Biology and Health Sciences

For Rwandan schools

Senior 3

Teacher's Guide

Contents

PART I
INTRODUCTION

SECTION 1 GENERAL INTRODUCTION

This teacher's guide is presented in **two** parts. **Part I and Part II**. This is the general introduction part detailing pedagogical issues. It is divided into three sections:

- Section 1 – is the general information
  Section 2 – is the content map
- Section 3 – is the sample lesson plan
- **Key words in the unit** – a list of new words or vocabularies and their meanings.
- **Guidance on the problem statement**: A brief statement on how the teacher should introduce the unit and create a problem situation for learners to brainstorm and predict what the unit is about.

1.1. Background information on new curriculum

The goal to develop a competence-based society, the globalisation process, and particularly the growth of the world market and competition at the global level, as well as a shift from knowledge-based to competence-based curriculum 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 REB syllabus at secondary level was reviewed to ensure that the syllabus is responsive to the needs of the learner with a shift from knowledge-based learning to competence-based learning.

Competence-based learning refers to systems of instruction, assessment, grading, and academic reporting that are based on students 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 learner in the learning process. It further puts greater emphasis on skills a learner should acquire during each unit of learning. As a competence-based syllabus, it elaborates on the three aspects of **knowledge**, **skills** and **attitudes and values** in Biology.

1.2. Rationale of teaching and learning Biology

Biology is one of the natural science subjects and is an important discipline that has contributed significantly to the global environment. Biologists are at the forefront of genetic engineering and health transformation and a number of major developments in these areas are due to discoveries of biologists. The work of biologists has led to new technologies in the production of small scale and industrial products that are beneficial to man and the environment. Application of the knowledge of biology is evident in medicine, pharmacy, agriculture, fisheries and food processing industries. In particular, biology has played

a role in the harmonisation of man's needs with the conversation of nature and the environment.

Biology plays a role in the Rwandan ambition to:

- Develop a competence – based society.
- Promote science and technology competitiveness in regional and global job markets.
- Address the issues of lack of appropriate skills in the Rwandan education system.

Biology is a worthwhile subject because it prepares students for the real world of work through career pathways such as medicine, agriculture, pharmacy, food science, environmental studies and many others. Biology provides skills that guide the construction of theories and laws that help to explain natural phenomenon and manage man and the environment. It provides answers for the problems faced by our mordern society by empowering students to be creative, innovative and to use independent approaches to solve problems in unfamiliar situations.

1.3. Types of competences and their acquisition

Competences are statements of the characteristics that students should demonstrate which indicate they are prepared and have the ability to perform independently in professional practice. The two types of competences 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 the 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 hand-writing with correctly spelt words.
- Communicating ideas effectively through speaking using correct phonetics of words.
- 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) 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.

(iv) 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.

(b) Generic competences

The generic competences are competences that must be emphasized 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 these competences.

(i) 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.

(ii) 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.

(iii) 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.

(iv) Communication in official languages

Teachers, irrespective of being language teachers' should ensure the proper use of the language of instruction by learners which is **English**. The teachers should communicate clearly and confidently and convey ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary.

(v) Cooperation, inter - personal management and life skills

This will help the learner to cooperate in a team in whatever task assigned and to practise 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.

(vi) 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 fulfillment in areas that are relevant to their improvement and development.

Role of Biology as a subject in developing the competences

The national policy documents based on national aspirations identified some 'basic Competences' alongside the 'Generic Competences" that will develop **higher order critical thinking skills** and help the student to learn Biology and health sciences 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 learner 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 unit. This will be achieved through group works and cooperative learning, which in turn will promote interpersonal relations and teamwork.

The manipulation of apparatus, equipment and data 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.

1.4. 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

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 recognize 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 knowledge of personal 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 are available to them and encourages financial behaviours that enhance their overall economic well-being.

(c) Standardisation culture

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 standardization culture should have an impact upon health improvement, economic growth, industrialization, 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 provide 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 help 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 students 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 emphasized.

(e) Environment and sustainability

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

There is a strong moral imperative to afford every individual their basic human rights and 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/AIDS, STIs, Family planning and reproductive health)

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 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/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

Inclusive education involves ensuring all learners are engaged in education and that they are welcomed by other students 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 most 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.

1.5. 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 the 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 learners can fall in any of the following common categories:

- Physical difficulties
- Visual difficulties
- Hearing difficulties
- Intellectual difficulties
- Emotional disorders

The teacher should identify such cases and help facilitate the affected learners' learning. 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 organize for the learners' 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 pressurized 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. Such learners could be longsighted or short sighted.

The material to be observed should

be brought closer to the learner and a magnifying lense 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 intellectual 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.

(f) Learners with emotional disorders

These are learners who get annoyed easily either because of past experiences or it may be just their nature. The teacher should handle this category of learners with care and caution other learners against mishandling them.

1.6. 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.

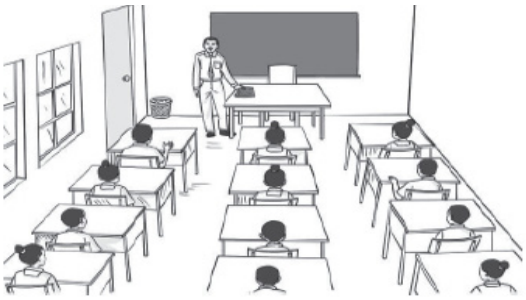


Fig. 1.1 Sample classroom arrangement

(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 the teacher normally stand; the teacher should be able to communicate with all learners, and also have a general view of all learners in the class.

In certain lessons, the teacher may wish to carry out a demonstration. In this case, the learners should be sitting or standing in a semicircle, 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.

Grouping learners 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.

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 learners for learning has increasingly become popular in recent years. In fact, the shift from knowledge based to competence-based 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 Biology, groupings are commonly those of types (a), (b), (c) and (d). Grouping learners has several advantages such as:

(a) The individual learner's 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.

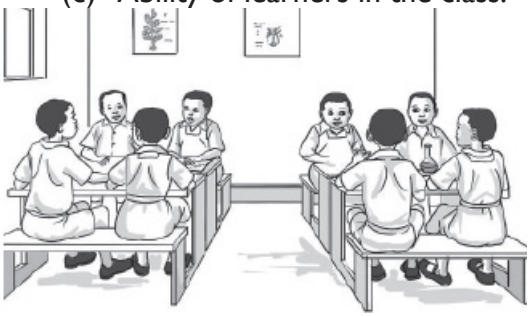


Fig. 1.2 Sample classroom grouping

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

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 material available, 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 pairwork depending on the nature of the content being taught at the time.

Note:

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.

1.7. Safety in the classroom

Learners in secondary school are extremely 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 learners during the period he or she is handling them.

1.8. Assessment and evaluation methods

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual learner's progress in learning and to make a judgement about a 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.

Types of assessment

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

(a) Formative or 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 the teacher is planning his/her lesson, he/she should establish criteria for performance and behaviour changes at the beginning of the unit. Then at the of end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competences 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 competences 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:

- Observations - to judge the extend of skills acquisition
- Written tests
- Practical work/activities
- Oral questions or interviews
- Project works
- 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 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. He or she also assesses the learner's curiosity, patience, and teamwork cooperation spirit among others.

(iv) Oral questions or interviews

Asking learners 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 learner's level of competence.

(v) 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 use to gauge learner achievement in the various generic competency areas is 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
Green – Good
Yellow – Excellent
Blue – Average
RS – Research Skills
PS – Problems-solving skills

COMM – Communication in English
I & C – Interpersonal skills & Cooperation
CT – Critical Thinking
LL – Life long 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 judgement of a competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's 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 student must be able to show mastery of all competences.

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. 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 competence-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 test broad competences as stated in the syllabus.

