	<p>Observation and presentations Listening and note taking Research work Discussion Listening</p>	<p>Observation and presentations Listening and note taking Discussion Comparison</p>	<p>Discussion Drama and role play Research work</p>	<p>Discussion Drama and role play Research work Report writing comparison</p>	<p>Observation and presentations Listening and note taking Discussion Research work</p>
<p>Revision</p>	<p>Self-evaluation tests and Test your competence provided in the Student's Book and Extension exercises in the Teacher's Guide.</p>				
<p>Formative Assessments</p>	<p>To assess knowledge and understanding, let learners do Self-evaluation Tests in the student's book Gauge learner's communication, co-operation, critical thinking and problem solving abilities as they carry out group discussions Ask probing questions on attitude change.</p>				

Learning outcomes	To be able to identify symptom of common infectious diseases, their prevention and treatment..	To be able to describe natural and artificial methods that fight against infection.	To be able to explain safe sex, sexuality and sexual behaviour.	To be able to apply knowledge of pregnancy prevention.	To be able to apply knowledge of STI and HIV transmission, prevention and treatment.
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INTRODUCTION

Section 1: Basic information

1.1. Organisation of the book

This teacher's guide is organised into two main sections. Part 1 is the general introduction section detailing pedagogical issues. Part 2 is the main topics area. It gives the details of the expected learning units as organised in the learner's book. The main elements of Part 2 are:

- **Topic Area page** - detailing the various Sub-topic Areas and the units covered under the topic area.
- **Unit heading**—this is accompanied by some text in the learner's book to motivate the learners. Also, the total number of lessons per unit is given.
- **Key Unit Competence:** This is the competence, which will be achieved once learners have met all the learning objectives in the unit.
- Outline of **main sections** in the unit – is a quick summary of the subtopics covered under the unit.
- **Learning Objectives:** The content in this area is broken down into three categories of learning objectives, that is, knowledge and understanding; skills; attitudes and values.
 - Knowledge and understanding: In the existing curriculum, knowledge and understanding is very important.
 - Skills: It is through the skills that learners apply their learning and engage in higher order thinking. These skills relate to the upper levels of Bloom's taxonomy and they lead to deep rather than surface learning.
 - Attitudes and values: Truly engaging with the learning requires appropriate attitudes and values that relate to the unit.
- **Links to other subjects:** It is important for learners to gain an understanding of the interconnections between different subjects so that learning in each subject is reinforced across the curriculum. This platform does exactly that. It prepares the teacher to pass this information to the learners so that they are aware.
- **Assessment criteria:** This is meant to evaluate whether learners have succeeded in achieving the Key Unit Competence(s) intended. This section will help the teacher

in assessing whether the unit objectives have been met.

- **Background information:** This is the introduction part of the unit. It aims at giving insights to the teacher on the subject matter.
- **Additional information for the teacher:** This section gives more information than what the syllabus recommends for purposes of preparing the teacher to answer tough questions from learners.
- **Learning Activities:** These are given per lesson and have these sub-sections:
 - Lesson titles
 - Specific objectives of the lesson
 - Materials and learning resources
 - Teaching methodology
 - Suggested teaching/learning approach
 - Generic competencies covered
 - Cross-cutting issues covered
 - Special needs and multi-ability learning
 - Formative assessment
 - Extended exercises/activities for fast learners and remedial (reinforcement) exercises/activities for slow learners.
 - Answers to self-evaluation exercises

These are repeated in all lessons until the end of the unit. They are followed by the answers or tips on the Test your

Competence questions at the end of every unit.

1.2. The Structure of the syllabus

Biology subject is taught and learned in senior secondary education as a core subject. At every grade, the syllabus is structured in Topic areas, and then further broken down into Units. The units have the following elements:

- Unit is aligned with the Number of Lessons.
- Each Unit has a Key Unit Competency whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners.
- Each Key Unit Competency is broken into three types of Learning Objectives as follows:
 - Type I: Learning objectives relating to Knowledge and Understanding. These are associated with Lower Order Thinking Skills or LOTS.
 - Type II and Type III: These Learning Objectives relate to acquisition of skills, Attitudes and Values. They are associated with Higher Order Thinking Skills or HOTS. – These Learning Objectives are actually considered to be the ones targeted by the present reviewed syllabus.
- Each Unit has a Content area which indicates the scope of coverage of what a teacher

should teach and student should learn in line with stated learning objectives.

- Each Unit suggests Learning Activities that are expected to engage learners in an interactive learning process as much as possible (learner-centred and participatory approach).
- Finally, each Unit is linked to Other Subjects, its Assessment Criteria and the Materials (or Resources) that are expected to be used in teaching and learning process.

In all, the Biology Senior1 level has got three Topic Areas namely:

- Biodiversity
- Organisation and maintenance of life
- Health and diseases

As for units, there are a total of 14 units in Biology Senior (S1)

1.3. Background Information on new curriculum

The goal to develop:

- A competence-based society
- The globalisation process
- The growth of the world market and competition at the global level.
- A shift from knowledge-based to competence-based curriculum.

All these necessitated a comprehensive review of the national curriculum to address the required skills in the Rwandan education system.

It is against this background that the syllabus at secondary level was reviewed. This ensures that it is responsive to the needs of the learner. The syllabus curriculum shifts from knowledge-based learning to competence-based learning.

Competence-based learning refers to systems of instruction, assessment, grading, and academic reporting. It is based on learners demonstrating that they have acquired and learned the prerequisite knowledge, skills and attitudes as they progress through their education. Apart from being integrative, the newly revised syllabus guides the interaction between the teacher and the students in the learning process. It further puts greater emphasis on skills a learner should acquire during each unit of learning. As a competency-based syllabus, it elaborates on the three aspects of knowledge, skills and attitudes in science.

1.4. Rationale of Teaching and Learning Biology

The study of Biology equips learners with skills needed to solve real life problems, prevent diseases and maintain good health.

Teaching biology helps to solve problems associated with the 21st century. Furthermore, it constitutes an unequalled important added value not only in developed countries but also in developing countries such as Rwanda. The love and interest in Biology begins in primary school where young

children tend to be more curious and motivated to learn science. The study of Biology in Secondary School reflects its importance in many aspects of our daily lives, at work, at school and at home. It is a prerequisite for careers in human health and medicine, food industry, research and development, forestry and environmental conservation, veterinary medicine and livestock farming. Most importantly, it cultivates a positive attitude towards Biology and provides learners with opportunities to experience the excitement of working as a scientist.

Above all, the rationale of teaching and learning Biology is embedded in the need for learners to have a greater awareness of the role of Biology in everyday life. Biology at the secondary level enables the learner to develop competencies, which have great impact on the society in general. Teaching Biology helps to develop cultural and democratic notions of scientific literacy.

Learners have to be prepared for active and responsible citizenship. With this regard, Biology strives to equip learners to understand and situate scientific and technological developments in their cultural, environmental, economic, political and social contexts. At the centre of teaching and learning of Biology, hands on activities will play a key role, which in turn, should contribute significantly towards improving learner achievement, motivation,

technological literacy and test scores.

1.5. Types of Competences and their acquisition

Competencies are statements of the characteristics that learners should demonstrate. It indicates their preparedness and the ability to perform independently in professional practice. The two types of competencies envisaged in this curriculum are basic and generic competences.

a) Basic competences

Basic competences are addressed in the stated broad subject competences and in objectives highlighted year on year basis and in each of units of learning. They include:

i) Literacy

- Reading a variety of texts accurately and quickly.
- Expressing ideas, messages and events through writing legible texts in good handwriting with correctly spelt words.
- Communicating ideas effectively.
- Listening carefully for understanding and seeking clarification when necessary.

ii) Numeracy

- Computing accurately using the four mathematical operations.
- Manipulating numbers, mathematical symbols,

quantities, shapes and figures to accomplish a task involving calculations, measurements and estimations.

- Use numerical patterns and relationships to solve problems related to everyday activities like commercial context and financial management.
- Interpreting basic statistical data using tables, diagrams, charts and graphs.

iii) ICT and digital competences

- Locating, extracting, recording and interpreting information from various sources.
- Assessing, retrieving and exchanging information via internet or cell phones.
- Using cell phones and internet for leisure and for money transactions.
- Using computer keyboard and mouse to write and store information.
- Using information and communication technologies to enhance learning and teaching(all subjects).

iv) Citizenship and national identity

- Relating the impact of historical events on past and present national and cultural identity.

- Understanding the historical and cultural roots of Rwandan society and how the local infrastructure functions in relation to the global environment.
- Demonstrating respect for cultural identities and expressing the role of the national language in social and cultural context.
- Advocating for the historical, cultural and geographical heritage of the nation within the global dimension.
- Showing national consciousness, a strong sense of belonging and patriotic spirit.
- Advocating for a harmonious and cohesive society and working with people from diverse cultural backgrounds.

v) Entrepreneurship and business development

- Applying entrepreneurial attitudes and approaches to challenges and opportunities in school and in life.
- Understanding the obligations of the different parties involved in employment.
- Planning and managing micro projects and small and medium enterprises.
- Creation of employment

and keeping proper books of accounts.

- Risk-taking in business ventures and in other initiatives.
- Evaluating resources needed for a business.

vi) *Biology and technology*

- Apply scientific skills to solve practical problems encountered in everyday life including efficient and effective performance of a given task.
- Develop a sense of curiosity, inquisitiveness and research to explain theories, hypotheses and natural phenomena
- Reason deductively and inductively in a logical way.
- Experiment with Biology and draw appropriate conclusions.

b) **Generic competences**

The generic competencies are competences that must be emphasised and reflected in the learning process. They are briefly described below and teachers must ensure that learners are engaged in tasks that help them to acquire the competences.

1. *Critical thinking and problem solving skills*: The acquisition of such skills will help learners to think imaginatively, innovatively and broadly and be able to evaluate and find solutions to

problems encountered in their surroundings.

2. *Creativity and innovation*: The acquisition of such skills will help learners to take initiatives and use imagination beyond knowledge provided in classroom to generate new ideas and construct new concepts.
3. *Research skills*: This will help learners to find answers to questions based on existing information and concepts and use it to explain phenomena from gathered information.
4. *Communication in official languages*: Teachers, irrespective of being language teachers should ensure the proper use of the language of instruction by learners. The teachers should communicate clearly and confidently. They should convey ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary.
5. *Cooperation, interpersonal management and life skills*: This will help the learner to cooperate in a team in whatever task assigned and to practice positive ethical moral values and while respecting rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocate for personal, family and community health, hygiene and nutrition and

responding creatively to a variety of challenges encountered in life.

6. *Lifelong learning*: The acquisition of such skills will help learners to update knowledge and skills with minimum external support. The learners will be able to cope with evolution of knowledge advances for personal fulfilment in areas that are relevant to their improvement and development.

Biology as a subject and developing the competences

The national policy documents based on national aspirations identify some 'basic Competencies' alongside the 'Generic Competencies' that will develop higher order critical thinking skills and help the student learn Biology for application in real life. The nature of learning activities which are mainly inquiry oriented contribute to the achievement of those competencies. Through observations, experimentation, and presentation of information during the learning process, the student will not only develop deductive and inductive skills but also acquire cooperation and communication, critical thinking and problem-solving skills. This will be realised when learners make presentations leading to inferences and conclusions at the end of learning a unit. This will be achieved through student group work and cooperative learning of Biology, which in turn will promote interpersonal relations and teamwork.

The manipulation of apparatus

and data during class experiments and undertaking of project work by learners will involve analytical and problem-solving skills directed towards innovation, creativity and research activities by learners.

The acquired knowledge in learning Biology should develop a responsible citizen who adapts to scientific reasoning and attitudes and develops confidence in reasoning independently. The learner should show concern of individual attitudes, environmental protection and comply with the scientific method of reasoning. The scientific method should be applied with the necessary rigor, intellectual honesty to promote critical thinking while systematically pursuing the line of thought.

1.6. Cross-cutting issues to be infused during learning

These are emerging issues which need to be incorporated in the learning process. Each of the cross-cutting issues has its own important programme of learning reflecting key national priorities. This learning is integrated into the syllabuses of subjects across the curriculum rather than each issue having a dedicated timetable slot of its own. As a result of this integration, the learning activities in the units of subjects across the curriculum incorporate all the learning associated with the cross-cutting issues. The eight cross-cutting issues are:

a) *Peace and Values Education*

This is captured in the student's

book as “**fairness is my other name**”. The need for Peace and Values Education in the curriculum is obvious. Peace is clearly critical for society to flourish and for every individual to focus on personal achievement and their contribution to the success of the nation. Values education forms a key element of the strategy for ensuring young people recognise the importance of contributing to society, working for peace and harmony and being committed to avoiding conflict.

b) Financial Education

Financial education makes a strong contribution to the wider aims of education. It makes learning relevant to real life situations. It aims at a comprehensive financial education program as a precondition for achieving financial inclusion target and improves the financial capability of Rwandans. Financial education has a key role of not only improving personal knowledge but also transforming this knowledge into action. It provides the tools for sound money management practices on earnings, spending, saving, borrowing and investing. Financial education enables people to take appropriate financial services both formal and informal that is available to them and encourages financial behaviours that enhance their

overall economic well-being.

c) Standardisation Culture

This is captured as “**quality check**”. Standardisation culture develops learners’ understanding of the importance of standards as a pillar of economic development and in the practices, activities and lifestyle of the citizens. It is intended that the adoption of standardisation culture should have an impact upon health improvement, economic growth, industrialisation, trade and general welfare of the people. While education is the foundation and strength of our nation, standards are one of the key pillars of sustainable economic development.

d) Genocide Studies

Genocide Studies provides young people with an understanding of the circumstances leading to the genocide and the remarkable story of recovery and re-establishing national unity. Genocide Studies helps learners to comprehend the role of every individual in ensuring nothing of the sort ever happens again.

The intent of a cross-cutting curriculum around the topic of genocide is to fight against genocide, genocide denial, and genocide ideology; and to equip learners with a more fundamental and comprehensive understanding of the genocide,

thereby preventing further human rights violations in the future and enabling Rwanda's population of young people to more competently and thoughtfully enter the workforce. So, it needs to be emphasised.

e) *Environment and sustainability*

This is captured as "**My environment my life,**" in the student's book. The growing awareness of the impact of the human race on the environment has led to recognition of the need to ensure our young people understand the importance of sustainability as they grow up and become responsible for the world around them. Hence Environment and Sustainability is a very important cross-cutting issue. Learners need basic knowledge from the natural sciences, social sciences and humanities to understand and interpret principles of sustainability. They also need skills and attitudes that will enable them in their everyday life to address the environment and climate change issue and to have a sustainable livelihood.

f) *Gender education*

This is captured as "**We are all equal**" in the student book. There is a strong moral imperative to afford every individual their basic human rights. Gender inequality results in women and girls being treated less favourably than men.

A strongly negative impact of unequal treatment, which affects the nation as a whole, is the fact that it results in women being held back and their talents and abilities not being fully realised. With a good understanding of the principles of Gender Equality, it is intended that future generations will ensure that the potential of the whole population is realised.

g) *Comprehensive sexuality education (HIV and AIDS, STI, Family planning, Gender equality and reproductive health)*

This is captured as "**Health check**" in the student book. Comprehensive sexuality education, which is age appropriate, gender sensitive and life skills based can provide young people with the knowledge and skills to make informed decisions about their sexuality and life style. Preparing children and young people for the transition to adulthood has been one of humanity's greatest challenges with human sexuality and relationships at its core. Few young people receive adequate preparations for their sexual lives. This leaves them potentially vulnerable to coercion, abuse and exploitation. Unintended pregnancy and sexually transmitted infections (STIs) including HIV and AIDS. Many young people approach adulthood faced with conflicting

and confusing messages about sexuality and gender. This is often exacerbated by embarrassment, silence, disapproval and open discussion of sexual matters by adults (parents, teachers) at the very time when it is most needed.

Comprehensive sexuality education supports a rights - based approach in which values such as respect, acceptance tolerance, equality, empathy and reciprocity are inextricably linked to universally agreed human rights. A clear message concerning these dangers and how they can be avoided, from right across the curriculum, is the best way to ensure that young people understand the risks and know how to stay healthy.

h) Inclusive Education

This is also captured as “**we are all equal**”. Inclusive education involves ensuring all learners are engaged in education and that they are welcomed by other learners so that everyone can achieve their potential. Inclusive practice embraces every individual regardless of gender or ability including those with learning difficulties and disabilities. The utmost focus of inclusive curriculum is on ensuring participation in education of learners with different learning styles and other difficulties. To be successful, it

entails a range of issues including teacher’s positive attitudes, adapting the learning resources, differentiation of teaching and learning methods and working together. Overall, the benefits of an inclusive curriculum extend to all learners.

1.7. Special needs education and inclusivity

All Rwandans have the right to access education regardless of their different needs. The underpinnings of this provision would naturally hold that all citizens benefit from the same menu of educational programs. The possibility of this assumption is the focus of special needs education. The critical issue is that we have persons/ learners who are totally different in their ways of living and learning as opposed to the majority. The difference can either be emotional, physical, sensory and intellectual learning challenges traditionally known as mental retardation. These learners equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream schools. Therefore, the schools’ role is to enrol them and also set strategies to provide relevant education to them. The teacher therefore is requested to consider each learner’s needs during teaching and learning process. Assessment strategies and conditions should also be standardised to the needs of these learners. Also, ensure that you include learners with special educational needs in classroom activities as much as possible.

The special needs children can fall in any of the following common categories:

- Physical difficulties
- Visual difficulties
- Hearing difficulties
- Mental difficulties
- Genocide traumatised learners

The teacher should identify such cases and help facilitate the learning of the affected students. For example, learners with visual and hearing difficulties should sit near the teacher's table for easy supervision and assistance. The following are some suggestions on how to support special needs children in your class.

(a) Learners with physical difficulties

In this group of learners, the affected areas are normally some body parts, especially the limbs. There may be partial or total loss of use of the limbs. In case the legs are affected, the learners will need assistance during activities that involve movement. This could be during a nature walk and other activities that learners have to stand for some reason. The teacher should organise for the learner's ease of movement around. The learner should also be given time to catch up with the others.

In case the hands are affected, the learners should be given more time to finish their work. In both cases, the learners should not be pressurised to do things that can cause injury or ridicule.

(b) Learners with visual difficulties

These learners normally have problems with their eyesight. They should sit in a position where they are able to see the chalkboard without straining

Note: The learner could be longsighted or shortsighted.

The material to be observed should be brought closer to the learner and a magnifying lens used where necessary. The teacher should use large diagrams, charts and labels. In some cases, the learners can be allowed to touch and feel whatever they are looking at. Other learners can assist by reading aloud. The lighting system in the classroom can also be improved.

The teacher should read aloud most of the things he/she writes on the chalkboard.

(c) Learners with hearing difficulties

The affected part in this case is the ear. The learner should have hearing aids. The teacher should use as many visual aids as possible. They should also project their voice and always talk while facing the learners. Use of gestures and signs while talking helps the learner figure out what the teacher is saying as well.

(d) Learners with speech difficulties

A common example in a normal class is the stammerer. They always speak with a lot of difficulties. The teacher

should be patient with them and encourage such learners to express themselves in their own way. Such learners should be given more written exercises.

(e) Learners with mental difficulties

The teacher should try to identify the nature and level of the mental difficulty. Learners with mental difficulties should then be given special assistance and attention at an individual level. They can be given special tests or assessments. In general, all the learners with difficulties should be reinforced promptly. This encourages and motivates them. The teacher and the rest of the class should never ridicule learners with any of the difficulties. Note that generally, people with any kind of disability can be very sensitive to any kind of negative comments or criticism.

Remind them that '**Disability** is not inability'.

The teacher should avoid giving privileges where the learners do not deserve them. Treat them fairly but not with undue favours. In extreme cases it can be recommended for the learners to join a special school.

(f) Genocide traumatised learners

Studies have shown that learners from families that were affected by genocide suffer post-traumatic stress disorder (PTSD). As such, they need to be treated as a special case. As a teacher, you need to be careful when dealing with such learners. Also, the teacher needs to be in control especially when the topic under discussion touches on genocide issues. Any language that may elicit emotional reactions from learners either by fellow learners or by the teacher should be avoided.

Section 2: Preparing to teach and the teaching process

2.1. Understanding the Scientific process

Although the process of science aims at guiding the learners on how, rather than what to learn, the process of discovering or finding out cannot exist without content or something to be found out. A teacher cannot teach about classification without something to classify, for instance. On the other hand, nothing can be classified without knowledge of the materials to be classified. It is, therefore, necessary for the teacher to strike a balance between giving some scientific information and guiding the learners to discover on their own through investigations.

Problem-solving in Science

In order to apply the scientific method of solving problems, learners need certain skills. The process of scientific problem solving can be seen as a continuous chain through the following steps:

1. Identifying the problem.
2. Collecting information and making relevant observations.
3. Making predictions, building a theory or a hypothesis.
4. Designing experiments.
5. Carrying out or doing the experiments.
6. Recording the results.
7. Analysing results.
8. Making conclusions after comparing predictions with results.
9. Communicating or reporting and exchange of information.

Most often we do not consciously think about each of these steps every time we try to solve a practical problem. The approach we use to solve our daily problems many times becomes a habit. It is during the early years of our lives that basic patterns of behaviour are established. Therefore, it is very important for learners to master the skills of problem-solving. These skills should be applied many times over to solve problems at the learner's own level of understanding and interest.

Among the basic skills necessary for carrying out the process of scientific problem solving are:

- Asking questions.
- Collecting relevant information.
- Making predictions.
- Constructing and collecting apparatus and materials.
- Sorting and classifying.
- Recording of information and results.
- Reporting and exchange of information (communication).

Let us briefly discuss each of them.

(a) Asking questions

Learners should be encouraged to ask any question(s) which arise from their work. It is the responsibility of the teacher to help the learners to find answers to their questions or problems through their own observations and experiments.

Instead of giving answers directly, the teacher should help to put the learners in a situation whereby they can find out the answers for themselves. Sometimes, the nature of the learners' questions makes this impossible. In such a case, the teacher should give an honest answer and research to find the answer.

(b) Collecting information

We can use all our senses to learn more about the world around us. Learners should be encouraged to observe keenly, listen, feel, smell and even taste with caution. Sometimes information can be obtained from suitable reference materials and experts. Whatever, the source, careful gathering of information is a major step in problem solving. It may also lead to discovery of new problems which will need solving.

(c) Making predictions or hypotheses

Predicting is not the same as guessing. We make a prediction only after careful consideration of the information available to us. In other words, because we observed that certain things took place in the past, we suppose that certain other things will happen in the

future. For example, if the position of the shadow of a flag post is marked on the ground at 9.00 am, 10.00 am and 11.00 am in the morning, then the learners can predict where the shadow will fall at noon with some level of accuracy.

(d) Construction and collection of apparatus and materials

Experiments in Science most often require apparatus, equipment and other materials. These can be acquired through collection and construction using locally available materials.

A good Biology teacher is often described as a scavenger and his learners, as young scavengers. This means that they collect as many waste materials as possible.

Every class should have a Biology corner or store at which they keep the apparatus and materials safely.

(e) Sorting and classifying

Learners should be given an opportunity to group things in ways they themselves believe are suitable. The process of sorting and arranging things gives learners valuable practice in decision making.

Through classifying, patterns may emerge which may help to solve problems and unveil new ones.

(f) Recording of information

Learners should be encouraged to keep a record of what they do as well as what they observe. These records

may be in the form of drawings, charts, models or reports. When records are analysed, conclusions and appropriate decisions can be made.

(g) Drawing conclusions

A skilful teacher can help the learners to look for simple cause and effect relationships based on observations made or the results obtained from an experiment analysed.

A conclusion may be the solution to a problem and sometimes may lead to new problems.

(h) Reporting and exchange of information (Communication)

Learners should be made to realise that they can learn from one another. They should be encouraged to exchange information through reports, displays and discussions.

The conclusions made from an investigation should be communicated to other people who may use it to solve a practical problem.

2.2. Important attitudes in learning of Biology

a) In learners

There are certain useful attitudes, which the teacher should help to develop in the learners as they carry out investigations in science. Biology as a problem solving discipline is expected to make an impact on a learner's general behaviour.

The nature of the scientific method demands learners to be honest with themselves as they record results and make unbiased conclusions. They should be aware of the danger involved in making generalisations out of limited information. They should be open-minded and able to distinguish between propaganda and truth.

Some of the scientific attitudes that learners should develop include:

- **Practical approach to problem solving** - Learners should seek answers to their questions and problems by carrying out investigations wherever possible.
- **Responsibility** - A learner should be responsible enough to effect tasks apportioned and take good care of apparatus during and after an investigation.
- **Cooperation** - Learners will often be working in groups while carrying out investigations and need therefore to cooperate with all other members of the group.
- **Curiosity** - Learners should have a curious attitude as they observe things and events around them. This is the first step towards solving a problem.
- **Self-confidence** - Learners should have the will to attempt to solve a problem. The feeling of self-confidence can be strengthened in young learners if they experience many small successes that win

approval and encouragement from the teacher. The problems which learners attempt to solve should not be so difficult that they lead to frustration.

- **Honesty** – As they make observations, record, analyse results and draw conclusions.
- **Patience** – Learners should be patient for the results of an experiment which may take time to manifest.

a) In teachers

- Engage learners in variety of learning activities.
- Apply appropriate teaching and assessment methods.
- Adjust instructions to the level of the learner.
- Creativity and innovation.
- Makes connections/relations with other subjects.
- Show a high level of knowledge of the content.
- Develop effective discipline skills to manage adequately the classroom.
- Good communicator.
- Guide and counsellor.
- Passion for children teaching and learning.

2.3. Philosophy of teaching Biology

In the teaching of science, two definite approaches or techniques have been used. The first is the passive traditional approach where the teacher is the

central figure around whom all other things revolve. In this setup, the teacher talks and issues command. The learners sit and listen. The teacher treats the learners like an 'empty pot' waiting for information to be poured into it. A small amount may enter; some will stay in while the rest evaporates. This teacher centred approach has no place in our schools today. In the second approach, which we call the dynamic or activity-oriented approach and which is being advocated for, the learners are active participants in the learning process. They are the doers and the materials and apparatus they work with are the tellers. The teacher's role is that of a guide and facilitator in the learning process. Biology is a practical subject and learners understand it best by doing.

(a) Learner role in learning Biology

Learning takes place only when the student has internally digested and assimilated the material to be learnt. As such, learning is a highly personal and individual process. It therefore means that a learner must be actively engaged in the learning exercise.

For active participation in learning, the learner must:

- (a) Develop the curiosity, powers of observation and enquiry by exploring the local environment.
- (b) Raise questions about what is observed.
- (c) Suggest solutions to those questions and carry out

investigations to search for answers.

- (d) Manipulate a variety of materials in search of patterns and relationships while looking for solutions to problems.

The competence-based approach considers the learning process to involve the construction of meaning by learners. Simply, it emphasises the need for students to think about scientific activity in order to make sense of and understand the scientific concepts being introduced. In this new dispensation, learners are in the driver's seat, which implies they will construct their knowledge by posing questions, planning investigation, conducting their own experiments, analysing and communicating results. More specifically, when engaging in inquiry, learners will describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. By so doing, the learners will take ownership of the learning process.

Learners' activities are indicated against each learning unit reflecting their appropriate engagement in the learning process. Even though they do not necessarily take place simultaneously in each and every Biology lesson and for all levels, over time learners get involved in the following activities:

- Observing and, where possible, handling and manipulating real objects;

- Pursuing questions which they have identified as their own even if introduced by the teacher;
- Taking part in planning investigations with appropriate controls to answer specific questions;
- Using and developing skills of gathering data directly by observation or measurement and by using secondary sources;
- Using and developing skills of organising and interpreting data, reasoning, proposing explanations, making predictions based on what they think or find out;
- Working collaboratively with others, communicating their own ideas and considering others' ideas;
- Expressing themselves using appropriate scientific terms and representations in writing and talk;
- Engaging in lively public discussions in defence of their work and explanations;
- Applying their learning in real-life contexts;
- Reflecting self-critically about the processes and outcomes of their inquiries.

During this reciprocal interaction, what learners will acquire is not only content knowledge, but a number of skills including how to approach a problem, identify important resources, design and carry out hands-on

investigations, analyse and interpret data, and, perhaps most importantly, recognise when they have answered the question or solved the problem.

(b) Teacher's role in learning and teaching

The teacher is one of the most important resources in the classroom. The teacher's role is central to the successful implementation of the learning programme in the school. The role of the teacher will remain critical. However, instead of being the "sage on the stage"; the teacher will rather be "the guide on the side" who acts as facilitator in a variety of ways which include:

- Encouraging and accepting learner autonomy and initiative;
- Using raw data and primary sources, along with manipulative, interactive, and physical materials;
- Using cognitive terminology such as classify, analyse, predict, and create when framing tasks.
- Allowing learner responses to drive lessons, shift instructional strategies, and alter content;
- Familiarising themselves with learners' understandings of concepts before sharing their own understandings of those concepts;
- Encouraging learners to engage in dialogue, both with the teacher and one another;
- Engaging learners in experiences that pose contradictions to their

initial hypotheses and then encouraging discussion;

- Providing time for learners to construct relationships and create metaphors.
- Nurturing learners' natural curiosity.
- Organising the classroom to create a suitable learning environment.
- Preparing appropriate materials for learning activities.
- Motivating learners to make them ready for learning.
- Coordinate learners' activities so that the desired objectives can be achieved.
- Assessing learners' activities and suggest solutions to their problems.
- Assist learners to consolidate their activities by summarising the key points learnt.

From time to time, the teacher should interact with the learners individually or in groups to diagnose their weaknesses and frustrations, appraise their efforts, imagination and excitement. This will assist and guide them in the task of learning. The teacher must make an effort to teach learners how to team up but still have each learner directly involved in working with materials, consulting with the teacher and with fellow learners. Remember that whatever you do during the class, the interests of the learner remain paramount! Therefore the teacher should allow and encourage the learners to:

- Explore their local environment.
- Ask questions about things and events.
- Make observations.
- Perform simple investigations and experiments to seek answers to their questions.
- Talk to each other and to the other learners about their experiences, interests, problems, successes and even frustrations.
- Play and make models of things that interest them.

There is no doubt that scientific knowledge is increasing at such a rapid rate that it is impossible for any teacher to teach, or any child to learn, all the information available on any particular topic, within the time allocated. As an alternative, we should take on a strategy that is practical and time-saving. It involves equipping the learners with skills, which they can use to find out information, and solutions to problems in Biology and in their daily lives. We therefore advocate the teaching of Biology as a process, combined with providing Biology facts, which are appropriate in content to the age and stage of mental development of learners under your charge. The scientific skills which the teacher must endeavour to introduce and promote in his /her learners include:

Observing, comparing, classifying (sorting), recording, predicting, experimenting, measuring, controlling variables, collecting data, recognising

patterns and relationships, analysing and interpreting data, making conclusions (inferring) and communicating.

These skills, used in conjunction with the introduction of basic Biology facts will form a firm foundation which learners can build more as they learn both inside and outside of school.

Education at school is about children learning. The process of organising students learning so as to achieve the aims and objectives of the curriculum involves bringing together the needs and characteristics of the learners. To do this, the skills, knowledge and experience of the teacher are all required within a given situation.

2.4. Teaching resources

These refer to things that the teacher requires during the teaching process. They include:

- The classroom
- Textbooks
- Wall charts and wall maps
- Materials and apparatus
- Various tools and equipment
- Biology kit
- Models
- Resource persons
- Social facilities such as health centres, other learning institutions, community organisations, etc.
- Enterprises such as agricultural farms, industries, among others.

a) Classroom as a learning environment

Classroom generally refers to the place where learning takes place. Students learn from everything that happens around them, such as the things that they hear, see, touch, taste, smell and play with. It is therefore important for the teacher to make his classroom an attractive and stimulating environment. This can be done by:

- Carefully arranging the furniture and desks.
- Putting up learning and teaching aids on the walls. Examples are wall charts or pictures or photographs.
- Displaying models.
- Providing objects for play for example toys.
- Having a display corner in the classroom where learners display their work.
- Securing a storage area.

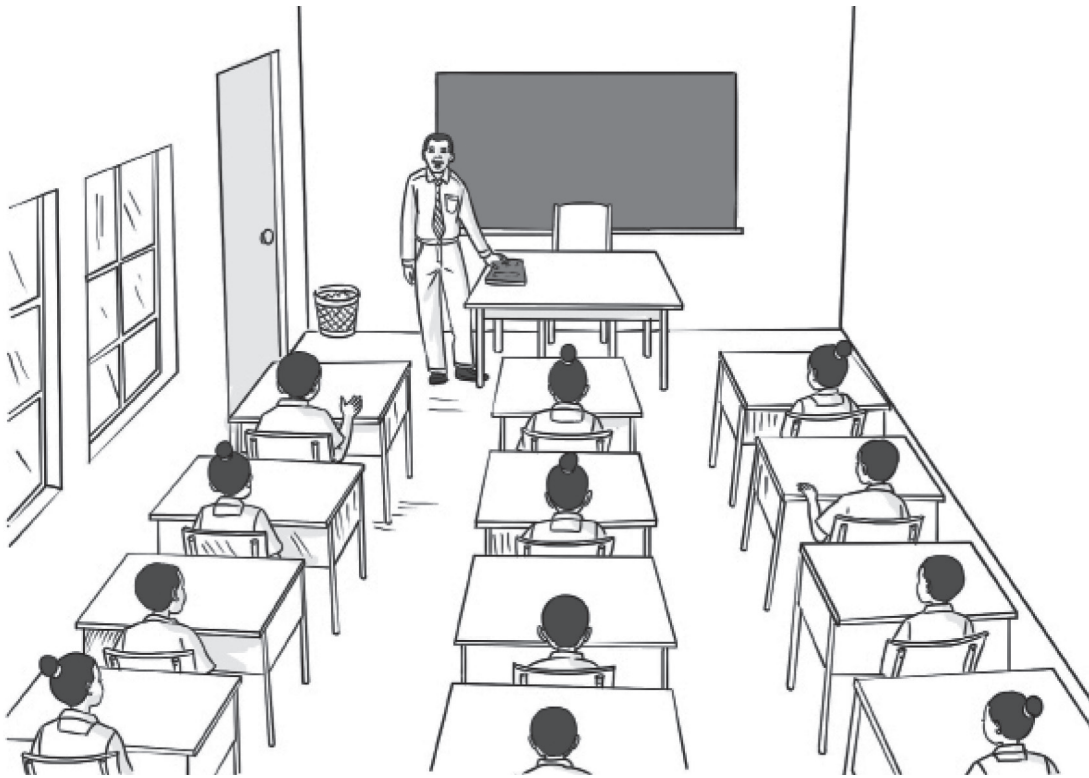
The materials in the classroom should get the students thinking and asking questions about what is around them and encourage them to do worthwhile activities.