Structure and format of the examination

Paper	Component	Weighting
Paper 1	The paper will measure the both knowledge of the subject matter and acquisition of competences. The first part will assess the first two (low) levels of Bloom's taxonomy, which is knowledge and understanding and will account for 30%. The second will assess skills, it will consist of questions from higher levels of Bloom's taxonomy (application, analysis, evaluation and synthesis) and will account for 40%.	70%
Paper 2	Practical skills paper: This paper measures practical / experimental skills (observation, recording & report writing, manipulation, measurement, planning & designing). The experiments should be drawn from different topic areas of the syllabus. This paper requires candidates to carry out practical work in a set period of time. It will account for 30% of total marks.	30%

Note: Discussing biology objectives should focus on three aspects: The candidate should demonstrate knowledge and understanding of scientific phenomenas, facts, laws, definations, concepts and theories etc. (refer to syllabus)

Record Keeping

This is gathering facts and evidence from assessment instruments and using them to judge the student'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 be recorded and stored in a portfolio because they will contribute for remedial actions, for alternative instructional strategy and feed 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 students.

This portfolio is a folder (or binder or even a digital collection) containing the student's work as well as the student'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 student learning. The portfolio output (formative assessment) will be considered only as enough for three years of ordinary 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.

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 students are doing well and where they need to improve.

SECTION 2 CONTENT MAP

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Unit Title	Interdepen-dence among organisms in an ecosystem	Population Size	Nutrient Cycles	Effects of human activities on ecosystems 1	Effects of human activities on ecosystems 2: Conservation and sustainability	Mitosis and Meiosis	Heterotrophic nutrition	Circulatory system in humans
Number of periods	6	8	6	8	8	8	12	12
Key unit competence	Classify examples of species interactions.	Analyse and interpret population curves.	Describe the water, carbon and nitrogen cycles.	Assess the consequences of uncontrolled human activities on ecosystems.	Assess the outcomes of conservation measures.	Explain the different processes of cell division and their implications for living organisms.	Compare forms of heterotrophic nutrition and explain the process of digestion in humans.	Relate the structure of the circulatory system to its functions.
Number of lessons	2	3	3	8	6	8	5	5

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Learning and teaching materials required	Photographs, wildlife videos, ICT materials, Illustrations	Audio-visuals, photographs, charts, IT materials to draw growth curve	Illustrations of the nutrient cycles, audio visuals	Audio-visuals, photographs and computer aided learning materials	Audio-visuals, photographs and computer aided learning materials	Charts and micrographs of cells at different stages of mitotic and meiotic cell division, computer simulations of mitosis (onion root tip, acetocarmine, scissors , forceps , razor bled , 1M Hcl, Pasteur pipette , dissection prop with a wooden back, water bath, distilled water , microscope, microscope slide ,cover slip and meiosis	Computer animations, illustrations and charts of digestive systems and processes, teeth from rabbits, hydrochloric acid, thread, clock timer, lemon juice. Egg shells and fizzy drinks (such as cola)	Computer animations, charts and diagrams of components of the mammalian circulatory system and that of fish, micrographs of blood smear, blood vessels, tables of blood group compatibility in transfusion, clock timer and Sphygmomanometer sphygmomanometer.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Activities/ Tech-niques	• Role-plays • Practical activities • Research activities • Group work • Question and answers • Discussion and presentation • Experimentation	• Research activities • Case studies • Role-plays • Practical activities • Group work • Question and answers • Discussion and presentation • Experimentation	• Case studies • Role-plays • Practical activities • Research activities • Group work • Question and answers • Discussion and presen-tation • Experimenta-tion	• Discussion and presentation • Experimenta-tion • Case studies • Practical activi-ties • Research activi-ties • Group work • Question and answers	• Research activities • Field trips • Case studies • Practical activities • Group work • Question and answers • Discussion and presen-tation • Experimenta-tion	• Discussion and presentation • Experimentation case studies • Practical activities • Research activities • Group work • Question and answers	• Discussion and presentation • Experimenta-tion • Field trips • Case studies • Practical activities • Research activities • Group work • Question and answers	• Discussion and presen-tation • Experimentation case studies • Practical activities • Research activities • Group work • Question and answers

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Generic competencies practiced	**Cooperation and interpersonal skills:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information by themselves. **Communication in English**: Participate in discussions and presentations.	**Cooperation and interpersonal skills:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information on their own. **Communication in English**: Participate in discussions and presentations	**Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results. **Lifelong skills:** Environmental awareness	**Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results. **Lifelong skills:** Environmental awareness.	**Critical thinking and problem solving skills:** Answer probing questions and discuss the results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information on their own. **Communication in English**: Participate in discussions and presentations. **Cooperation and interpersonal skills:** Group discussions and pair-work.	**Research skills:** Find more information on their own **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results. **Lifelong skills:** Environmental awareness	**Lifelong skills:** Environmental awareness. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results.	**Cooperation and interpersonal skills:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information by themselves. **Communication in English**: Participate in discussions and presentations

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Cross-cutting issues to be addressed	**Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards.	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate	**Inclusive learning:** All learners to participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards.	**Inclusive learning:** All learners to participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards.	**Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwanda Standards board. **Peace and values education:** Working harmoniously with each other during all class activities.	**Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate **Inclusive learning:** All learners should participate in all class activities.	**Inclusive learning:** All learners to participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards.	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Peace and values education:** Working harmoniously with each other during all class activities.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Assessment strategies of the key unit competence	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 2 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 3 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Compe-tence 4 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evalua-tion test at the end of each lesson • Test your Compe-tence 5 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 6 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 7 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self evaluation test at the end of each lesson • Test your Competence 8 at the end of the unit .

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Unit Title	Cellular Respiration	Skin and homeostatic mechanisms	Response and Coordination in Plants	Response and Coordination in Animals	Asexual and Sexual Reproduction	Sexual Reproduction in Flowering Plants	Reproduction in Humans	Social Factors that Affect good Health
Number of periods	8	10	8	16	8	10	12	6
Key unit compe-tence	Compare energy yield in aerobic and anaerobic respiration.	Explain homeostatic mechanisms and the role of skin in temperature control.	Explain response to light and gravity by plants and understand importance of tropisms in plants.	Relate structures of nervous and endocrine systems to their functions.	Differentiate between asexual and sexual reproduction, giving advantages and disadvantages of each.	Explain how sexual reproduction occurs in flowering plants.	Describe the process of sexual reproduction in humans.	Describe the social factors that affect good health and apply knowledge gained in familiar and unfamiliar contexts.
Number of lessons	4	5	3	13	7	7	8	4

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Learning and teaching materials required	Sugar/ripe bananas, yeast, conical flasks, viable seeds, vacuum flasks, thermometers, cotton wool, stands and camps.	Electric oven/ electric iron, charts, model of the skin, computer aided learning materials..	Potted plant seedlings, cotton wool, pea and bean seeds, transparent plastic beakers, aluminium foils, graph charts for effects of auxin concentration on shoot and root growth.	Ruler, clock timer, mirror, charts and slides of the sense organs, slides of neurones, location of glands, computer animations of impulse transmission, functioning of the eye and model..	Illustrations and computer aided materials, Perennating organs such as rhizomes, stem tubers, corms and Bryophyllum leaf.	Flowers, hand lenses, illustrations, fruits and seeds, computer aided materials and suitable containers for germination investigations.	Computer animations; charts for reproductive parts, menstrual cycles and fertilisation and pregnancy; photomicro-graphs; semen with sperm and egg.	Charts/illustrations and computer aided materials.