Classroom organisation

A well organised classroom is an asset

to good biology teaching but there is no one correct style to suit all classrooms and situations. However, the teacher should consider the following factors when organising the classroom:

- (a) Furniture should be well arranged so as to allow free movement of learners and the teacher.
- (b) Set a corner for storing materials so as not to obstruct learners or distract them.
- (c) The number of learners in the class and their ages.
- (d) Learners should be reasonably spread out so that they do not interfere with one another's activities.
- (e) The series of lessons or activities going on for a number of days or weeks such as individual or group work or whole class.
- (f) Classroom itself, that is, positions of windows, doors such that learners face the lighted areas of the room.
- (g) Personal preferences. But these should be in the interest of the learners especially where you normally stand, you should be able to communicate with all learners, and also have a general view of all learners in the class.



A classroom setting

Grouping students for learning

Most of the Biology activities are carried out in groups and therefore the teacher should place 2 or 3 desks against each other and then have a group of learners sitting around those desks.

In certain activities, the teacher may wish to carry out a demonstration. In this case, the learners should be sitting or standing in a semi circle, or arranged around an empty shape of letter “U” such that each learner can see what the teacher is doing clearly and without obstruction or pushing. If the learners are involved in individual work, each learner can work on the

floor or on the desk or a portion of the desk if they are sharing. In this case, they need not face each other.

Grouping students for learning has increasingly become popular in recent years. In fact, the shift from knowledge-based to competence curriculum will make grouping the norm in the teaching process. Grouping learners can be informed by one or all of the following:

- (a) Similar ability grouping
- (b) Mixed ability grouping
- (c) Similar interests grouping
- (d) Needs grouping
- (e) Friendship grouping

(f) Sex grouping

In Science, groupings are commonly those of types (a), (b), (c) and (d). Grouping learners has several advantages such as:

- (a) The individual learner progress and needs can easily be observed.
- (b) The teacher - learner relationship is enhanced.
- (c) A teacher can easily attend to the needs and problems of a small group.
- (d) Materials that were inadequate for individual work can now easily be shared.
- (e) Learners can learn from one another.
- (f) Cooperation among learners can easily be developed.

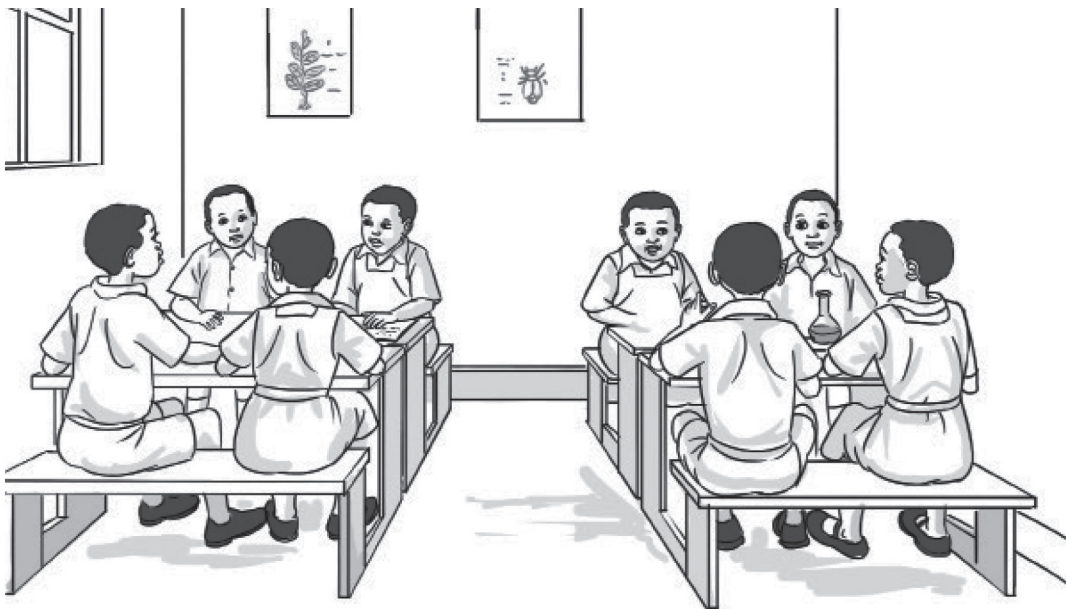
(g) Many learners accept correction from the teacher more readily and without feeling humiliated when they are in a small group rather than the whole class.

- (h) Learners' creativity, responsibility and leadership skills can easily be developed.
- (i) Learners can work at their own pace.

The type of "grouping" that a teacher may choose depends on:

- (a) The topic or task to be tackled.
- (b) The materials available.
- (c) Ability of learners in the class (fast, average, slow).

However, the teacher must be flexible enough to adjust or change his/her type of grouping to cope with new situations.



Grouping in a classroom setting

There is no fixed number of learners that a group must have. This again will be dictated by such factors as the task to be done, the materials, characteristics of learners in your class, size and the space available. However, groups should on average have between four to seven learners. You can also resort to pair work depending on the nature of the content being taught at the time.

There is no one method or approach to teaching that is appropriate to all lessons. A teacher should, therefore, choose wisely the method to use or a combination of methods depending on the nature of the topic or subtopic at hand.

Safety in the classroom

Learners in secondary school are active and curious. As such, they are inclined to getting harmed and injured. They should therefore be constantly protected from sources of injury and harm. The teacher is therefore advised to take strict safety precautions whenever learners are in class or outside the classroom. Some areas that need consideration as far as safety is concerned include:

- During tasting and smelling things;
- When using tools and equipment
- During experiments, demonstrations involving use of fire or harmful chemicals;
- When handling glass apparatus;
- When handling sharp or pointed objects like machete, pair of

scissors, razor blade, knife, etc;

- During nature walks and field visits. Learners should avoid handling poisonous plants and harmful animals, etc.

Remember, according to Rwanda laws, the teacher is responsible for the safety of the children during the period he or she is handling them.

(b) Apparatus and materials

For learners to study biology through the activity method, a number of materials and apparatus are required. The important role played by materials in learning has been felt for centuries. This is noted for instance in the old Chinese proverb that says:

- **What I hear I forget**
- **When I see I remember**
- **When I do I understand**

Since Biology is largely a practical subject, materials help the teacher to convey his/ her points, information or develop skills, simply and clearly, and to achieve desired results much faster.

Most of the materials that a teacher requires for Biology activities can be collected from the local environment.

Many others can be improvised while some will have to be purchased. Whether collected, improvised or purchased, there are certain materials that are valuable to have around almost all the time. These include:

- Tools: Scalpel, Hand lens, forceps, petri dishes, labels, strings, tin covers, sweep nets etc.

- Containers: Tins, pots, bottles, jars, a cartons etc.
- Powders: Salt, sugar, flour, soap, powder, ash etc.
- Liquids: Water, kerosene, methylated spirit, used engine oil, cooking oil, ink etc.
- Colours: for example, from flowers, leaves, roots and stems, charcoal and chalk.
- Soils: Clay, loam, sand and gravel.

Others include pieces of wood and sticks of various sizes, wires, ropes, nails, pins, thorns, grass stalks, growing plants like peas, beans, maize, seeds and cuttings of various plants.

The teacher should organise a place within the school for the proper storage of science materials and in labelled boxes.

Encourage learners to collect and bring as many materials and apparatus to the school as they can. This will continuously replenish your materials and apparatus collection.

Improvisation

If each learner is to have a chance of experimenting, cheap resources must be made available. Expensive, complicated apparatus may not always be available in most schools. Such sophisticated equipment made by commercial manufacturers is usually expensive and majority of schools cannot afford them. The teacher is therefore advised to improvise using locally available materials as

much as possible. Improvisation should however not be regarded as a cheap substitute of proper laboratory equipment. Many of the great masters of Biology used improvised apparatus and many great discoveries have been made using improvised equipment.

Timing of topics and the local weather pattern

Certain topics are best studied during a particular weather condition than at other times. For instance, rapid growth of plants is best observed during the rainy season. Soil erosion by water and siltation are best studied during the rainy season. Certain insects appear only during the dry weather while others emerge with the onset of the rains. Nature walks and visits are best done when the weather is sunny and dry. The teacher should therefore think ahead while making the scheme of work so that the prevailing weather pattern is considered. This will ensure that suitable activities for learning biology are planned for with the weather in mind.

However, a good scheme of work should be sufficiently flexible to cope with unexpected situations and can be altered or modified to suit certain circumstances.

c) Science Kit

A science kit is a special box containing materials, apparatus and equipment necessary to conduct an array of experiments. The content of the science kit depends on the curriculum requirements per level. Most science

kits are commercially available and target particular levels of learners. However, the teacher is encouraged to come up with a kit based on the syllabus requirements.



Science kit

d) Resource persons

A resource person refers to anybody with better knowledge on a given topic area. Examples include health practitioners such as doctors, nurses and laboratory technologists, agricultural extension officers, environmental specialists among others. Depending on the topic under discussion, the teacher can organise to invite a resource person in that area to talk to learners about the topic. The learners should be encouraged to ask as many questions as possible to help clarify areas where they have problems.

e) Models

A model refers to a three-dimensional representation of an object and is usually much smaller than the object. Several models are available

commercially in shops. Examples include model of the heart, skin, lungs, eye, and ears, among others. These can be purchased by schools for use during practicals.

2.5. Teaching methods

There is a variety of possible ways in which a teacher can help the students to learn. These include:

- (a) Direct exposition
- (b) Discovery or practical activity
- (c) Group, class or pair discussion
- (d) Project method
- (e) Educational visit/ field trips
- (f) Teacher demonstration
- (g) Experimentation

The particular technique that a teacher may choose to use is influenced by several factors such as:

- The particular group of learners in the class.
- The skills, attitudes and knowledge to be learned.
- Learning and teaching aids available.
- The local environment.
- The teacher's personal preference.
- The prevailing weather.
- The requirements of the Biology syllabus.

(a) Direct exposition

This is the traditional way of teaching whereby the teacher explains something while the learners listen. After the teacher has finished, the learners may ask questions. However, remember that in competence-based

curriculum, this technique should be used very minimally.

(b) Guided discovery

In this technique, the teacher encourages learners to find out answers to problems by themselves. The teacher does this by:

- Giving learners specific tasks to do.
- Giving learners materials to work with.
- Asking structured or guided questions that lead learners to the desired outcome.

Sometimes learners are given a problem to solve and then left to work in an open-ended manner until they find out for themselves.

With the introduction of the new curriculum, this is the preferred method of teaching.

(c) Group or class discussion or pair work

In this technique, the teacher and learners interact through question and answer sessions most of the time. The teacher carefully selects his questions so that learners are prompted to think and express their ideas freely, but along a desired line of thought. Discussion method should take learners from known to unknown in a logical sequence; and works well with small groups of learners. The disadvantage of this method is that some learners maybe shy or afraid to air their opinions freely in front of the teacher or their peers. This may give

them more confident learners a chance to dominate the others. However, the method should be embraced as it intends to eliminate the lack of confidence in learners. Further, it is hoped that it will help improve interpersonal and communication skills in learners.

(d) Project method

In this approach, the teacher organises and guides a group of learners or the whole class to undertake a comprehensive study of something in real life over a period of time such as a week or several weeks.

Learners using the project method of studying encounter real life problems which cannot be realistically brought into a normal classroom situation. A project captures learners' enthusiasm, stimulates their initiative and encourages independent enquiry. The teacher, using the project method, must ensure that the learners understand the problem to be solved and then provides them with the necessary materials and guidance to enable them carry out the study. You can use the project method for topics, which cannot be adequately studied during the normal time-tabled school lessons.

Disadvantages

If a project is not closely supervised, learners easily get distracted and therefore lose track of the main objective of their study. Studying by the project method does not work well with learners who have little or no initiative.

(e) Educational visits and trips/ nature walks

This is a lesson conducted outside the school compound during which a teacher and the learners visit a place relevant to their topic of study. An educational visit/nature walk enables learners to view their surroundings with a broader outlook that cannot be acquired in a classroom setting. It also allows them to learn practically through first-hand experience. In all “educational visit/nature walk lessons”, learners are likely to be highly motivated and the teacher should exploit this in ensuring effective learning. However, educational visits are time consuming and require a lot of prior preparation for them to succeed. They can also be expensive to undertake especially when learners have to travel far from the school.

(f) Demonstration lessons

In a demonstration, the teacher shows the learners an experiment, an activity or a procedure to be followed when investigating or explaining a particular problem. The learners gather around the teacher where each learner can observe what the teacher is doing. It is necessary to involve the learners in a demonstration, for example by:

- Asking a few learners to assist you in setting up the apparatus.
- Requesting them to make observations
- Asking them questions as you progress with the demonstration.

This will help to prevent the demonstration from becoming too teacher-centred.

When is a demonstration necessary?

A teacher may have to use a demonstration, for example when:

- The experiment/procedure is too advanced for learners to perform.
- The experiment/ procedure is dangerous.
- The apparatus and materials involved are delicate for learners to handle.
- Apparatus and equipment are too few.

2.6. The content map

This is a guide to direct both the teacher and learner on where to find certain content in the book. It also includes what is covered in every unit and sub-unit. A content map has been provided at the beginning of this guide. The learner’s book also has the map at the first pages.

2.7. Planning to teach

The two most important documents in planning to teach are the schemes of work and the lesson plan.

a) Schemes of work

A scheme of work is a collection of related topics and subtopics drawn from the syllabus and organised into lessons week by week for every term. It is also a forecast or plan that shows details under these sub-headings:

- Week
- Key unit competency
- Lesson
- Learning objectives
- Learning resources and reference materials
- Teaching methods and techniques
- Observations/self-evaluation
- Comments from school director (DOS)

In addition, the schemes of work show the day when a specific lesson will be taught and how long it is intended to take.

- Week** - refers to the week in the term e.g. 1, 2, 3, etc.
- Key unit competency** - Gives the competence learners are expected to achieve at the end of the unit.
- Lesson** - refers to the lesson being taught in that week e.g. lesson 1,2,3 and 4, etc. This shows which lesson is single and which one is a double lesson.
- Date** - the day when the lesson will be taught.
- Sub-topic** - a subset of the topic which is a smaller component of the unit e.g. under the topic plants, one could have 'parts of a plant' as a sub-topic.
- Objective** - what learners are expected to achieve at the end of the lesson.
- Learning resources** - any materials that will be used by the students and the teacher for learning and teaching.
- References** - books or other materials that will be consulted or used in the teaching process. Books that students will use should also be shown here; indicating the actual pages.
- Observations/self-evaluation** - this should be a brief report on the progress of the lesson planned in the scheme of work. Such reports could include: 'taught as planned'. 'Not taught due to abrupt visit by Country Director of Education.' 'Children did not follow the lesson, it will be repeated on... (Specific date).
- Comments from director of school** – space left for comments by the school director.

Below is a sample scheme of work for your familiarisation.

Unit Plan/Scheme of work

Academic year: 2016

Term: I

School:

Subject: Biology

Teacher's name:

Class: Senior 2

Dates	Unit title	Lesson title + Evaluation	Learning objectives (copied or adapted from the syllabus depending on the bunch of lesson) + Key unit competence	Teaching methods & techniques + Evaluation procedures	Resources & References	Observations
Week 1	Unit 1: Classification of Kingdom - Animalia	Lesson 1: General characteristics of animals. (2 Periods)	By the end of the lesson, learners should be able to: a) Knowledge and Understanding: State the characteristics of all animals. b) Skills: Distinguish different groups of animals using observable features. c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	Live animals Preserved specimens Audio -visual resources such as videos on various animals Photographs of animals Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.	Comment on the effectiveness of the teaching process based on your evaluation of the lesson. For example, learners of low ability had challenges distinguishing between unique and general characteristics of various groups of animals. Remedial teaching is necessary for this category of learners.

<p>Lesson 2: Phylum Chordata (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in phylum - chordate.</p> <p>b) Skills: Distinguish chordates from other groups of animals using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of chordates</p> <p>Audio -visual resources such as videos on chordates</p> <p>Photographs of various chordates</p> <p>Longhorn Biology Senior</p> <p>2 student's book, Internet connectivity, other biology reference books.</p>	
<p>Lesson 3: Class – Pisces (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a Knowledge and Understanding: Identify the common features of animals in class – Pisces (Fish). Describe the adaptations of fish to their habitat (aquatic environment)</p> <p>b) Skills: Distinguish fish from other chordates using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of various fish</p> <p>Audio -visual resources such as videos on fish</p> <p>Photographs of various fish</p> <p>Longhorn Biology Senior</p> <p>2 student's book, Internet connectivity, other biology reference books.</p>	

<p>Lesson 4: Class – Amphibians (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in class – amphibians</p> <p>b) Skills: Distinguish amphibians from other chordates using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of frog, toad, newt or salamanda.</p> <p>Audio -visual resources such as videos on amphibians</p> <p>Photographs of amphibians</p> <p>Longhorn Biology Senior</p> <p>2 student’s book, Internet connectivity, other biology reference books.</p>	
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Week 2	Lesson 5: Class – Reptilia (1 Period)	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in class – Reptilia</p> <p>b) Skills: Distinguish reptiles from other chordates using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	Live /Preserved specimens of reptiles Audio -visual resources such as videos on reptiles Photographs of reptiles Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.
	Lesson 6: Class – Aves (1 Period)	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in class – Aves (Birds). Describe the adaptations of birds to their mode of feeding</p> <p>b) Skills: Distinguish birds from other chordates using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	Live /Preserved specimens of various birds Audio -visual resources such as videos Photographs of birds Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.

Lesson 7: Class – Mammalia (1 Period)	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in class – Mammalia</p> <p>b) Skills: Distinguish mammals from other chordates using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of various mammals</p> <p>Audio -visual resources such as videos on mammals</p> <p>Photographs of mammals</p> <p>Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.</p>
Lesson 8: Phylum Arthropoda (1 Period)	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in phylum - Arthropoda. Describe the economic importance of arthropods.</p> <p>b) Skills: Distinguish arthropods from other groups of animals using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of various arthropods</p> <p>Audio -visual resources such as videos on arthropods</p> <p>Photographs of arthropods</p> <p>Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.</p>

Week 3	Lesson 9: Class - Insecta (1 Period)	By the end of the lesson, learners should be able to: a) Knowledge and Understanding: Identify the common features of animals in Class – Insecta Describe the adaptations of insects to their habitat. b) Skills: Distinguish insects from other arthropods using observable features. c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	Live /Preserved specimens of various insects Audio -visual resources such as videos on insects Photographs of various insects Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.
	Lesson 10: Class - Crustaceans (1 Period)	By the end of the lesson, learners should be able to: a) Knowledge and Understanding: Identify the common features of animals in Class – crustaceans Describe the adaptations of crustaceans to their habitat. b) Skills: Distinguish crustaceans from other arthropods using observable features. c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	Live /Preserved specimens of various crustaceans Audio -visual resources such as videos on crustaceans Photographs of crustaceans such as prawn, lobster, crayfish, etc. Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.

<p>Lesson 11: Class – Diplopoda (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in Class – Diplopoda Describe the adaptations of diplopods to their habitat.</p> <p>b) Skills: Distinguish diplopods from other arthropods using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of millipede</p> <p>Audio -visual resources such as videos on millipedes</p> <p>Photographs of millipedes</p> <p>Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.</p>
<p>Lesson 12: Class – Chilopoda (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in Class – Chilopoda Describe the adaptations of chilopods to their habitat.</p> <p>b) Skills: Distinguish Chilopods from other arthropods using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of centipede</p> <p>Audio -visual resources such as videos on centipedes</p> <p>Photographs of centipedes</p> <p>Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.</p>

<p>Lesson 13: Class – Arachnida (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Identify the common features of animals in Class – Arachnida Describe the adaptations of arachnids to their habitat.</p> <p>b) Skills: Distinguish arachnids from other arthropods using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of various arachnids such as spider</p> <p>Audio -visual resources such as videos on spiders</p> <p>Photographs of spiders</p> <p>Longhorn Biology</p> <p>Senior 2 student's book, Internet connectivity, other biology reference books.</p>
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<p>Week 4</p>	<p>Lesson 14 – Other Phyla in Kingdom – Animalia (1 Period)</p>	<p>By the end of the lesson, learners should be able to:</p> <p>a) Knowledge and Understanding: Name the other phyla in Kingdom – Animalia other than Chordata and arthropoda. Give examples of animals under each category above.</p> <p>b) Skills: Distinguish animals in these phyla from Chordates and arthropods using observable features.</p> <p>c) Attitudes and Values: Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. Appreciate the need for classification of animals.</p>	<ul style="list-style-type: none"> • Guided discovery • Group discussions • Pair work • Research • Presentations • Practical activities • Question and answer • Case studies 	<p>Live /Preserved specimens of various animals other than chordates and arthropods Audio -visual resources such as videos on these animals Photographs of animals other than chordates and arthropods Longhorn Biology Senior 2 student's book, Internet connectivity, other biology reference books.</p>
<p>Summative Evaluation 1</p>	<p>Key unit competence: After studying this unit, learners should be able to classify animals into their main groups based on external features.</p>	<p>Evaluation procedures:</p> <ul style="list-style-type: none"> • Give oral exams to gauge learner attitude and values • Give written tests to evaluate learner understanding of the concepts taught. • Allow learners to participate in practical activities as you evaluate skills acquisition and manipulation of apparatus. 		

b) Lesson plan

A lesson plan is a detailed outline of how the teacher intends to carry out a specific lesson.

Important sub-headings of a Lesson Plan

1. *Administrative details*

Date..... Subject.....

Class.....

Time..... Roll.....

2. *Topic area*

Broad area studied, taken from the syllabus.

3. *Sub-topic area*

A section of the topic, from which a lesson will be taught.

4. *Key unit competence*

This is/are the competence(s) that the learner is expected to achieve at the end of the unit.

5. *Learning Objectives*

These represent what the teacher anticipates learners to achieve by the end of the lesson. Objectives should be clear and specific. They should also be stated in behavioural terms that is, in a way that the outcome can be seen, displayed or measured. In science, one should distinguish between knowledge, skill and attitude objectives.

6. *Learning/teaching resources*

Any materials and apparatus used by the learners and the teacher during the lesson.

7. *References*

Any resources consulted or used by the teacher to prepare the lesson as well as any books that

the learners will use during the lesson.

8. *Introduction*

This is the start of the lesson. The teacher should motivate the learners by creating learning situations that interest them e.g. posing a problem, telling an amusing but relevant story or episode, showing an object or picture that arouse their interest. The introduction should link what the learners have already learnt with what they are going to learn.

9. *Presentation/lesson development*

This should mainly include the activities that learners and the teacher will perform in order to achieve the stated objectives; as well as the questions that learners will answer as they do the various activities.

It is convenient to distinguish between the learners and teacher's activities under two columns.

10. *Summary/conclusion: (Consolidation)*

This is the step in which the lesson activities are tied up or consolidated to emphasise the main points, summarise the lessons or make conclusions. The summary should correspond to the objectives stated for that lesson.

11. *Comments/self-evaluation:*

Teacher should write remarks on whether the objectives were achieved or not and what he or she intends to do to improve on the weak points noted during the lesson.

Sample Competence – based lesson plan

School Name: Teacher's Name:.....

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
I	3 /1/2017	Biology	S2	1	1 of 7	80 minutes	31
Type of special educational needs to be catered for in this lesson and number of learners in each category				<ul style="list-style-type: none"> • 2 students with vision impairment will be grouped with closer friends • 4 students with hearing impairment will be assisted by students using sign language 			
Unit title		Classification of Kingdom Animalia					
Key Unit Competence:		To be able to classify animals into their main groups based on external features.					
Title of the lesson		General characteristics of animals					
Instructional objectives		Using various live specimen of animals for example, birds, fish, mammals such as cow, goat and sheep; reptiles, amphibians and insects; such as butterfly, cockroach and grasshopper or their stored laboratory specimens or using charts showing these animals and insects learners should accurately describe the general characteristics of animals and put animals together in distinct groups based on the characteristics.					
Plan for this Class (location: in / outside		In the school garden and in the classroom.					
Learning materials (for all learners)		Specimen bottles, forceps, sweepnets, gloves, pooter, a livestock farm, live animals in the field, charts showing various animals, stored specimens of animals in the laboratory, handouts & pamphlets.					
References		Longhorn Biology Senior 2 Student's Book, this Teacher's Guide, pamphlets/ handouts on characteristics of animals, other reference textbooks such as zoology dictionary.					

Timing for each step	Description of teaching and learning activities		Generic competences and cross cutting issues to be addressed plus a short explanation
	Using live animals, specimens and charts, learners observe and note the characteristics of the various animals and put the animals into various groups based on the characteristics.		
	Teacher activities	Learner activities	
Introduction 10 minutes	Teacher initiates a brainstorming session by asking probing questions such as: <ol style="list-style-type: none"> 1. Are all animals the same? Why? 2. Can you give some differences between animals? 3. What does the answers to above questions tell you about diversity of animals? 	Learners respond to teacher questions. The answers are: <ol style="list-style-type: none"> 1. No. Because they have different features. 2. Some have legs, others lack, some have hair, others feathers and others scales covering their bodies. 3. There is a huge number of animals out there in nature. There is need to organise them into groups for ease of study. 	<i>(a) Generic competences:</i> Critical thinking: Foster this competence by guiding learner's in their thinking as they answer the probing questions. Cooperation, interpersonal management and communication skills: Ensure that all learners are actively engaged in group discussions and during activities and presentations. Also learners of different abilities should be paired up and roles allocated depending on their abilities.
Development of the lesson (40 minutes)	Guide learners to collect various animals from the field.	Learners collect various animals from the field. Examples include ants, grasshoppers, butterflies, mice, earthworms, millipedes among others.	

<p>Conclusion 20 minutes) a) Summary</p>	<p>Organise learners into groups of five considering learners of different abilities.</p> <p>Guide learners to identify the features of various animals.</p> <p>Gives learners charts and photographs of various animals to observe and note their characteristics.</p> <p>Ask learners to compare the characteristics they observed and those in the charts.</p> <p>Guide each group to choose a leader to present their findings to the rest of the class.</p> <p>Facilitates the learners to harmonise their findings and gives summarised notes on the general characteristics of animals.</p> <p>Teacher briefly highlights the key points about the characteristics of animals and clarifies misconceptions encountered during the lesson.</p>	<p>Learners form groups of five.</p> <p>Observe the various animals keenly and notes down their characteristics.</p> <p>Learners observe the charts and photographs and summarise the characteristics of the animals.</p> <p>Learners compare the characteristics of animals they observed and those in the charts.</p> <p>Present findings to the rest of class members.</p> <p>Learners write summary notes on characteristics of animals.</p> <p>Learner asks questions for clarifications.</p>	<p><i>Cross – cutting issues to be covered:</i></p> <p>Inclusive learning- Ensure that all learners participate actively in their study groups.</p> <p>Peace and values education -Bring to the attention of learners the need to accommodate other people’s views during the group discussions. Also, discipline should be observed at all times in the groups since some cases can make learners diverge from the main objectives of the lesson.</p> <p>Gender education: Let learners know that through the study of Biology, all people irrespective of gender can succeed in any profession that stems from the study of Biology. For example, females too can be taxonomists and forensic scientists. Give examples of role models of females in these fields.</p>
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<p>b) Assessment</p>	<p>Teacher gives oral questions on characteristics of animals.</p> <p>Questions may include:</p> <ol style="list-style-type: none"> 1. Which characteristics are common in animals? 2. Based on the characteristics above can you say that animals are living or non-living? <p>Gifted learners are given research work. For example, find out the differences between the various groups of animals, while remedial activities are planned for slow learners. Such activities include: while at home, look at the domestic animals you keep. How many legs, ears and eyes do they have? What covers their bodies?</p>	<p>Learner answers oral questions</p> <p>Answers to questions:</p> <ol style="list-style-type: none"> 1. Some have eyes, ears and nose. They breathe, eat, respond to stimuli reproduce and grow. 2. Animals are living things. <p><i>Answers to research activity for gifted learners</i></p> <ol style="list-style-type: none"> 3. For characteristics of the various groups of animals. Refer to learner's book. <p><i>Answers to remedial activity for slow learners</i></p> <p>Cow, cat, goat, sheep, dog have four legs and hair covering their body. Chicken, duck, turkey, pigeon have two legs and feathers covering their body. All animals have two eyes, two ears.</p>	<p>Environment and sustainability: Make learners aware of the fact that our environment sustains us therefore we should conserve it.</p> <p>Let them catch the animals for study then release them back to their natural habitats. Learners should also desist from destroying plants as they look for animals for this study.</p>
<p>Teacher self-evaluation</p>	<p>The teacher asks questions such as:</p> <ol style="list-style-type: none"> 1. Who is now aware of characteristics of animals? 2. Can you now give the differences between living and non-living things? <p>After weighing the level of understanding of learners based on answers to the above questions, I conclude that the lesson was successfully taught!</p>		

This teacher's book has been written to help you guide students to learn Biology in the most enjoyable and captivating manner. You are reminded to always arouse the curiosity of learners as you teach. Some things that you may do before you go for a lesson include:

- Go through the expected learning outcomes – this should help guide you on the manner of teaching.
- Read through the unit for the lesson in advance to get an overview of the content required.
- Form a mental picture of the teaching situation and the ways in which you will interact with learners when dealing with the suggested activities.
- Collect the materials that will be needed during the lesson in advance.
- In some cases, try out the suggested activities/experiments in advance to avoid embarrassments like - the experiment failing to work during the lesson.

Remember: The suggested teaching activities in this book are just a guide. You may not need to follow them to the letter! Feel free to incorporate other innovative teaching methods that will help in delivering the intended content optimally.

Assessment is the process of evaluating the teaching and learning processes. It is done through collecting and interpreting evidence of individual

learner progress in learning. It also involves making judgment about learner's achievements measured against defined standards. Assessment is an integral part of the teaching and learning processes. In the new competence-based curriculum assessment must also be competence-based; whereby a learner is given a complex situation related to his/her everyday life and asked to try to overcome the situation by applying what he/she learned.

Section 3: Assessment and Evaluation methods

3.1 Types of assessment

The two types of assessment that will be employed in the new curriculum is formative and summative assessment.

a) Formative and continuous assessment (assessment for learning)

Formative or continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a teacher is planning their lesson, they should establish criteria for performance and behaviour changes at the beginning of a unit. Then at the end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competencies basing on the criteria stated, before going to the next unit. The teacher will assess how well each learner masters both the subject matter and the generic competencies described in the syllabus

and from this, the teacher will gain a picture of the all-round progress of the learner. The teacher will use one or a combination of the following:

- Observation to judge the extent of skills acquisition
- Written tests
- Oral questions
- Project work
- Attitude change – this can be done by asking probing questions and checking body language as learners respond to the questions.

(i) Written tests

Under this, learners are given questions or tasks and are required to respond in writing. Examples of written tests are: short answer type questions, structured type questions, filling blanks, multiple choice questions, true-false questions and matching items.

(ii) Practical work or Activity

In this category, learners are required to perform a task or solve a problem practically. The teacher then assesses the finished work by looking at the materials used, procedures followed, whether it works or not or whether it is finished. He or she then awards marks accordingly.

(iii) Observation

This involves the teacher observing learners as they perform a practical task to assess acquisition of skills and attitude change. The teacher checks ability

of the learner to measure, classify, communicate findings, etc. The teacher also assesses the learner curiosity, patience, teamwork and co-operation spirit among others.

(iv) Oral questions or interviews

Asking learner's questions which require a verbal response such as naming parts of human body, a system or short explanations of a process such as digestion can also be used to assess a learner's level of competence.

(v) Drawing

This involves asking learners to draw something they have observed or learnt about. They can also collect data and draw graphs and interpret the graph and give conclusions. This helps to assess their skill in communication through recording.

(vi) Project work

In a project, learners undertake a comprehensive study of something in real life over a period of time such as several weeks or even months after which they present a report. In project work, let learners begin from planning stage (come up with a schedule of events), execute the plan, analyse the results and look back (reflect on the challenges encountered during the project and come up with solutions to those challenges (problem-solving skills).

A teacher can use one or several of these assessment methods depending

on the subtopic being studied or the purpose for which assessment is required.

When should the teacher assess learning progress?

The teacher should decide whether to assess learners at the end of the lesson

or at any other appropriate time when enough content has been covered. The general criteria to be used to gauge learner achievement in the various generic competency areas are given in the table below

Name of Learner	COMM	I&C	CT	RS	LL	PS	C&I
A	Red	Blue	Yellow	Blue	Red	Green	Yellow
B	Yellow	Red	Blue	Yellow	Blue	Red	Blue
C	Green	Blue	Red	Yellow	Blue	Red	Yellow
D	Yellow	Green	Yellow	Red	Yellow	Yellow	Green
E	Red	Blue	Yellow	Blue	Yellow	Red	Blue
F	Blue	Yellow	Red	Yellow	Blue	Green	Red
G	Yellow	Green	Blue	Yellow	Red	Blue	Green

KEY:

Red – Poor

Yellow – Excellent

Green – Good

Blue – Average

COMM – Communication in English

I & C – Interpersonal skills & Co-operation

CT – Critical Thinking

RS – Research Skills

LL – Lifelong skills

PS – Problems solving skills

C & I – Creativity & Innovation

Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored here and in the various tests given to assess skills

acquisition and attitude change.

b) Summative assessment (assessment of learning)

When assessment is used to record a judgment of a competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner competence or progress at any specific moment. The main purpose of summative assessment is to evaluate whether learning objectives have been achieved and to use the results for the ranking or grading of learners, for deciding on progression, for selection into the next level of education and for certification. This assessment should have an integrative aspect whereby a learner must be able to show mastery of all competencies.

It can be internal school based assessment or external assessment in the form of national examinations. School based summative assessment should take place once at the end of each term and once at the end of the year. School summative assessment average scores for each subject will be weighted and included in the final national examinations grade. School based assessment average grade will contribute a certain percentage as teachers gain more experience and confidence in assessment techniques. In the third year of the implementation of the new curriculum it will contribute 10% of the final grade, but will be progressively increased. Districts will be supported to continue their initiative to organise a common test per class for all the schools to evaluate the performance and the achievement level of learners in individual schools. External summative assessment will be done at the end of S3.

Item writing in summative assessment

Before developing a question paper, a plan or specification of what is to be tested or examined must be elaborated to show the units or topics to be tested on, the number of questions in each level of Bloom's taxonomy and the marks allocation for each question. In a competency based curriculum, questions from higher levels of Bloom's taxonomy should be given more weight than those from

knowledge and comprehension level.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competency based assessment by doing the following:

- Identify topic areas to be tested on from the subject syllabus.
- Outline subject matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorisation or recall answers only but testing broad competencies as stated in the syllabus.

Structure and format of the examination

There will be 2 papers in Biology Subject and time for each paper will be three (3) hours. The papers will be structured as follows:

- Paper 1 will be composed of multiple choice questions, semi-structured questions of a variable mark values, and three extended questions from which a choice of one will be made by the candidates. All questions will be based on the 'O' Level syllabus content. Candidates will answer all questions.

- Paper 2 will be a practical paper consisting of two or three experiments drawn from different areas of the 'O' Level syllabus that require candidates to carry out practical work in timed conditions.