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Activities/ Techniques	• Discussion and presentation • Experimentation • Role-plays • Group work • Question and answers • Role-plays • Practical activities • Research activities	• Experimentation • Role-plays • Practical activities • Research activities • Group work • Question and answers • Discussion and presentation	• Role-plays • Practical activities • Research activities • Group work • Question and answers • Discussion and presentation • Experimentation	• Group work • Question and answers • Discussion and presentation • Experimentation • Role-plays • Practical activities • Research activities	• Discussion and presentation • Experimentation • Role-plays • Practical activities • Research activities • Group work • Question and answers	• Practical activities • Research activities • Group work • Question and answers • Discussion and presentation • Experimentation • Role-plays	• Research activities • Discussion and presentation • Experimentation • Role-plays • Group work • Question and answers • Role-plays • Practical activities	• Question and answers • Discussion and presentation • Experimentation • Role-plays • Practical activities • Research activities

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Generic competencies practiced	**Cooperation and interpersonal management:** Group discussions and pair-work **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results **Lifelong skills:** Good environmental management and work skills **Research skills:** Find more information by themselves. **Communication in English**: Participate in the discussions and presentations.	**Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information by themselves. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results.	**Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results. **Lifelong skills:** Environmental awareness.	**Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations	**Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results	**Critical thinking and problem solving skills:** Answer probing questions and discuss the results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information on their own. **Communication in English**: Participate in discussions and presentations. **Cooperation and interpersonal skills:** Group discussions and pair-work.	**Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal skills:** During group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss results. **Lifelong skills:** Environmental awareness. **Research skills:** Find more information on their own.	**Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Cross-cutting issues to be addressed	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities.	**Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards.	**Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities.	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities	**Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working	**Standardisation culture:** Use of material certified by the Rwandan Bureau of Standards. **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working	**Peace and values education:** Working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities **Inclusive learning:** All learners should participate in all class activities.. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards. **Environment and sustainability education**: Protection and conservation of the environment.	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities

	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16
Assessment strategies of the key unit competence	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self – evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self – evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit	• Guidance on the problem statement at the beginning of the unit • Practical activities • Self –evaluation test at the end of each lesson • Test your Competence 1 at the end of the unit

	Unit 17	Unit 18	Unit 19	Unit 20	Unit 21	Unit 22	Unit 23
	Decision-making Regarding Sexual Relationships	HIV and AIDS. Stigma, treatment, care and support	Sexual behaviour and sexual response	Genetics	Gene technology	Variation and Adaptive Features	Natural and artificial selection
Number of periods	8	4	4	10	8	6	4
Key unit competence	By the end of the unit, the learner should be able to identify potential legal, social and health consequences of sexual decision-making.	By the end of the unit, the learner should be able to explain the importance and key elements of living positively with HIV.	By the end of the unit, the learner should be able to describe common sexual behaviours and how to make responsible decisions.	By the end of the unit, the learner should be able to explain how genes determine structure and function of individuals.	By the end of the unit, the learner should be able to explain the role of genetic engineering in industrial production of insulin and genetically modified.	By the end of the unit, the learner should be able to explain that variation is caused by both genetic and environmental factors and adaptive features shown different organisms	By the end of the unit, the learner should be able to explain natural and artificial selection in relation to evolution and breeding.
Number of lessons	8	4	4	8	3	4	2
Equipment and learning and teaching materials required	Illustrations and computer aided materials.	Journals, access to government leaflets and other materials, newspaper articles, access to the internet.	Illustrations and computer aided materials.	Online resources, CDs, simulations, diagrams, charts.	Online resources, CDs, simulations, diagrams, charts, micrographs.	Collected specimens of plants, charts, illustrations, computer animations.	Online resources,CDs, simulations

	Unit 17	Unit 18	Unit 19	Unit 20	Unit 21	Unit 22	Unit 23
Activities/ Techniques	Discussing examples of difficult situations related to sexual relationships. Suggesting concrete strategies for how to reduce risk of STIs and HIV related to the various difficult situations. Making word webs with factors that affect decision making. Role plays focusing on effective communication in difficult situations.	Conducting research to identify human rights related to living with HIV, and exploring laws, social, and health policies that relate to living with HIV in Rwanda. Choosing an issue/ dilemma related to living with HIV and how they think this issue can be addressed and writing a short story or play about it. Discussing ways to promote non-discrimination and inclusion of PLHIV in their communities. If possible, a visit from someone who is HIV – positive who tells their story.	Game: high risk/ low risk/no risk: Students are presented different behaviours and have to discuss whether they think that behaviour has high, low or no risk of transmitting STIS or HIV and why (e.g. unprotected intercourse/ oral sex/anal sex, kissing, touching). Students write fictional stories about possible consequences of sexual decisions. Role play of how to avoid transactional sexual activity and other sexually abusive relationships. Carry out dialogue for communication exercises in pairs for negotiation skills for safer sex.	Independently or in groups interpret pedigree diagrams on charts for the inheritance of a given characteristic and present findings to the class. In groups use Punnett squares in crosses which result in more than one genotype to work out and show the possible different genotypes. In groups use genetic diagrams to predict the results of monohybrid crosses involving codominance or sex linkage and calculate phenotypic ratios. Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic ratios, limited to 1:1 and 3:1 ratios.	Students write a paragraph in which they suggest that plants could be genetically altered to improve world's food supply. In their paragraph student should have a clear sentence followed by supporting details. Suggest plants that require less fertilizer, resist drought, diseases, pests and cold weather or produce more nutritious or abundant fruit and suggest methods to produce these plants. Produce a report for evaluation. In groups; learners discuss the advantages and disadvantages of genetically modified crops such as soya, maize and rice .	In groups record and present the differences between continuous and discontinuous variation in a table form. In groups, learners measure and record the heights of classmates, ability to tongue roll and presence to interpret forms of variation. Observe and record adaptive features of given or collected hydrophytes and xerophytes and report the observations.	Visit nearby animal farms and observe selection of domestic animals to assess the effect of selection on domesticated animals and crops and record the findings in journal for presentation in groups. Using documentaries, CDs computer simulations, learners observe natural and artificial selection in plants and animals to determine the course of evolution. Observe and interpret images of extinct animals and related present species to determine the course of evolution as result of natural selection.

	Unit 17	Unit 18	Unit 19	Unit 20	Unit 21	Unit 22	Unit 23
Generic competencies practiced	**Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations	**Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work	**Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results	**Cooperation and interpersonal management:** Group discussions and pair-work. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer probing questions and discuss the results.	**Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills	**Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work. **Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own.	**Critical thinking and problem solving skills:** Answer the probing questions and discuss the results. **Lifelong skills:** Good environmental management and work skills. **Research skills:** Find more information on their own. **Communication in English**: Participate in the discussions and presentations. **Cooperation and interpersonal management:** Group discussions and pair-work

	Unit 17	Unit 18	Unit 19	Unit 20	Unit 21	Unit 22	Unit 23
Cross-cutting issues to be addressed	**Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities	**Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities.	**Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities.	**Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment.	**Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities. **Financial education:** All activities have financial implications in terms of cost.	**Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Environment and sustainability education**: Protection and conservation of the environment. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities **Financial education:** All activities have financial implications in terms of cost. **Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards	**Standardisation culture:** Use of materials certified by the Rwandan Bureau of Standards **Inclusive learning:** All learners should participate in all class activities. **Gender education:** Both boys and girls should participate equally in all activities. **Financial education:** All activities have financial implications in terms of cost. **Peace and values education:** Importance of working harmoniously with each other during all class activities. **Health education:** Take care of their well-being during all activities

	Unit 17	**Unit 18**	**Unit 19**	**Unit 19**	**Unit 21**	**Unit 22**	**Unit 23**
Assessment strategies of the key unit competence	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit	· Guidance on the problem statement at the beginning of the unit · Practical activities · Self – evaluation test at the end of each lesson · Test your Competence I at the end of the unit

SECTION 3 LESSON PLAN

3.1. Important sub-headings of a lesson plan

The most important document when planning to teach is the lesson plan.
A lesson plan is a detailed outline of how the teacher intends to carry out a specific lesson.

(a) Administrative details

These include: Term……
Date…… Subject…….
Class……. Duration…….
Class size……

b) Special Educational needs
A list of types of special educational needs to be catered for during the lesson and the number of learners in each category.

(***c) Unit title***
This refers to the broad area that is to be studied – taken from the syllabus.

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

(e) Title of the lesson
This is the lesson title extracted from the learning objective(s).

(f) Instructional objectives
This represents what the teacher anticipates pupils to achieve by the end of the lesson. A good instructional objective have five elements, that is, conditions, who, action/behaviour, content and standard or ctiteria for acceptable performance.

(g) Plan for the class
This refers to location of the lesson i.e. where the lesson will be taught.

(h) Learning materials/teaching resources
These any materials and apparatus that the pupils and the teacher will use during the lesson.

(i) References
These are resources consulted or used by the teacher to prepare for the lesson as well as any books that the pupils will use during the lesson.

(j) Description of the teaching and learning activities
These are divided into two: teacher activities and learner activities. They describe what the teacher and the learner should do during the teaching/learning process. Further, the teacher should be cognizant of the fact that the various generic competences and the cross cutting issues should be brought out during the teaching/learning activities. Highlight these as the activities are on going.

(k) Timing for each step
This section is divided into three:

- Introduction to the lesson
- Lesson development
- Conclusion of the lesson

(i) Introduction of the lesson
This is the beginning of the lesson. It is allocated 10 minutes in a double lesson. The teacher should motivate the pupils by

creating problem situations that interest pupils e.g. posing a question, telling an amusing but relevant story or episode, showing an object, picture or video that arouses their interest. The introduction should also if possible link what the pupils have already learnt with what they are going to learn.

(ii) Lesson development

This is the main part of the lesson. It is allocated 50 minutes in a double lesson. Lesson development should mainly include the activities that pupils and the teacher will perform in order to achieve the stated objectives; as well as the generic competence and the cross-cutting issues to be addressed. It is more convenient to distinguish between the pupils' and teacher's activities under two columns as shown in the sample lesson plan.

(iii) Conclusion of the lesson

This is the step in which the lesson activities are tied up or consolidated to emphazise the main points i.e. summarize the lesson. It is followed by assessing whether the learning objectives have been met. It is allocated the last 20 minutes of the lesson; 10 minutes for summary and 10 minutes for assessment.

(l) Teacher self-evaluation

Here, the teacher states what went well or wrong with the delivery of the lesson and gives what he/she plans to do moving forward.

3.2. Sample lesson plan

School Name: **Teacher's name:**

Term	Date	Subject	Class	Unit N°	Lesson N°	Duration	Class size
I	25 /09/17	Biology	S3	1	1 of 6	80 minutes	35

Type of Special Educational Needs to be catered for in this lesson and number of learners in each category	• Learners with low vision (2) • Learners with hearing problems (2) • Learners with language difficulties (5) • Intellectually challenged learners (3) • Bright learners (4)
Unit title	Interdepedence among organisms in an ecosystem
Key Unit Competence:	To be able to classify examples of species interactions in organisms
Title of the lesson	Meaning of intraspecific and interspecific interactions
Instructional Objective	By making observations during the nature walk in an anthill on how termites interact and by watching the video on how bees interact with one another in a colony , learners should accurately define interspecific and intraspecific interactions and appropriately distinguish between them.
Plan for this Class (location: in / outside)	• Nature walk to observe interaction between various organisms • Watching a video on interaction of bees • Conduct the lesson inside the Biology laboratory
Learning Materials (for ALL learners)	• Anthill and other forms of animal interactions in the local environment • Charts showing various forms of interactions between various organisms • Computers connected to the internet • DVDs or VCDs and their player and TV set (for displaying the videos) or a projector
References	Biology Senior 3 textbook, computer with internet connection and any other relevant reference textbook

Timing for each step	Description of teaching and learning activity		Generic competences and cross cutting issues to be addressed plus a short explanation
	By observing the behaviour of termites in an anthill during the nature walk as well as the behaviour of bees learners discover the relationship between interspecific and intraspecific interactions and will come up with the differences between inter and intraspecific interractions.		
	Teacher activities	**Learner activities**	
Introduction (10 minutes)	Motivate learners by showing them pictures on page 1 of their books and ask probing questions such as: **Sample Questions:** 1. Name some relationships that occur in an ecosystem between organisms. 2. Which of them are depicted in Pictures A, B and C? 3. Based on your answers to the above questions, what do you think you will learn in this unit?	Study the pictures and answer the questions. **Answers to Sample Questions** 1. Parasitism, predation, commensalism, symbiosis 2. A - predation, B - Symbiosis, C- Commensalism 3. How organisms interact in nature 4. Learners discuss and share their positions with other class members 5. Ask learners to discuss the questions and take position and present their predictions	**a) Generic competences** 1. Observation skills through observation of behaviour of termites and bees 2. Communication and cooperation among students 3. Crtical thinking through predictions

<table>
<tr>
<td>Development of the lesson (50 minutes)</td>
<td>Take learners for a nature walk to observe how termites interact during construction of anthill. Ask learners to come up with a table on various activities done by different types of termites.

Show learners a video of bees interracting in a colony.
Ask learners to describe the interraction between the various types of bees.

Show learners photographs or video of a pride of lions scrambling for Zebra/ gazelle/antelope, etc meat.

Assists learners to form groups depending on class size and ability of learners.

Ask learners to compare the two types of interractions (bees& termites vis a viz lion and antelopes/ gazelle/ zebra) and writes a report then present their work.</td>
<td>Go for nature walk and observe the behaviour of termites.
Draw table on activities of various termites, for example,
<table>
<tr><th>Type of termite</th><th>Role</th></tr>
<tr><td>Worker</td><td>Looks for food, builds anthill, takes care of young ones</td></tr>
<tr><td>Soldier</td><td>Protects colony</td></tr>
<tr><td>King</td><td>Fertilises eggs</td></tr>
<tr><td>Queen</td><td>Lays eggs</td></tr>
</table>
Observe the video of bees in their colony.

Describe the nature of interraction between different types of bees in the colony, For example:
Worker bees-build the nest, forage for pollen or nectar, feed larva; queen - lays eggs, drone - fertilises the eggs while other bees protect the swarm.

Observe the photographs and/or watch the video and describe what is going on.

Form groups as directed by the teacher.

Discuss their findings, come up with reports and present them to the rest of the class.

Summary:
Bees and termites interraction - intra-specific
Lions and zebra/antelope/ zebra interraction - interspecific</td>
<td>1. Critical thinking and problem solving skills
As learners think about the type of interraction involving bees & termites and lions and zebras, gazelles and antelopes.
2. Presentation skills
As learners participate in pairs and in groups and as they present their work to the rest of the class.</td>
</tr>
</table>

Conclusion (20 minutes) **a) Summary** **b)Assessment**	Ask a volunteer to come and summarise what they have learnt in this lesson. Recap by highlighting main points and correcting the learner who volunteered. Give oral achievement questions to assess achievement of lesson objectives. The questions may include: **Sample questions** 1. What is interdepedence? 2. Distinguish between interspecific and intraspecific interraction. 3. Which type of interaction is involved when a tapeworm lives in the intestine of an animal?	Listen to a fellow learner and take short notes. ***Summary*** *Intraspecific competition is competition within a species of organisms for example in a bee colony or that of termites.* *Interspecific competion is between organisms belonging to different species for example lions and zebras, gazelles or antelopes.* Listen to the teacher and correct the wrong notes taken during fellow learner presentation. Learners answer oral questions given by the teacher **Answers to sample question** 1. This is when organisms depend on one another either for food, shelter, etc. 2. Intraspecific - interaction within a species; Interspecific - interaction betwen different species. 3. Parasitism	**a) Generic competences** ***Listening and writting skills-*** As learners listen to fellow student and take summary notes. ***1.Communication in official language*** As the learner does presentation to the rest of the class. and as the rest participate by asking questions.
Teacher self-evaluation	Some learners had challenges differentiating between intraspecific and interspecific competion. Remedial classes will be arranged to mitigate this.		

PART 2 Unit Sections

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:

- **Unit Title** – as per the syllabus. Further number of periods per unit is also provided.
- **Key Unit Competence**: This is the competence which will be achieved once students have met all the learning objectives in the unit.
- **Unit outline** – A list of subtopics covered under each unit.
- **Pre-requisite of the unit** –This section details what is required to ensure success of the unit i.e. what should be done for the key unit competence to be attained.
- **Learning Objectives** –The content in this area is broken down into three categories, that is, knowledge and understanding; skills; attitudes and values.
  - *Knowledge and understanding:* As in the existing curriculum, knowledge and understanding is very important.
  - *Skills:* It is through the skills that students 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 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 allows teachers to identify areas that link to other subjects and this is of great benefit to learners.
- **Assessment criteria:** This gives the teacher guideline on whether the objectives of the unit have been achieved.
- **Materials and teaching aids:** This gives a list of teaching resources that the teacher will use during the learning process in the unit.
- **Background information**: This is the introduction part of the unit. It aims at giving insights to the teacher on the subject matter.
- **Cross cutting issues** as you teach, highlight these areas depending on

the subject matter. Refer to pages (vii),(xiv) for more detials on the cross-activity issues to cover.