3.2 Record Keeping

This is gathering facts and evidence from assessment instruments and using them to judge the learner's performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used shall generate data in the form of scores which will be carefully recorded and stored in a portfolio because they will contribute for remedial actions, for alternative instructional strategy and feed back to the learner and to the parents to check the learning progress and to advice accordingly or to the final assessment of the learners.

This portfolio is a folder (or binder or even a digital collection) containing the learner's work as well as the learner's evaluation of the strengths

and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but also it is a record of the activities undertaken over time as part of learner learning. The portfolio output (formative assessment) will be considered only as enough for three years of Advanced level. Besides, it will serve as a verification tool for each learner that he/she attended the whole learning before he/she undergoes the summative assessment for the subject. The results from the portfolio will contribute 50% on summative assessment of each year.

3.4. Reporting to parents

The wider range of learning in the new curriculum means that it is necessary to think again about how to share learners' progress with parents. A single mark is not sufficient to convey the different expectations of learning, which are in the learning objectives. The most helpful reporting is to share what learners are doing well and where they need to improve.

Unit 1: Classification of Kingdom Animalia

Refer to Learner's Book

(Number of periods 14)

Key unit competence

After studying this unit, learners should be able to classify animals into their main groups based on external features.

Unit outline

- General characteristics of animals in phylum Chordata: fish, amphibians, reptiles, birds and Mammals.
- Key classes of phylum Arthropoda: Insecta, Crustaceans, Diplopoda, Chilopoda and Arachnida)
- Other phyla in kingdom Animalia: Platyhelminthes; nematodes, annelids, molluscs, coelenterates / Cnidarians, Porifera / Sponges, echinoderms.

Links to other subject areas

The content in this unit will help the learner to gain knowledge on species and later engage in conservation programs.

Assessment criteria

Learners should be able to classify animals into their specific phyla based on external features.

- To assess skills acquisition – you may engage learners to practically observe the characteristics of collected specimens belonging to

different phyla and compare to the characteristics of other phyla in kingdom Animalia.

Background information

Classification is used by scientists to put living organisms in order using the unique features they possess. Classifying organisms is important to scientists since it enables them to accurately identify species wherever they are. Animals are multicellular eukaryotic organisms belonging to kingdom Animalia also called metazoan. Animals are distinguished from bacteria because they are multicellular and eukaryotic. They are also distinguished from plants, algae, and fungi because they lack cell walls. Animals are heterotrophs, thus they feed directly or indirectly on other living organisms.

Lesson 1. General characteristics of animals

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to

- State the general characteristics of all animals.
- Identify unique features that distinguish animals from organisms in the other kingdoms.

Materials and learning resources

Low cost/no cost	High cost
Animal specimen, specimen bottles	Textbooks/ reference materials
Pair of forceps, gloves, sweep nets, pooter	Dictionary
Pictures of specific animals	

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion
- Games
- Role playing

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of specimen by the learners.
- You will guide the learners in the collection of specimen from the field.
- You are also required to organise for the class activity in advance by providing preserved specimen if they are not available locally and apparatus for collection of specimen.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to identify features that

distinguish animals from other organisms.

2. Organise learners into groups of four and guide them to carry out Activity 1.1. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
3. Provide the apparatus for collection of specimen and dictionaries for the discussion activity.
4. Let learners go into the field. Guide them as they collect the animal specimen and bring them into the laboratory.
5. Caution learners against coming into contact with dangerous animals.
6. Let learners observe the animals and identify their external features.
7. Also, show learners charts with photographs or pictures of various animals. Let them identify the animals. Thereafter discuss the general features of animals and compare with the observed ones.

Answers to study questions in Activity 1.1

- (a) No
- (b) Refer to student book under characteristics of animals.
- (c)
- Eukaryotic - An organism made up of cell with true nucleus i.e membrane bound with other organelles.
 - Multicellular - made up of many cells.
 - Heterotrophic - Depending on other organisms for food. The opposite of autotrophic.

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss the characteristics of animals.
- Cooperation and interpersonal skills-As learners interact through group work during collection of specimens.
- Communication – As learners discuss the characteristics of animals.
- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of animals on the collected specimen.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<p>Give slow learners additional task to identify characteristics animals collected. They can also use photographs.</p> <p>Give fast learners additional task on identifying the unique features of collected animals.</p>	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Cross-cutting issues

- Inclusive learning: All learners should participate actively in class and in the field.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in field activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 2. Phylum Chordata

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson , learners should be able to:

- Identify common features of all chordates.
- Name the classes that comprise phylum Chordata.

Materials and learning resources

Low cost/no cost	High cost
Note books	Textbooks/reference materials
Pictures of specific animals	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Field study
- Question and answer
- Discussion

Lesson preparation

- This is a discussion lesson that will involve learners exchanging ideas.
- You will guide the learners during the discussion.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to state distinguishing

features of chordates from other organisms.

2. Organize learners into groups of four for discussion. Refer to discussion corner of Student's book. Encourage learners to work as a team as they openly share ideas and their views. This will improve their team work, communication and interpersonal skills as a result.
3. Provide dictionaries for the discussion activity.
4. Let learners note their discussion points in their notebooks.

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners discuss characteristics of Chordates.
- Cooperation and interpersonal skills-As learners interact through group work.
- Communication – As learners discuss the characteristics of chordates.
- Lifelong skills-As learners acquire observation skills, when observing characteristics of chordates on the collected specimen.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand the meaning of the terms notochord and endoskeleton. • Give slow learners additional task to identify animals provided in photographs. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Cross-cutting issues

- Inclusive learning: All learners should participate actively in class.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Test learner's skills in their ability to distinguish different groups of animals using observable features.
3. Ask probing questions to test learner's attitude in appreciating the existence of animal diversity.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 3: Features of fish

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- Identify main features of fish.
- Describe features that adapt fish to live in water.

Materials and learning resources

Low cost/no cost	High cost
- Locally available fresh fish	- Textbooks/ reference materials
- fish pond	- Aquarium
- Hand lenses	

Suggested teaching methodology

- Guided discovery
- Questions and answers
- Discussion
- Or take learners to an aquarium or nearby fish pond to observe alive fish

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of provided specimen by the learners.
- You are also required to organise for the class activity in advance by providing fresh or preserved fish.

Suggested teaching/learning activities/approach

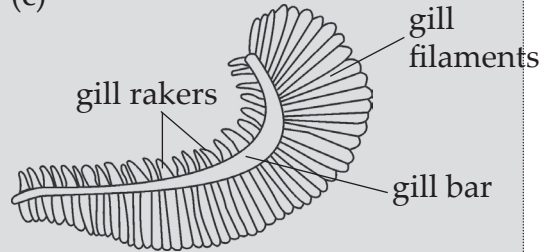
1. Introduce the lesson by asking learners to think about features

that distinguish fish from other chordates.

2. Organise learners into groups of four and guide them to carry out Activity 1.2. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
3. Let learners carry out research on the adaptive features of fish. Refer to the research activity of student's book. Allow them to present their findings in class.

Answers to study questions in Activity 1.2

- (a) Refer to Student's book characteristics of class - pisces.
- (b) Refer to Fig. 1.3 student's book.
- (c)



- (d) Site for gaseous exchange in fish.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be assisted to identify the operculum and fins. • Give fast learners additional task to research on how to distinguish bony fish and cartilaginous fish. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss adaptive features of fish to live in water.
- Cooperation and interpersonal skills-As learners interact through group work.
- Communication – As learners discuss the characteristics of fish.
- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of fish on provided specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their class activities.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views.
- Gender education: Let learners know that people of all gender can contribute equally in class.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Test learner's skills in their ability to observe characteristics of fish.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Lesson 4: Features of Amphibians

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to identify unique features of amphibians.

Materials and learning resources

Low cost/no cost	High cost
Preserved amphibians	Textbooks/reference materials

Suggested teaching methodology

- Guided discovery
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of specimen by the learners.
- You are also required to organize for the class activity in advance by providing preserved specimen.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to think about distinguishing features of amphibians.
2. Organise learners into groups of four and guide them to carry out activity 1.3. Organise to bring the photos of the various amphibians to class as an alternative to the practical. Let learners study the photos and answer the questions in the activity.
3. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Give slow learners additional task to identify other examples of amphibians other than frogs and toads. • Give fast learners additional task to research on other breathing structures used by adult frogs other than lung. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Answers to study questions in Activity 1.3

- (a) A toad has warts on its skin, making it rough, a frog's skin is smooth.
- (b) No
- (c) Four legs

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out answers to questions asked on reptiles.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the characteristics of amphibians and reptiles.
- Lifelong skills-as learners acquire

skill of scientific observation when they look for characteristics of animals on the collected specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the

fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 5: Features of reptiles

Refer to learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to identify unique features of reptiles.

Materials and learning resources

Low cost/no cost	High cost
Preserved reptiles	Textbooks/ reference materials

Suggested teaching methodology

- Guided discovery
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of specimen by the learners.
- You are also required to organize for the class activity in advance by providing preserved specimen.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to think about distinguishing features of reptiles.
2. Organise learners into groups of four and guide them to carry out activity 1.4. You can take learners to collect live specimens during a nature walk (CAUTION - they should not touch dangerous reptiles like snake) or bring bottled specimens to class for the practical. You can also use photographs or pictures of these animals. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 1.4

- (a) The scales face backwards.
- (b) It is dry unlike that of some amphibians which is moist.
- (c) Snake
- (d) Four

- (e) Snake - land, Crocodile - water
Lizard - rocks, Tortoise - land,
Turtle - water. Assess learner response and mark accordingly.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none">• Give slow learners additional task to identify more examples of reptiles.• Give fast learners additional task to differentiate the scales on fish and reptiles.	<p>All learners with special educational needs should participate actively in the class activity.</p> <p>Learners with sight problems should be placed at the front of the class.</p> <p>Remember disability is not inability!</p>

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out answers to questions asked on reptiles.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the characteristics of amphibians and reptiles.
- Lifelong skills-as learners acquire skill of scientific observation

when they look for characteristics of animals on the collected specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Lesson 6: Features of birds

Refer to learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson , learners should be able to:

- Identify main features of birds.

- Describe features that adapt birds to their environment.

Materials and learning resources

Low cost/no cost	High cost
Locally available live birds	Textbooks/ reference materials
Hand lenses	

Suggested teaching methodology

- Guided discovery
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of provided specimen by the learners.
- You are also required to organize for the class activity in advance by providing live birds.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to think about features that distinguish birds from other chordates.
2. Organise learners into groups of four and guide them to carry out activity 1.5. Plan to bring some caged birds to class or their specimens for the practical. You can also use charts with photographs of the birds. Encourage learners to work as a team as they share duties, ideas and openly share their

views. This will improve their team work, communication and interpersonal skills.

3. Refer to fig 1.8 of Student's book to confirm learner activity of the bird.
4. Put learners into groups of five and allow them to carry out a discussion on adaptations of birds. Refer to discussion corner of Student's book.

Answers to questions in discussion corner

- (a) For flying.
- (b) Reduces air resistance during flight.
- (c) Reduces their weight hence makes it easy for them to float
- (d) For feeding (eating)

5. Further organise learners to carry out Activities 1.7, 1.8 and 1.9 in pairs. Guide them where appropriate. You can pair high ability and low ability learners in these Activities.

Answers to study questions in Activity 1.6





Bird	Mode of feeding
A	Seed eater
B	Water plant eater
C	Filter feeder
D	Flesh eater
E	Insect eater
F	Nectar feeder

Answers to study questions in Activity 1.7

1.

Bird's feet	Adaptation
A	Nail-like toes for scratching soil to find food.
B	Webbed feet to float on water.
C	Have curved claws for grasping prey.
D	Long back toes to grab and patch tightly onto a tree.

2.

A	
B	
C	
D	

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be assisted to understand adaptive features of birds. • Give fast learners additional task to research on common features of birds and reptiles. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss adaptive features of birds to their environment.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the characteristics of birds.
- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of fish on provided specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should

be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.

- Gauge learners based on competence and gauge them appropriately.

Lesson 7: Features of mammals

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- Identify main features of mammals.
- Describe features of different sub-classes of mammalia.

Materials and learning resources

Low cost/no cost	High cost
Locally available live mammal safe to handle	Textbooks/ reference materials
Photographs/ pictures of mammals that are not locally available	

Suggested teaching methodology

- Guided discovery
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of provided specimen by the learners.
- You are also required to organize for the class activity in advance by providing live birds.

Suggested teaching/learning activities/approach

- Introduce the lesson by asking learners to think about features that distinguish mammals from other chordates.
- Organise learners into groups of four and guide them to carry out activity 1.6. You may have planned in advance and brought live specimen like mouse and rabbits into the class or obtained a permission to visit a museum or a nearby national park or animal farm for the learners to observe the animals. You can also bring photographs of various mammals to class for this activity. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 1.8

- Produces milk for the new born to suckle.
- Hair or fur
- The ear of mammals is found both outside and inside the body. It is made up of outer ear (also called external ear), middle ear and inner ear. What we see outside is the pinna which directs sound waves into the ear. Its size and shape differs from one animal to another.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be assisted to distinguish the different sub-classes of mammalia. • Give fast learners additional task to research on unique features of rare mammals like the penguins, wrinkle faced bats, Saiga antelope and slow Loris. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss adaptive features of birds to their environment.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the characteristics of birds.
- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of fish on provided specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners

the need to accommodate other people’s views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Answers to self-assessment Test 1.1

Refer to Learner's Book

- C
- B
- A
- Pisces, reptilia and amphibia - poikilotherms

Aves and mammalian - Homoeotherms

5.

Class of phylum chordate	Scales	External ear	Mammary glands	Feathers
Birds	√	X	X	√
Reptilia	√	X	X	X
Amphibia	X	X	X	X
Mammalia	X	√	√	X
Pisces	√	X	X	X

Lesson 8: Classes of Phylum Arthropoda

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State the features common in all arthropods.

- State the distinguishing features of insects, arachnids, crustaceans and myriapods.

Materials and learning resources

Low cost/no cost	High cost
Animal specimen	Textbooks/reference materials Dictionary

Suggested teaching methodology

- Guided discovery
- Field study
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve collection and observation of specimen by the learners.
- You will guide the learners in the collection of specimen from the field.
- You are also required to organize for the class activity in advance by providing preserved specimen if they are not available locally and apparatus for collection of specimen.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to identify features shown in Fig. 1.10 of Student's book. Ask them if they know the animals.
2. At this point you can introduce the term 'Arthropod'. Let learners do some research to give its meaning.
3. Explain the meaning of the word then emphasise the fact that some are good while some are harmful to us. Refer to student's book.
4. Organise learners into groups of four and guide them to carry out activity 1.9. Earlier you should have organised to bring live specimen of these animals or stored specimen in the laboratory. Also, you can use a chart with photographs of the animals. Provide the apparatus for collection of specimen and dictionaries for looking up technical terms. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
5. Help the learners to discover the various categories of arthropods based on the characteristics that they have observed. Let them list them down.
6. Narrow down to a few members of this group i.e. Insects, Arachnids, Crustaceans, Diplopods and Chilopods. Guide learners through activities 1.10, 1.11, 1.12, 1.13, 1.14 and 1.15 and help them discover the characteristics of these groups of arthropods. Summarise the characteristics as they take notes.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand the meaning of terms pedipalps, antennae, chelicerae and exoskeleton. • Give fast learners additional task to research on importance of exoskeleton in arthropods. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss meaning of technical terms.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the characteristics of animals.
- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of animals on the collected specimen.
- Peace and values education: Bring to the attention of learners the need to accommodate other people’s views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to self- evaluation

Test 1.2

Refer to Learner's Book

1. Arachnids have pedipalps while crustaceans lack pedipalps.
Arachnids lack antennae while crustaceans have antennae.
2. Allows a spider to catch a prey without having to hunt for it.
3. Because fertilisation occurs only in water.
4. a) They have mammary glands.
b) It does not have feathers instead its body is covered with fur.
c) It gives birth to a miniature young one that continues developing in the pouch.

5.
 - Pairs of limbs.
 - Presence or absence of wings.
 - Presence and number of antennae.

6. **Similarities**
 - Segmental bodies
 - Numerous legs

- Differences**
- Number of legs per segment
 - Poisonous glands

Lesson 9. Other phyla of kingdom Animalia

Refer to Learner's Book

Duration: 2 periods

Specific objective

By the end of the lesson, learners should be able to state the distinguishing features of the other phyla of kingdom Animalia.

Materials and learning resources

Low cost/no cost	High cost
Preserved animal specimen	Textbooks/ reference materials Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve observation of specimen by the learners.
- You are also required to organize for the class activity in advance by providing preserved specimen.

Suggested teaching/learning activities/approach

1. Introduce the lesson by letting learners know that apart from chordates and arthropods there are many other organisms that belong to different phyla.
2. Let them know that they will learn more about these organisms at advanced level though it may not harm to know about them.
3. Show them the pictures and names of Student's book. Summarise their characteristics.
4. To map up this topic, organize learners into groups of four and guide them to carry out activity 1.16. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
5. Provide the apparatus for collection of specimen and dictionaries for looking up meaning of technical terms.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none">• Slow learners can be helped to understand one main distinguishing feature of each phylum.• Give fast learners additional task to state more examples of each phylum.	<ul style="list-style-type: none">• All learners with special educational needs should participate actively in the class activity.• Learners with sight problems should be placed at the front of the class.• Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss meaning of technical terms.
- Cooperation and interpersonal skills-As learners interact through group work.
- Communication – As learners discuss the characteristics of animals.

- Lifelong skills-as learners acquire skill of scientific observation when they look for characteristics of provided specimen.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the fact that each organism in the ecosystem has a role to play. Learners should therefore only collect the number of specimen needed and which should not be killed but be returned to the environment.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
3. Gauge learners based on competence and gauge them appropriately.

Answers to Self-evaluation test 1.3

Refer to Learner's Book

1.
 - i. Coelenterata
 - ii. Cnidaria/platyhelminthes
 - iii. Porifera
 - iv. Echinodermata
 - v. Nematoda
2.
 - i. Coelenterata
 - ii. Platyhelminthes
 - iii. Coelenterata
 - iv. Annelida
 - v. Porifera
 - vi. Echinodermata
3. Arthropoda

Answers to End unit assessment 1

Refer to Learner's Book

Duration: 1 period

1. Kingdom, phylum/division, class, order, family, genus, species.
2. A
3. C
4. C
5. D
6. a) Vertebrates and invertebrates
b) Vertebrates have a backbone while invertebrates lack a backbone.
7. Chordata
8. a) Mollusca
b) Chordata
c) Arthropoda
d) Mollusca
9. insects are useful in the following ways;
 - They act as pollinators
 - Bees produce honey that is used both as food and medicine
 - Some insects are a source of food
 - They are harmful in the following ways;
 - Some like mosquitoes and tsetse flies are disease vectors
 - Some like locusts and weevils destroy crops

10. a) Are ectothermic
b) Double circulatory system
c) Are endothermic
d) Arthropoda

Reason – have jointed appendages

b) Poison glands called chelicerae

c) X

11.a. Arthropoda - jointed appendages

- b. poison glands/ hiding/ camouflage/ fighting back
- c. X-Arachnida

12. Use of anaesthesia/ safety gear

13. Check if learners are able to argue for and against the importance of insects

14. Learners should be able to describe external features of a chosen animal, draw it and label it well.

Additional information for teacher

Mammals include many orders such as:

- Rodents e.g. mice, rats, squirrels
- Lagomorpha e.g. rabbit, hare
- Carnivores e.g. cat dog, lion
- Ungulates or ruminants e.g. sheep, goat, giraffe
- Insectivores e.g. mole, hedgehogs
- Chiropterans e.g. bats
- Cetaceans e.g. whales, dolphins
- Proboscideans e.g. elephants
- Edentates e.g. spiny ant eater, armadillo,
- Primates e.g. lemur, gorilla, human

Most insects do have wings. Fleas, lice, silverfish, and firebrats are the only truly wingless insect groups that most of us are familiar with. Most adult insects have two pairs of wings, but they're not always visible. Often they're hidden, shortened, or nonfunctional

Remedial activities

Q/ Explain why the spider is not an insect

Ans/ Because a spider has only 2 body parts instead of 3, it has 4 pairs of legs instead of 3

Consolidation activity

Q/Differentiate between herbivorous and carnivorous mammals.

Ans/

Carnivores	Herbivores
Complete dentition	Incomplete dentition
Developed canines	No developed canines

Unit 2: Introduction to environmental biology

Refer to Learner's Book

(Number of periods 8)

Key unit competence

After studying this unit, the learners should be able to explain the concepts applied in environmental biology including the interaction and interdependence of organisms.

Unit outline

- Introduction to ecology
- Food chain and food webs
- Ecological pyramids.
- Energy flow in ecosystems.

Background information:

As an old saying goes no man is an island. This seems to apply to all other organisms on this planet. Organisms do not exist in isolation. They depend on each other for survival. Plants obtain their energy from the sun, herbivores like cows also eat these plants for survival. In return, the carnivores like lions also have to feed on herbivores if they are to survive. Through this interdependence, organisms have developed feeding relationships between each other. The scientific study of these relationships between organisms and the environment they live in is called ecology

Lesson 1: Concepts of ecology

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson , learners should be able to:

- Define the terminologies/ difficult words used in ecology
- Understand the functioning of ecological systems
- Appreciate the importance of ecology

Materials and learning resources

High cost	Low cost
Text books,projector,wall charts, preserved rare specimens.	Organisms from the compound, quadrat, strings, nails, hammer.

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer using kahoot or quizlet questions.

Lesson preparation

- This is basically a practical lesson that will involve many activities by the learners.
- You will engage learners in a discussion regarding the activities and assessing learning achievements.
- You are therefore required to get the various reference materials in advance and organise the class in a way that will encourage the teaching methods suggested.

Suggested teaching/ learning activities

1. Ask the learners to have a tour around the school compound.
2. Introduce the unit by asking learners to identify the different living organisms in the compound. This will enable them to appreciate biodiversity.
3. Ask learners to identify places where these organisms are found living. This will bring into them the idea of a habitat. They should also be able to identify the roles played by such organisms in the ecosystem.
4. Introduce activity 2.1, provide the learners with various biology reference textbooks, specimen and wall charts. Let them discuss the different terminologies as used in ecology.
5. Bring the learners attention to the picture in the Learner's Book that shows the components of an environment.

6. Let the learners list down some of the organisms and explain how they are related to others.

Generic competences covered

- **Communication:** as the learners work together in groups, they are able to develop communication skills.
- **Critical thinking:** this is as a result of answering the discussion questions provided as the lesson goes on
- **Cooperation and interpersonal skills.** Learners develop interpersonal skills through having time to share together during the tour around the school.

Cross- cutting issues

- **Inclusive learning:** All learners should participate actively in their study groups whether disabled or normal.
- **Environment and sustainability:** Make learners aware of the need to conserve biodiversity and the environment at large.

Formative assessment:

1. Find out if learners are able to:
 - Appreciate the importance of different organisms in the environment.
 - Accept each other's ideas and how they get along in the group

- Identify the relationships that exist between organisms.
 - Design specific questions to test the learner's knowledge on the content covered. For example
 - i. Define the term habitat
 - ii. Give examples of biotic factors
 - iii. Identify the role of plants in the ecosystem.
2. Test the learner's attitude towards conservation of life by asking probing questions and checking for interest.
e.g. ask the learner to find out the usefulness of snakes to man?
3. Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation Test 2.1

Refer to learner's book

1.

Term	Definition
a	(iii)
b	(v)
c	(i)
d	(vi)
e	(ii)
f	(iv)

2. Abiotic factors like air, water, light and soil influences life of organisms.

Lesson 2: Components and energy flow in an ecosystem

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson , learners should be able to:

- Define an ecosystem
- Appreciate the types of ecosystems
- Identify the biotic and abiotic factors of an ecosystem
- Explain how energy flow occurs in an ecosystem.

Materials and learning resources

High cost	Low cost
Text books, projector, wall charts, preserved rare specimens	Organisms from the compound, quadrant, strings, nails, hammer

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities

1. Introduce the lesson by showing learners the different types of ecosystems using photos, charts, maps and a micro ecosystem e.g. yoghurt.

2. Probe the learners to identify why yoghurt is considered to be an ecosystem.
3. Instruct learners to identify the different types of ecosystems as shown on the wall charts. Ask them where they are located around the school.
4. You should explain the different trophic levels of an ecosystem.
5. You ask the learners to identify where wetlands as an ecosystem are placed? Ask the learners to construct a food chain and a food web from a wetland.
6. Ask the learners to point out the importances of wetlands to the community they live in? Challenge the learners by asking them what would happen if such wetlands were reclaimed?
7. Let the learners note down the points in their note books.

Generic competences covered

- **Communication:** as the learners work together in groups, they are able to develop communication skills.
- **Critical thinking:** this is as a result of answering the discussion questions provided as the lesson goes on
- **Cooperation and interpersonal skills.** Learners develop interpersonal skill through having time to share together during the tour around the school.

- **Analytical skills:** The learner develops such skills through analyzing the charts, graphs and maps provided to him or her.

Cross- cutting issues

- **Inclusive learning:** All learners should participate actively in their study groups whether disabled or normal.
- **Environment and sustainability:** Make learners aware of the need to conserve biodiversity and the environment at large.

Formative assessment:

1. Find out if learners are able to:
 - Appreciate the different types of ecosystems
 - Acknowledge the importances of these ecosystems to man.
 - Assess whether learners understand that green plants form the basis of every ecosystem
 - Design specific questions to test the learner's knowledge on the content covered. For example
 - iv. Define an ecosystem
 - v. Give the different major types of ecosystems on earth?
 - vi. Identify the role of plants in any ecosystem?
2. Test the learner's attitude towards conservation of ecosystems. You can ask the importances of conservation of Akagera National park?

3. Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation Test 2.2

Refer to learner's book

1. a. A
b. grasshopper increase/
Grass decrease
2. D
3. a. Crocodile
b. Mosquito larvae - they transform into adults.
c. Microscopic algae →
mosquito larvae →
small fish → large fish
→ crocodile
4. Loss of energy

Lesson 3: Energy flow and ecological pyramids

Refer to Learner's Book

Duration: 3 periods

Specific objectives:

By the end of the lesson ,learners should be able to:

- Describe an ecological pyramid
- Relate the different types of ecological pyramids
- Draw different types of ecological pyramids and appreciate their importances.
- Analyse the flow of energy in an ecosystem

Materials and learning resources

High cost	Low cost
Text books, projector, wall charts, preserved rare specimens	Organisms from the compound, quadrant, strings, nails, hammer

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities

1. Introduce the lesson by explaining the different forms of energy.
2. You should describe how energy is transferred and lost at each trophic level.
3. Provide learners with textbooks and handouts. Ask them to identify the different types of ecological pyramids.
4. Let the learners use data collected from the previous study tour to draw a pyramid of numbers.
5. Probe the learners to answer the following questions.
 - What are the importances of ecological pyramids?
 - Why are plants placed at the beginning of each pyramid?

- Identify why scientists are interested in such bio data as in pyramids?
6. You should allocate some time to learners to note down main points in their books.

Generic competences covered

- **Communication:** as the learners work together in groups, they are able to develop communication skills.
- **Critical thinking:** this is as a result of answering the discussion questions provided as the Lesson goes on
- **Cooperation and interpersonal skills.** Learners develop interpersonal skills through having time to share together during the analysis of the bio data provided.
- **Analytical skills.** The student develops such skills through analyzing the charts, graphs and diagrams provided to him/her.

Cross-cutting issues

- **Inclusive learning:** All learners should participate actively in their study groups whether disabled or normal.
- **Environment and sustainability:** Make learners aware of the need to conserve biodiversity and the environment at large.

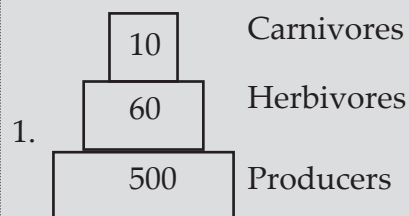
Formative assessment:

1. Find out if learners are able to:

- Appreciate the source of energy in an ecosystem.
 - Be able to explain how energy flows in an ecosystem.
 - Identify and analyse the different types of ecological pyramids
 - State the need for ecological pyramids
 - Design specific questions to test the learner's knowledge on the content covered, for example;
 - i. Define biomass?
 - ii. Identify the role of producers in the pyramid of energy
2. Gauge learners based on their competence and grade them accordingly

Answers to Self-evaluation Test 2.3

Refer to learner's book



- a) Producers weigh more than consumers
 - b) Loss of energy
2. < 1000 Kg
 3. a) D
b) Oak tree
c) Sun energy
d) bacteria , fungi

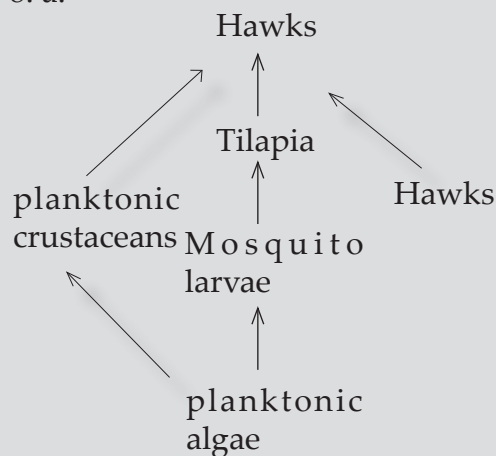
4. Yes-green plants are the producers, they make their own food.

Answers to End unit assessment 2

Refer to Learner's Book

Duration: 1 period

1. C
2. C
3. D
4. a. Grass increases
b. Fit in all levels
5. Interdependent
6. a. to preserve it
b. Pollution/ exploitation
c. Education/ sensitization
7. a. affect prey population
b. readily available food
c. prey increase but eventually affected by carrying capacity
d. Biological control methods
8. a.



- b. i. Planktonic algae → planktonic crustaceans → hawk
ii. Planktonic algae → mosquito larvae → tilapia → hawk
- c. i. Planktonic algae
ii. Producers make their own food/ no energy loss
- d. i. Planktonic crustaceans/ mosquito larvae
ii. Planktonic algae
- e. Pollution/overfishing/ controlling mosquito breeding
9. Sun
10. Check for correct flow, diversity and usage of local animals

Additional information for teacher:

According to Sir ELTON, when a pyramid of number is inverted that means that the lower trophic level has either a surplus biomass or a higher rate of birth, or higher turnover or a short lifespan than the upper trophic level.

A pyramid of energy is the most accurate method of representing feeding relationships.

It allows different ecosystems to be compared, and the relative importance of populations within one ecosystem can also be compared.

It always gives a true shape of pyramids. Inverted pyramids are never obtained.

Remedial activity

1. What are the three main trophic levels of an ecosystem?
2. Do you think that the decomposers are important for our life? Why?

Answers

- (1) Producers – Consumers – Decomposers.
- (2) Decomposers are important because they allow decay of organic matter and the recycle of nutrients.

Consolidation activity

Rwanda realized that no lions were present in Akagera. So, eight new lions were reintroduced in Akagera in 2017. Assess the importance of introducing lions in Akagera.

Ans/

This is to avoid over population of primary consumers in Akagera.

High number of herbivores would lead to over grazing and therefore desertification of Akagera park because naturally primary consumers have high turnover.

Unit 3: Passive movement across a cell membrane

Refer to Learner's Book

(Number of periods 8)

Key unit competence

After learning this unit, learners should be able to explain different processes of movement of water, ions into and out of cells.

Unit outline

- Diffusion of gases and solutes.
- Factors that influence rates of diffusion
- Define osmosis.
- Role of turgor pressure within cells

Links to other subject areas

The learner will be able to apply the knowledge of solvent molecules in concentration of solutions and dilutions in chemistry.

Background information

The movement of substances in and out of cells involves different physiological processes, that is; diffusion, osmosis and active transport. Certain conditions determine which physiological process will move the substances in or out of cells. For diffusion to take place, a concentration gradient must exist. This condition also applies to osmosis only that the later involves only water molecules. Diffusion and osmosis occur because molecules possess kinetic energy.

Active transport involves use of energy since molecules move against a concentration gradient. Animal cells are more affected by intake of solvent molecules since they only have cell membranes. Plant cells have cell walls that prevent them from bursting when turgid. Plant cells are normally turgid and this is important because it provides strength to the plant.

Lesson 1: Diffusion of gases and solutes

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Define diffusion.
- Describe an experiment to demonstrate diffusion.
- Explain the factors that affect diffusion.
- Explain the importance of diffusion in plants and animals

Materials and learning resources

Low cost/no cost	High cost
Perfume	Textbooks/reference materials
Water	Beakers
	potassium permanganate

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve investigation of diffusion by the learners.
- You will guide the learners through the procedure.
- You are also required to organize for the class activity in advance by providing the required apparatus and reagents.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to define diffusion and explain why diffusion is a passive process.
2. Organize learners into groups of five and guide them to carry out activity 3.1. Provide the

apparatus and reagents for the experiment. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 3.1

- (a) The blue colour of copper sulphate spreads evenly throughout the water.
- (b) The particles move from where the crystal was placed to the rest of the water.
- (c) Because of the difference in concentration of copper Sulphate particles in the water i.e. moves from where the concentration is high to where it is low.
- (d) I will ask a friend to go to one corner of the room then spray the perfume. I will then find out the time it took for him or her to get the smell compared to when I did.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none">• Slow learners can be helped to understand the concept of kinetic energy possessed by particles.• Give slow learners additional task to define a concentration gradient.• Give fast learners additional task to research on Brownian motion in diffusion.	<ul style="list-style-type: none">• All learners with special educational needs should participate actively in the class activity.• Learners with sight problems should be placed at the front of the class.• Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners investigate passive movement of potassium manganate ions in water.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a activities.
- Communication – As learners discuss their observations from the practical activity.
- Lifelong skills-as learners acquire skill of scientific skill on applications of physiological processes in living organisms.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability:

Make learners aware of the turgidity in plant support; and the need to irrigate crops during long spells of water shortage. This will prevent flaccidity of cells and eventually wilting that may cause plant death.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 2: Factors affecting diffusion

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain how temperature, surface area, concentration gradient, size of molecules and surface area to volume ratio affect the rate of diffusion.
- Relate surface area to volume ratio with size of an organism.

Materials and learning resources

Low cost/no cost	High cost
Razor blades	Textbooks/ reference materials
Ruler	
Irish potatoes	

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve investigation of factors affecting the rate of diffusion by the learners.
- You will guide the learners through the procedure.
- You are also required to organize for the class activity in advance by providing the required apparatus and reagents.
- Using question and answer, discuss the importance of diffusion in living organisms.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to explain the effect of temperature on kinetic energy possessed by particles.

2. Describe how the different factors affect the rate of diffusion.
3. Organize learners into groups of five and guide them to carry out activity 3.2. Provide the apparatus and reagents for the experiment.
4. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 3.2

(a) S.A.X - $(1 \times 1) \times 6 = 6 \text{ cm}^2$;

Y - $(3 \times 3) \times 6 = 54 \text{ cm}^2$

Volume - X - $1 \times 1 \times 1 = 1 \text{ cm}^3$;

Y - $(3 \times 3 \times 3) = 27 \text{ cm}^3$

$$\frac{\text{S.A.}}{\text{V}} \Rightarrow X = \frac{6}{1} = 6; Y = \frac{54}{27} = 2$$

Therefore X has a larger surface area to volume ratio, hence diffusion will be higher.