- **Generic competences** these should also be highlighted as well. Different generic competences will be addressed depending on the content area and the teaching methodology employed. Refer to pages (x) – (xi) for the summary of these competences.
- **Attention to special needs education**: This section gives guidance on how to cater for multi-ability learning and how to support learners with special needs.
- **List of lessons:** This section gives lesson number, title and number of periods expected to cover the lesson. Immediately after the list are the lessons themselves covered in detail.
- **Lessons development**

All the lessons have these main features**:**

  – Lesson number and title

  – Pre-requisite of the lesson – guidance on how to begin the lesson.

  – Teaching aids or resources in line with the teaching objectives.

  – Suggested learning activities

- **Lesson sythesis** – which is an indication to the teacher on how to go about in order to meet the lesson objective(s).
- **Assesment –** A suggestion or how to assess whether lesson objectives have been attained.

These are repeated across all units until unit 23 which is the last unit in the book.

UNIT 1 Interdependence among organisms

Key unit competence

After studying this unit, learners should be able to classify examples of species interactions.

Learning objectives

Table 1.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, the learner should be able to:		
• Define the intraspecific and interspecific relationships in ecosystems. • Provide examples of specific interactions in ecosystems. • Discuss positive and negative effects of competition among individuals of the same species and between those from different species.	• Observe features that allow a predator to kill and feed on its prey. • Differentiate between intraspecific and interspecific relationships using examples. • Interpret graphs and predator-prey relationships in an environment. • Illustrate commensalism.	• Appreciate the interdependence (intraspecific and interspecific relationships)

Pre-requisites of this unit

Learners have learnt about interdependence among organism insenior 1 and senior 2. Remind learners of some of the interspecific and intraspecific relationships that were learnt in the senior 1 and senior 2 but were not detailed. Review interdependence among organisms and give detailed information to the learners. This unit deals with relationships among organisms and the importance of the relationships.

During the lessons, strive to bring to the awareness of learners the fact that the content in this unit will help the learner to gain knowledge on

harmfulness of parasites in Agriculture. Let them understand that at this level, they may only need the basic information otherwise, details of the topic's will content be learnt at higher levels in parasitology.

Background information

Interdependence of organisms is a biological interaction that all organisms use in order to survive. Some interdependence requires organisms to adapt in order to get what they need from other organisms, for example, endoparasites such as *Ascaris lumbricoides* (intestinal round worms) and *Entamoeba histolytica*. Others do not require much modification, for instance Egrets which feed on ticks.Ticks are parasites for cows and buffaloes.

There are some types of interdependence that are not direct, for example, a food chain.The importance of an organism can be felt when it is removed. Survival of lions depends on grass but lions are not modified in any way to depend on grass as the dependence is not direct.

Cross-cutting issues to be addressed

1. ***Standardisation culture***

Bring to the attention of learners the importance of seeking medical attention from qualified doctors in case they have any conditions or diseases associated with endoparasites or ectoparasites.

2. ***Gender education***

Emphasise to learners that anybody irrespective of their gender can pursue a carrier in human parasitology. Give examples of role models who are successful parasitologists or veterinary doctors in the area where the learners come from.

3. ***Inclusive education***

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs as they engage discussion on interspecific relationships.During presentations, you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentations as slow learners contribute.

2. ***Research skills***

Guide the learners on how to find information regarding various topics

such as meaning of interspecific and intraspecific relationship. Guide the learners on how to come up with summarised notes from a large body of texts.

3. Communication in English

Developed as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in the discussions, presentations and during questions and answer sessions.

4. Critical thinking

This will be developed by learners as they answer the probing questions such as those on page 5. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. Lifelong skills

Advice learners that content learnt in these lessons would be applicable in their reproductive life future. Also make learners aware that they can become veterinary doctors if they take this topic seriously.

Key words in this unit and their meanings

Predation is a kind of relationship in which one form of species serves as food to the other species. This involves a predator and prey relationship where one species is hunted by the other as food to eat.

Competition is a relationship in which the two or more species are competing with each other to utilize the same limited resources that are necessary in order for them to survive.

Amensalism is a kind of relationship in which one population of species is inhibited while the other population of species is not affected.

Neutralism is a kind of relationship in which one population of species does not affect the other.

Commensalism is a relationship between species in which one of the organisms benefits from the relationship while the other organism is neither benefited nor harmed.

Allelopathy refers to the chemical inhibition of one species by another.

Grazing is a method of feeding in which a herbivore feeds on plants such as grasses.

Guidance on the problem statement

Introduce the unit by focusing the learners to the environment since most of the examples will be coming from the nearest surroundings. You may use simple examples to explain relationships between organisms especially those that

students are used to. For example while explaining the predator-prey relationship, you can give an example of a rat and a cat.

To make students understand more about interdependence, you can use videos. You will show a video to students and let them discuss about the types of relationships they have been able to learn from the video. Nature walks can also be some other way students can familiarise with relationships that exist between organisms in the environment.

Attention to special educational needs

Support for multi-ability learning	Support for special need learning
• Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. • Ensure all learners respect others' views irrespective of their shortcomings or talents. • Gifted learners to be given heavy tasks requiring more critical thinking while slow learners be given tasks which they can manage such as collecting materials for use during practicals.	• All learners whether able or disabled should participate actively in the class activity. • Physically challenged learners should be given priority in the learning process. In the group work, disabled learners should be given lighter duties like recording observations; while those able go to the field to collect specimen. • Learners with sight problems should be placed at the front of the class. • Remember disability is not inability!

List of lessons

Lesson Number	Lesson title	Number of periods
1	Introduction and meaning of intraspecific and interspecific interactions	2
2	Interspecific relationships	4

Answers for introductory activity

A is predator prey relationship because the lion which is the predator caches the zebra which is a prey to serve as food for lion.

B is Mutualism because the bird which is on the zebra picks parasites from it body to eaten as result zebra gets free from parasites then the bird get food.

C is commensalism because Birds nesting in trees provide an example of a commensal relationship where The tree is not harmed by the presence of the nest among its branches.

So this unit is about Interdependence among organisms in an ecosystem.

Lesson 1: Introduction and the meaning of intraspecific and interspecific relationship *(to be covered in two periods)*

Refer to Student's book.

Specific objectives

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

- Define intraspecific and interspecific relationships in ecosystems.
- Differentiate between intraspecific and interspecific relationships.
- Outline the types of interspecific relationship.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson.

   Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Organise to have the charts in place before the lesson.

3. Provide reference materials.

Teaching aids

- Computers and internet connection
- Reference books
- Senior 3 Student's book

Pre-requisite of the lesson

Introduce the lesson by reviewing food chains and food webs. Show learners charts and diagrams of food webs and food chains. Allow them to identify organisms involved and the flow of energy.

Teaching/learning activities

Activity 1.1(refer to Student's Book)

- Organise learners into groups of four to carry out Activity 1.1. Encourage learners to work as a team as they share duties, ideas and openly share their views.
- Take learners outside the classroom to observe interactions in the environment. Let them relate their observations to what is being studied.
- Provide learners with reference materials for research. If computers with internet are available they can do their research and watch

animated interactions and videos. Allow learners to discuss their findings with their classmate.

- Hold a class discussion on interdependence and its definition. Go further and explain what intraspecific relationship is, giving examples. Refer to students book.
- Let learners attempt Self-evaluation Test 1.1.

Answer for activity 1.1

1 and 2.

Type of termite	Role
Worker	Looks for food, builds anthill, takes care of young ones
Soldier	Protects colony
King	Fertilizes eggs
Queen	Lays eggs

3. Interraction between different types of bees in the colony, For example:

   Worker bees build the nest, forage for pollen or nectar, feed larva and protect the swarm; queen - lays eggs, drone fertilizes the eggs.

4. predator prey relationship because the lion which is the predator caches the zebra which is a prey to serve as food for lion.

5. Between bees the interaction is intra-specific.

Between termites the interaction is intra-specific.

Between Lions and zebra interaction is interspecific.

Synthesis

This lesson is meant to introduce the whole unit of ecology to learners. You will stimulate learners to understand the meaning of an ecosystem by referring them to the diagrams. Ask them if they understand what they portray. You will engage students to watch movies which will stimulate their understanding of relationships that exist between organisms for example the predator prey-relationship that exists between lions and zebras in a forest.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is interspecific relationship?

   Ans: This a type of relationship which involves the interaction between organisms belonging to different species.

2. What is intraspecific relationship?

   Ans: This is interaction between organisms of the same species.

Lesson 2: Intraspecific relationships

Refer to Student's book .

Specific objective

By the end of the lesson, learners should be able to discuss the various types of interspecific relationships.

Preparation for the lesson

1. This lesson will involve individualized work and discussing in pairs. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring reference textbooks and photographs of intraspecific relationships.

Teaching Aids

- Photographs
- Student's reference book
- Computers connected with Internet

Pre-requisite to the lesson

Introduce the lesson as explained under **guidance on the problem statement** above then narrow down to this lesson.

Teaching/learning activities

- Introduce the lesson by discussing interspecific relationships. Let learners give examples as you discuss each.

Activity 1.2 (refer to Student's book)

- Organise learners into groups of two, let them carry out Activity 1. Provide learners with videos of wildlife. Let them watch the videos and assess effects of predation, competition and grazing.
- Provide each group with charts of predator-prey relationships. Allow them to study the charts carefully. Allow each group to present their findings to rest of the class.
- Based on their findings, lead in discussing on mutualism, neutralism, amensalism and allellopathy. Refer to Student's Book. Let learners take notes as you discuss.
- Give learners time to attempt Self-evaluation Test 1.2 in Student's book.
- Instruct learners to attempt Test your Competence 1 at the end of the unit. This will gauge their competence, skills and knowledge level of the unit. This will enable you give more remedial lessons to deserving learners.

Answer for activity 1.2

Definition:

Competition for the same resource by two organisms of the same species is referred to as intraspecific competition. Examples male animals of the same species compete for the female animals for mating.

Synthesis

This lesson is meant to introduce the different forms of relationships that exist between the different species of organisms in an ecosystem. You will engage learners in activities that will make them grasp different forms of relationships in organisms.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is parasitism?

   Ans: It is a symbiotic relationship between spicies where the parisite live in or on the other organism called host causing it some harm or parasitism is the interaction between two organisms, in which one organism benefits and the other is harmed.

2. Name different types of interspecific relationship.

   Ans: Parasitism, predation, grazing, commensalism, mutualism, amensalism, allelopathy

Answers to Self-evaluation Test 1.1

Refer to Student's book

1. This is the competition between organisms of the same species.

2. It can lead to death of the weaker organisms that cannot compete and therefore poor genes are eliminated from the gene pool.

3. - It helps organisms to achieve a certain task easily as a group.
   - Organisms can guard themselves against predators with a strong force.
   - It is easy for them to identify danger when they are together.

Answers for activity 1.3

1 &2. Ticks, fleas ,lice ,tsetse flies and mites are ectoparasites, they benefit from their host by sucking bloods causing them to suffer .

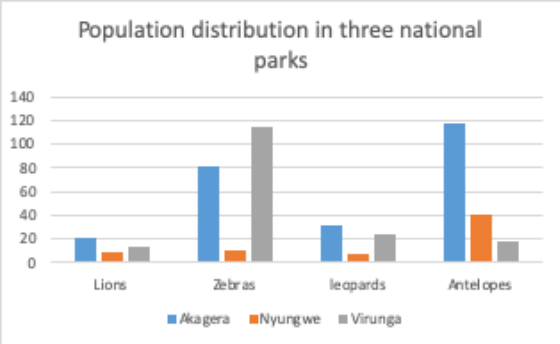
3. Bees, butterflies and birds visit the flower to find out the nectar as food. By moving from one flower to another pollen attached to their body can be transported hence pollination taking place.

4. In the ecosystem organisms need to interact in order to survive.

Answers for activity 1.4

1. Lions and leopards are predators, Zebra and antelopes are prey

2. Bar graph



3. If the lion eats zebra only, Akagera and Virunga has a good number of zebra which can help lion to survive. In Nyungwe zebras are very few which can cause lions to die.

   If leopards eat antelopes only, Akagera and Nyungwe has a good number of antelopes which can help leopards to survive. In Virunga antelopes are very few which can cause leopards to die.

4. If I am conservationist, I would look where there are many predators among three parks and take them where they are few the same applies to prey in order to avoid the disequilibrium among those three parks.

Answers to Self-evaluation Test 1.2

Refer to Student's book

1. a) - Introduce insect larvae that can eat these weeds.
   - Introduce herbivores that can graze on these weeds.

   b) Introduce another species which can compete with them for food and water.

2. a) Parasitism

   b) Predator-prey relationship

   c) Intraspecific competition

   d) Intraspecific competition

   e) Mutualism

3. a) As the population of the predators increases, the population of the prey reduces.

   b) For the population of the predator to increase, it requires the population of the prey to increase as well until a certain time when the increase is vice versa.

   c) The preys would be over populated leading to high competition among them as well as easy spread of disease between them.

d) A farmer can apply this knowledge in pest control, for example he can introduce predators to feed on certain pests on his farm.

e) Check for correct graph as shown in the Learner's Book.

Summary of this unit

This unit is meant to introduce ecology to learners. You will stimulate learners to understand the meaning of an ecosystem by referring them to the diagrams. You will engage students to watch movies which will stimulate their understanding of relationships that exist between organisms. Emphasise the fact that taking this unit seriously may lead to careers such as veterinary doctors, game wardens and also environmentalists.

Additional information for the teacher

Autotrophs and heterotrophs

Some organisms, called autotrophs, also known as self-feeders, can make their own food that is, their own organic compounds out of simple molecules like carbon dioxide. There are two basic types of autotrophs:

- **Photoautotrophs**, such as plants, use energy from sunlight to make organic compounds—sugars—out of carbon dioxide in photosynthesis. Other examples of photoautotrophs are algae and cyanobacteria.
- **Chemoautotrophs** use energy from chemicals to build organic compounds out of carbon dioxide or similar molecules. This is called chemosynthesis. For instance, there are hydrogen sulfide-oxidising chemoautotrophic bacteria found in undersea in communities where no light can reach.

Autotrophs are the foundation of every ecosystem on the planet. That may sound dramatic but it's no exaggeration! Autotrophs form the base of food chains and food webs, and the energy they capture from light or chemicals sustains all the other organisms in the community. When we're talking about their role in food chains, we can call autotrophs **producers**.

Heterotrophs, also known as other-feeders, can't capture light or chemical energy to make their own food out of carbon dioxide. Humans are heterotrophs. Instead, heterotrophs get organic molecules by eating other organisms or their byproducts. Animals, fungi, and many bacteria are heterotrophs. When we talk about heterotrophs' role in food chains, we can call them **consumers.** As we'll see shortly, there are many different kinds of consumers with different ecological roles, from plant-eating insects to meat-eating animals to fungi that feed on debris and wastes.

Food chains

A **food chain** is a linear sequence of organisms through which nutrients and energy pass as one organism eats another. Let's look at the parts of a typical food chain, starting from the bottom—the producers—and moving upward.

- At the base of the food chain lie the **primary producers**. The primary producers are autotrophs and are most often photosynthetic organisms such as plants, algae or cyanobacteria.
- The organisms that eat the primary producers are called **primary consumers**. Primary consumers are usually **herbivores**, plant-eaters, though they may be algae eaters or bacteria eaters.
- The organisms that eat the primary consumers are called **secondary consumers**. Secondary consumers are generally meat-eaters—carnivores.
- The organisms that eat the secondary consumers are called **tertiary consumers**. These are carnivore-eating carnivores, like eagles or big fish.
- Some food chains have additional levels, such as **quaternary consumers**—carnivores that eat tertiary consumers. Organisms at the very top of a food chain are called **apex consumers**.