- (b) It affects the rate of diffusion of substances in and out of a cell. The larger it is, the faster the rate of diffusion.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand better how the mentioned factors affect the rate of diffusion through peer teaching • Give fast learners should be given application questions on how surface area to volume ratio affects the rate of diffusion. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners calculate surface area to volume ratio.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a activities.
- Communication – As learners discuss their findings from the practical activity.
- Lifelong skills-as learners acquire scientific skill on application of surface area to volume ratio in uptake of substances and loss of heat from the body of organisms.
- Peace and values education: Bring to the attention of learners the need to accommodate other people’s views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the turgidity in plant support; and the need to irrigate crops during long spells of water shortage. This will prevent flaccidity of cells and eventually wilting that may cause plant death.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Answers to self- assessment test

3.1

Refer to Learner's Book

1. Does not involve use of energy.
2. A concentration gradient.
3. C
4. C

Lesson 3: Osmosis

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson , learners should be able to:

- Define osmosis using the terms water potential.
- Define the terms isotonic, hypotonic, hypertonic, water potential, and osmotic pressure.

Materials and learning resources

Low cost/no cost	High cost
Water	Textbooks/reference materials Apparatus for the experiment

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- Prepare a dilute solution, concentrated solution and two solutions of similar concentration that you will use to define the terms hypertonic, hypotonic, isotonic solutions, water potential and osmotic pressure.
- Organise learners to discuss these terms in pairs.

Suggested teaching/learning activities/approach

1. Introduce the lesson by asking learners to define osmosis.
2. Explain the terms used in describing osmosis.
3. Carry out demonstrations using the solutions you prepared and explain the meaning of the technical terms used in describing osmosis.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand better the technical terms used in describing osmosis • Give fast learners given extra work to research and explain using water potential the uptake of water by plants. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners distinguish technical terms using the prepared solutions of different concentrations.
- Cooperation and interpersonal skills-As learners interact through group work and sharing activities.
- Communication – As learners discuss meaning of technical terms used to describe osmosis.
- Lifelong skills-as learners acquire scientific knowledge on water is absorbed by plants.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.

- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the need for plants to take up water from the soil.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.

- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.
- You will guide the learners through the procedure.
- You are also required to organize for the class activity in advance by providing the required apparatus.
- Using question and answer, discuss the observations made at the end of the experiment.

Lesson 4: Demonstration of osmosis using visking tubing

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to use the technical terms learnt to account for movement of water molecules from the dilute solution to the more concentrated solution.

Materials and learning resources

Low cost/no cost	High cost
Water	Textbooks/ reference materials
Salt	Laboratory apparatus
Strings	

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a discussion lesson that will involve investigation of osmosis using visking tubing.

Suggested teaching/learning activities/approach

1. Introduce the lesson by reviewing the technical terms used to describe osmosis.
2. Organize learners into groups of five and guide them to carry out activity 3.3. Provide the apparatus and reagents required for the experiment.
3. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 3.3

- (a) - Level of solution in capillary tube increased.
- The visking tubing expanded.
 - The level of distilled water in the beaker reduced.
- (b) There is higher concentration of salt solution in the visking tubing hence water molecules moved into it by osmosis making it swell and increasing the volume of solution in the capillary tube.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Provide a different practical set up with distilled water in the visking tubing and sugar solution in the beaker. This is to ascertain understanding of the concept learnt from the initial practical done. • Ask to describe how they would set up a control experiment. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competency covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-Account for the observations made from the experiment.
- Cooperation and interpersonal skills - As learners interact through group work and sharing a activities.
- Communication – As learners discuss their findings from the practical activity.
- Lifelong skills-as learners acquire scientific skills on movement of solvent molecules from one solution to another.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners

the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the turgidity in plant support; and the need to irrigate crops during long spells of water shortage. This will prevent flaccidity of cells and eventually wilting that may cause plant death.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 5: Demonstration of osmosis in plant tissues

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to use the technical terms learnt to account for movement of water molecules from the plant tissue or into the plant tissue.

Materials and learning resources

Low cost/no cost	High cost
Scalpels, ruler and labels	Textbooks/reference materials
Salt	Laboratory apparatus
Potatoes, arrow roots or cassava; pumpkin leaves.	

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

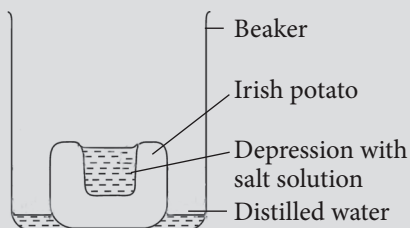
- This is a practical and a discussion lesson that will involve investigating osmosis using plant tissues.
- You will guide the learners through the procedures for the practical activity.
- You are also required to organize for the class activity in advance by providing the required apparatus.
- Using question and answer, discuss the observations made at the end of the experiment.

Suggested teaching/learning activities/approach

1. Introduce the lesson by reviewing what they learnt during the previous lesson.
2. Organize learners into groups of five and guide them to carry out activity 3.4 and 3.5. Provide the apparatus and reagents for the experiment.
3. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 3.4

(a)



- (b) No, it is higher.
- (c) Water molecules move into the depression by osmosis due to the concentration gradient that exists between salt solution and distilled water.
- (d) When boiled Irish potato is used, the level of water in the depression remains the same. This is because boiling kills the cells in the potato tissue hence osmosis does not take place.

Answers to study questions in Activity 3.5

(a)



- (b) The piece that was placed in sucrose solution bent (curled) with its epidermis (exposed side) facing inwards while the piece that was placed in distilled water bent (curved) with its epidermis facing outwards. This is because the cells making up the tissues lost or gained water respectively by osmosis. The one in air remained the same.
- (c) Control experiment

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Ask slow learners to state and account for the observation they would make if a similar piece of potato with a hole was left in the open air. This is to ascertain understanding of the concept learnt from the initial practical done. • Ask to describe to explain the need of repeating the experiment using boiled potato. • Fast learners may be asked to explain how to improve the investigation. • Learners with sight problems should be placed at the front of the class. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-Account for the observations made from the experiment and calculate the average length of potato cylinders at the end of the experiment.
- Cooperation and interpersonal skills-As learners interact through group work and sharing activities.
- Communication – As learners discuss their findings from the practical activity.
- Lifelong skills-as learners acquire scientific skills effect of solutions of different concentration on plant tissue.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

- Environment and sustainability: Make learners aware of the turgidity in plant support; and the need to irrigate crops during long spells of water shortage. This will prevent flaccidity of cells and eventually wilting that may cause plant death.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 6: Water relations in plant cells

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain the role of osmosis in plants and animals.
- Explain how plants are supported by turgor pressure.

Materials and learning resources

Low cost/no cost	High cost
Manila papers	Textbooks/ reference materials
	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson on importance of osmosis in plants and animals.
- You will guide in the learners the discussion activity of Student's Book.

Suggested teaching/learning activities/approach

1. Introduce the lesson by explaining the concept of turgidity and plasmolysis.
2. Put learners into pairs (considering their abilities) to carry out the discussion corner of student's book. Let learners write summarised notes and share with other class members.
3. Summarise main points on the chalkboard as learners take notes. Refer to content of student's book.

4. Organise learners into groups of five to discuss how plants are supported by turgidity and the importance of osmosis in plants and animals. Guide them to carry out Activity 3.6 in the student's book.
5. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

Answers to study questions in Activity 3.6

(a)

Set up	Initial length	Final length	Change in length
Distilled water with raw potato	6 mm	8 mm	2 mm
5% sucrose	6 mm	5.5 mm	0.5 mm
20% sucrose	6 mm	4 mm	2 mm
Distilled water with boiled potato	6 mm	6 mm	0 mm

(b) - In distilled water, the cells in the potato tissue absorbed water by osmosis thereby increasing their length.

- In sucrose solution, there was lose of water from the cells in the potato tissues due to difference in concentration. However, the loss was higher in 20% sucrose solution hence more reduction in length.

- In boiled potato, the cells are dead hence no osmosis took place.
 (c) It acted as a control experiment and also to show that dead cells do not allow osmosis to take place.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped through peer teaching to understand better importance of osmosis in plants and animals. • Fast learners may be given research question to explain absorption of water from the soil to the roots of the plant using the terms water potential. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As learners research and discuss the importance of osmosis in plants and animals.
- Cooperation and interpersonal skills - As learners interact through group work and sharing activities.
- Communication – As learners discuss the role of turgor pressure and importance of osmosis in plants and animals.
- Lifelong skills-as learners acquire scientific knowledge on the importance of osmosis in animals

and the need to avoid dehydration due to loss of water from cells.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people’s views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the

group activities and the learning process as a whole.

- Environment and sustainability: Make learners aware of the turgidity in plant support; and the need to irrigate crops during long spells of water shortage. This will prevent flaccidity of cells and eventually wilting that may cause plant death.

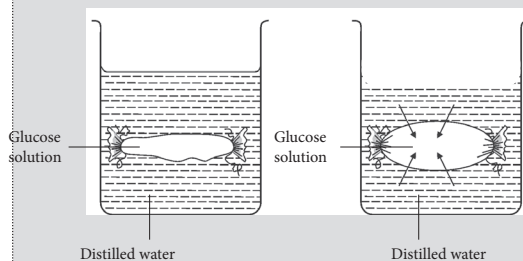
Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to Self- evaluation Test 3.2

Refer to Learner's Book

1. B
2. C
3. C
4. a.



- b. Osmosis occurred
- c. Cell membrane

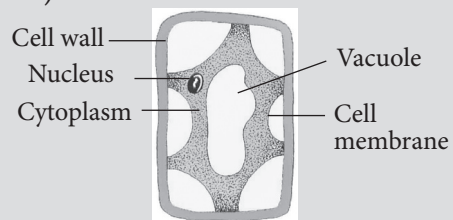
5. Has a cell wall.
6. Plant cells have a rigid cell wall while animal cells have only a cell membrane.

Answers to End unit assessment 3

Refer to Learner's Book

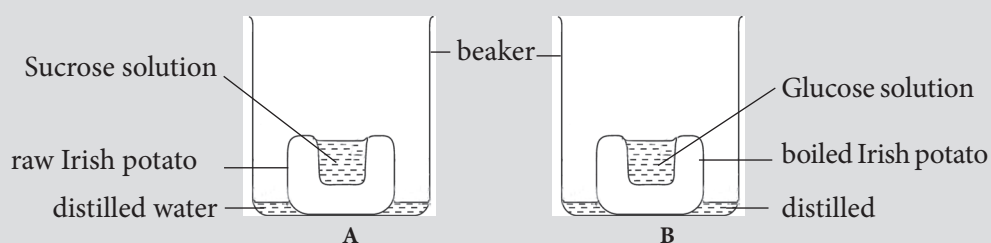
Duration: 1 period

1.
 - a) Diffusion, high concentration, low concentration, uniform.
 - b) Permeable, permeable, less, more, osmosis, water, dilute, concentrated.
2. D
3. B
4. a)



- b) Plasmolysis.
- c) The plant cell sap has high water potential; hence loses water to hypertonic solution by osmosis.
- d) The red blood cell would shrink and become flaccid.

- 5.
- Condition of cell membrane of plant cells pulling away from cell wall when cell is placed in hypotonic solution or distilled water.
 - For placed in hypotonic solution or distilled water.
 - No, the cells lack cell walls.
 - The solution is isotonic to cell saps; hence there is no net movement of water.
 - Nature of cell saps relative to the sucrose solution.
 - Wilted.
6. a) Volume of sugar solution in the cavity of raw potato increased, while volume of sugar solution in the cavity of boiled solution remained the same. See the figures below.



- The glucose solution is hypertonic to water; water molecules moved by osmosis into the potato cells and eventually into the cavity of the potato. The cell membranes of the cells of the boiled potato were destroyed; hence osmosis does not take place. This explains why the volume of glucose solution in the potato cavity remained the same.
7. It does not require use of energy
8. (a) (i) No observable change occurred.

9. - Plants won't be able to take up water from the soil.
- There would not be opening and closing of stomata. This would interfere with transpiration process.
 - Movement of water from one cell to another would not be possible. This would cause drying up of plants.
10. Turgidity is the state of being turgid or swollen due to presence of a fluid such as water. It causes turgor pressure which maintains the shape of cells. It brings about support especially in herbaceous plants which do not have tough structural materials.

Additional information for teacher:

Visking tube mimics a semi-permeable membrane but is not dynamic like the cell membrane. That is why it cannot be used to demonstrate the active transport.

Diffusion is important in both plants and animals. For example, diffusion occurs in animals when food and oxygen are carried in the blood to the cells. The oxygen and food diffuse from the blood into the cells. Carbon dioxide and wastes diffuse out of the cells into the blood. Diffusion occurs in plants when carbon dioxide diffuses from the air through the stomata into the leaves.

The leaf produces oxygen and water vapour when it makes food by photosynthesis. These diffuse out of the plant cells through the stomata.

Remedial activity

1. Write a definition of diffusion.
2. Supply the missing word in each of these sentences:
 - a) Food and oxygen _____ into the body cells from the blood.
 - b) Wastes and carbon dioxide pass from the body cells into the blood by _____.
 - c) Water enters the plant cell by _____.

Ans/

- (1) Diffusion is the movement of molecules from the region of high concentration to that of low concentration
- (2) a) diffuse b) diffusion c) osmosis.

Consolidation activity

Put a teabag in a cup of hot water. Leave it for 5 minutes and observe what is going on. Use key terms used from this lesson to explain what is going on.



Ans/

By imbibition hot water enters the teabag. The dye of the tea leaves dissolves and diffuses from the bag where it is hypertonic to the remaining water molecules which are hypotonic until all the content of cup becomes isotonic. The diffusion is observed by the flow of brown dye in water.

Unit 4: Active transport

Refer to Learner's Book

(Number of periods 6)

Key unit competence

After learning this unit, learners should be able to:

- Analyse and interpret the process of active transport.
- Explain the significance of the process of active transport to living organisms.

Unit outline

- Active transport and its importance.
- Endocytosis and exocytosis.

Links to other subject areas

Active mode of transport like cycling and walking

Background information

Active transport involves the transportation of substances against a concentration gradient but the process will use chemical energy and a few integral proteins. The integral membrane proteins can move ions or molecules in one direction (antiport) or in the same direction (symport). Some molecules that are transported into or out of the cell are too large and polar that special kind of active transport has to be involved. Endocytosis is a special kind of active transport that transports molecules into the cell by engulfing them while exocytosis

involves the transportation of large molecules out of the cell.

Lesson 1: Active transport and its importance

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Define active transport
- State location in plant and animal tissues where active transport occurs
- Compare active transport and passive transport
- Explain the importance of active transport

Materials and learning resources

Low cost/no cost	High cost
Manila paper, marker pen and cello tape	Textbooks/reference materials Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson that will involve discussion of the differences between active transport and passive transport by the learners.
- You will guide the learners through the discussion activity.

Suggested teaching/learning activities/approach

1. Introduce the topic by asking learners to discuss the pictures in Fig. 4.1 (a) and (b) of Student's Book. Guide them to answer the questions associated with the pictures.
2. Organize learners into groups of five for the discussion activity on .
3. Give them manila paper cellotape and maker pens to summarise their points. Help them identify a group member to do a presentation to the rest of the class. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
4. Wrap-up by giving main points and allowing learning to take short notes.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
Slow learners can be helped to understand better the definition of the term active transport by giving them day to day examples. For example moving a boulder up a hill. Give fast learners additional task to research on the effect of respiratory poisons on the process of active transport.	All learners with special educational needs should participate actively in the class activity. Learners with sight problems should be placed at the front of the class. Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss meaning of technical terms.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss the differences between passive transport and active transport.
- Lifelong skills-as learners acquire skill of scientific on processes in

the role of active transport in our bodies.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Lesson 2: Role of proteins in active transport

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson, learners should be able to explain how membrane proteins aid in active transport.

Materials and learning resources

Low cost/no cost	High cost
Charts	Textbooks/ reference materials
Animated pictures	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson that will involve demonstration of active transport using animated pictures by the learners.
- You will guide the learners through the activity of the student book.

Suggested teaching/learning activities/approach

1. Begin the lesson by reviewing the definition of active transport.
2. Organise learners into pairs for activity 4.1. Guide them through the activity and answer questions to clarify various concerns.
3. Encourage learners to work as a team as they share duties,

ideas and openly share their views. This will improve their team work, communication and interpersonal skills.

4. Provide the materials required for the discussion activity.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be asked to state the conditions necessary for active transport to occur. • Give fast learners additional task to explain how marine organisms offset osmotic imbalance. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competencies covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss meaning of technical terms.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss how the process of active transport occurs.
- Lifelong skills - As learners acquire skill of scientific on processes in the role of active transport in our bodies.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their

study groups, whether disabled or normal.

- Peace and values education: Bring to the attention of learners the need to accommodate other people’s views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 3: Role of active transport in living organisms

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson, learners should be able to explain the importance of active transport in living organisms.

Materials and learning resources

Low cost/no cost	High cost
Fools caps	Textbooks/reference materials
	Dictionary

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand better the importance of active transport through peer teaching. • Give fast learners additional task to research on the special types of active transport. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

This is a discussion lesson that will involve discussion of the importance of active transport in living organisms.

Suggested teaching/learning activities/approach

1. Begin the lesson by reviewing how active transport occurs.
2. Explain the role of active transport in living organisms. Refer to student's book.
3. Use question and answer to ascertain understanding of concepts.

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out the use of active transport in an organism's body.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss how the process of active transport occurs.
- Lifelong skills-as learners acquire skill of scientific on processes in the role of active transport in our bodies.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Lesson 4: Factors affecting active transport

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson, learners should be able to explain the factors that affect active transport.

Materials and learning resources

Low cost/no cost	High cost
Fools caps	Textbooks/ reference materials
	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

This is a discussion lesson that will involve discussion of the factors that affect active transport.

Suggested teaching/learning activities/approach

1. Begin the lesson by asking the learners to state the conditions for active transport to occur.
2. Highlight the factors that affect active transport as highlighted in Student's book.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none">• Slow learners can be helped to understand that glucose is a substrate and how its amount affects the process of active transport.• Give fast learners additional task to research on why protein carriers are affected by pH and temperature.	<ul style="list-style-type: none">• All learners with special educational needs should participate actively in the class activity.• Learners with sight problems should be placed at the front of the class.• Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out how temperature and pH affects the protein carriers involved in active transport.
- Cooperation and interpersonal skills-As learners interact through group discussion.
- Communication – As learners discuss and present the factors that affect the process of active transport.

- Lifelong skills-as learners acquire scientific skills on the effect of respiratory poisons on active transport and metabolic processes in our bodies.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can

make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Answers to Self-evaluation

Test 4.1

Refer to Learner's Book

1. C
2. C
3. a) The uptake reduces then stops completely after sometime.
b) The process of respiration is affected and eventually stops. As a result energy is not produced hence mineral ions that are low in concentration in the soil are not taken up by the root of the plants.

Lesson 5: Endocytosis and exocytosis

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Describe the processes of endocytosis and exocytosis using animations.
- Explain the difference between pinocytosis and phagocytosis.

Materials and learning resources

Low cost/no cost	High cost
Fools caps Charts	Textbooks/ reference materials Computers

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson that will involve investigation of how endocytosis and exocytosis occurs.
- Provide the required resources for the lesson .
- Ensure that computers are working and in good condition.

- Look for a website with a video of endocytosis and exocytosis such as www.youtube.com/watch?v=DuDmvlbjHQ.

Suggested teaching/learning activities/approach

1. Begin the lesson by explaining why intake or removal of substances in bulk may require a more specialized mode of transport.
2. Show learners the video animation on endocytosis and exocytosis (Refer to Activity 4.2 of student's book). Let learners discuss what happens in the videos.
3. Summarise by discussing what endocytosis, phagocytosis and pinocytosis are.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be given more time to conceptualize the animations and simulations. • Give fast learners additional task to research on how the mode of white blood cells called phagocytes. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out the differences between pinocytosis and phagocytosis.
- Cooperation and interpersonal skills-As learners interact through group discussion.
- Communication – As learners discuss and present the factors that affect the process of active transport.

- Lifelong skills-as learners acquire scientific skills on the importance of phagocytes on our bodies.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to self- assessment test 4.2

Refer to Learner's Book

1. *Difference*

In endocytosis, materials are transported in bulk inside secretory vesicles while in active transport ions are taken up across membranes.

Similarity

Both processes use energy.

2. Endocytosis
3. (iii) and (iv)

Answers to End unit assessment 4

Refer to Learner's Book

Duration: 1 period

1. C
2. a. i. & ii. Active transport
b. Concentration of oxygen and glucose/ Temperature/ enzyme inhibitors/pH
3. Refer to learner's book
- 4.

Endocytosis	Exocytosis
Uptake of substances by the cell	Release of substances by the cell
Formation of vesicles	Vesicles fuse with plasma membrane

5. The amount of oxygen affects aerobic respiration. Therefore, when the amount of oxygen is low, less energy is produced and rate of active transport reduces. As amount of oxygen increases, more energy is produced; hence the rate of active transport increases.
6. Plants; shoot and root apexes.
Animals; testes and muscles.
7. A. - II
B. - (I)
C. - (III)
D. - (V)
E. - (IV)

Additional information for teacher

It has been observed that both Oxalis and glassworts have high concentration of salt than the soil on which they grow. Instead of transferring their salt to the surrounding soil they keep on absorbing mineral salt ions from the soil by active transport.



Oxalis is edible for its sour taste (a)



A typical glasswort plant (b)

Root hair cells carry out an active transportation to absorb mineral salts from the soil because of the role played by mineral salts in plants.

Halophyte plants are plants that are adapted to high salinity. They have some cells having in their vacuole sap high concentration of salt than the surrounding soil and have many mitochondria to provide enough energy for the active transport of mineral salts.

Passive transports	Active transports
Does not require ATP energy	Requires ATP energy
From high concentration to low concentration (in gradient of concentration)	From lower concentration to high concentration (against gradient of concentration)

Remedial activities

1. Differentiate between passive transport and active transport. Suggest two examples of each.
2. What is the importance of active transport in human life and plant life?
3. What is the role of the membrane proteins in active transport?

Answers

- 1) Differences between passive and active transports:

2) Active transports allows:

Animals

- The absorption of mineral salts, glucose and amino acids from the ileum
- Re-absorption of mineral salts, glucose urea from the filtrate in the tubule of the nephron.

Plants

- Absorption of mineral salts from the soil or substrate by the root hairs.

3) The membrane proteins are carrier molecules that allow materials to flow freely in and out of the cell.

A. Diffusion
C. Pinocytosis
E. Exocytosis.

B. Osmosis
D. Endocytosis

Consolidation activities

1. Fertilisers are chemicals used in farming to enrich the soil around the soil. Explain how the mineral from the fertilizer can reach the leaf of the plant.
2. The white blood can engulf pathogenic bacteria in our body. Choose the term which matches better with the verb engulf:

Answers

- 1) Fertilizers contain mineral salt which first dissolve in the water in the soil. From there, root hair cells absorb soluble mineral salts by active transport and the mixture of water and mineral salts is passes in the xylem up to the leaf where photosynthesis takes place.
- 2) It is by endocytosis.

Unit 5: Identification of food components

Refer to Learner's Book

(Number of periods 8)

Key Unit Competence

After studying this unit, I should be able to carry out chemical tests on a variety of foods to identify the nature of food substances.

Unit outline

Chemical food test for starch reducing sugars, proteins, fats and vitamin C.

Links to other subjects

Quantitative analysis in chemistry

Background information

The food we eat contains different classes of nutrients which are meant to serve different activities in our body. It is therefore essential that we know the components of the food we eat if we are to live a healthy life. Drinks and foods that are manufactured in factories need to be tasted first in order to confirm their authenticity. This process by which foods and drinks are taken to the laboratory to confirm the type of food components in them is called food testing.

Lesson 1 : Test for starch

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- To carry out food test for starch safely
- To identify several foods that contain starch
- Be able to manipulate the different apparatus used during the starch taste experiment.

Materials and learning resources

High cost	Low cost
Iodine solution, test tubes, starch solution/maize extract	Droppers, milletflour, water

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. You may introduce the topic by initiating a class discussion on what happens during grading of coffee or tea. Let learners look at the picture Fig. 5.1 of Student's Book and discuss what is going on. They should then relate this to what they will learn in this topic.

2. Let learners brainstorm about the components of food. They should come up with a list. Let them know that this topic will entail methods of testing for those components of food.
3. Narrow down to testing of starch. Put learners in groups of five and guide them through Activity 5.1 in Student's Book.
4. Initiate a discussion on the results of the experiment. Modulate the discussions. Correct where learners have gone wrong and add to where they have not given enough. The procedure, presentation of data after the experiment, hazardous material used and sources of error should be emphasized during the discussions.
5. Conclude the lesson by asking questions. Ask learners what they know about testing for starch. You should try to find out the learners attitude towards testing for starch

Table 1

	Tests	Observations	Deductions
i.	To 1 cm ³ of starch solution in a test tube add 2 drops of iodine solution.	The colour changes from whitish to dark blue or blue black when iodine solution was added.	Starch is present
ii.	Repeat test (i) using sucrose solution	The colourless solution of sucrose solution changes to yellowish the colour of iodine	Starch is absent
iii.	Repeat test (i) using glucose solution.	The colourless solution of glucose solution changes to yellowish-the colour of iodine	Starch is absent
iv.	Repeat test (i) using a piece of potato.	The yellowish colour of iris potato changed to blue black or dark blue	Starch is present

Generic competences covered

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become food scientists in future.
- Analytical skills: These are attained as the learner observes and records the colour changes during the practical procedures.
- Listening and note taking skills: this is achieved as the learners listen to their group mates and also as they take notes.

Cross-cutting issues

- Standardisation culture: laboratory equipment should be on standard since those which are of poor quality can easily break down. This increases the chances of laboratory accidents.
- Financial education: remember to warn learners not to misuse laboratory reagents. They cost a lot of money.
- Inclusive education: this must be observed especially by mixing more able and less able learners in study groups.

Formative assessment:

The following must be assessed.

1. Skill acquisition: The skills that can be assessed are those where the knowledge acquired can be applied to the local situation like manipulation of apparatus, clear identification of colour changes.
2. Attitude change and values attained Let: learners understand the value of testing for starch. They must understand the value of testing foods before public consumption.
3. Knowledge and understanding: Give an exercise about the procedures taken to test for starch and how the information is presented by students.

Lesson 2: Testing for reducing sugars

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson ,learners should be able to:

- To carry out food test for reducing sugars safely
- To identify several foods that contain reducing sugars
- Be able to manipulate the different apparatus used during the reducing sugar taste experiment.

Materials and learning resources

High cost	Low cost
Benedict's solution/ Fehling's solution, heat source, spatula, beakers, test tubes, test tube holders, orange juice extract, safety gaugles, maltose solution	Sieve

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. Remind learners about the test they carried out in the previous lesson. Let them understand that

just like starch, we can test food substances for the presence of reducing sugars.

2. Put learners into groups depending on their abilities then guide them to carry out Activity 5.2 in the student's book.
3. Initiate a discussion on the results of the experiment. Correct where learners go wrong and add to where they have not given enough. The procedure, presentation of data after the experiment, hazardous materials used and sources of error should be emphasized after the experiment.
4. Conclude the lesson with questions. Ask learners what they know about testing for reducing sugars. You should also try to find out the learners attitude towards testing for reducing sugars.
5. Table 2 below gives a summary of expected outcomes.

Table 2

	Test	Observations	Deductions
i.	To 2 cm ³ of Glucose add 5 drops of Benedict's solution and boil.	When Benedict's solution is added the colour changes from colourless to blue-the colour of Benedict's solution. Then on heating the colour changes to yellow, then to dirty-green and finally to brick-red.	Reducing sugars present
ii.	To 2 cm ³ of banana extract in a test tube, add 2 cm ³ of Benedict's solution and boil.	When Benedict's solution is added to banana extract, the colour changes from cloudy to blue-the colour of Benedict's solution. Then on heating the colour changes to yellow, then to dirty-green and finally to brick-red.	Reducing sugar is present
iii	To 1 cm ³ of distilled water add 1 cm ³ of Benedict's solutions and boil.	When Benedict's solution is added, the colour changes from colourless to blue-the colour of Benedict's solution. Then on heating there is no colour change.	Reducing sugars NOT present

iv	To 1 cm ³ of starch solution in a test tube, add 1 cm ³ of Benedict's solution then boil.	The whitish colour of starch solution changes to blue-colour of Benedict's solution. There was no colour change when the mixture was heated.	Reducing sugar NOT present.
v.	To 1cm ³ of sucrose solution, add 1 cm ³ of Benedict's solutions and boil.	The colourless solution of sucrose solution changes to blue-colour of Benedict's solution. There was no colour change when the mixture was heated	Reducing sugars NOT present.

Generic competences covered

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become food scientists in future.
- Analytical skills: These are attained as the learner observes and records the colour changes during the practical procedures.
- Listening and note taking skills: this is achieved as the learners listen to their group mates and also as they take notes.

Cross-cutting issues

- Standardisation culture: laboratory equipments should be on standard since those which are of poor quality can easily

break down. This increases the chances of laboratory accidents.

- Financial education: remember to warn learners not to misuse laboratory reagents. They cost a lot of money.
- Inclusive education: this must be observed especially by mixing more able and less able learners in study groups.

Formative assessment:

The following must be assessed.

1. Skill acquisition: The skills that can be assessed are those where the knowledge acquired can be applied to the local situation like manipulation of apparatus, clear identification of colour changes.
2. Attitude change and values attained Let: learners understand the value of testing for non-reducing sugars. They must understand the value of testing foods before public consumption.
3. Knowledge and understanding: Give an exercise about the

procedures taken to test for reducing sugars and how the information is presented by students.

Lesson 3: Test for non-reducing sugars

Refer to Learner's Book

Duration: 1 period

By the end of the lesson ,learners should be able;

- To carry out food test for non-reducing sugars safely.
- To identify several foods that contain non-reducing sugars.
- Be able to manipulate the different apparatus used during the non-reducing sugar test experiment.

Materials and learning resources

High cost	Low cost
Benedict's solution/ Fehling's solution, heat source, spatula, beakers, test tubes, test tube holders, orange juice extract, safety gaugles, table sugar solution, dilute hydrochloric acid, sodium hydroxide solution	Sieve

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. This is a closely related to the test of reducing sugars. Remind learners about the test they carried out with reducing sugars. Let them reproduce the procedure individually.
2. Emphasise the fact that in this test, a procedure is required to break down the non-reducing sugars first before the normal test for reducing sugars continue. This is done using dilute hydrochloric acid. Another reagent, sodium hydrogen carbonate is required to neutralise excess acid.
3. You can then put learners into groups of four and guide them to carry out Activity 5.3. They should follow the procedures keenly and write down their observations. Lead a class discussion on the results. Correct where learners have gone wrong and add to where they have not given enough. The procedure, presentation of data after the experiment, hazardous material used and sources of error should be emphasized during the experiment.
4. Conclude the lesson with questions. Ask learners what they know about testing for non-reducing sugars. Let them compare and contrast this and the procedure for reducing sugars.

Table 3 below gives a summary of results for the experiment in Activity 5.3

Table 3

Procedure	Observations	Deductions
To 2 cm ³ of solution, add 2 cm ³ of dilute hydrochloric acid (HCl), heat and cool. Add 1 cm ³ of dilute sodium hydrogen carbonate solution Na(HCO ₃), shake to mix, then add 1cm ³ of Benedict's solutions and boil.	There was no observable change when dil. HCl was added. Then there was effervescence on addition of NaHCO ₃ . Then the colourless solution became blue when Benedict's solution was added colour changes from colourless to blue-the colour of Benedict's solution. Then on heating, the colour changes to yellow, then to dirty green and finally to brick-red.	A non- reducing sugar present. e.g. sucrose.

Generic competences covered

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become food scientists in future.
- Analytical skills: These are attained as the learner observes and records the colour changes during the practical procedures.
- Listening and note taking skills: this is achieved as the learners listen to their group mates and also as they take notes.

Cross- cutting issues

- Standardisation culture: laboratory equipments should be on standard since those which are of poor quality can easily break down. This increases the chances of laboratory accidents.
- Financial education: remember to warn learners not to misuse laboratory reagents. They cost a lot of money.
- Inclusive education: this must be observed especially by mixing more able and less able learners in study groups.

Formative assessment:

The following must be assessed.

- I. **Skill acquisition:** The skills that can be assessed are those where

the knowledge acquired can be applied to the local situation like manipulation of apparatus, clear identification of colour changes.

- II. **Attitude change and values attained Let:** learners understand the value of testing for sweet non-reducing sugars. They must understand the value of testing foods before public consumption.
- III. **Knowledge and understanding:** Give an exercise about the procedures taken to test for sweet non-reducing sugars and how the information is presented by students.

- To identify several foods that contain proteins
- To identify several foods that contain lipids
- Be able to manipulate the different apparatus used during the experiment to taste for lipids and proteins.

Materials and learning resources

High cost	Low cost
Biurets reagent, millions reagent, ethanol, distilled water, heat source, spatula, beakers, test tubes, test tube holder, cooking oil, cow ghee	Sieve

Answers to Self- evaluation Test 5.1

Refer to Learner's Book

1. Reducing sugars, for example, glucose galactose and maltose reduce copper ions in Benedict's solution while non-reducing sugars, for example, starch and sucrose cannot.
2. Neutralizes excess acid
3. Inform of glycogen in the liver.

Lesson 4: Testing for proteins and lipids

Refer to Learner's Book

Duration: 2 periods

Lesson objectives

By the end of the lesson ,learners should be able to:

- To carry out food test for proteins and lipids safely

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. Let learners understand that the two tests for proteins are (a) Million's test and (b) Biuret test. Briefly explain the difference between the two tests.
2. Put learners into groups depending on class size and their abilities then guide them to carry out Activities 5.4 and 5.5. These are tests for proteins.
3. Lead a class discussion on the results of the experiments.

- Emphasise colour changes that confirm presence of protein.
- After finishing with protein tests, lead learners into carrying out a lipid test. Refer to activity 5.6 student's book.
 - Again lead a class discussion on the results of the experiment. Help them make deductions as well.
 - Tables 4, 5 & 6 shows the expected results.
 - Conclude the lesson with questions. Ask learners what they know about testing for proteins and lipids. You should try to find out the learners attitude towards testing for proteins and lipids.