Food chains give us a clear-cut picture of who eats whom. However, some problems come up when we try and use them to describe whole ecological communities.

For instance, an organism can sometimes eat multiple types of prey or be eaten by multiple predators, including ones at different trophic levels.

To represent these relationships more accurately, we can use a food web, a graph that shows all the trophic—eating-related—interactions between various species in an ecosystem.

Answers to end unit assessment 1

Refer to Student's book

1. C
2. This is how organisms depend on one another majorly for food.
3. a) Commensalism

   b) Mutualism

   c) Parasitism

   d) Amensalsim
4. Intraspecific competition is where organisms of the same species

compete against each other for a resource that is scarce for example hunting lions while interspecific competition is that competition between organisms of different species for a certain resource e.g. Maize plants and bean plants competing for sunlight.

5. Because predator kills the prey populations but a scavenger does not kill its prey

6. - It is larger than its prey.
   - It has claws to use as weapons.
   - It has good tactics of tracking the prey.

7. - Weeds and pests cause disease to crops and animals that are reared by man.
   - Farmers spend a lot of money to buy pesticides and herbicides.
   - Research is made about pests and diseases in laboratories.
   - Some of these weeds act as food for domestic animals.
   - Some of these weeds act as herbs that treat certain diseases.

8. It can lead to death of other plants since they are denied a chance of getting water.

9. **Predators**
   - They have a sharp sight for hunting at night.
   - They have a high ability to camouflage.
   - They have sharp claws and teeth for hunting.

   Preys
   - They have high speed to escape from predators.
   - They have strong senses to help them adapt to changing environments.
   - Some move and feed in groups for protection.
   - Some have poison that repels the predator.

10. Parasitism is only beneficial to the parasite but detrimental to the host. This is because parasites get food from the host but they end up giving disease to the host.

11. The environment should be conserved because of the following reasons:

    - The government earns foreign exchange from forests and other ecosystems that act as tourist destinations.
    - We get oxygen from most of the plants so their conservation is very important.
    - Plants are a source of medicine for both man and other domestic animals.
    - Some animals help us in transport and doing work for example donkeys.

12. a) Check if it is a line graph with two lines clearly indicating which is prey line and which is predator line. Check on the labels **x** and **y** axis, also the graph lines if they reflect the data provided.

    b) The population of the predator increases as that of the prey also increases because of the availability of food. When the population of the predators reaches a maximum, the prey will be consumed in large numbers or amounts leading to the decrease in their numbers.

    c) Cats and mice

    d) It helps to check populations of certain organisms that exhibit such relationships.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Help in collecting materials required for practicals. 2. Use Manila paper to write the differences between intraspecific and interspecific relationships.	1. Do further research in textbooks or the internet about interdependency among organisms in an ecosystem. Prepare power point and present to the rest of the class. 2. Come up with an acronym that can be used to memorise all the types of interspecific relationships.
Remedial questions for slow learners 1. Name the types of interdependency in an ecosystem.	**Extended questions for gifted learners** 1. Come up with a project explaining how the government can reduce pouching in Rwanda. Provide limit for project work.
Answers remedial questions for slow learners 1. Intraspecific and interspecific relationships.	**Answers to extended questions for gifted learners to guide the teacher.** 1. Mark according to the learners' explanation.

UNIT 2 Population size

Key Unit Competence

After studying this unit, the learners should be able to analyse and interpret population curves.

Learning objectives

Table 2.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, the learner should be able to: • Define population. • State the factors affecting the rate of population growth. • Identify phases in the sigmoid population growth curve and explain factors that lead to different phases and in the sigmoid curve of population growth. • Describe the increase in human population size over the past 250 years and its social and environmental implications.	By the end of this unit, the learner should be able to: • Interpret population growth curves. • Sketch population growth curves on basis of size (figures) against time. • Interpret graphs and diagrams of the human population growth.	By the end of this unit, the learner should be able to: • Advocate for family planning with reference to social and resource demand of the human population and harmful effects (e.g. climate change and pollution, competition for resources leading to possible conflicts).

Pre–requisites of this unit

Learners have learnt about population size in senior 1 and senior 2. Remind them of some of the key words used while studying population size and give brief meaning of the key words. Prepare the learners psychologically to know what the unit entails. This you can do by reviewing the sub-topics such as environmental factors, population growth curve and human population.

During the lessons, let the learners be aware of the fact that this topic is related to the environment in which they are

part of. Let them understand that at this level, they may only need the basic information.

Analysis of nutrients cycles in details involving complicated ecological factors will be learnt later. This lesson is preparing them to be advocates for protection of the environment.

Background information

A population is the sum of all interbreeding organisms of the same species which live in the same area. The population must be capable of increasing in number. Therefore all organisms should be capable of interbreeding. Usually more than one species live in the same area. Therefore many populations living together in an area form what is called a community. A population is never static. It can either increase or decline in number. The increase has a common characteristic in all populations, which can be described as "J – shaped" or "S or sigmoid shape".

Cross-cutting issues to be addressed

1. ***Standardisation culture***

Bring to the attention of learners the need of each student to understand the advantages of controlling population by various methods such as family planning and educating the masses,

2. ***Financial education***

Let learners be aware of the financial loss involved in the explosion of population. A lot of foreign exchange is used in buying medicine and other items which can't be found locally.

3. ***Gender education***

Emphasise to learners that anybody irrespective of their gender can participate in protecting the environment by becoming an environmentalist.

4. ***Inclusive education***

All learners should be encouraged to participate during lessons and practicals. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs and as they engage in group work to discuss the extent of damage done to ecosystems in process of development. During presentations, you can allow rotational presentations within the group

members. Gifted learners should help in coming up with presentations as slow learners contribute.

2. Research skills

Developed for example, in activities 2.1, 2.2, 2.3 as learners find out in advance various information regarding population size. Guide the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in the discussions, presentations and during question-and-answer sessions.

4. Critical thinking

Guide learners to discover for themselves various aspects that affect population size such as food, education, medicine, e.t.c .through various probing questions and the videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities.

5. Lifelong skills

Students will understand rapid population size increase leads to increased human activities that lead to pollution of air, land and water. This will help them to understand the negative effects of large populations.

Key words in this unit and their meanings

Population: This is a total number of all the organisms of the same species which live in a particular geographical area, and have the capability of interbreeding.

Environment: This is the surrounding that influences living organisms capable of modifying their growth and development.

Population size: This is the number of individual organisms in a population.

Population growth: This is the increase in the number of individuals in a population.

Population growth rate: This is the rate at which the number of individuals in a population increases in a given time period as a fraction of the initial population.

Predation: This is the style of life in which food is obtained mainly by the killing and eating of animals.

Predator: This is the hunter or organism which hunts other creatures for food.

Prey: It's the organism which is hunted and killed for food by the predator.

Disease: This is a particular abnormal condition, a disorder of a structure or function, that affects part or all of an organism.

Mortality rate: This a measure of the number of deaths in a particular population per unit of time.

Abiotic factors: These are non-living chemical and physical parts of the environment that affect living organisms and the functioning of ecosystems.

Biotic factors: These are living organisms that affect other organisms such as animals that consume other organisms. Each biotic factor needs energy to do work and food for proper growth. Biotic factors include human influence.

Carrying capacity: This is the maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water and other necessities available in the environment.

Guidance on the problem statement

This topic is about population size and its effect on the environment. To make students understand the concept of population increase and its effect on the environment, you should ask questions that stimulate their imagination about population increase.

- What could happen if the population of Rwanda doubles overnight?
- Compare the advantages and disadvantages of population size increase.