Table 4 Millon's test for proteins

Test	Observation	Deduction
To 2 cm ³ of cooking oil, in a test-tube, add Millon's reagent and boil.	No observable change is made	Proteins are absent
To 2 cm ³ of egg albumin, add 1 cm ³ of Millon's reagent and shake gently then boil.	The colour changes from colourless to pink and finally purple on heating	Proteins are present.
To 2 cm ³ of milk solution, add 1 cm ³ of Millon's reagent then boil.	The milk coagulate then colour changes from milky to purple.	Proteins are present.
To 2 cm ³ of distilled water in a test tube, add Millon's reagent.	No observable change is made	Proteins are absent

- You can also task learners by giving them extra practical work about proteins
 - Prepare soya beans for protein testing. Soak 500 g of the soya beans in water for 12 hours.
- Remove the beans from water and grind them to form a pest. Add 250 ml of water to form a mixture. Filter the mixture and get a solution. Repeat the above experiment and record the results as shown below.

Table 5 Biuret test for proteins

Test	Observation	Deduction
To 2 cm ³ of soya bean solution add 2 cm ³ of sodium hydroxide solution. Add 4-5 drops of copper sulphate then shake.	The colour changes from colourless to pink	Proteins are present.
To 1 cm ³ of distilled water add 1 cm ³ of dilute sodium hydroxide followed by 4-5 drops of copper sulphate then shake.	Colour of the solution changes to blue-the colour of copper sulphate.	Proteins are NOT present.
To 2 cm ³ of orange juice solution add 1 cm ³ of dilute sodium hydroxide followed 4-5 drops of copper sulphate then shake	The yellowish colour of orange juice changes to blue-the colour of copper sulphate when copper sulphate is added.	Proteins are NOT present

Table 6 Testing for lipids

Test procedure	Observation	Conclusion
To 2 cm ³ of cooking oil in a test tube, add ethanol and shake, and then add water.	Cream/milky emulsion seen	Lipids present in the food sample
To 2 cm ³ of groundnut extract solution in a test tube, add ethanol and shake, and then add water	Cream/milky emulsion seen	Lipids present in the food sample
To 2 cm ³ of distilled water in a test tube add ethanol and shake then add water.	The solution retains the colour of ethanol	Fats absent

Note: The test tube involving distilled water is a control experiment. Too much lipid in diet causes obesity.

Generic competences covered

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become food scientists in future.
- Analytical skills: These are attained as the learner observes and records the colour changes during the practical procedures.
- Listening and note taking skills: this is achieved as the learners listen to their group mates and also as they take notes.

Cross- cutting issues

- Standardisation culture: laboratory equipments should be on standard since those which are of poor quality can easily break down. This increases the chances of laboratory accidents.
- Financial education: remember to warn learners not to misuse laboratory reagents. They cost a lot of money.
- Inclusive education: this must be observed especially by mixing more able and less able learners in study groups.
- Gender balance: ensure that females are given the same chances as males during the

Lesson . Boys tend to dominate the use of apparatus. You should encourage girls to participate as well.

Formative assessment:

The following must be assessed.

1. Skill acquisition: The skills that can be assessed are those where the knowledge acquired can be applied to the local situation like manipulation of apparatus, clear identification of colour changes.
2. Attitude change and values attained Let: learners understand the value of testing for proteins and lipids. They must understand the value of proteins and lipids in the diet.
3. Assess whether learners are able to state the procedures taken in tasting for proteins and lipids.

Answers to Self- evaluation

Test 5.2

Refer to Learner's Book

1. Biuret, copper (II) sulphate and sodium hydroxide
2. Peptide bonds
3. Biuret reagent

Lesson 5: Test for vitamin C

Refer to Learner's Book

Duration: 1 period

Specific objectives:

By the end of the lesson ,learners should be able;

- To carry out food test for vitamin C safely.
- To identify several foods that contain vitamin C.
- Be able to manipulate the different apparatus used during the vitamin C test experiment.

Materials and learning resources

High cost	Low cost
DCPIP, solution tubes, beakers	Orange extract, droppers, distilled water

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. Put learners into groups depending on their abilities and

size of class then guide them to carry out the test in Table 5.8 of student's book.

2. Lead a class discussions on the results observed. Correct where learners have gone wrong and add to where they have not given enough. Highlight the fact that DCPIP is hazardous hence need to be used carefully.
3. Conclude the lesson by asking learners what they know about testing for vitamin C. Also try to find out the learners attitude towards testing for vitamin C.
4. Table 7 shows the expected results of the experiment.
5. To summarise the topic, lead learners to do further activity 5.9 in the student's book. Help them make deductions about the types of foods present in food extract A (orange juice + milk solution)

Answers to study questions in further activity 5.9

Results for extract A

Experiment	Observations	Deduction
(i)	The yellowish colour of iodine remains	No starch present
(ii)	Brick-red solution is formed	Some reducing sugars present
(iii)	The colour changes from colourless to pink and finally purple	Proteins present
(iv)	Deep blue colour of DCPIP changes to colourless	Proteins present

- (a) Reducing sugars (Lactose), proteins and vitamin C.
- (b) Lactose - is a source of energy. It is converted to glucose and galactose which undergo respiration to provide the body with energy.
- Proteins - help in building body tissues and in repair of worn out tissues.
- Vitamin C - prevents scurvy - a nutritional deficiency disease associated with lack of vitamin C in diet.

Table 7: Testing for vitamin C

Procedure	Observation	Deduction
To 1cm ³ of DCPIP in a test tube, add the orange extract drop by drop.	The mixture turns colourless	Vitamin C present
To 1cm ³ of DCPIP in a test tube, add distilled water drop by drop	The solution retains the blue colour of DCPIP	Vitamin C absent

Generic competences covered

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Analytical skills: These are attained as the learner observes and records the colour changes during the practical procedures.
- Listening and note taking skills: this is achieved as the learners listen to their group mates and also as they take notes.
- Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become food scientists in future.

Cross- cutting issues

- Inclusive education: this must be observed especially by mixing more able and less able learners in study groups.
- Standardisation culture: laboratory equipments should be on standard since those which are of poor quality can easily break down. This increases the chances of laboratory accidents.
- Financial education: remember to warn learners not to misuse laboratory reagents. They cost a lot of money.
- Gender balance: ensure that females are given the same chances as males during the Lesson . Boys tend to dominate the use of apparatus. You should encourage girls to participate as well.

Formative assessment:

The following must be assessed.

1. Skill acquisition: The skills that can be assessed are those where the knowledge acquired can be applied to the local situation like manipulation of apparatus, clear identification of colour changes.
2. Attitude change and values attained Let: learners understand the value of testing for proteins and lipids. They must understand the value of proteins and lipids in the diet.

3. Assess whether learners are able to state the procedures taken in tasting for proteins and lipids.

Answers to Self- evaluation Test 5.3

Refer to Learner's Book

1. Scurvy
2. Obesity/ heart diseases may attach the person
3. B

Answers to End unit assessment 5

Refer to Learner's Book

Duration: 1 period

1.

Monosaccharide	Glucose	Plant cell sap	Energy production
Disaccharide	Sucrose	Fruits	
Polysaccharide	Starch	Cereals	

2. Lipids>Carbohydrates> proteins

3.

Food substance	Food nutrient
(a)	(iii)
(b)	(i)
(c)	(v)
(d)	(ii)
(e)	(vi)
(f)	(iv)

4. (a) (i) Iodine changes to blue- black
(ii) The colour of iodine remains

(b) At 30°C, the enzymes in the saliva are active hence breaks down starch into glucose. The test is negative.

At 40°C, the enzymes in the saliva get denatured hence do not break down starch. The test using iodine is therefore positive.

(c) It is important to regulate human body temperature to enable enzymes that catalyse the various body reactions to function normally.

5. (i) Glucose (ii) amino acids (iii) fatty acids
6. A
7. C
8. It is easily absorbed by the body.
9. (a) C,H,O
(b) N
(c) Because upto 20 amino acids are available for making proteins while the building blocks of carbohydrates i.e glucose, galactose and fructose are very few
10. Deep blue? Vitamin C, blue

Additional information for teachers

Complex carbohydrates such as starch, are made up of many units of simple sugars. They are also called polysaccharides (poly means 'many', saccharide means 'sugars').

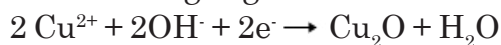
Polysaccharides have the following characteristics:

- not sweet
- insoluble in water
- cannot be crystallised
- do not change the colour of Benedict's solution.

Besides starch, other examples of polysaccharides are glycogen and cellulose.

Benedict's solution contains copper(II) sulphate mixed with sodium hydroxide. This solution is blue because of the copper(II) ions in the copper(II) sulphate. It is also alkaline because of the sodium hydroxide.

When the mixture of a sugar and Benedict's solution is heated and turns brown, the sugar is qualified to be reducing sugar because it causes the reduction of Cu^{2+} into brown Cu_2O according to the equation. If not it is non-reducing sugar.



Remedial activities

- 1) List the three types of carbohydrates.
- 2) Explain why proteins are an important part of the diet.

Answers:

- 1) Monosaccharides – Disaccharides – Polysaccharides
- 2) Proteins Our bodies need it to make body tissue, particularly muscle. Protein is needed for growth and to repair damaged tissues. It is also needed to make enzymes. Enzymes are the special catalysts that control all the chemical reactions in our cells

Consolidation activities

- 1) Briefly explain why it is important to be able to do food tests.
- 2) Copy and complete this table of food tests:

Food substance	Reagent	Colour of reagent	Colour changes
Simple (reducing) sugars			
Starch			
Proteins			
Lipids			
Vitamin C			

Answers

- 1) It is important to be able to do food tests in order to know the constituents within the food we eat
- 2)

Food substance	Reagent	Colour of reagent	Colour changes
Simple (reducing) sugars	Benedict's solution	Blue	Yellow/Orange/Brown

Starch	Iodine solution	Brown	Blue-black
Proteins	Millon	Colorless	Pink
	Biuret	Blue	Purple
Lipids	Ethanol	Colorless	Milky
Vitamin C	DCPIP	Blue	Colorless

Unit 6: Enzymes

Refer to Learner's Book

(Number of periods 8)

Key unit competence

After studying this unit, learners should be able to explain the role of enzymes in living organisms and how they are affected by temperature and pH.

Unit outline

- Characteristics of enzymes.
- Factors that affect enzyme action.
- Mode of enzyme action.

Links to other subject areas

Inorganic catalysts and rates of reactions in Chemistry

Background information

Enzymes are biological catalysts that speed up reactions at rates fast enough to sustain life. The study of enzymes is called enzymology. They convert molecules at the beginning of a reaction called substrates to products. Enzymes make conversion of substrate much faster by lowering the activation energy. Unlike other catalysts, enzymes are much more specific since they have active sites with specific shape. Enzymes are affected by other molecules like inhibitors that lower the rate of enzyme catalysed reaction. Activators are molecules that increase enzyme action.

Lesson 1: Types of enzymes

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Define the terms catalyst and enzyme.
- Distinguish between intracellular and extracellular enzymes.
- Write a chemical equation for the breakdown of hydrogen peroxide by catalase.

Materials and learning resources

Low cost/no cost	High cost
Water	Textbooks/ reference materials
Irish potatoes, liver, yeast sand and matchbox,	Laboratory apparatus and reagents

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical lesson that will involve investigation of presence of enzymes in plant tissues.

- You will guide the learners through the procedure for the practical activity.
- You are also required to organise for the class activity in advance by providing the reagent in the required concentration.

Suggested teaching/learning activities/approach

1. You may introduce the topic through a brainstorming session on the photographs of student's book. Let learners ponder about the relationship between using soap or detergent during washing and the working of enzymes.
2. You can then introduce this lesson on finding out presence of enzymes on tissues.
3. Ask learners to define the term catalyst and give examples of inorganic catalysts they may have used in chemistry. Ask them to relate this to working of enzymes.
4. At this point, you can emphasise the different types of enzymes and their roles. Refer to Student's Book.
5. Organize learners into groups of four and guide them to carry out activity 6.1.
6. Encourage learners to work as a team as they share duties, ideas and openly share their views. This will improve their team work, communication and interpersonal skills.
7. Sample results are shown in the table below

Table 6.1 Sample results

Test tube	Observations	Conclusions
A	No effervescence, glowing splint not relit	Oxygen gas absent
B	No effervescence, glowing splint not relit	Oxygen gas absent
C	Effervescence occurs, glowing splint re-lit	Oxygen gas present
D	Effervescence occurs, glowing splint re-lit	Oxygen gas present

8. Guide learners to understand the results of the above experiment. The results show that there was catalase enzyme in potatoe and liver tissues and not sand and hydrogen peroxide sample. Use the equation of student book to explain further.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand the difference between enzymes and inorganic catalysts. • Give fast learners additional task to research on examples of intracellular and extracellular enzymes. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss meaning of technical terms.
- Cooperation and interpersonal skills-As learners interact through group work and sharing activities.
- Communication – As learners discuss the difference between intracellular and extracellular enzymes in pairs.
- Lifelong skills-as learners acquire scientific skills on presence of enzymes in living tissues and their role.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other

people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the role of enzymes in biodegradation. Plastics are wastes with more negative effect on the environment due to their non biodegradable nature. Enzymes like some enzymes however have the ability to degrade some plastics such as agricultural mulch films.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.

- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Lesson 2: Characteristics of enzymes

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain the characteristics of enzymes.
- Write an equation to show specificity of enzymes.

Materials and learning resources

Low cost/no cost	High cost
Fools caps	Textbooks/ reference materials

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson on the characteristics of enzymes.
- You will guide the discussion guidelines.
- Organise for each group to present their work to the rest of the class.

Suggested teaching/learning activities/approach

1. Introduce the lesson by reviewing the definition of an enzyme.
2. Organize learners into groups of five for the discussion in the Student's Book.
3. Encourage learners to work as a team as they share duties, and ideas. This will improve their team work, communication and interpersonal skills.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<ul style="list-style-type: none"> • Slow learners can be helped to understand that when enzymes are denatured by high temperatures; it the active site that is destroyed and this is not killing of an enzyme. • Give fast learners additional task to research on more examples of enzymes in the human body and their specific pH. 	<ul style="list-style-type: none"> • All learners with special educational needs should participate actively in the class activity. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out and discuss.
- Cooperation and interpersonal skills-As learners interact in the group discussion.
- Communication – As learners discuss the difference between intracellular and extracellular enzymes in pairs.
- Lifelong skills-as learners acquire scientific skill on efficiency of enzymes which they can apply in home or industrial processes like juice extraction.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the role of enzymes in biodegradation.

Plastics are wastes with more negative effect on the environment due to their non biodegradable nature. Enzymes like some enzymes however have the ability to degrade some plastics such as agricultural mulch films.

Formative assessment

- Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.
- Gauge learners based on competence and gauge them appropriately.

Lesson 3: Effect of amylase on starch

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain how amylase breaks down starch.
- Write a word equation to show the products formed from break down of starch by amylase.

Materials and learning resources

Low cost/no cost	High cost
Water	Textbooks/reference materials
	Laboratory equipment and reagents

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is both a practical and discussion lesson on effect of enzyme amylase on starch.
- You will guide learners through the practical procedure.

Suggested teaching/learning activities/approach

1. Introduce the lesson by reviewing enzyme specificity.
2. Organize learners into groups of five guide them to carry out activity 6.2.
3. Guide the learners in accounting for the results of the experiment. Encourage them to work as a team as they share duties and ideas. This will improve their team work, communication and interpersonal skills.

Sample results

Test tube A - Test for starch is negative. This is because amylase broke it down into glucose.

Test tube B - Test for starch is positive there was no amylase hence starch remained intact.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
Slow learners can be helped to understand the concept of simple sugars that constitute starch which is a polysaccharide. Give fast learners additional task to research on enzymes that break down sucrose and lactose and the products formed.	All learners with special educational needs should participate actively in the class activity. Learners with sight problems should be placed at the front of the class. Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.

- Problem solving skills-As the learners find out products formed from the mentioned disaccharides.
- Cooperation and interpersonal skills-As learners interact in the group discussion.
- Communication – As learners discuss the findings from the practical activity.
- Lifelong skills-as learners acquire scientific skill on efficiency of enzymes which they can apply in home or industrial processes like juice extraction.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the role of enzymes in biodegradation. Plastics are wastes with more negative effect on the environment due to their non biodegradable

nature. Enzymes like some enzymes however have the ability to degrade some plastics such as agricultural mulch films.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to Self evaluation Test

6.1

Refer to Learner's Book

1. Enzymes are protein in nature and unlike other catalysts, enzymes are specific.
2. a) To alter the original chemical structure of an enzyme. This means that the shape of the active site is changed and the enzyme is completely destroyed.
b) Enzymewhoseconfiguration is not as intended; for example the active site is not exposed due to factors such as low temperature.
3. • Enzymes catalyse reversible reaction.

- Enzymes are not changed by the reactions they catalyse.
4. Enzymes have active sites whose shape complements with the substrate. Therefore, only a substrate with a specific shape fits into the active site of the enzyme.

Lesson 4: Factors that affect enzyme activity including PH

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State the optimum pH for enzyme ptylin (amylase).
- Explain the effect of acidic and alkaline pH on action of amylase.

Materials and learning resources

Low cost/no cost	High cost
Labels	Textbooks/ reference materials
	Laboratory equipment and reagents

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is both a practical and discussion lesson on effect of pH enzyme amylase on starch.
- You will guide learners through the practical procedure.
- You are also required to prepare for the practical activity in advance and provide the required apparatus and reagents.

Suggested teaching/learning activities/approach

1. Bring to the attention of learners the various factors that affect enzyme action. Refer to student's book.
2. Emphasise the fact that at this level, they will learn about pH and temperature only.
3. Introduce the lesson on pH by explaining what optimum pH is and the effect of extreme pH on enzyme action.
4. Organise learners into groups of five and guide them to carry out activity 6.3.
5. Guide learners into interpreting the results of the experiment. Encourage them to work as a team as they share duties and ideas. This will improve their team work, communication and interpersonal skills.
6. Repeat steps 3-5 but this time with temperature as a factor. Narrow down to Activity 6.4.
7. The results of the experiments are shown in the following tables:

(a) pH test results

Test tube	Test for starch		Test for reducing sugar	
	Observation	Conclusion	Observation	Conclusion
A	Iodine colour changed to blue black	Starch present	Benedict's solution colour remained blue	No reducing sugars present
B	Iodine changed colour to blue black	Starch present	Benedict's solution colour remained blue	Reducing sugars absent
C	Brown colour of iodine persisted	Starch absent	Benedict's colour changed to brick red	Reducing sugars present

Note: In test tube A, starch was broken down due to the presence of hydrochloric acid. Amylase enzyme works under neutral conditions.

(b) Temperature test results

Test tube	Test for starch		Test for reducing sugar	
	Observation	Conclusion	Observation	Conclusion
A	Brown colour of iodine changed to blue black.	Starch present	Blue colour of Benedict's solution persisted	Reducing sugars absent
B	Brown colour of iodine persisted	Starch absent	Colour changed from blue to brick-red	Reducing sugars present
C	Brown colour of iodine changed to blue-black	Starch present	Blue colour of Benedict's solution persisted	Reducing sugars absent

Note: The temperatures in B (i.e. 37°C) were favourable for the action of amylase enzyme (body temperature). The enzyme broke down starch to its constituent reducing sugars (glucose). In A the temperatures were too low (0°C temperatures of ice) hence inactivated the enzyme. On the other hand, in C, the temperatures were too high (100°C) hence deactivated the enzyme.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<p>Slow learners can be helped to understand better the effect of pH by giving them more data questions. They will be required to draw graphs and determine the optimum pH of given enzyme. You will help them to account for the shapes of the graphs. Help them also understand that the effect of increasing temperature on the rate of enzyme catalysed reaction depends on the initial temperature of the reaction.</p> <p>Give fast learners additional task to research on how different and extreme pH other than the optimum changes the configuration of an enzyme; and denature the enzyme.</p>	<p>All learners with special educational needs should participate actively in the class activity.</p> <p>Learners with sight problems should be placed at the front of the class.</p> <p>Remember disability is not inability!</p>

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out optimum pH from the data questions given.
- Cooperation and interpersonal skills-As learners interact in the practical activity.
- Communication – As learners discuss the findings from the practical activity.
- Lifelong skills-as learners acquire scientific skill on efficiency of enzymes which they can apply in home or industrial processes like juice extraction.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the role of enzymes in biodegradation.

Plastics are wastes with more negative effect on the environment due to their non biodegradable nature. Enzymes like some enzymes however have the ability to degrade some plastics such as agricultural mulch films.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to Self-evaluation Test 6.2

Refer to Learner's Book

1. C
2. High temperatures beyond optimum and extreme pH.
3.
 - a) 2
 - b) Hydrochloric acid
 - c) 37°C
 - d) Higher temperature denatures the enzyme; hence the substrate cannot be worked on.

4.
 - a) Optimum temperature for the enzyme.
 - b) Rate of reaction decreases with increase in pH above 7.
 - c) Enzyme would be denatured.
5.
 - a) Rate of reaction increases with increase in substrate concentration.
 - b) Rate of reaction does not increase further with increase in substrate concentration since it is no longer a limiting factor; instead all active sites of the enzymes are occupied.
 - c) Add more enzyme molecules.

Lesson 5: Mode of enzyme action

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the Lesson, learners should be able to use the key and lock mechanism to explain how enzymes catalyse reactions.

Materials and learning resources

Low cost/no cost	High cost
Padlocks	Textbooks/ reference materials

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is both a discussion and practical lesson on mechanism of enzyme action.
- You are required to explain the concept and allow learners to do experiments.

Suggested teaching/learning activities/approach

1. Introduce the lesson by reviewing how enzymes convert substrates to products.

2. Put learners into groups and guide them to carry out Activity 6.5. Help them to relate the outcome of this practical to the working of enzymes. Refer to text of student's book.
3. Explain the concept of key and lock hypothesis and allow learners to discuss further in pairs.

Answers to study questions

- (a) Yes
- (b) Not any key can open any padlock
- (c) Key - substrate
Paddock hole - Enzyme Active Site

4. Wind up this topic by organising learners to carry out the further activity 6.6 of the student's book.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
Slow learners can be helped to relate enzyme specificity and mode of action.	All learners with special educational needs should participate actively in the class activity.
Give fast additional task to write at least five substrates and the enzymes that break them down.	Learners with sight problems should be placed at the front of the class.
	Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners use guiding questions to study subject content.
- Problem solving skills-As the learners find out which keys open each padlock.
- Cooperation and interpersonal skills-As learners interact in the activity.

- Communication – As learners discuss in pairs and give answer to questions asked in class.
- Lifelong skills-as learners acquire scientific skill on enzyme specificity.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.
- Environment and sustainability: Make learners aware of the role of enzymes in biodegradation. Plastics are wastes with more negative effect on the environment due to their non biodegradable nature. Enzymes like some enzymes however have the ability to degrade some plastics such as agricultural mulch films.

Formative assessment

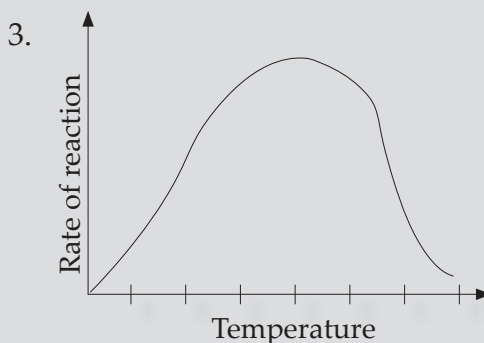
1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

2. Use differentiation when asking questions to test understanding for both slow and fast learners.
3. Ask probing questions to test learner's attitude.
4. Gauge learners based on competence and gauge them appropriately.

Answers to self-evaluation test 6.3

Refer to Learner's Book

1. B
2. The shape of an enzyme active site is complementary only to a specific substrate which can fit into the active site. Therefore, a particular enzyme only catalyses a specific reaction.



Answers to End unit assessment 6

Refer to Learner's Book

Duration: 1 period

1. B
2. B
3. B
4. It may decrease or increase. This depends on the initial temperature of reaction; if it is below optimum, the rate of reaction increases. If it is at optimum, the rate of reaction will decrease.
5. X - Optimum reaction rate
 - (a) Y - Optimum temperature.
 - ii. The enzymes are denatured.
6. Enzyme amylase acts best at neutral pH that is present in the mouth; acidic pH in the stomach denatures the enzyme.
7. a) Temperature
 - i) 6
 - ii) pH 6 is the most suitable for action of catalase hence the rate of reaction is highest.
8. Active site in specific
9. (a) B- favourable conditions.
 - (b) Salivary amylase digest starch. Unfavourable conditions
 - (c) Effects of pH and temperature on action of salivary amylase.

Additional information for teachers

Enzymes are globular proteins i.e. with ball shape and always soluble in water.

Enzymes speed up the rate of metabolic reactions by lowering the activation energy (E_a) required for reactions to take place.

Most enzymes are denatured at high temperature. But those from thermophilic bacteria can withstand at high temperatures. That is why they are used in industrial processes.

Remedial activities

What do you understand by enzyme peptidase?

Answer:

Peptidase is the enzyme that hydrolyses the breakdown of peptide into amino acids.

Consolidation activities

What will happen to the rate of the enzyme controlled reaction if the

temperature passes from 15°C to 25°C?

Answer:

The rate of the reaction will double because the temperature increases by 10°C from 15°C to 25°C

Unit 7: Photosynthesis

Refer to Learner's Book

(Number of Periods 14)

Key unit competence

After studying this unit, the learners should be able to explain the process of photosynthesis and how various environmental factors affect the rate at which photosynthesis occurs.

Unit outline

- Photosynthesis
- Necessities of photosynthesis
- Limiting factors of photosynthesis.
- Adaptations of a leaf for photosynthesis
- Importance of photosynthesis
- Mineral requirements for plant growth

Links to other subjects

Chemical equations in chemistry, Green houses, fertilizers in modern agriculture

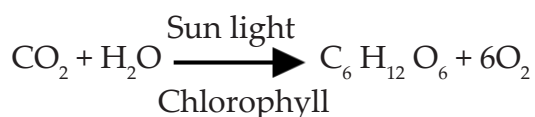
Assessment criteria

Learners are able to explain the process of photosynthesis and how various environmental factors affect the rate of photosynthesis.

Background information

The prime source of energy in the biosphere is sun light. Its absorbed by chlorophyll molecules found in plants ,some Protista and some bacteria

Light is the source of energy to fix carbon dioxide into carbohydrates with the use of water.. $(\text{CH}_2\text{O})_n$



The carbohydrates act as food for the plant. This type of feeding is called Autotrophic nutrition. Sometimes it's referred to as Halophytic nutrition. Some bacteria and some Protista feed by the same method.

Lesson 1: Introduction to Photosynthesis

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to.

- Define the term photosynthesis
- Identify the products of photosynthesis
- Explain the adaptations of a leaf to carry out photosynthesis.

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books..	Potted plants,
Ethanol, Iodine solution, Beakers, Boiling test tubes ,White tile, Forceps,	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approach

1. Introduce the topic by asking probing questions of Student's book. Let learners observe the photograph of leaves in Fig. 7.1 then have a discussion on which is suited for photosynthesis and why. You can then help them to predict what they will learn in this topic.
2. Introduce the concept of photosynthesis by emphasising the fact that the green plants are autotrophs (make their own food) as opposed to heterotrophs (depend on others for food). State what enables green plants do this.
3. At this stage, you can guide learners to carry out Activity 7.1. Make sure that all learners are given equal chances of participation. Females alike should be encouraged to participate during the activity.
4. Let learners discuss the importance of each of the following steps done.
 - (i) Boiling the leaf in water.
 - (ii) Heating the leaf in ethanol.
 - (iii) Not boiling ethanol directly over fire.
5. Guide learners to compare what they have come up with during the practical activity.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become Teachers so they acquire skills that will help them to teach
- Analytical skills: When learners analyse the results of testing for starch they get the necessary skills of analyzing data
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

Find out if learners are able to:

- To define photosynthesis.
- Outline the stages needed to test for starch in a leaf.
- Find out if photosynthesis process takes place in the leaf.

Lesson 2: Necessities of photosynthesis (Chlorophyll)

Refer to Learner's Book

Duration: 2 periods

By the end of the lesson, learners should be able to:

- Understand the necessity of chlorophyll in photosynthesis.
- Explain an experiment which is used to prove that chlorophyll is necessary

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books	Potted plants with variegated leaves,
Ethanol, Iodine solution, Beakers, Boiling test tubes, White tile, Forceps,	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Lesson preparation

1. Start the lesson with activity 7.2. It should be noted that the potted plant must be de-starched before the experiment by keeping it in darkness for a minimum of 10 hours.
2. Use textbooks to explain why the leaf was boiled in water and in methylated spirit.
3. You will make sure that all learners are given equal chances of participation. Females alike should be encouraged to participate during the activity.

Suggested teaching/ learning activities/approaches

1. First detach the variegated leaf by keeping the plant in darkness for 24 hours.
2. Put learners into groups of 3 or 4 in the laboratory to carry out Activity 7.2.
3. Demonstrate to learners so that they know where and when they have to be careful especially when they are boiling the leaf in alcohol.
4. Allow learners to carry out the activity as you guide them. Help them answer the study questions.

Answers to study questions

- (a) (i) Blue-black (ii) Brown
(b) The green parts tested positive for starch, the variegated parts tested negative. This shows that chlorophyll which is responsible for the green colour is important during photosynthesis.
(c) Green part.

5. Let learners discuss the importance of using a variegated leaf as opposed to green one.
6. Guide learners into making summary notes on the necessity for chlorophyll in photosynthesis.

Generic competences covered.

- **Critical thinking:** this is achieved as learners find out the answers to the questions you give to them.
- **Interpersonal skills:** learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- **Lifelong skills:** Some of these learners can become teachers so they acquire skills that will help them to teach
- **Analytical skills:** When learners analyse the results of testing for starch in a variegated leaf. The areas which are not green will give negative results.
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.

Cross-cutting issues

- **Inclusive education:** this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

Find out if learners are able to:

1. To understand the necessity of chlorophyll in photosynthesis.
2. Observe the areas of a variegated leaf which carried out photosynthesis and those which didn't.
3. To explain why starch is not found in all parts of the leaf.

Lesson 3: Necessities of Sunlight in photosynthesis

Refer to Learner's Book

Duration: 3 periods

Specific objectives

By the end of the lesson, learners should be able to:

- Identify that is necessary for photosynthesis to take place.
- Prove light is the source of energy in photosynthesis.

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Textbooks. Ethanol, Iodine solution, Beakers, Boiling test tubes , White tile, Forceps, Aluminium foil, and paper clips Water in wash bottles, water bath	Potted plants, water plant .e.g., Elodea or Ceratophyllum submersum

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/ learning activities/approaches

1. It should be noted that the potted plant must be de-starched before the experiment by keeping it in darkness for 24 hours.
2. Guide learners to carry out activity 7.3. You will ask learners to form groups of three or four students
3. Let learners set up the experiment as shown on . One plant should be in dark room. Then they should test for the presence of starch.

4. Guide learners to answer the study questions in the activity, they should write down main points as you summarise the lesson.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- Analytical skills: Learners will be able to analyse results got from the three water plants.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross-cutting issues

- Financial education: It will be noted that girls need more money for cloth and other material than boys
- Inclusive education: this is observed as learners are given equal chances to express their ideas during the Lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

Find out if learners are able to:

1. Have understood the importance of light in photosynthesis process.
2. Outline the stages taken to prove that light is necessary in photosynthesis
3. Explain why different amount of oxygen is given out in the three water plants exposed to different amount of light.
4. Design specific questions to test the learner's knowledge on the content covered, for example:
 - a) Is it possible to replace sunlight?
 - b) What is the use of sunlight in photosynthesis
 - c) To which form does chlorophyll change sunlight energy?

Lesson 4: Necessities of Carbon dioxide in photosynthesis

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- Prove that carbon dioxide is necessary in photosynthesis.
- To set up an experiment which proves the necessity of carbon dioxide
- Identify chemicals used this particular experiment

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books. Ethanol, Iodine solution, Beakers, Boiling test tubes , , Forceps, Sodium hydroxide(soda lime) ,Potassium hydroxide. Sodium hydrogen carbonate,	Potted plants,

Water in wash bottles, water bath, Transparent plastic bags White tile,

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/ learning activities/approaches

1. This is a demonstration lesson which requires a whole day preparation. The potted plants should be prepared at least 24 hours before the actual experiment. It should be noted that the potted plant must be de-starched before the experiment by keeping it in darkness for 24 hours.
2. Guide learners to carry out Activity 7.4. Correct them as they discuss the study questions under this activity. Learners may work in groups of three or four students.

3. Emphasise the roles played by sodium hydroxide and sodium hydrogen carbonate in the experiment.
4. Wrap up the lesson by highlighting the end products of photosynthesis i.e. glucose and oxygen. Guide learners to carry out Activity 7.5. Emphasise the fact that oxygen is produced during photosynthesis using a chemical equation.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give them for example why does the potted plant in which sodium hydroxide was placed in a transparent plastic bag fail to make starch?
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process especially when explaining their questions.

Cross-cutting issues

- Inclusive education: this is observed as learners are given equal chances to express their

ideas during the lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

Find out if learners are able to:

1. Has understood the importance of carbon dioxide in photosynthesis process.
2. Outline the stages taken to prove that carbon dioxide is necessary in photosynthesis
3. Design specific questions to test the learner's knowledge on the content covered.
 - (i) Name the element which is mostly found in living organisms.
 - (ii) Outline the end products of photosynthesis.

Answers to Self-evaluation

Test 7.1

Refer to Learner's Book

1. Carbon dioxide / water
2. a. Chlorophyll
b. Glucose
3. Starch, root system, stems , leaves
4. a. Uneven distribution of starch
b. Starch made was transported to storage organs immediately.

Lesson 5: Adaptations of the leaf and limiting factors of photosynthesis

Refer to Learner's Book

Duration: 2 periods

By the end of the lesson, learners should be able to:

- Outline and understand the limiting factors of photosynthesis
- To discuss when a factor needed in photosynthesis can become a limiting factor.
- Understand how glasshouses operate to overcome limiting factors.

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books. Ethanol, Iodine solution, Beakers, Boiling test tubes , , Forceps, Sodium hydroxide(soda lime) ,Potassium hydroxide. Sodium hydrogen carbonate, Water in wash bottles, water bath, Transparent plastic bags White tile,	Potted plants,

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/ learning activities/approaches

1. You may introduce this lesson by way of a research activity. Put learners into groups depending on their abilities and size of class. Let them do research and present findings about the discussion corner in student's book.
2. Let learners find the meaning of limiting factors of photosynthesis.
3. Correct learners where necessary and add to where they have not given enough.
4. Conclude the lesson by giving main points as learners write short notes. Then learners should know when limiting factors become limiting.
5. Ask learners what they know about the functioning and use of greenhouses. You can use this analogy to explain further the meaning of limiting factors.

Generic competences covered

- **Critical thinking:** this is achieved as learners find out the answers to the questions you give to them. For example Why is it difficult to carry out an experiment that confirms water to be a limiting factor?

- **Interpersonal skills:** learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- **Communication skills.** This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process especially when explaining their questions.

Cross-cutting issues

- **Inclusive education:** this is observed as learners are given equal chances to express their ideas during the lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

Find out if learners are able to:

1. Explain the term limiting factor in the photosynthesis process.
2. Outline all limiting factors that affect the rate of photosynthesis.
3. Ask learners to draw graphs that illustrate limiting factors.

Answers to Self-evaluation Test 7.2

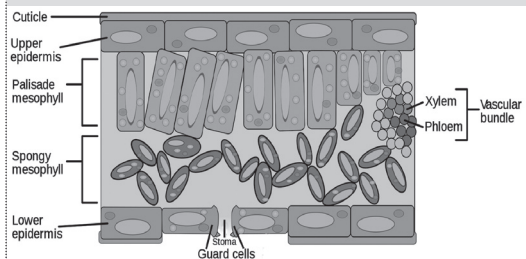
Refer to Learner's Book

1. A
2. Other limiting factors play part
3. At high temperatures, the enzymes get denatured.
4. It will increase then flatten out due to other limiting factors.

Answers to Self-evaluation Test 7.3

Refer to Learner's Book

1. a.



- b. Palisade cells
 - c. Allows light to penetrate the leaf (it is thin).
 - d. They have many air spaces between them.
 - e. Bean-shaped hence allows opening and closing of stomata.
2. a. Guard cells have chloroplasts epidermal cells lack
 - b. Their packaging - spongy has a lot of airspaces, palisade layer has tightly packed cells.

4. a. Trap sunlight energy
- b. Allow sunlight energy to penetrate
- c. Allow light to penetrate as well

Answers to Self- evaluation Test 7.4

Refer to Learner's Book

1. Producers i.e. green plants manufacture food for everything.
2. - Afforestation
- Cover cropping
- Crop rotation

Lesson 6: Importance of photosynthesis and Mineral requirements for plant growth

Refer to Learner's Book

Duration: 2 periods

By the end of the lesson, learners should be able to:

- Describe the adaptation of the leaf to photosynthesis.
- Explain the importance of photosynthesis and minerals to plant growth.
- Understand the source of oxygen and energy needed by animals.
- Analyse mineral content in different soil samples.

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books. Different plots with different soils but with same type of plants.	Leaves of different structures i.e. leave of xerophytes.

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/ learning activities/approaches

1. Put learners into groups and guide them to carry out the research Activity, the discussion corner and a class debate.
2. Let the learners find out the adaptations of leaves for photosynthesis. Then they should also discuss the importance of different mineral salts in plants. Let each group explain to others what they have found out.
3. Moderate the discussions and correct where learners have gone wrong and add to where they have not given enough.

4. Conclude the lesson with questions.
5. Let learners:
 - Outline different adaptations of leaves
 - Mention uses of minerals to plants
 - Explain symptoms of mineral deficiencies in plants

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process especially when explaining their questions.

Cross-cutting issues

- Financial education: It will be noted that plants that are planted on poor soils cannot give good yields. Therefore cash crops must be planted in mineral rich soils.
- Inclusive education: This must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential

Formative assessment

Find out if learners are able to:

1. Explain adaptation of leaves for photosynthesis in different environment
2. Outline the harmful effects of nitrogen in the environment
3. Ask learners to draw graphs that illustrate limiting factors.

Answers to Self-evaluation Test 7.5

Refer to Learner's Book

1. (a) Yellowing of leaves
(b) Poor plant growth
2. a. Plant growth affected
b. Chlorosis of leaves

Answers to End unit assessment 7

Refer to Learner's Book

Duration: 1 period

1. D
2. (a) Water/ oxygen
(b) Sunlight
(c) Chlorophyll
(d) trap sunlight
(e) Magnesium
3. a. To remove traces of starch before the experiment
b. To observe changes clearly
c. Absorb carbon dioxide
d. Positive for starch
e. Photosynthesis took place
f. Control experiment

4. The farmer decides how much water, nutrients, light and other elements the plants receive.
5.
 - a) tissue development
 - b) stunted
 - c) Magnesium required for chlorophyll
6.
 - a)
 - i. Increases
 - ii. Temperature and carbon dioxide
 - b) Increases then flattens out.
 - c) After optimum temperature the rate of reaction reduces due to denature of enzymes.

Additional information for teachers

Autotrophic organisms are described as producers because of their capacity to produce organic food from inorganic materials.

Remedial activities (group research)

State two limiting factors of photosynthesis which are at the same time necessary conditions for photosynthesis.

Answer:

Light and concentration of carbon dioxide.

Consolidation activities

Allow maize grains to germinate and grow in a dark place receiving air and water. Record your observation within two weeks and suggest an explanation.

Answer

The grains have germinated and started growing. But the leaves lost the green color and finally dried out.

The light is necessary for photosynthesis and event for the formation of chlorophyll

Unit 8: Transport of water, minerals and organic foods in plants

Refer to Learner's Book

(Number of periods 10)

Key Unit Competence

After studying this unit, the learners should be able to explain the process of uptake and transport of mineral and organic saps, transpiration and translocation and their roles in plants.

Unit outline:

- Transport system in plants
- Uptake of water and mineral salts
- Transpiration
- Adaptations of plants to different environments
- Translocation of organic food substances

Links to other subjects

Vaporisation, heat capacity and pressure in fluids in Physics.

Assessment criteria

Learners can explain the process of uptake and transport of xylem sap, transpiration and translocation and their roles in plants.

Background information

All living organisms are made up of cells. In order to stay alive; these cells take up useful substances from their environment. They also produce and release waste substances.

Plants are complex multicellular organisms. Therefore diffusion alone is not enough to transport materials. This is because they have a lower surface area to volume ratio. Their cells are far away apart from the outside environment where these materials are located.

This necessitates a transport system to enable movement of materials in plants

Lesson 1: Transport system in plants

Refer to Learner's Book

Duration: 2 periods

Specific objective

By the end of the Lesson, learners should be able to:

- Should be able to describe plant transport systems
- Explain the functions of the vascular bundles
- Describe translocation and transpiration
- Should be able to identify the different adaptations of plants which make them suitable to live in their environments.

Materials and learning resources

High cost	Low cost
dye, permanent slides, microscopes, hand lenses, capillary tubes, bell jar	White polythene bag, potted plant, food colour

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. Introduce the topic by way of brainstorming about the picture in Fig. 8.1 of students book. Ask probing questions about how materials are transported in the tree. You can then narrow down to transport network in the tree.
2. You will then ask learners to form groups of four and guide them to carry out Activity 8.1.
3. You will place prepared slides of a dicot root under the microscope. Ask learners to observe under low power and high power objective lenses. Remember to inform the learners of the possibility of the objective lenses breaking the slide during the process of manipulation.
4. Let learners note down the different tissues they see and their locations
5. You will ask the learners to draw a plan diagram showing the position and lay out of these tissues. Remember to caution them against shading.
6. Let the learners compare their diagram with the one in the textbook fig. 8.2.
7. Allow learners to correct their errors on their diagrams using the textbook as a reference.
8. Let learners discuss the following questions.
 - i. Describe the pattern of arrangement of xylem in relation to phloem in dicot roots.
 - ii. Where are the root hairs located in the roots?
9. Let the learners share their findings in class. Correct them where they go wrong.

Suggested teaching learning activities

- Observing prepared slides of monocot and dicot roots under a microscope.
- Discussion and comparison of what the learner have observed. This can be done using the numerous questions that you will provide.
- Drawing diagrams as seen under the microscope.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.

- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
 - Lifelong skills: practical work will equip learners with skills to manipulate apparatus which they will use later in some professional careers. Some of these learners can become laboratory technicians.
 - Analytical skills: These are attained as the learner studies the slides under the microscope.
 - Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.
- Explain the importance of vascular systems in plants
 - Draw diagrams showing locations of the vascular system in plants.
 - Design specific questions to test the learner's knowledge on the content covered for example:
 - i. Describe a vascular system in plants
 - ii. Give the different types of tissues that make up the vascular system?

2. Test the learner's ability to differentiate different tissues that make up the vascular system. Through asking them to draw these tissues as seen under the microscope.
3. Gauge learners based on their competence and grade them accordingly.

Cross- cutting issues

- Standardisation culture: laboratory equipment should be on standard since those which are of poor quality can easily break down. This increases the chances of laboratory accidents.
- Financial education: remember to inform learners to handle carefully the microscopes. They are expensive to buy.
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

1. Find out if learners are able to:
 - Describe plant transport systems

Lesson 2: Absorption and uptake of water and mineral salts

Refer to Learner's Book

Duration: 2 periods

Specific objective

By the end of the lesson , learners should be able to

- Should be able to describe the structure of root hair cells.
- Explain the mode of absorption of water and uptake of mineral salts by root hair cells.
- Describe the forces responsible for uptake and transport of water and mineral salts.

Materials and learning resources

High cost	Low cost
Capillary tubes	Dye, beakers.

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. Obtain a chart containing root hair cell and bring into class. You can also bring an uprooted plant with root hairs to class.
2. Let learners observe the roots with root hairs and the chart. Put them in groups of five for this Activity. Refer to discussion cover. in student's book.
3. Guide learners to understand adaptations of root hair cell to their functions. Refer to student's book.
4. At this point, introduce the concept of water and mineral absorption. Inform learners that root hairs are responsible for this in plants. Show them Fig. 8.4.
5. Inform learners that several factors contribute to absorption and movement of water in plants.
6. Using capillary tubes of different diameters, placed in beakers with coloured water. Illustrate

that the thinner the tube, the more distance it will travel in the capillary tube. You will stimulate learners to understand the relationship between the height moved by the coloured liquid in the tube and its diameter. This can be done through asking learners questions like

- In which tube has the coloured liquid moved highest?
 - What causes the liquid to move higher than the other?
 - Which forces are responsible for the upward movement of water in the capillary tube?
7. Let learners contribute to the discussion. Correct the learners where they go wrong.
 8. You can build on the learner's contributions and then explain how similar the xylem vessels in plants are to the capillary tubes.
 9. Guide learners to carry out Activity 8.2 and 8.3. Relate their findings to what happens during water movement in plants and what is responsible for the transportation. Guide them to answer the study questions in these activities.

Answers to study question in Activity 8.2

- a) Xylem tissues
- b) Use a dried (dead) *Oxalis latifolia*

Answers to study question in Activity 8.3

- a) No - they are different
- b) In dicots - the vascular bundle form a ring. In monocots, they are scattered in the stem. See Fig. 8.9 and 8.10 in the student's book.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross-cutting issues

- Inclusive education: this is observed as learners are given equal chances to express their ideas during the Lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

1. Find out if learners are able to:
 - a. Describe processes responsible for water and mineral salts transport
 - b. Appreciate the effect of diameter to the working of xylem vessels.
 - c. Design specific questions to test the learner's knowledge on the content covered for example
 - i. Explain how mineral salts and water differ while entering into the root hair cells?
 - ii. Which forces affect the movement of water up the stem?
 - iii. Why is it not possible for the stream of water to break as it moves up the plant?
2. Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation

Test 8.1

Refer to Learner's Book

1. To move materials
2. Check fibrous versus tap root system
3. Refer to Fig. 8.2 Student's book

Lesson 3: Transpiration

Refer to Learner's Book

Duration: 2 periods

By the end of the lesson, learners should be able to:

- Define transpiration process.
- Understand the mechanism of transpiration.
- Explain the effects of respiration on plants.

Materials and learning resources

High cost	Low cost
Text books, handouts, bell jar	White polythene bag, potted plant

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. You will prepare a potted plant with a white polythene bag covering it on top. Leave it to stand for 3 hours before the lesson begins.
2. Let the learners observe the experiment and the water that has condensed on the polythene.
3. Ask the learners what they think is the reason behind this. Ask them why they think it is important for plants to lose water?
4. You may also relate this phenomenon to sweating in man.
5. Introduce this topic by Activity 8.4. Refer to Student's book. Help them to answer study questions in this Activity.

6. Build on the learners experiences and contributions to explain the process of transpiration and why it happens in plants.
7. Make sure that all learners are given equal chances of participation during the lesson. Females alike should be encouraged to participate.
8. You can let learners research on the factors that affect rate of transpiration individually then share their findings in class. Let them write summary notes as you highlight important points and clarify where they go wrong. Refer to Student's book.
9. Wrap up the lesson by demonstrating how to measure rate of transpiration using a potometer. Refer to the Activity 8.5 of Student's book.
10. For each of the conditions in table 8.1, give hypothetical figures and let learners calculate rate of transpiration. Allow a discussion on the rates above. Clarify points of confusion among learners.

Answers to study questions

- a) A - water droplets in the polythene bag. B - No water droplets.
- b) Plants remove water in form of water vapour through leaves.
- c) Set-up B
- d) It turns pink showing presence of water.

Generic competences covered

- Critical thinking. This is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross-cutting issues covered

- Inclusive education: this is achieved through giving learners equal chances to participate during the teaching learning process.
- Environmental conservation: remember to remind learners that the process of transpiration in plants is responsible for rainfall formation it is therefore important to conserve the environment to avoid changes in seasons.

Formative assessment

1. Find out if learners are able to:
 - a. Describe transpiration.
 - b. Appreciate the importance of respiration.
 - c. Describe an experiment illustrating the process of transpiration.
 - d. Design specific questions to test the learner's knowledge on the content covered, for example:
 - i. Where in a plant does transpiration take place?

- ii. Is transpiration important or harmful to a plant? Answer with reasons.
- iii. Explain the different forms of transpiration in plants?
- iv. How is the process of transpiration related to rainfall formation?

2. Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation Test 8.2

Refer to Learner's Book

1. It is a controlled environment where factors like wind don't come into play.
2. Root pressure

Lesson 4: Adaptations of plants to different environmental conditions

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain why plant forms are different.
- Outline the different adaptations for plants as a result of their environment.

Materials and learning resources

High cost	Low cost
Text books, internet, photographs, hand outs	Potted laboratory plant, Waterlily, cactus, murram grass

Suggested teaching methodology

- Guided discovery.
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. You may begin the lesson by asking learners why they think plants growing in different places have different features.
2. Put learners into groups depending on their ability and class size.
3. Provide learners with textbooks, internet and handouts. Also, provide them with plants from different environments e.g cactus, bean plant, water hyacinth.
4. Ask the learners to identify the differences between these plants. Lead them to discover such differences using the following questions:
 - Are these plants similar?
 - If yes, what are the similarities?
 - If no, what are the differences?

5. Let them write their points down. How are these characteristics on the provided plants related to the environments they live in?

Let the learners use the text books and internet to research on the adaptations of plants that make them live in their environments.

6. Remember to guide these learners by grouping the plants into different classes according to the environment they live in, for example,
 - Mesophytes
 - Hydrophytes
 - Halophytes
 - Xerophytes

7. Allow learners time to present their work. Use their work to guide them to correct where they may have gone wrong.

Let them write down short notes on characteristics of the various groups of plants as you explain.

Generic competences covered

- Critical thinking. This is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process
- Communication skills: These are attained as learners carry out a discussion. The ability to speak in public is a major necessity for success.

Cross cutting issues covered

- Inclusive education: you should make sure that every learner in class is taking part in the learning process.

Formative assessment

1. Find out if learners are able to:
 - a. Describe the different plant adaptations to their environments.
 - b. Explain the reason behind such adaptations.
 - c. Design specific questions to test the learner's knowledge on the content covered, for example
 - Identify the adaptations of a cactus to living in a desert?
 - How is a water lily adapted to living in water?
2. Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation Test 8.3

Refer to Learner's Book

1. Reduce rate of transpiration.
2. They have salt glands that secrete excess salts.
3. Submerged plants

Lesson 5: Translocation

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Define translocation
- Identify the phloem vessels as responsible for translocation in plants.
- Understand how translocation takes place in a plant.
- Appreciate sink and source as used in translocation

Materials and learning resources

High cost	Low cost
Text books, internet	potted plant

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. Put learners into groups of fours or fives. Make sure these are mixed groups. Girls should mix with boys and able learners with less able ones.
2. Let the learners do research on the discussion corner on of Student's book. Provide the different

- groups with research materials like textbooks, internet and handouts. Remind the learners to also consult the wall charts in their classroom.
3. You will write the following questions on the chalkboard for the learners to discuss. Make sure that the discussion is controlled and also everyone participates.
 - i. Define the term translocation.
 - ii. Where in a plant does translocation take place?
 - iii. Identify the source and sink in plants?
 - iv. Is the phloem tissue made of dead or living cells?
 - v. Which form does the phloem take in leaves?
 4. You may then give the learners time to point out what they have discussed in their groups. Praise them where they are correct. Build on their ideas to lead them to the meaning of translocation.
 5. Remember to use wall charts to show learners the structure of the phloem vessels. Ask the learners to draw both the dicot and monocot stems showing the position of the phloem vessels. Narrow down to the structure of phloem (Fig. 8.23), Student's book).
 6. You will remember to explain to learners that leaves contain chlorophyll. They are always manufacturing food for the plant. For this reason they are known as the **source**. Other non-photosynthetic parts of the plant only consume this food or store it. They are then known as the **sink**.
 7. Wrap up the lesson by doing a demonstration of the Experiment in Activity 8.7 (The Ringing Experiment). Remind learners to keep observing the ringed plant for some time (atleast 1 month). Let them write down their observations. Guide them to give an explanation to what they observed.

Generic competences covered

- **Critical thinking:** It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- **Interpersonal skills:** As the learners work together in groups, they learn how to live together. They can also help each other to understand some concepts in the Lesson .
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.

Cross cutting issues covered

- **Inclusive education:** you should make sure that every learner in class is taking part in the learning process.

Formative assessment

Find out if learners are able to:

1. Define the process of translocation
2. Locate the position of phloem vessels in roots and stems of different types of plants.
3. Define a sink and a source in plants
4. Appreciate the importance of translocation in plants.
5. Design specific questions to test the learner's knowledge and skills on the content covered. For example
 - i. Where does translocation take place in plants?
 - ii. Draw a diagram to show the position of phloem vessels in a dicot root.

Gauge learners based on their competence and grade them accordingly

Answers to Self- evaluation Test 8.4

Refer to Learner's Book

1. Source - Where food is manufactured in a plant (leaves)
Sink - Where food is utilised or stored in a plant (can be stem, leaves, roots, flowers, fruits, etc)
2. Leaves , translocation

Answers to End unit assessment 8

Refer to Learner's Book

Duration: 1 period

1. A
2. B
3. The whole body is in contact with the environment hence can get all that it requires through diffusion.
4. Active transport
5. Thorny leaves to reduce transpiration/ thick succulent stems to store water.
6. Xylem –transports water and mineral salts / movement is unidirectional.
Phloem – transports food and nutrients/ movement is bidirectional
7. Regulates activities of sieve tube element
8. a. Enables water to move from roots through stem to the leaves then out of the leaves.
b. Light/temperature/ wind/ humidity
9. Measures the rate of water uptake of a leafy plant shoot. Refer to learners book for details
10. Absorption and movement of water in plants.
11. Amoeba in unicellular hence can survive through diffusion alone.

Additional information for teachers

By analogy you can introduce this unit from the following case:

WASAC (Water and Sanitation Corporation) is a company that supplies water in Rwanda. It first identifies the sources of water. After collection and treatment, water is distributed from the large pipes to costumers 'homes. If the junctions of the pipelines are not well connected, water leaks and customers do not get enough or not at all water.

Likewise, Inyange industry supplies the pasteurized milk from its industry at Masaka in Kigali. Inyange milk is transported in large tanks throughout all Rwanda and even reaches neighbouring countries for its standards.

Plants also transport water, mineral salts and organic foods through a transport system made of two types of tissues: Xylem and phloem.

Between the transport of water from WASAC and that of milk from Inyange industry, which one has more analogy with transport in plants? Why?

Remedial activity

Q/Why do consider the transpiration as a necessary evil for a plant?

Ans/

Because transpiration allows plant to lose excess water and mineral to move.

Consolidation activity

Q/Explain why the volume of lost water in transpiration is slightly lesser than that up taken water.

Ans/

The volume of lost water by transpiration is lesser than that of up taken water because:

- The lost water is replaced by a continuous column of water moving upward slowly
- Some up taken water is used as reactant in metabolic processes of the plant (e.g. photosynthesis)
- Some up taken water is saved in the succulent organs of the plant.

Unit 9: Gaseous exchange in humans and plants

Refer to Learner's Book

(Number of periods 12)

Key unit competence:

After studying this unit, the learner should be able to explain gaseous exchange in humans and plants.

Unit outline:

- Respiratory surfaces
- Mechanism of breathing in humans
- Gaseous exchange in the alveoli
- Respiratory diseases and smoking
- Gaseous exchange in plants

Links to other subjects

Diffusion of gases is linked to Physics and Chemistry

Assessment criteria

Learners can explain gaseous exchange in humans and plants

Background information

Cellular respiration takes place constantly in living cells. This creates a constant demand for oxygen and a need to eliminate carbon dioxide gas. Organisms such as plants need to take in or release oxygen or carbon dioxide at one time or another during respiration and photosynthesis. Animals on the other hand, always take in oxygen and release carbon dioxide during

respiration. Gaseous exchange therefore is:

- i. Exchange of respiratory gases in animals
- ii. Exchange of photosynthetic and respiratory gases in plants

Gaseous exchange is a biological process through which different gases are transferred in opposite directions across a specialised respiratory surface. Therefore an efficient system for their exchange is extremely important. Gaseous exchange is necessary because organisms are able to obtain useful gases from their environment and get rid of waste gases into the environment.

Lesson 1: Respiratory surfaces

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State and describe the respiratory structures in human beings and some animals.
- Describe the characteristics and make inferences on various adaptations of the respiratory structures.
- Describe the characteristics of the respiratory surface in human and other organisms.

- Describe and explain the breathing mechanism in humans and other organisms.
- Compare and contrast the human respiratory system with that of other organisms.

Materials and learning resources

High cost	Low cost
Text books, internet, lungs from a mammal.	Insects, leaves of plants

Suggested teaching methodology

- Inquiry learning
- Guided discovery.
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities

1. Remind learners what they learnt in Senior 1 about gaseous exchange. Let them look at the picture in Student's book and discuss in groups the probing questions. You should then help them predict what this topic is about.
2. Organise learners in groups of four or five to carry out the discussion corner in Student's book. Let them research about these questions.
 - Define a respiratory surface?
 - What is the respiratory surface in man?
3. Emphasize the need of a gaseous exchange surface in multicellular animals as opposed to unicellular animals. (The concept of surface area to volume ratio viz a viz diffusion).
4. Help learners to identify the characteristics of a respiratory surface? Ask them to note down their answers in their notebooks.
5. Let them discuss their findings with their classmates. You will build on the learner's contribution and lead them to the correct information about respiratory surfaces. Remember to explain the general characteristics of all respiratory surfaces. Emphasize the importance of large surface area to volume ratio. You will provide each of the groups four cubes of 1 cm³ and a larger cube of 8 cm³. Ask learners to calculate the total surface area of the smaller cubes and the larger cube.
6. Explain that smaller objects will have a larger surface area to volume ratio than bigger objects. The larger the surface area to volume ratio, the more effective the respiratory surface will be at gaseous exchange. This explains the existence of several alveoli in a single lung. You will ask a few more questions: such as:
 - What will happen if the alveoli surface is more than one layer of cell?

- Why must the alveoli have a wet surface?
 - Why gaseous absorption cannot function efficiently if there is no a web of capillaries?
 - Can anyone list down the four characteristic of the alveoli again for the class?
 - Observing a lung from a mammal
 - Brainstorm in classroom about the pandemic covid-19 then relate the disease to respiratory diseases
7. Wrap up the lesson by summarising the characteristics of respiratory surfaces as learners take notes.

Generic competences covered

- **Critical thinking:** It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- **Interpersonal skills:** As the learners work together in groups, they learn how to live together. They can also help each other to understand some concepts in the Lesson .
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.
- **Moral values which include:** being cooperative and being systematic.

Cross cutting issues covered

- **Inclusive education:** you should make sure that every learner in

class is taking part in the learning process.

Formative assessment

1. Find out if learners are able to:
 - a. Explain what it is meant by a respiratory surface.
 - b. Identify the respiratory surface in man.
 - c. Identify the characteristics of a respiratory surface and the importance of each characteristic.
2. Design specific questions to test the learner's knowledge and skills on the content covered.

Lesson 2: Mechanism of breathing in humans

Refer to Learner's Book

Duration: 3 periods

By the end of the lesson , learners should be able to:

- Describe breathing process in man
- Explain inspiration
- Explain expiration

Materials and learning resources

High cost	Low cost
Text books, internet, wall charts	

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities/approaches

1. Begin the lesson by asking probing questions about what learners think happen during breathing. Put learners in pairs to carry out Activity 9.1.
2. Ask one of the learners in a pair to breathe in deeply then hold his breath.
3. Ask the second learner to observe carefully what is happening to the chest of his partner as he/she breathes in. Does the chest remain in one position?
4. Let the first learner breath out. The other learner should also note what is happening to the chest of a partner.
5. Ask the pair to change roles.
6. You will write the following questions on the blackboard. They will help learners to discover the mechanisms of breathing.
 - I. When does the chest move
 - Upwards
 - Outwards
 - Inwards
 - Downwards
 - II. Suggest the reasons why you think the chest moves
 - Upwards and outwards
 - Inwards and downwards
7. You will then use the learner's ideas to build your explanation about the breathing mechanisms in man. Refer to text on in the student's book.
8. Let learners come up with a summary table on the differences between inhalation and exhalation.

9. Wrap up this lesson by doing a demonstration of Activity 9.2 on constructing a breathing model. In this Activity let learners draw a similarity table between the model and how the breathing system works. **Hint:** Let them say what these represents:
 - (i) Bell jar _____
 - (ii) Balloons _____
 - (iii) Rubber sheet _____
 - (iv) The action of pulling the string downwards _____
 - (v) The action of releasing the string _____
 - (vi) Y - Shaped glass tubes _____

Suggested activities

- Observing breathing in man
- Construction of a model
- Comparison of breathing in man and a rabbit

Generic competences covered

- Critical thinking: It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- Interpersonal skills: As the learners work together in groups, they learn how to live together. They can also help each other to understand some concepts in the Lesson.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.
- Moral values which include: Being cooperative and being systematic.

Cross cutting issues covered

- Inclusive education: you should make sure that every learner in class is taking part in the learning process.

Formative assessment

Find out if learners are able to:

1. Explain breathing in man
2. State the changes that take place in the chest cavity during breathing.
3. Identify the characteristics of a respiratory surface and the importance of each characteristic.
4. Design specific questions to test the learner's knowledge and skills on the content covered. E.g.
 - Define inhalation?
 - What is the name of the sheet of muscle that contracts when you breathe in?
 - Why do we breathe faster?
 - What does it mean to ventilate a body?
 - What is the name of the air sacs inside your lungs?

Answers to Self- evaluation Test 9.1

Refer to Learner's Book

1. Nasal passages cleans the air/ diaphragm aids in relaxation and contraction of the lungs
2. Thin walls/moist inner surface/ a large surface area/ rich blood supply
3. Refer to Learner's Book

Lesson 3: Gaseous exchange in the alveolus

Refer to Learner's Book

Duration: 3 periods

Specific objectives

By the end of the lesson, learners should be able to;

- Be able to appreciate an alveolus as the basic unit of gaseous exchange
- Draw the structure of alveolus.
- Be able to show the direction of flow of gases in the alveolus.

Materials and learning resources

High cost	Low cost
Text books, internet, lungs from a mammal.	

Suggested teaching methodology

- Inquiry learning
- Guided discovery.
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/ learning activities/approaches

1. You will provide learners with text books and the internet. Also hang wall charts showing the alveolus.
2. You will ask learners to research on the following questions
 - i. Where is the alveolus located?
 - ii. How do respiratory gases cross the alveolus?

- iii. Which characteristics make the alveolus good for its functions?
3. At this point, you carry out a dissection of a small mammal such as a mouse or a rat for activity 9.3 for them to appreciate what alveoli are. Let learners feel the lungs and say why they are spongy. (Because of numerous alveoli with air inside them).
4. Cut through the lungs and let learners observe it. Guide them to identify airways (trachea, bronchi and bronchides).
5. Ask learners to draw the breathing system in their notebooks. They can refer to the wall charts to label it.
6. Narrow down to the alveolus. Let them study the chart showing the relationship between the lungs and the alveolus.
7. Ask learners to draw the structure of the alveolus in their note books.
8. Learners should research from textbooks and other resources how gases cross the alveolus. Let them share their findings with their classmates.
9. Build on the ideas the learners have raised to explain the mechanism of gaseous exchange on the alveolus.
10. Give learners extra activities of researching on the various processes that are involved during gaseous exchange and present their reports to the rest of the class.
11. You can guide learners to do a further activity on testing the gas produced during breathing (Activity 9.4). What happens:

	Flask A	Flask B
Breathing in	Atmospheric air rush in slightly white precipitate formed CO_2 of CO_2 in atmospheric air.	Air rushes out of flask
Breathing out	Air gets out of flask	Air from lungs get into limewater reacts with it, more precipitate formed.

More precipitate is formed in B, because breathed air has more carbon dioxide than atmospheric air. See table 9.2 of the student's book.

Generic competences covered

- **Critical thinking:** It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- **Interpersonal skills:** As the learners work together in groups, they learn how to live together. They can also help each other to

understand some concepts in the Lesson .

- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.
- **Moral values** which include: Being cooperative and being systematic

Cross cutting issues covered

- **Environmental conservation:** respiratory gases arise from photosynthesis. Remind the learners that environmental conservation is necessary if we are to breathe clean air.
- **Inclusive education:** This is achieved through using different forms of teaching methods. The methods should ensure understanding in all groups of students. Whether the most able or less able.

Formative assessment

Find out if learners are able to:

1. Draw a diagram of the alveolus
2. Explain the way gases cross the alveolus
3. Identify the characteristics of an alveolus that makes it a good respiratory surface.
4. Design specific questions to test the learner's knowledge and skills on the content covered, for example:
 - Why should the alveolus be having a large surface area?
 - What is the importance of moisture on the surface of the alveolus?

Lesson 4: Respiratory diseases and smoking

Refer to Learner's Book

Duration: 2 periods

Specific objective

By the end of the lesson , learners should be able to

- Point out some of the respiratory diseases.
- Identify signs and symptoms of these respiratory diseases.
- Appreciate that smoking is unnecessary and undesirable.
- Be able to identify the dangers of smoking to man.

Materials and learning resources

High cost	Low cost
Text books, internet, photographs showing lung cancer, inhaler.	

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. You will provide learners with text books, handouts, photographs and computers connected to internet to carry out the research

Activity of Student's book.

3. You will ask them to form groups of four or five depending on the size of the class.
4. Ask them to find out information regarding diseases of the respiratory tract. For example
 - Bronchitis
 - Tuberculosis
 - Asthma
 - Influenza
5. Ask the learners to find out about their causes, signs and symptoms and how such diseases can be controlled. How can we prevent ourselves from contracting the diseases?
6. Ask the learners to find out why people smoke. What are some of the dangers of smoking?
7. Show the learners in the class diagrams of two lungs. A healthy lung and one affected by lung cancer. Ask them to identify the one affected by lung cancer. Ask them to identify the cause of lung cancer.
8. Give learners time to discuss with their group members and later with the class mates.
9. Build from what the learners discuss and explain to them the various respiratory diseases their signs and symptoms and how they can be prevented.
10. Conclude the lesson by explaining the dangers of smoking and how it is related to lung cancer.

Suggested teaching/ learning activities

- Researching on the alveolus
- Drawing the alveolus

Generic competences covered

- **Critical thinking:** It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- **Interpersonal skills:** As the learners work together in groups, they learn how to live together. They can also help each other to understand some concepts in the lesson .
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.
- **Moral values** which include: Being cooperative and being systematic

Cross cutting issues covered

- **Environmental conservation:** remind the learners that pollution of the air is one of the causes of respiratory diseases. They should be vigilant on conserving the environment. They should sensitize the community on the need to conserve the environment.
- **Inclusive education:** this is achieved through using different forms of teaching methods. The methods should ensure understanding in all groups of

students. Whether the most able or less able.

Formative assessment

Find out if learners are able to:

1. Outline the diseases that affect the respiratory tract.
2. Describe ways in which these diseases are spread from one person to another.
3. Explain the dangers of smoking to one's health.
4. Design specific questions to test the learner's knowledge and skills on the content covered for example:
 - How can you advise a smoker to quit smoking?
 - How can you prevent the spread of tuberculosis in a society if you are a healthy worker?

Answers to Self- evaluation Test 9.2

Refer to Learner's Book

1. Wearing protective gear such as mouth mask, gloves and overall.
2. No, tell them the dangers of smoking/ refer them to counsellor
3. May lead to drug resistant

Lesson 5: Gaseous exchange in plants

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson , learners should be able to;

- Identify the respiratory surface in plants and its characteristics.
- Appreciate the role of the stomata in gaseous exchange.
- Explain how gases are exchanged in plants?
- Explain the role of the air spaces in gaseous exchange.

Materials and learning resources

High cost	Low cost
Text books, internet, photographs showing the internal structure of the leaf and the structure of the stomata.	

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities/approach

1. You may begin the lesson by asking learners in pairs to discuss about the following questions.

- Where does gaseous exchange take place in plants?
 - What is the role of the stomata in gaseous exchange?
 - Identify the role of the air spaces in plant leaves?
 - Explain the direction of flow of gases in the leaf of the plant?
2. Give the learners a chance to discuss their ideas with each other. They should then present their work to fellow classmates.
 3. Build on the learners presentation to explain how gaseous exchange takes place in plants. Be sure to mention the role of stomata.
 4. Put learners into groups depending on their abilities and class size and guide them to do Activity 9.5 Student's book. Let them draw and label the structure of stomata in their note books. Refer to Fig. 9.13 in Student's book.
 4. Conclude the lesson by asking the learners to observe and draw the internal structure of the leaf. Let them note down the importance of each part to a leaf. Refer to Fig 9.14 Student's book.

Generic competences covered

- **Critical thinking:** It is important to let learners think. This normally leads them to solving problems they meet in their everyday lives. The questions asked to learners will motivate them to critical thinking.
- **Interpersonal skills:** As the learners work together in groups, they learn how to live together.

They can also help each other to understand some concepts in the lesson .

- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.
- **Moral values** which include: Being cooperative and being systematic

Cross cutting issues covered

- **Environment sustainability:** Make learners aware of the need to conserve the environment for future prosperity.
- **Inclusive learning:** All learners should work together irrespective of disabilities and gender.

Formative assessment

1. Assess learner's attitude by their interest and active participation during the Lesson .
2. Find out learners understanding by asking them to name the parts of a plant leaf. You can use diagrams, pictures or photographs of different parts of a leaf which they are supposed to identify.
3. Check learners' skills in explaining gaseous exchange in plants.
4. Allocate marks for each colour in the table of general criteria used for grading. Calculate the marks that the learner has attained. Grade the learners based on how they will have scored from the table and from the various tests given to assess skills acquisition.

Answers to Self- evaluation Test

9.3

Refer to Learner's Book

1. Guard cells are bean-shaped and have chloroplasts.
2. Roots need oxygen for active transport of mineral salts from the soil during absorption.

Answers to End unit assessment 9

Refer to Learner's Book

Duration: 1 period

1. B
2. B
3. To ensure supply of vital gases such as oxygen (in animals) and carbon dioxide (in plants) which they require for their survival.
4. Refer to text of Student's book.
5. No, it should not ban as it is a free market. However, the government through the ministry of health should educate and warn people on dangers of smoking.
6. Having stomata and spongy mesophyll layer.
7. a. W- cuticle , Y- palisade mesophyll, V- vascular bundles, U- spongy mesophyll, X-stoma
b. W-protects internal structures; X- allows movement of gases in and out of the leaf.

8. Check for inhalers in their pockets and administer or call for help from a medical practitioner
9. Increases breathing rate due to increased demand of oxygen in tissues
10. a. Leaf A has more stomata on the lower surface while leaf B has more stomata on the upper surface
b. Has spaces
c. A- Mesophytes terrestrial / B- hydrophytes (water plant)
11. Oxygen is required in the body for respiration/ nitrogen is obtained through eating proteins.

Additional information for teachers

Smoking is the major cause of lung cancer.

In plants, gaseous exchange occurs by diffusion. Gases diffuse out

through the stomata. Each stoma is surrounded by two kidney-shaped cells called guard cells. The opening and closing of stomata is controlled by the concentration of potassium ions.

Remedial activity

- 1) Name the raw materials and products of photosynthesis.
- 2) Explain how gaseous exchange occurs in the leaf.

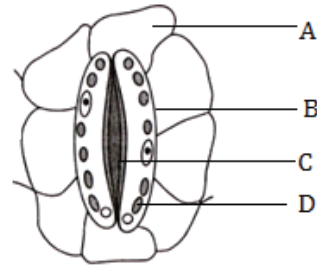
Answers

- 1) Raw materials: CO_2 and H_2O
Products: Carbohydrates and Oxygen
- 2) By diffusion through the stomata to the spongy mesophyll.

Consolidation activity

Draw a labelled diagram of a stomata.

Answer:



A= Neighbouring cell B= Guard cell
C= Stoma D= Chloroplast

Unit 10: Excretion in Humans

Refer to Learner's Book

(Number of periods 4)

Key unit Competence

After studying this unit, the learner should be able to describe the structure and function of excretory organs and suggest good practices for healthy kidneys.

Assessment criteria

Learners will describe clearly the structure and function of excretory organs and identify precisely the common urinary diseases

Background information

Excretion is the removal of substances that cannot be used nor stored by the body. All excretory products are a result of metabolism. The most dangerous waste products that are excreted everyday from our bodies are the nitrogenous compounds such as urea, uric acid and used hormones. Other compounds such as excess salts and water are removed whenever they are in excess.

Lesson 1: Need for excretion

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to

- Define the term excretion and explain the need for excretion.
- Identify different excretory organs and their products in human beings.
- Differentiate between main excretory products and incidental losses.

Materials and learning resources.

High cost	Low cost
Internet, computers, charts, Text books, Models	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities/approaches

1. You may introduce this topic by way of brainstorming about the pictures in Fig 10.1 of Student's book. Let them work in pairs and answer the probing questions. Relate the incidences in the pictures to excretory system in human beings.

2. Learners should then discuss excretion and its importance in our bodies.
Refer to Discussion corner in student's book.
3. Let learners outline the main excretory products and their organs.
4. You can build on the learner's contributions to give them a true picture and correct them as is appropriate.
5. Emphasise the need of an excretory organ in multicellular organisms where diffusion alone is enough.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- 4-Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.
- Lifelong skills: Some of these learners can become teachers, nurses or doctors

Cross-cutting issues

- Inclusive education: this is observed as learners are given equal chances to express their ideas during the lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

Find out if learners are able to:

1. Differentiate between defecating and excretion.
2. Identify excretory products.
3. Design specific questions to test the learner's knowledge on the content covered.
 - What are the incidentals loses and why are they not excretory products
 - Name the organs which are involved in the incidental loses?
 - Why are feaces not referred as excretory products?

Lesson 2: The role of the liver in excretion

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to explain the role of the liver in excretion.

Materials and learning resources

High cost	Low cost
Internet, computers, charts, Text books, Models	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching/learning activities/approaches

1. You may begin this lesson by reminding learners about the various excretory organs and their waste products. Draw a table on the chalkboard and let one learner fill the table.
2. Narrow down to the liver as an excretory organ. Ask learners whether they have heard of the liver and its functions in the body.
3. You can then ask learners to form groups of four to carry out the discussion of the Student's book.
4. Learners should discuss the role of the liver in excretion.
5. Emphasise the importance of liver in removal of waste products.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- 4-Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.
- Lifelong skills: Some of these learners can become teachers, nurses or doctors

Cross-cutting issues

- Inclusive education: this is observed as learners are given equal chances to express their ideas during the Lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

Find out if learners are able to:

1. Understand the importance of the liver
2. Identify excretory products that are removed by the liver.
3. Design specific questions to test the learner's knowledge on the content covered.

- What is detoxification and deamination?
- What is the danger of high concentration of cholesterol in blood.
- Give the use of bile.
- Describe the structure of the kidney
- Describe the process of urine formation
- Explain factors that affect concentration of urine
- Explain best ways of maintaining healthy urinary system.

Answers to Self- evaluation Test 10.1

Refer to Learner's Book

1. They are not products of metabolism.
2. Waste. Kidney, ultrafiltration, respiration, liver, lungs
3. i. Deamination
ii. Liver
iii. Urea
iv. glucose/fat
4. Bile pigment/ammonia
5. From the liver where deamination occurs through hepatic vein to the vena cava to heart to aorta to renal artery and finally to the kidneys.

Lesson 3: The structure of the urinary system and practices that maintain healthy urinary system

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to;

- Describe the structure of urinary system

Materials and learning resources

High cost	Low cost
Internet, computers, charts, Text books, Models	
Hand lens or dissecting microscope.	-Fresh kidney of sheep, goat or cow.
-Knife or scalpel, razor blade, dissecting board.	

Suggested teaching methodology.

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities

1. Remind learners that the kidney is where urine is manufactured. It forms part of the urinary system.
2. Put learners into groups depending on their abilities and class size. Give them charts and text books with urinary system.

3. Allow learners to study the charts. They should then draw the charts in their exercise books and label the various parts.
4. Plan in advance to do a demonstration on dissecting an animal (mouse or rabbit) to show learners the urinary system and the kidney (or Activity 10.2).
5. Dissect the kidney and let learners observe it.
6. Let learners examine the external features of the kidney.
7. Let learner use textbooks and charts to label diagrams illustrating the internal features of the dissected kidney.
8. Let learners use textbooks to describe the functional unit of the kidney called Nephron. Let them locate different regions of the nephron.
9. Lead a discussion on the functions of a nephron as learners write short notes. Refer to content of Student's book.
10. Let learners carry out a research project of their book. Follow up on this by correcting their findings.
11. Take learners through the factors that affect urine production. Refer to Student's book.
12. Learners should then discuss the good habits that enhance healthy urinary system.
13. You will make sure that all learners are given equal chances of participation. Females alike should be encouraged

to participate especially in the dissection of the kidney.

Generic competences covered

- **Critical thinking:** this is achieved as learners find out the answers to the questions you give to them.
- **Interpersonal skills:** learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups. These skills are achieved mainly when identify the three regions of the kidney
- **Communication skills.** This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- **Listening and note taking skills:** this is achieved as the learners listen to you and during the note taking process.
- **Lifelong skills:** Some of these learners can become teachers, nurses or doctors

Cross- cutting issues

- **Inclusive education:** this is observed as learners are given equal chances to express their ideas during the Lesson. Females should be given equal chances like males. This brings in gender equality.
- **Financial education:** It will be noted that fresh kidneys which are bought are used whenever they carry out dissection.

Formative assessment

Find out if learners are able to:

1. Identify kidney and describe its internal structure
2. Describe the nephron and be able to realize it as the most important part of the kidney.
3. Outline ways that maintain the urinary system health.
3. Design specific questions to test the learner's knowledge on the content covered.
 - Identify the Bowman's capsule, proximal convoluted tubule, Loop of Henle and distal convoluted tubule
 - What is ultra filtration and selective reabsorption?
 - What are the main factors that affect urine production?

Answers to Self- evaluation Test 10.2

Refer to Learner's Book

1. Refer to Fig 10.3 of Student's book.
2. i, v, ii, iii, iv
3. Produces plenty dilute and clear urine (because it moves from a salty environment to a fresh water body)

Answers to Self- evaluation Test 10.3

Refer to Learner's Book

1. Alcohol contains a lot of water hence production of more dilute urine.
2. Treating a known disease/ avoid drug abuse.
3. The body needs water for many of its functions.

Answers to End unit assessment 10

Refer to Learner's Book

Duration: 1 period

1. D
2. B
3. E
4. Produces small concentrated urine due to increased reabsorption of water in the kidney to reduce osmotic pressure of blood.
5. i. Vol. = $1.18 \text{ dm}^3/\text{min}$
 $24 \text{ hours} = 24 \times 60 \text{ minutes}$
 $= 1440 \text{ minutes}$
Vol. for 24 hrs = 1.18×1440
 $= 1699.2 \text{ dm}^3$

ii. Volume of blood filtered in 24 hours = 1699.2 dm^3
urine produced in 24 hours = 1.7 dm^3

$$\begin{aligned} \therefore \text{Vol. of blood} &= \frac{1699.2 \text{ dm}^3}{1.7 \text{ m}^3} \\ \text{excreted as urine} &= 999.5 \text{ dm}^3 \end{aligned}$$

$$\begin{aligned} \text{Vol. of blood} &= \frac{1699.2 \text{ dm}^3}{1.7 \text{ m}^3} \times \\ 100\% & \\ \text{as urine} & \\ &= 58.8\% \end{aligned}$$

6. Excretion is the removal of metabolic wastes while egestion is the removal of undigested and indigestible food materials from the body.
7. Re-absorption of water takes place.
8. a. M - bigger diameter; Q - Smaller diameter enables ultrafiltration to occur
b. ultrafiltration
c. selective reabsorption
9. i. A-proximal convoluted tubule,
B-distal convoluted tubule
ii. Reabsorbed took place.
10. A longer loop of Henle.

Additional information for teachers

Excretion is an essential process in all forms of life because the accumulation of waste products is toxic for our body.

Excretion is also necessary to remove excess water, salts, and many other substances from the body.

The urine of a healthy human does not contain sugar, proteins and blood cells. The presence of glucose in urine is a sign of diabetes.

The presence of hormone HCG (human Chorionic gonadotrophine) in the urine of a woman is a sign of pregnancy.

Remedial activity

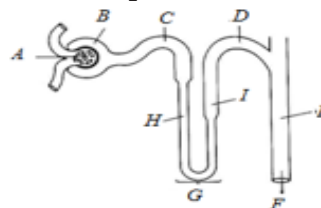
Q/ State the main excretory organs in human and their respective secretion.

Answer

Kidney – urine Liver – bile Sweat gland – Sweat Lungs – Carbon dioxide.

Consolidation activity

The diagram below represents a structure of a nephron



- a) Name parts labelled A to I
- b) Suggest a name to the structure made of A and B above

Answer

- a) A = Glomerulus b = Bowman capsule C= Proximal convoluted tubule D = Distal convoluted tubule E = Collecting duct F = Ureter G = Loop of Henle H = Descending limb I = Ascending limb.
- b) A + B = Malpighian body.

Unit 11: Joints and movement

Refer to Learner's Book

(Number of periods 6)

Key unit competence

After learning this unit, learners should be able to describe types of joints and relate their structures to their functions.

Unit outline

- Types of joints
- Action of antagonistic muscles in the movement of a hinge joint
- Practices that promote healthy bones

Links to other subject areas

Physical education in sports training and function of a fulcrum in a lever system in physics.

Background information

Bones are pulled by muscles to make them move; movement would however not be possible without joints. Human beings would be like statues were it not for joints between bones that allow bones to move. Joints can be movable, immovable or non-movable. Movable joints are places in the body where the bones rub together; therefore we need to pay more attention to them. The three major types of joints are classified structurally as fibrous, cartilaginous and synovial. Joints may also be classified functionally although it is limited since it does not allow for a precise classification scheme.

Lesson 1: Types of joints

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State the three main kinds of joints in human body.
- Explain the meaning of technical terms associated with joints and movement.
- Describe the structure of a synovial joint.

Materials and learning resources

Low cost/no cost	High cost
Fools caps	Textbooks/reference materials
	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion and demonstration lesson that will involve identification and movement of joints by learners.

- You will guide the learners in the identification of joints.
- Describe the different types of joints, their examples and the structure of a synovial joint.

Suggested teaching/learning activities/approach

1. This unit is closely linked to the skeletal system that the students learnt about in Senior 1. Remind them about this. Ask them probing questions about the skeletal system.
 2. Relate the skeletal system to bones and joints. Show learners the pictures in Fig 11.1 of Student's book. At this point you can point out the role of the joints in the body. What are some of the things that facilitate movement at the joints (muscles, ligaments and cartilages/tendons).
 3. At this point, you can introduce the two types of joints (movable and fixed).
 4. Organize learners into groups of four and guide them to carry out activity 11.1 in pairs and discuss as a group.
- Provide learners with dictionaries for the discussion activity.
5. Encourage learners to work as a team as they share duties and ideas. This will improve their team work, communication and interpersonal skills.
 6. You can then inform learners that movable joints can be divided into gliding or sinovial joints. Explain what each means.
 7. Narrow down to synovial joints. Give the different types of synovial joints.
 8. Guide learners to carry out Activity 11.2 of Student's book. Explain that this is a type of joint known as hinge joint. Others are saddle (found at the wrist), pivot (found at the neck) and Ball and socket (found at the shoulders).
 9. Show learners a chart showing synovial joint. Let them draw it in their notebooks and label. Refer to Fig. 11.7 of Student's book

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<p>Slow learners can be helped to understand the meaning of the technical terms and how to identify a specific type of joint using unique features.</p> <p>Give slow learners additional task to locate the different types of joints on a human skeleton in a worksheet</p> <p>Give fast learners additional task to research on different movements that can occur at a joint.</p>	<p>All learners with special educational needs should participate actively in the class activity.</p> <p>Physically challenged learners should be given priority in the learning process.</p> <p>Learners with sight problems should be placed at the front of the class.</p> <p>Remember disability is not inability!</p>

Generic competences covered

- Critical thinking-As learners identify unique features used to identify the different types of joints.
- Problem solving skills-As the learners locate position of different types of joints in their bodies.
- Cooperation and interpersonal skills-As learners interact through group work and sharing a dictionary.
- Communication – As learners discuss meaning of technical terms.
- Lifelong skills-as learners acquire skill of scientific observation when they look for the position of the different types of joints in the body.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

- 1 Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.

- 2 Use differentiation when asking questions to test understanding for both slow and fast learners.
- 3 Ask probing questions to test learner's attitude.
- 4 Gauge learners based on competence and gauge them appropriately.

Answers to self- evaluation test 11.1

Refer to Learner's Book

1. B
2. B
3. E

Lesson 2: Action of antagonistic muscles in the movement of a hinge joint

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State the antagonistic muscles on the upper part of the forearm.
- Explain how the antagonistic muscles bring about straightening and bending of the arm.

Materials and learning resources

Low cost/no cost	High cost
Door	Textbooks/ reference materials
	Dictionary

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a practical and a demonstration lesson that will involve straightening and bending of the arm to show effect of antagonistic muscles at a joint.
- You will guide the learners in identifying the flexor and extensor muscles of the arm.

Suggested teaching/learning activities/approach

1. Introduce the lesson by explaining the meaning of flexion and extension.
2. Organise for learners to work in pairs in the bending and extending of the arm.
3. Let learners follow the instructions given of their books.
4. Let learners research about what happens during the activity above. They should write summary notes and share with others. Correct them as is appropriate.

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
<p>Slow learners can be helped to differentiate between flexor and extensor muscles.</p> <p>Give fast learners additional task to research on other examples of antagonistic muscles in the human body.</p>	<p>All learners with special educational needs should participate actively in the class activity.</p> <p>Physically challenged learners should be given priority in the learning process.</p> <p>Learners with sight problems should be placed at the front of the class.</p> <p>Remember disability is not inability!</p>

Generic competences covered

- Critical thinking-As learners find out the effect of biceps and triceps on movement of the arm.
- Problem solving skills-As learners research on more examples of antagonistic muscles in the body.
- Cooperation and interpersonal skills-As learners interact as they work in pairs.
- Communication – As learners discuss in pairs and give answers to questions asked at the beginning and end of the Lesson .
- Lifelong skills-as learners acquire skill of scientific observation when they observe extending and flexing of the arm.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.

- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

- 1 Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
- 2 Use differentiation when asking questions to test understanding for both slow and fast learners.
- 3 Ask probing questions to test learner's attitude.

Answers to Self-evaluation Test 11.2

Refer to Learner's Book

1. Flexion
2. This is because muscles contract and relax but cannot push or stretch themselves. Hence when one muscle contracts, the other contracts allowing contraction in both directions.

Lesson 3: Practices that promote healthy bones and joints

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson, learners should be able to:

- Explain the effect of dehydration on a joint.
- Explain lifestyle practices that help promote healthy bones and joints.

Materials and learning resources

Low cost/no cost	High cost
Foollscaps	Textbooks/reference materials
	Dictionary

Special needs and multi-ability learning

Support for multi-ability learning	Support for special need learning
Give slow learners additional to research on more practices that promote healthy bones and joints.	All learners with special educational needs should participate actively in the class activity.

Suggested teaching methodology

- Guided discovery
- Research
- Questions and answers
- Discussion

Lesson preparation

- This is a discussion lesson practices that promote healthy bones and joints.

Suggested teaching/learning activities/approach

1. Introduce the lesson by explaining the meaning of osteoporosis and arthritis. (These are common diseases of bones.)
2. Organise for learners to work in groups for the discussion of Student's book. They should write down and share their findings.
3. Correct the learners as is appropriate and allow them to write summary notes on the content covered. Refer to learners book.

Give fast learners additional task to research on elbow problems that is caused by excessive rubbing of against a hard surface.

Learners with sight problems should be placed at the front of the class.

Remember disability is not inability!

Generic competences covered

- Critical thinking-As learners find out habits that promote healthy bones and joints in the group discussion.
- Problem solving skills-As learners research on effect of dehydration on a joint.
- Cooperation and interpersonal skills-As learners interact as they work in the group discussion.
- Communication – As learners discuss in groups.
- Lifelong skills-as learners acquire scientific skill on movement of the arm and maintenance of healthy bones and joints.

Cross-cutting issues

- Inclusive learning: All learners should participate actively in their study groups, whether disabled or normal.
- Peace and values education: Bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.
- Gender education: Let learners know that people of all gender can contribute equally in the group activities and the learning process as a whole.

Formative assessment

1. Find out if learners can express their ideas well by allowing each group to present their work to the rest of the class.
 2. Use differentiation when asking questions to test understanding for both slow and fast learners.
- Ask probing questions to test learner's attitude.

Answers to Self- evaluation

Test 11.3

Refer to Learner's Book

1. Extra body weight can cause arthritis and may also cause inflammation of tendons.
2. It may result to bone depletion hence weak bones.
3. Wrong shoes or clothes may cause excessive stress on the knee; resulting to wear and tear of the ligaments, cartilage and knee cap. This may cause knee pain.

Answers to End unit assessment 11

Refer to Learner's Book

Duration: 1 period

1. B 2. D 3. A
4. a. Sutures
b. Immovable
c. Protecting the brain
5. Refer to learner's book
6. To maintain bone mass and healthy bone structure.
7. No. Animals are not able to make their own food therefore, they have to move around to search for food, water, shelter among others.
8. Milk, fish (whose bones are edible) soya beans, green leafy vegetables.
9. B
10. Walking/ jumping/ swimming/ bending

Additional information for teachers

Remember that there are three main types of skeletons:

- Endoskeleton
- Exoskeleton and
- Hydrostatic skeleton.

Milk, eggs and meats are main sources of calcium and phosphorus required to harden our bones.

Remedial activity

Make group research to find out how you can make glue from cow bones.

Consolidation activity

You are provided with the human skeleton model. Identify at least ten types of bone.

Unit 12: Infectious diseases

Refer to Learner's Book

(Number of periods 8)

Key unit competence:

After studying this unit, the learner should be able to identify symptoms of common infectious diseases and their prevention and treatment

Unit outline

- Transmission of infectious diseases
- Defence against infection
- Symptoms, prevention and control of common diseases.

Assessment criteria

Check whether learners can identify symptoms of common infectious diseases namely cholera, malaria, Ebola, HIV and AIDS and their treatments.

Formative assessment criteria

The following formative assessment method should help you to confirm that the key competency of the unit has been met. It provides ways for assessing knowledge acquisition, skills attainment and attitude change.

- To assess knowledge and understanding of concepts – use the Self-evaluation Tests and specific questions in the Test Your Competence at the end of each unit. You can also formulate your own questions and/or use the extended exercises in this unit targeting special educational need learners.
- To assess skills acquisition – you may engage learners to practically observe the characteristics of collected specimens belonging to different phyla and compare to the characteristics of other phyla in kingdom Animalia.
- To assess attitude change - you may ask probing questions aimed at finding out the attitude of the learner towards classification in kingdom Animalia. This can also be assessed by giving learners sample animals to classify and assessing body language of the learner. Also, specific questions have been provided in the end of Test Your Competence which target attitude change and societal values.
You can also decide whether to assess learners at the end of the lesson or at any other appropriate time when enough content has been covered.

Background information

Infectious diseases are disorders caused by organisms – such as bacteria, viruses, fungi or parasites. Many organisms live in and on our bodies. They're normally harmless

or even helpful, but under certain conditions, some organisms may cause disease. Some infectious diseases can be passed from person to person.

Lesson 1: Transmission of infectious diseases

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to

- Define an infectious disease
- Define terminologies used in the study of infectious diseases.
- Give examples of pathogens and diseases they cause.
- Explain the modes of transmission of diseases from one person to another.

Materials and learning resources

High cost	Low cost
Text books, internet, handouts	

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Lesson preparation

- Learners to discuss the meaning of infectious diseases. They use text books and handouts given.
- Let the learner's research on the different pathogens and the diseases they cause.
- Presentation on modes of transmission of infectious diseases. This can be done in form of role plays.

Suggested teaching/learning activities/approaches

1. Introduce this unit through a discussion on the picture of the Student's book. Let the learners answer the probing questions about this picture and then correct them as appropriate.
2. Guide learners to discover what an infectious disease is.
3. Write the following journal prompts on the board or overhead; "Using a paragraph format, how would you describe the term infectious disease?"
4. Pair learners and have them discuss their responses and come up with a definition of infectious disease to share with the class.
5. Write each definition of infectious disease on the board or overhead.
6. Hold a class discussion on infectious diseases; ask learners the following information about infectious diseases which they should have picked up from the

text books and handouts. Write their responses on the board:

- a) Is cholera an infectious disease? How do you know?
 - b) Give other examples of infectious diseases?
 - c) Why are these diseases potentially fatal?
 - d) What conditions from the wagon trains or life during that time might lead to getting this disease?
 - e) How do they treat this disease?
7. Share with the class “What are re-emerging infectious diseases?”.
 8. Have learners brainstorm what they think might cause a re-emergence of a particular disease then have the entire class read the section “What causes emergence or re-emergence of infectious diseases?” Add any pieces of information that they may have previously overlooked
 9. Conclude the lesson by asking the learners to do more research of student’s book.
 10. You can also organise for a health officer to visit the school and talk to learners about infectious diseases (Activity 12.1).

Generic competences covered

- Cooperation and interpersonal skills-as learners work in group during an activity.

- Communication skills – as learners interact and do a presentation of their research findings.

Cross-cutting issues covered

- Financial education: This should be brought about while explaining to learners that diseases are costly to patients as they seek treatments.
- Health education should be emphasised. Learners should be taught the value of the *umuganda* as done every month. This helps to control some of the diseases like malaria.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the Lesson by their participation.
2. Find out whether learners can identify the types of diseases and be able to classify them accordingly. Use a matching table for this test.
3. Test learner’s skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various competencies and the tests given to assess skills acquisition and attitude change.

Answers to Self- evaluation Test 12.1

Refer to Learner's Book

1. A
2. TB/ cold/ flu/whooping cough
3. HIV and AIDs/ malaria

Lesson 2: Defence against infection

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson ,learners should be able to

- Describe how the body defends itself from disease-causing pathogens.
- Explain the body's first line of defence.
- Describe the body's second line of defence.

Materials and learning resources

High cost	Low cost
Text books, internet, hand outs,projector	

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Lesson preparation

1. This is generally a discussion lesson.
2. You will provide learners in groups with text books, internet accessibility and handouts.

Suggested teaching/learning activities/approach

1. You may motivate learners to find out the lines of defence of the body through use of questions such as,
 - What is the function of the Rwandan army?
 - Do you think the body also has an army?
 - What could be the function of the skin, hydrochloric acid, mucous membranes and lysozyme enzymes of the tears?
 - What do you think would be the case if bacteria broke the skin and entered into the body?
 - Explain the cell reaction and the process of phagocytosis.
2. Give the learners time to discuss these questions in their small groups.
3. Ask the learners to choose a leader within their groups. This leader will present the ideas of the group to the rest of the class.
4. You should correct their presentations. Write the final points on the chalk board. Let the learners copy them into their note books.

5. You can then ask learners the meaning of defence. They will come up with various suggestions. Use their suggested answers as a base to explain the importances of the body's defence system.
6. Guide learners to differentiate between the first line and second line defence systems. Refer to Student's book. Emphasise what body immunity is
7. Organise learners in groups of four. Provide them with charts showing the bodies lines of defence. Ask them to identify the different sections that make up the bodies lines of defence.

Generic competences covered

- Cooperation and interpersonal skills-as learners work in group during an activity.
- Communication skills—as learners interact and do a presentation of their research findings.
- Critical thinking: This is achieved when learners are given time to think and find answers for the research questions.

Cross-cutting issues covered

- Financial education: This should be brought about while explaining to learners that diseases are costly to patients as they seek treatments. They should appreciate the importance of body's defence mechanisms.
- Health education should be emphasised. Learners should be

taught the value of having good health. We can only have good health if we are protected from pathogens.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the Lesson by their participation.
2. Find out whether learners can identify the types of diseases and be able to classify them accordingly. Use a matching table for this test.
3. Test learner's skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various competencies and the tests given to assess skills acquisition and attitude change.

Answers to Self- evaluation Test 12.2

Refer to Learner's Book

1. Protection against disease
Resisting attack
Pathogens/ germs
Host
2. First line prevents entry of microorganisms while second line fights the microorganism in the body.

Lesson 3: Symptoms, prevention and control and treatment of infectious diseases

Refer to Learner's Book

Duration: 3 periods

Specific objectives

By the end of the lesson, learners should be able to:

- State the pathogens that cause infectious diseases.
- State the vectors of malaria and cholera.
- Describe the symptoms of infectious diseases.
- Describe how one can prevent infectious diseases.

Materials and learning resources

High cost	Low cost
Text books, internet, hand outs	Wall charts

Suggested teaching methodology

- Inquiry learning
- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Lesson preparation

- Learners will learn by engaging the health worker in a discussion.

Suggested teaching/learning activities/approach

1. This is generally a field study lesson where learners will visit a healthy center.
2. You will ask the learners to prepare questions to ask the health worker at the health center, for example.
 - What are the common infectious diseases in Rwanda?
 - How is malaria spread from one person to another?
 - What has the government of Rwanda done to bring down these diseases?
 - Why is cholera a potentially dangerous disease?
 - What can community members do to stop the spread of cholera other infectious diseases?

Note: You will give guidelines on how these learners shall behave during the trip.

4. On reaching the health center, you will ask learners to engage the health worker in a series of questions. These should strictly be about the infectious diseases.
5. Let the learners note down the answers they get in their notebooks.
6. You will conclude the lesson by harmonising learners findings and correcting them where necessary.

Note: The lesson should concentrate on these infectious diseases: Cholera, TB, Malaria, Salmonellosis, typhoid, Ebola and HIV and AIDS.

Generic competences covered

- Cooperation and interpersonal skills-this is achieved as the learners engage the healthy worker in a series of questions .and later as they discuss the results amongst themselves.
- Communication skills—as learners interact and do a presentation of their research findings.
- Critical thinking: This is achieved when learners are given time to think and find answers for the research questions.

Cross-cutting issues covered

- Financial education: This should be brought about while explaining to learners that diseases are costly to patients as they seek treatments. They should appreciate the importance of body's defence mechanisms.
- Health education should be emphasised. Learners should be taught the value of having good health. We can only have good health if we are protected from pathogens. Learners should also be reminded that washing hands is one way of controlling diseases.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the Lesson by their participation.
2. Find out whether learners can state the cause of malaria and be able to describe how cholera can be controlled. Use a matching table for this test.
3. Test learner's skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various competencies and the tests given to assess skills acquisition and attitude change.

Answers to Self- evaluation

Test 12.3

Refer to Learner's Book

1. B
2. Protection / keeping proper hygiene
3. Education/ immunization/ quarantine

Answers to End unit assessment 12

Refer to Learner's Book

Duration: 1 period

1.
 - Drugs / hospital bills eat into family income
 - Loss of bread winner
 - Strain on medical facilities and family income
2. Resistance to first line drugs.
3. Ignorance and sticking to traditions that promote spread of the disease.
4. Compromises the immune system of the body.
5. Blood group/ screening for diseases.
6.
 - i. Malaria
 - ii. D
 - iii. Use mosquito net
7. Prevent germs from getting into the body.
8. Check for facts, correctness and measures suggested.
9. Not possible-due to migrations/ pathogens can find favourable environment and become active.
10. Poverty/ ignorance/ lack of seriousness.

11. The roleplay should include:

To prevent the spread of COVID-19:

- Clean your hands often. Use soap and water, or an alcohol-based hand rub.
- Maintain a safe distance from anyone who is coughing or sneezing.
- Wear a mask when physical distancing is not possible.
- Don't touch your eyes, nose or mouth.
- Cover your nose and mouth with your bent elbow or a tissue when you cough or sneeze.
- Stay home if you feel unwell.
- If you have a fever, cough and difficulty breathing, seek medical attention

Additional information for teachers

Not all diseases are infectious diseases. But when their signs or symptoms are similar to those of infectious diseases, it is cautious to guess infectious diseases and to take preventive measures.

Remedial activity

State an infectious disease caused by:

- a) Viruses
- b) Bacteria
- c) Protozoa

Answers

- a) AIDS/HIV – Ebola – Covid-19 – Influenza
- b) Tuberculosis – Cholera – Gonorrhoea – Typhoid
- c) Malaria – Amoeba – African sleeping sickness.

Consolidation activity

Discuss the accuracy of wearing mask to prevent Covid-19.

Answer:

Masks can help prevent the spread of the virus from the person wearing the mask to others. Masks alone do not protect against COVID-19, and should be combined with physical distancing and hand hygiene. Follow the advice provided by your local health authority.

Unit 13 : Immunity and vaccination

Refer to Learner's Book

(Number of periods 8)

Key Unit Competence

After studying this unit, the learner should be able to describe natural and artificial methods that fight against infection.

Unit outline:

- Antibody and antigen
- Immune response
- Immunisation

Assessment criteria

Check whether learners can describe natural and artificial methods that fight against infection.

Background information

All vertebrate animals have an automatic system called immune system which protects their bodies. It's largely made of special proteins called antibodies. Usually the immune system is triggered by substances called antigens. The response of an organism to antigen which results into elimination of antigen is called immunity.

Lesson 1: Antibodies and Antigens

Refer to Learner's Book

Duration: 4 periods

Specific objectives

By the end of the lesson , learners should be able to.

- Define the term immunity and vaccination.
- Understand how antibodies destroy antigens.
- Describe pathogens in relation to immune response

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books.	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching, learning activities

1. Let learners discuss what is going on in the picture. Learners should then predict what the topic is about.
2. Put learners in groups to carry out activity 13.1 in the student's book.
3. Use text books to identify blood components and organisms which can be pathogens that can act as antigens.

4. Let learners find out why it's difficult to destroy some antigens especially the foreign antigens such as viruses, for example, Human Immuno deficiency Virus (HIV).

Make sure that all learners are given equal chances of participation. Females alike should be encouraged to participate.

5. Use charts and text books to identify cells which produce antibodies.
6. Discuss the "one antibody one antigen phenomenon" Let learners find out why antibodies are specific to only one type of antigen.
7. Learners should then draw the structure of antibody (Fig. 13.2) in their books and label it.
 - Discuss and compare what learners have come up with concerning the phenomenon

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become teachers, nurses or doctors or Health workers.

- Analytical skills: When learners discuss "one- antibody one-antigen" phenomenon ,they get analytical skills.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

- Financial education: Finances are considered when discussing the source of antibodies used in vaccination..
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

Find out if learners are able to:

1. Describe the structure of antibodies in relation to antigens
2. Design specific questions to test the learner's knowledge on the content covered, for example:
 - a) What is the difference between antibodies and antigens?
 - b) Why are antibodies important in our bodies?
 - c) Which blood components are responsible for the immune response?
 - d) Give examples of foreign antigens.
 - e) Describe the process of inflammation.

Answers to Self- evaluation Test 13.1

Refer to Learner's Book

1. Check for correct diagram
2. Having an immune system

Lesson 2: Immune response

Refer to Learner's Book

Duration: 2 periods

Specific objective

By the end of the lesson, learners should be able to.

- Define the term immune response.
- Categorise types of immunity.
- Immunisation

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books.	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching, learning activities

1. Begin the lesson with the activity 13.2. Let learners watch an

animation video illustrating inflammation of the skin.

2. Guide learners to understand what an immune response is and the various types of immunity.
3. Guide learners to use text books, charts and internet to find out the differences between innate immunity and acquired immunity natural/artificial immunity and active/passive immunity.
4. Let learners find out the importance of vaccination. Refer to discussion corner.
5. Use charts and textbooks to identify types of immunity.

Let learners find out why breast feeding is important in the immunisation process.

- Discuss and compare what learners have come up with concerning this phenomenon.
 - Guide them to make short notes and share with other class members.
6. Make sure that all learners are given equal chances of participation. Females alike should be encouraged to participate.

Answers to Self- evaluation Test 13.2

Refer to Learner's Book

1. Active immunity is due to contact with pathogen or its antigen while passive immunity is due to antibodies from outside.
2. The immune system is made up of a network of cells, tissues and organs that work together to protect the body.
3. Breast milk contains all nutrients and antibodies for immunity/ easily digested/ helps in bonding.

Lesson 3: Immunisation and auto immunity

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson, learners should be able to:

- Define the term immunisation.
- Explain autoimmunity.
- Describe Type 1 diabetes.

Materials and learning resources

High cost	Low cost
Internet, computers, charts and Text books.	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching, learning activities

1. You may carry a immunisation card to class to introduce this topic. Ask learners whether they know what it is.
2. Find out from learners the importance of the cards. Group them to discuss why Rwanda government insists on immunising children.
3. Let them compile notes and choose one member to do a presentation. Correct them as they go along.
4. In their groups, let them discuss about type 1 and type 2 diabetes. Refer to the discussion corner of Student's book.
5. Guide learners to find out the meaning of the word autoimmunity.
6. Let learners watch an animation illustrating complications due to altered immune response.
7. Use textbooks, charts and internet to find out the differences between type 1 and type 2 diabetes caused by altered immune response.
8. Let learners use internet and textbooks to find out other

diseases caused by altered immune system.

9. Discuss and compare what learners have come up with concerning altered immune response. Correct them where appropriate.

Refer to Student's book for details.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become teachers, nurses or doctors or health workers.
- Analytical skills: When learners discuss antibody antigen phenomenon, they get analytical skills.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross-cutting issues

- Financial education: Finances are considered when discussing the source of antibodies used in vaccination. Production of vaccines can generate income.

- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

Find out if learners are able to:

- To describe the altered immune response.
- Design specific questions to test the learner's knowledge on the content covered for example:
 - a) What does the baby lack when is fed on cow's milk instead of mother's milk
 - b) Outline viruses which have antigens similar to antigens of beta cells.
 - c) Give disorders that normally result from altered immune response.
 - d) What are the phagocytes?

Answers to Self-evaluation Test 13.3

Refer to Learner's Book

1. Wrong immune response
2. Refer to Student's book

Answers to End unit assessment 13

Refer to Learner's Book

Duration: 1 period

1. It has antibodies
2. The antibody has an active site which binds the antigen molecule. The active site is thought to have a fixed structure (the lock), which exactly matches the structure of a specific antigen.
3.
 - a. To prevent/reduce severity of childhood diseases.
 - b. Possibility of full-blown childhood diseases.
4. B
5.
 - (a) False
 - (b) True
 - (c) True
 - (d) False
6. C
7.
 - a. Active, antigen-antibody
 - b. Innate
 - c. islets of Langerhans, insulin.
8.
 - a. False rumor
 - b. Take his child for vaccination.
 - c. Check for correct myths in the society.

Additional information for teachers

Two types of white blood cells are important in the immune system: lymphocytes and phagocytes. There

are two types of lymphocytes: T-cells and B-cells.

Both types of lymphocytes have surface receptors, but they react differently to foreign antigens:

- T-cells attack and destroy the foreign antigen.
- B-cells bind to the foreign antigen and prevent it from being active.

Remedial activity

Differentiate the mode of action of T-lymphocytes and that of B-lymphocytes

Answer

- T-lymphocytes attack and destroy the foreign antigen.
- B-lymphocytes bind to the foreign antigen and prevent it from being active.

Consolidation activity

In pairs, refer to Figure 13.2 and answer these questions:

- 1) Explain to your partner why the way in which antibodies and antigens work can be compared to a lock and key.
- 2) Ask your partner to explain what is meant by the term 'binding site'.

Answers

- 1) Because both antibody and antigen have complementary shapes like those of a key and its padlock
- 2) Binding site is the region of the antibody where the antigen fits in.

Unit 14 : Sexual behaviour and sexual response

Refer to Learner's Book

(Number of periods 4)

Key unit competence

After studying this unit, the learner should be able to explain safe sex, sexuality and sexual behaviours and argue for control of sex violations.

Unit outline:

- Sexual stimulation and responses
- Puberty and sexual relationships
- Sexuality
- Violation of human rights

Links to other subjects:

Early and unintended pregnancies are causes of early death and poverty as studied in Geography and Economic.

Assessment criteria

Check whether the learner can explain male and female sexual response and apply critical thinking skills in discussing forming relationships and control of sex violations.

Background information

Continuity of life depends on reproduction. One type of reproduction is sexual reproduction which involves union of a female and male gamete. In vertebrate animals before reproduction occurs the animal must reach sexual maturity. This maturity is both physical and

emotional. Organisms which do not reach sexual maturity can have successful reproduction.

Lesson 1: Male and female response

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson , learners should be able to:

- Describe the male and female responses to sexual stimulation
- Explain different ways couples can show love and affection
- Recognise that sexual relationships require emotional and physical maturity.

Materials and learning resources

High cost	Low cost
Internet,computers,charts books	

Suggested teaching and methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities /approaches

1. Use the pictures of student's book to introduce the topic.
2. You will ask learners to form groups of four.
3. Learners should discuss what they know about love and adolescence and its risks.
4. Let learners contribute to the discussion. Correct the learners where they go wrong.
5. You can build on the learner's contributions to give them a true picture about love.
6. Highlight the various stages in human sexual response and their advantages and disadvantages. Refer to student's book.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Communication skills. This is achieved as the learners express their ideas to the teacher and class members during the discussion.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

Inclusive education: this is observed as learners are given equal chances to express their ideas during the Lesson. Females should be given equal chances like males. This brings in gender equality.

Formative assessment

1. Find out if learners are able to:
 - Express love without sexual relationship
 - Outline feelings, beliefs and attitudes towards sex.
 - Design specific questions to test the learner's knowledge on the content covered. For example
 - i .What are the examples of sex violation?
 - ii. In what ways can sex violations be controlled?

Gauge learners based on their competence and grade them accordingly.

Answers to Self- evaluation Test 14.1

Refer to Learner's Book

1. Refer in the student's book.
2. Learners should be able to come up with a step diagram that shows sexual response.
3. Avoid bad company, lewd music, books and videos/engage in hobbies and constructive activities.

Lesson 2: People and sexual relationships

Refer to Learner's Book

Duration: 1 period

Specific objectives

By the end of the lesson , learners should be able to:

- Know changes that occur in their bodies in relation to sexual stimulation
- Explain the cause of sexual feeling.
- Describe what happens to the body of a girl and a boy during puberty.

Materials and learning resources

High cost	Low cost
Projector,CDs, computers, internet	Charts,

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions.
- Question and answer.

Suggested teaching and learning activities

1. You will ask learners to form groups of four.

2. Let learners use textbooks to find out male and female secondary characteristics and write them down.
3. Let the learners note down the differences they find between female and male secondary characteristics.
4. Let learners discuss the power of sexual stimulation and do the following activities
 - Look and describe diagrams and charts illustrating secondary characteristics
 - Discussion and comparison of what the learners have observed.
5. Summarise the topic by highlighting the sexual problems and disappointments. Refer to student's book.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become nurses or doctors
- Analytical skills: These are attained as the learner study sex related violence especially in homes.

- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

- Financial education: It will be noted that girls need more money for cloth and other material than boys
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

1. Find out if learners are able to:
 - Explain the secondary characteristics.
 - Explain the importance of some of mentioned secondary characteristics.
2. Design specific questions to test the learner's knowledge on the content covered for example:
 - What brings the secondary characteristics
 - Who first shows the secondary characteristics?
 - How are the secondary characteristics related to sexual stimulation?

Lesson 3: Sexuality, age and culture

Refer to Learner's Book

Duration: 1 period

Specific objective

By the end of the lesson , learners should be able to:

- Define the term sexuality
- Understand the effect of age on sexual activity of an individual
- Explain human right violations especially those related to sexual activities

Materials and learning resources

High cost	Low cost
Text books, Internet, computers.	Charts

Suggested teaching methodology

- Guided discovery.
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching learning activities

1. Start the lesson with an activity such as watching a movie on sexual violation.
2. Let learners use textbooks to find out sexual violation and human right.
3. Ask the learners what they think about sugar mummies and sugar daddies. Guide them accordingly.
4. You will make sure that all learners are given equal chances of participation. Females alike should be encouraged to participate.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become nurses or doctors or health workers.
- Analytical skills: These are attained as the learner study sex related violence especially in homes.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

- Financial education: It will be noted that girls need more money for cloth and other material than boys.
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

Find out if learners are able to explain the term sexuality. Design specific questions to test the learner's knowledge on the content covered for example:

- (a) What are the causes of sexual violence?
- (b) Give examples of sexual violence.

Answers to Self- evaluation Test 14.2

Refer to Learner's Book

1. Unwanted pregnancies / dropping out of school/ contracting STIs
2. Poverty/ forced abuse / easy target
3. The community and religious views on sexual matters

Answers to End unit assessment 14

Refer to Learner's Book

Duration: 1 period

1. Complementing each other/ consulting each other/resolving emerging issues
2. Stage of discovering sexuality/ like experimenting/ vulnerable
3. Age where an organism is able to reproduce, puberty stage where critical decisions has to be made
4. Pointing out violations/ informing relevant authorities/ education
5. Unwanted pregnancies/ STIs
6. Support/ faithfulness/ perseverance/ understanding

7. a. Change of emotions / physical change/ responsibilities/ decision making
 - b. Engage in constructive activities (sports) and hobbies / guiding and counseling/support groups
8. Debatable; check for convincing arguments
9. Report to authorities, parents, teachers and guardians
10. Punishment to correct/ advice/ guiding and counselling.

Additional information for teachers

Boys and girls need to have a good knowledge of sexual behaviour as they reach puberty. This will enable them to make informed

choices about their own sexual behaviour.

In particular, girls need to know that they have rights over their own bodies. They should not allow themselves to be forced into relationships that they do not want.

Remedial activity

Which of the following behaviors can have a negative impact sexual responsiveness:

- A. Teenager brother and sister sharing the same bedroom
- B. Studying in mixed school of both boys and girls
- C. A girl playing football in the same team with boys
- D. Teenager boys watching porno films in their dormitory.
- E. A teenager boy and girl discussing their lesson in bungalow

Answer:

A and D (but E also when isolated or in darkness)

Consolidation activity

Will girls of your generation have more access to health care, education and information than your grandmothers did? Why?

Answer:

Yes, because the education of girls is now a worldwide concern that was like that in some years back.

Indeed, in some countries or areas, gender equity and gender balance are not addressed yet but everybody should combine effort for promotion of gender.

Unit 15 : Pregnancy prevention

Refer to Learner's Book

(Number of periods 6)

Key unit competence

After studying this unit, the learner should be able to apply knowledge of pregnancy prevention in sexual and reproductive decisions.

Unit outline

- Contraceptives
- Artificial contraceptives
- Hormonal based contraceptives
- Non-hormonal based contraceptive

Assessment criteria:

Check whether the learner can apply knowledge of pregnancy prevention in sexual and reproductive decisions.

Background information

The primary function of sexual intercourse is to produce. However sometimes its done for the purpose of pleasure. Sexual intercourse is unique in a way that it can always result into pregnancy weather a woman is forced or not. It's very important to plan for the family by preventing unwanted pregnancies.

Lesson 1: Contraceptives: Natural contraceptives

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson , learners should be able to:

- Define the term contraceptive
- Differentiate between myths and truth about contraceptives.
- Understand natural contraceptives.

Materials and learning resources

High cost	Low cost
Internet, computers, charts books	Various contraceptive

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching learning activities

1. Start the lesson with an activity on watching an animation about fertilisation or observing diagrams in textbooks and charts of fertilisation
2. Let learners use textbooks to find out the age bracket of women who can become pregnant and how women can avoid unplanned pregnancies.
3. Ask the learners what they think about contraceptives.
4. They should observe and describe diagrams and charts illustrating the use of contraceptive. Refer to students's book.
5. Have a discussion and comparison of what the learners have observed as they take notes.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become nurses or doctors or Health workers
- Analytical skills: These are attained as the learner find out causes of unwanted pregnancies and how they can be stopped.

- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process

Cross- cutting issues

- Standardization culture: As learners find out how to use contraceptives.
- Financial education: It will be noted that unplanned pregnancies are very expensive where as contraceptives are not expensive.
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

1. Find out if learners are able to explain the term contraceptive
2. Design specific questions to test the learner's knowledge on the content covered, for example:
 - (a) What is the attitude of people towards contraceptive?
 - (b) How effective are contraceptive?

Answers to Self- evaluation

Test 15.1

Refer to Learner's Book

1. Abstinence/ family
2. Check for correct misconceptions

Lesson 2: Artificial contraceptives

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson , learners should be able to:

- Differentiate between natural and artificial contraceptives.
- Know most of artificial contraceptive methods such as Barrier methods and Hormonal based contraceptive.
- Advantages and disadvantages of each artificial contraceptive.

Materials and learning resources

High cost	Low cost
Internet, computers, charts books	Various types of contraceptive,

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching learning activities

1. Start the lesson with an activity. Watch a movie of a learner who drops out of school because of pregnancy.

2. Let learner use textbooks and charts to determine the most effective method to prevent pregnancies.
3. Discuss the effects of unplanned pregnancies on both girls and boys.
4. Discussion and comparison of what the learners have as they take notes.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become nurses or doctors or Health workers
- Analytical skills: These are attained as the learner find out causes of unwanted pregnancies.
- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process

Cross- cutting issues

- Financial education: It will be noted that unplanned pregnancies are very expensive where as contraceptives are not expensive.
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can

help each other to realize their potential.

Formative assessment

1. Find out if learners are able to explain how a woman become pregnant.
2. Design specific questions to test the learner's knowledge on the content covered.

Lesson 3: Non-hormonal based contraceptive

Refer to Learner's Book

Duration: 1 periods

Specific objectives

By the end of the lesson , learners should be able to

- Differentiate between hormonal and non-hormonal contraceptives
- Know most of non-hormonal contraceptive methods such as IUD and permanent contraception methods.
- Outline advantages and disadvantages of each.

Materials and learning resources

High cost	Low cost
Internet, computers, charts, books	Various contraceptive,

Suggested teaching methodology

- Guided discovery
- Role playing

- Research
- Discussions
- Question and answer

Suggested teaching and learning activities

1. Begin the lesson with an activity on watching an animation illustrating how non hormonal based contraceptives methods are used.
2. Let learners use textbooks and charts to know the advantages and disadvantages of IUDs and permanent contraception. Determine the most effective method that prevent pregnancies.
3. Ask the learners what they think about abortion. Is it a necessary evil? Guide them accordingly.
4. Discuss the effects of non-hormonal based contraceptives.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become teachers, nurses, doctors or health workers.
- Analytical skills: These are attained as the learner find out causes of unwanted pregnancies.

- Listening and note taking skills: this is achieved as the learners listen to you and during the note taking process.

Cross- cutting issues

- Financial education: It will be noted that unplanned pregnancies are very expensive where as contraceptives are not expensive.
- Inclusive education: this must be observed especially by mixing more able and less able learners in groups created. These can help each other to realize their potential.

Formative assessment

1. Find out if learners are able to explain how IUDs are used and their side effects.
2. Design specific questions to test the learner's knowledge on the content covered for example
 - (a) Explain Non-hormonal based device(IUDs)
 - (b) Explain why few people opt for permanent contraception methods such as sterilization and vasectomy.

Answers to Self- evaluation Test 15.2

Refer to Learner's Book

1. No. It is illegal to do abortion in Rwanda. Check learners arguments.
2. They don't work on their own.
3. Diaphragm/ implant/ pill.

Answers to End unit assessment 15

Refer to Learner's Book

Duration: 1 period

1. D
2. B
3. Yes– because the chances of getting bruised during sexual intercourse is reduced hence reducing chances of transmission.
4. a. No. It is against human rights. People should be given the option to chose
b. Natural methods
5. Refer to student's book.
6. All are false
7. Ignoring doctor's instructions/ incompatibility with the body/ breakage or malfunction
8. No protection from STIs/ requires time to learn, commitment and discipline / abstinence is a challenge .
9. Lead to complications or death of both mother and foetus
10. a) Peer influence/the media/ lack of parenting/ sexual abuse/ lifestyle / rape.
b) Adoption / foster homes.
c) Check for learners arguments.

Additional information for teachers

There are many myths about pregnancy prevention among young people. So you need to help. Some say:

“The first time you have sex, it cannot result in pregnancy”. This is not true. This myth has led to many unwanted pregnancies.

“If you use contraception, you will never ever be able to start a family”. This is not true, except in the case of permanent contraception, which you will learn about later in this unit.

“ If a boy or a girl does not play sex early, he or she will become abnormal. This is false and just a trap for unwanted sex.

Remedial activity

The Rwandan government has reduced the occurrence of teenage pregnancies. What measures have contributed to this success?

Answer:

- Law punishes the early marriage (below 21) as well as the author of teenage pregnancy
- Girls are encouraged to study
- Youth is trained about the side effect of early pregnancy

Consolidation activity

Advocate for use of contraceptive methods in couples:

Answer:

- Contraception enables couples to decide whether or not to have children.
- Some people do not form committed relationships, but still have sexual intercourse. In this case, it is best for the woman to not fall pregnant as she has no guarantee of support and love from the man. And, she will be forced to raise the child alone.
- Some husbands and wives decide that their family is big enough. They can't or don't want to support, feed, clothe and educate more children.
- Some women, for health reasons, do not want to have more children.

Unit 16: Reducing risk of STIs and HIV and AIDS

Refer to Learner's Book

(Number of periods 8)

Key unit competence

After studying this unit, the learner should be able to apply knowledge of STI and HIV transmission, prevention and treatment in sexual decision making

Unit outline

- Transmission of STIs
- Ways of reducing STIs
- Role of condoms in preventing STIs

Assessment criteria

Check whether the learner can apply knowledge of STI and HIV transmission, prevention and treatment in sexual decision making

Background information:

Reproductive health refers to diseases, conditions and disorders that affect the functioning of the male and female reproductive systems. Some of disorders of reproduction include reduced fertility, premature birth, menstrual disorders and birth defects. Reproductive health implies that people are able to have responsible, safer sex life and to have children when they decide to. Irresponsible sexual behavior increases chances

of individuals contracting sexually transmitted infections. People therefore need to be informed on how to access safe, effective and affordable health care services.

Lesson 1: Transmission of sexually transmitted infections

Refer to Learner's Book

Duration: 3 periods

Specific objective

By the end of the lesson learners should be able to describe means by which sexually transmitted diseases are acquired from person to person.

Materials and learning resources

High cost	Low cost
Text books, projector, wall charts showing modes of transmission of STIs	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching and learning activities

1. Introduce the topic by asking probing questions about the picture on Fig 16.1. Guide the learners as they answer the questions. Organise learners into groups of four.
2. Ask each group to discuss only one disease under the following headings;
 - Causative agent (include scientific name).
 - Incubation lesson.
 - Mode of transmission.
3. You will provide each group with a manila paper. Ask the learners to put their work on the Manila paper.
4. Let each group choose a secretary. He/she will present the group work to the rest of the class.
5. You will assess the learner's presentation. Correct them as is appropriate.
6. Ask learners to write down main points in their note books.
7. Do the same for all the sexually transmitted diseases covered in student's book.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their

groups. They also learn how to solve problems that may arise in their groups.

- Lifelong skills: Some of these learners can become teachers, nurses, doctors or health workers.

Cross cutting issues

- Sex education
- Financial education
- Inclusive education.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the Lesson by their participation.
2. Find out whether learners can state the cause of STIs and be able to describe how STIs can be controlled. Use a matching table for this test.
3. Test learner's skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various competencies and the tests given to assess skills acquisition and attitude change.

Answers to Self- evaluation Test 16.1

Refer to Learner's Book

1. Abstinence for the unmarried/
condoms and faithfulness for
the married.
2. All can be prevented.
3. Sex

Lesson 2: Ways of reducing STIs

Refer to Learner's Book

Duration: 2 periods

By the end of the lesson ,learners should be able to:

- Explain methods through which STIs can be reduced.
- Appreciate the role of abstinence in reducing STIs.

Materials and learning resources

High cost	Low cost
Text books, projector, wall charts showing modes of transmission of STIs and their prevention.	

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching learning activities

1. This is generally a role play lesson.
2. You will group learners into fours.
3. You will ask them to create a role play/skit showing how a person can prevent himself/herself from acquiring STIs. This involves use of condoms, abstinence etc
4. You will ask learners in other groups to note down the knowledge learnt from these skits/role plays.
5. You will provide learners with textbooks, handouts and internet. Ask the learners to research on the following questions.
 - How to avoid contracting STIs?
 - Which method of prevention is the safest?
6. You will ask these learners to present their findings to the class.
7. Assess their answers and correct them as in appropriate let learners take notes during the discussion.

Generic competences covered

- Critical thinking: this is achieved as learners find out the answers to the questions you give to them.
- Interpersonal skills: learners learn working with each other in their groups. They also learn how to solve problems that may arise in their groups.
- Lifelong skills: Some of these learners can become teachers, nurses, doctors or health workers.

Cross cutting issues

- Sex education: Through guiding learners on how condoms are used. This equips learners with skills to avoid STIs and unwanted pregnancies.
- Inclusive education. Every learner should participate fully.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the lesson by their participation.
2. Find out whether learners can state the cause of STIs and be able to describe how STIs can be controlled. Use a matching table for this test.
3. Test learner's skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various competencies and the tests given to assess skills acquisition and attitude change.

Lesson 3: Treatment of STIs and HIV

Refer to Learner's Book

Duration: 2 periods

Specific objectives

By the end of the lesson, learners should be able to:

- Describe treatment of STI and HIV.
- Appreciate the role played by condoms in the prevention of STIs.

Materials and learning resources

High cost	Low cost
Text books, projector, wall charts showing use of condoms, penis model	Male and female condoms, yellow banana

Suggested teaching methodology

- Guided discovery
- Role playing
- Research
- Discussions
- Question and answer

Suggested teaching learning activities

1. This is generally a demonstration lesson. Distribute the handout to learners and instruct them to read the instructions. The handout can be completed during the demonstration or directly afterwards.
2. Let learners know that latex condoms are necessary to prevent transmission of STI and HIV.
3. Let learners know that the best treatment for STIs is abstinence and proper use of condoms.

4. Inform learners that early treatment of STI very important.

Generic competences covered

- Lifelong skills. Learners will acquire skills to use in their everyday life .this includes how to use a condom. It can help them to avoid un wanted pregnancies and sexually transmitted infections.
- Communication skills: these are attained as the learners communicate and discuss issues during the lesson.

Cross-cutting issues

- Sex education: Through guiding learners on how condoms are used. This equips learners with skills to avoid STIs and un wanted pregnancies.
- Inclusive education. Every learner should participate actively.

Formative assessment

1. Assess individual learners to gauge their attitude and interest in the Lesson by their participation.
2. Find out whether learners can describe how condoms are safely used. Use a matching table for this test.
3. Test learner's skills in researching and presentation of information during the activities.
4. Allocate marks for each colour and calculate the marks that the learner has attained. Grade the learners based on how they have scored on the various

competencies and the tests given to assess skills acquisition and attitude change.

Answers to Self- evaluation Test 16.2

Refer to Learner's Book

1. Pre-test and post- test counselling/ information on living positively with HIV and AIDS.
2. ART is Anti-retroviral therapy; a combination of several antiretroviral medicines used to slow the rate at which HIV makes copies of itself (multiplies) in the body.

Answers to End unit assessment 16

Refer to Learner's Book

Duration: 1 period

1. Sexual contact
2. Refer to student's book.
3. D
4. A
5. Stigmatisation/ loneliness/ lack of income/ death of breadwinner/ dropping out of school.
6. Use of ARV/ eating healthy and exercising/ support groups
7. Guiding and counselling / HIV testing/ support groups / ART.

8. Stage of discovery/ peer influence/ the media/ abuse by adults.
9.
 - a) Poses a greater risk
 - b) Should always use a condom or go for HIV test and be faithful to one partner.
 - c) No, -you can become infected during sex.
 - d) Only if used properly because they can burst or have leaks.
 - e) False
10. It offers a good opportunity to ask questions and clarify on issues affecting the youth.

Additional information for teachers

Around the world, there are an estimated 357 million new STI infections every year. Three serious STIs are chlamydia, gonorrhoea and syphilis.

As yet, there is no cure for HIV/AIDS, so a person who has AIDS will eventually die from the disease. However, anti-retroviral drugs (ARV) can help to delay the development of AIDS. These drugs and healthy feeding can therefore help people with HIV/AIDS to live healthier lives for longer.

Remedial activity

State any 3 STIs

Answer:

chlamydia, gonorrhoea and syphilis.

Consolidation activity

It is said that Aids is not an STI. Discuss

Answer:

Aids can be considered as STI because it is also transmitted through sex intercourse. But sex intercourse is not the only way of transmission of Aids. It can also be transmitted through the blood transfusion, breastfeeding and any other contact of mucus.

Glossary

A

Abiotic - physical factors in the environment that affect living organisms. They include; wind, humidity, sunlight, soil and atmospheric pressure among others.

Abortion - deliberate physical or chemical termination of human pregnancy.

Aboral- relating to or denoting the side or end that is furthest from the mouth, especially in animals that lack clear upper and lower sides, such as echinoderms.

Abstinence - act of restraining oneself from indulging or doing something; for example, restraining oneself from having sex.

Active transport - movement of particles against a concentration gradient.

Active site- a region on an enzyme that binds to a protein or other substance during a reaction.

Aerenchyma tissue - A spongy tissue with large intercellular air spaces that is found in aquatic plants. It provides buoyancy and allows the circulation of gases.

Aerosol - a substance enclosed under pressure and able to be released as a fine spray.

Agglutination - the clumping together in suspension of antigen-bearing cells, micro-organisms or particles in the presence of specific antibodies.

Amenorrhea - absence of menstruation for at least three months

Appendage - a structure that attaches to another part of the body.

Antagonistic muscles - a muscle that opposes the action of another, for example, the biceps and triceps.

Antibody - proteins found in plasma that are responsible for mediation of immunity in body fluids.

Antibiotic - a drug derived from bacteria or fungus and is used to treat bacterial infections.

Anti-retroviral (ARV) - drugs to maximally suppress the HIV virus and stop the progression of HIV disease.

Antigen - any substance that stimulates response of a specific immune system.

Articulate - meet at a point to form a joint.

Arthritis – a condition that causes pain and inflammation in a joint.

Autoimmune - a condition arising from an abnormal immune response to a normal body part.

B

Biotic - activities of living organisms that affect an ecosystem.

Bilateral symmetry - symmetrical arrangement of an organism or part of an organism along a central axis.

Bilirubin - a yellow pigment produced from the breakdown of heme in the worn out red blood cell.

Biodiversity - variety and variability of life forms on earth.

Biome - large ecological areas on the earth's surface, with fauna and flora (animals and plants) adapting to their environment.

Biuret test- a test that uses a reagent (a solution of copper sulfate (CuSO_4) and sodium hydroxide (NaOH)) used to determine the presence of peptide bonds in protein.

Bowman's capsule - the filtration unit of the glomerulus and has tiny slits in which filtrate may pass through into the nephron.

Bone - a rigid body tissue consisting of cells compressed into hard intercellular material.

C

Capillarity - the ability of a narrow tube to draw a liquid upwards against the force of gravity.

Carrier protein - a protein that transports specific substance across the cell membrane.

Cartilage - tough elastic tissue.

Catalyst - a substance that causes a chemical reaction to occur but is not itself involved in the reaction.

Cephalothorax - a term referring to the fused head and thorax occurring in many arthropods, particularly crustaceans and arachnids.

Chaetae - bristles made of chitin that are found on bodies of annelids.

Cholesterol - a fatty substance made in the body and found in certain foods. Some cholesterol are harmful others are useful to the body.

Carapace - hard structure made of chitin that covers the dorsal part of an animal and protects internal organs.

CD4 cell - white blood cells that play an important role in the immune system.

Cheliserae - a pair of appendages modified to form poison glands or mouthparts.

Chitin - a tough, semitransparent substance that is the main component of the exoskeletons of arthropods.

Concentration gradient - the gradual difference in concentration of a dissolved substance in a solution between a region of high density and one of lower density.

Contraceptives - a device or drug that prevents pregnancy.

Cortex - the outermost (or superficial) layer of an organ.

Crustaceans - animals that usually have a hard covering, or exoskeleton, and two pairs of antennae, for example, crabs and lobsters.

D

Denature - change the original or natural structure.

Destarch - process of eliminating starch from leaves by allowing the plant to use up the starch previously synthesized.

Deamination - the removal of an amino group from an amino acid or other compound.

Detritivours - an organism (as an earthworm or a fungus) that feeds on dead and decomposing organic matter.

Detoxification - the metabolic process by which toxins are changed into less toxic or more readily excretable substances.

Diffusion - the movement of molecules from areas of higher concentration to areas of lower concentration.

DCPIP – (Dichlorophenolindophenol) a reagent used to measure the amount of ascorbic acid (vitamin C) in fruits and plant material.

E

Edaphic - Relating to soil, especially as it affects living organisms.

Endocytosis - the transport of solid matter or liquid into a cell by means of a vacuole or vesicle.

Endoskeleton - internal support structure made of bone or cartilage.

Enzyme – substrate complex-intermediate formed when a substrate molecule interacts with the active site of an enzyme.

Epidermis - protective outermost portion of the skin.

Epidemiology - the study of how often diseases occur in different groups of people and why.

Exoskeleton - external support structure that protects the internal organs.

Exocytosis - is a process by which a cell transports secretory products through the cytoplasm to the plasma membrane.

Eukaryotic – containing nucleus bound by a nuclear membrane.

Exhalation - the act of breathing out air.

F

Flaccid - soft, flabby and weak.

Food testing - a process used to check that a food is safe and that it does not

contain harmful contaminants.

Flexion - the action of bending, especially the bending of a limb or joint.

G

Glomerula filtrate - the renal fluid in the blood filtered across the capillaries of the glomerulus.

H

Haemocoel - a body cavity (as in arthropods or some molluscs) that contains blood or hemolymph and functions as part of the circulatory system.

Halophytes - A plant that can tolerate a high concentration of salt in the soil.

Homeotherm- an organism that maintains its body temperature at a constant level, usually above that of the environment, by its metabolic activity.

Host - an organism that harbours a parasitic.

Hydrophytes –aquatic plants.

Hypotonic - solution that has a lower osmotic pressure than another solution.

Hypertonic –a solution where the concentration of solutes is greater outside the cell than inside it.

I

Immunisation - the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine.

Immune response - any reaction by the immune system.

Inhalation - the action of breathing in.

Insulin - a hormone made by the

pancreas that allows the body to regulate glucose.

Isotonic - two solutions having the same osmotic pressure across a semipermeable membrane.

J

Joint - A point of articulation between two or more bones.

K

Key and lock mechanism -the hypothesis that helps explain some of the ways that enzymes work.

L

Lateral line- a visible line along the side of a fish consisting of a series of sense organs that detect pressure and vibration.

Lesion- injured or diseased structure or part of tissue or organ.

Lignin - an organic substance in plants binding the cells, fibres and vessels which forms wood.

Ligament - a short, flexible, fibrous connective tissue that connects two bones or cartilages or holds together a joint.

M

Menopause – a period when a woman stops having periods and is no longer able to get pregnant naturally.

Mesophyte- a plant growing under conditions of well-balanced moisture supply.

Metabolism - all chemical reactions involved in maintaining the living state of the cells and the organism.

Moulting - periodic shedding of the cuticle in arthropods or the outer skin in reptiles.

Millon's test – a chemical test that detect the presence of proteins in a food sample.

Multicellular - an organism that is made up of many cells.

Muscle - a tissue composed of cells or fibers, the contraction of which produces movement in the body.

N

Nephron - the basic structural and functional unit of the kidney.

Notochord - a flexible rod-like structure that exists in bodies of vertebrates at some point in their lives.

Non-reducing sugars –sugars such as sucrose that cannot be oxidized.

O

Oral - relating to the mouth.

Omnivorous - an animal that eats food from both plants and animals.

Osmosis - the movement of water from a less concentrated solution to a more concentrated solution through a partially permeable membrane.

Osteoporosis - condition that weakens bones, making them fragile and more likely to break.

P

Passive - allowing what happens, without active response or resistance.

Pathogen - a parasite that causes disease.

Pedipals- segmented appendages attached to the cephalothorax of arachnids.

Pinocytosis - the ingestion of liquid into a cell by the budding of small vesicles from the cell membrane.

Pith - the soft, spongy tissue in the centre of the stems of most flowering plants, gymnosperms and ferns.

Potometer- a device used for measuring the rate of water uptake of a leafy plant shoot.

Phagocytosis - the process by which a cell engulfs material.

Plastids – are organelles that are the main site of photosynthesis in eukaryotic cells.

Pseudopodia - temporary or semi-permanent extension of the cytoplasm, used in locomotion and feeding in some protozoa.

Pooter - a device used to pick up small invertebrates without harming them.

Poikilotherm - an organism that cannot regulate its body temperature.

Plasmolysis - the contraction of the protoplasm of cells within plants due to the loss of water through osmosis.

Phloem - part of a vascular bundle that conducts sugars and other metabolic products downward from the leaves.

R

Receptor - a protein molecule that receives chemical signals from outside a cell.

Reducing sugars - any sugar such as glucose which is capable of being oxidised.

Respiratory surfaces - a special area that is developed in order to satisfy the requirements for gaseous exchange in larger organisms.

S

Septa - walls that divide internal body cavities or chambers.

Sessile – an organism, fixed in one place (immobile).

Selective reabsorption - The absorption of some of the components of the glomerular filtrate back into the blood as the filtrate flows through the nephrons of the kidney.

Sexual response - is the arousal of sexual desire, during or in anticipation of sexual activity.

Sexuality - the whole way a person goes about expressing himself or herself as a sexual being.

Source – the sites in a plant where net fixation of carbon dioxide occurs.

Sign - evidence of disease as seen by the examining physician.

Sink-the sites in a plant where assimilates are stored or used.

Spermicide – This comprise of creams, gels, foams and other suppositories that prevent sperm from moving.

Substrate - the substance on which an enzyme acts.

Sutures - a seam like immovable junction between two bones, such as those of the skull.

Synovial- a lubricating fluid secreted by certain membranes, for example, in joints.

Symptoms - evidence of disease perceived by the patient.

T

Tentacles - a slender, flexible limb or appendage in an animal.

Tendon - A band of tough, fibrous, inelastic tissue that connects a muscle to a bone.

Transpirational pull-a mechanism by which trees draw water through their roots.

Translocation - the movement of materials from leaves to other tissues throughout the plant.

Tracheid - a type of water-conducting cell in the xylem that lacks perforations in the cell wall.

Turgor pressure - the pressure of water against the inside wall of a plant cell.

U

Ultrafiltration – a process in the kidney in which urea, salt, water and glucose are taken out of the blood.

Urologist - a physician who specialises in diseases of the urinary tract and the male reproductive system.

V

Vaccine - preparation of weakened form of a pathogen such as killed microbe, altered microbes or derivative form of pathogens.

Vasectomy - a permanent method of birth control where sperm ducts are cut and the ends are sealed to prevent sperm from entering the ejaculate.

Vascular bundles - Xylem and phloem tissues.

Vector – an organism that transmits a disease or parasite from one animal or plant to another.

Verigated –having different colours.

Ventilation - the movement of air between the environment and the lungs via inhalation and exhalation.

Vessel element - An elongated, water-conducting cell in xylem.

W

Wall pressure - pressure exerted by the flow of water through a semipermeable membrane separating two solutions with different concentrations of solute.

Wilting- loss of turgidity and rigidity that occurs when the rate of water loss is greater than the rate of water uptake.

X

Xylem – a vessel in plants that transport water from roots to shoot and leaves, it also transports some nutrients.

Xerophytes –plants that grow in areas with very little water.

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