Guide them into discovering what they will learn in this unit based on their discussions. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as farming, game park rangers, environmentalists, etc.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners explain their effect on the environment due to population size increase. • When watching videos, you may rewind or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations.	• Models of degraded environments can be useful. • Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that short-sighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

Lesson Number	Lesson title	Number of periods
1.	Introduction, environmental factors and population size	2
2.	Population growth curves and limited resources	3
3	Human population growth and its effects.	3

Answers for introductory activity

-This increases in population is important in terms of human capital whereby there is increase of people which can work in different domains.

-The doubling of population affects negatively the environment on the earth in the following ways:

Deforestation where by people need the space for farming housing and other human activities.

Pollution of different types (water, soil and air pollution) cause by different human activity like industries….

-Yes, there will be scarcity of resources.

-The most factors that might affect the growth of future population are Inadequate supply of food and disease.

Lesson 1: Environmental factors and population size *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Explain factors that affect population increase.
- Explain the effects of rapid population increase on the environment.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI on the link: https://www.youtube.com/PQ-CQ3CQE3g in advance

to see if it is working. This link has a video on population size.

3. Obtain wall charts on population growth and other materials in advance.

Teaching Aids

- Charts on the population size increase.
- Video link: https://www.youtube.com/PQ-CQ3CQE3g
- Senior 3 Student's Book.

Improvisation: You may come up with your own charts drawn on Manila paper in case your school does not have the charts mentioned above.

Pre-requisite of the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is population size? (***Ans:*** is the number of individual organisms in a population.

  Name some factors that affect population increase. (Ans: Food, shelter, sex mates, immigration, emigration)
- Provide learners with the handouts, pamphlets and textbooks and ask them to find out what man has done to increase food production. They can also refer to the Internet.
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in Student's book on importance of monoculture and intensive farming.

Activity 2.1 (Refer to Student's book)

- Let the learners visit the website and take note of all factors that favour or limit population growth. They must observe in details of man's activities that affect population increase.
- Let the students write down all factors that favour population increase and effects of rapid population size increase.
- Summarise the lesson by highlighting the key points, which should include the impact of increased population size on the environment. Refer to Student's Book.

Synthesis

The lesson introduces learners to effects of population size increase on the environment such as destruction of the environment in search of food and shelter. The activities carried out during the lesson should help learners identify

the factors that favour rapid population size increase and ways of reducing population size.

Lesson assessment

1. What is population?

   Ans: This is a total number of all the organisms of the same species, which live in a particular geographical area and have the capability of interbreeding.

2. What is population size?

   Ans: It is the number of individual organisms in a population.

4. Outline some factors that favour population increase.

   Ans: Availability of food and shelter, advancement in medical services, ignorance on population control.

Lesson 2: Population growth curves and limited resources *(To be covered in 3 periods)*

Refer to Student's Book

Specific objectives

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

- Explain different population curves such as J-shaped and sigmoid curves.
- Describe the different phases on the population curve.
- Explain the effect of limited resources on the population size.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring pamphlets, handouts, and textbooks for reference in class.
3. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi https://www.youtube.com/PQ-CQ3CQE3g in advance to see if it is working. This link has a video on population growth curve.
4. Obtain wall charts on population growth curve and other materials in advance.

Teaching Aids

- Charts on the population growth curves
- Video https://www.youtube.com/PQ-CQ3CQE3g
- Student's Book.

Improvisation: You may come up with your own charts drawn on manila papers in case your school does not have charts mentioned above.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is name of the graph that illustrates population increase? (***Ans:*** J-shaped curve and sigmoid curve. What is the effect of limited resources on the population size increase? (***Ans:*** The effect is reduces population size increase and sometimes there is a decline.)

Activity 2.2 and 2.3 (Refer to Student's book).

- Supervise as learners carry out the above activities. Provide learners with the handouts, pamphlets and textbooks and ask them to find out how the population of drosophila increases when the resources are abundant and when they are scarce. They can also refer to the Internet.https://www.youtube.com/jP3t7eDs5AQ
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in Student's book on population size.
- Summarise the lesson by highlighting the key points, which should include the effect or resources on the population size increase.

Answer for activity 2.2

1&2. The population growth curve since 1990 in Rwanda shows that from 1990 up 1994 there is decrease of human population because of Genocide papetrated againest Tutsi. Then from 1995 population start to increase because of improved life conditions.

3. Mortality, fertility, and migration are the three important components of population growth. In Rwanda there is increase of population. This is due to improved health system and availability of the food and other improved life conditions which cause to have low mortality rate.

Synthesis

The lesson introduces learners to population curves and effects of resources on population size increase such food and shelter. The activities carried out during the lesson should help learners to understand the effect of resources on population size increase and the effect of large population size on the environment.

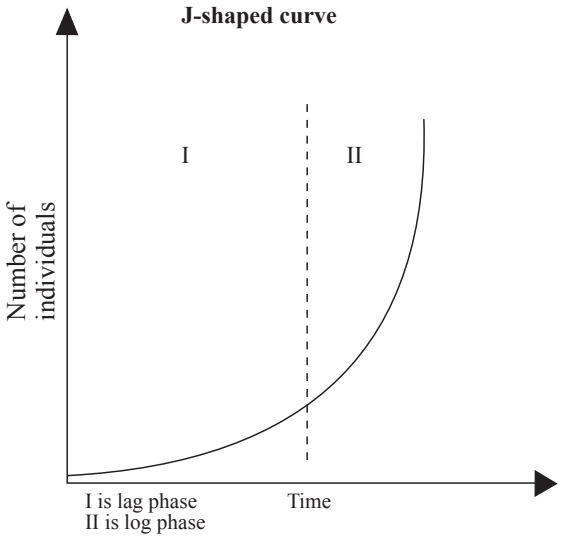
Lesson assessment

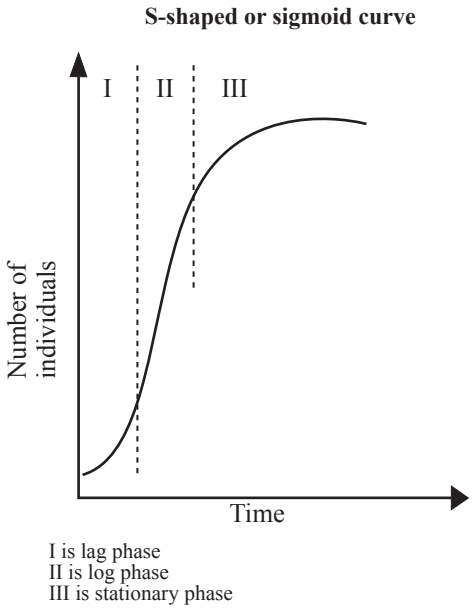
1. Name the phases of population size curves.

   Ans: Lag phase, log phase, stationary phase and decline phase.

1. Give the two types of curves used frequently to illustrate population size increase.

   Ans:





Lesson 3: Human population growth and its effects *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Understand the causes of over population.
- Explain the consequences of over population.

Preparation for the lesson

1. This lesson will involve individual work, video watching (https://www.youtube.com/3nnbd1b_tKQ) research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember**: When grouping

learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts, and textbooks for reference in class.

3. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI .

Teaching Aids

- Charts on the population sizes in different countries
- Video link: https://www.youtube.com/3nnbdlb-tkQ
- Senior 3 Student's Book.

Improvisation: You may come up with your own charts drawn on Manila paper in case your school does not have the charts mentioned above.

Pre-requisite to the lesson

Introduce the lesson as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which country has the highest population size? (***Ans:*** China) Which countries have the highest population increase? (***Ans:*** Most African countries and some Arab countries in Middle East)

Activity 2.4 (Refer to Student's book)

- Guide the learners as they do the above activity. Provide learners with the computers connected to internet, handouts, pamphlets and textbooks and ask them to find out the causes of human over population and which countries are over populated. They can also refer to the Internet.
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in Student's Book on human population growth and its effects.
- Summarise the lesson by highlighting the key points, which should include the effect on resources the human population growth has.

Synthesis

The lesson introduces learners to human population growth and its effects on the resources such as food and shelter. The activities carried out during the lesson should help learners to understand the effect of human population growth on population size increase and the effect of large population size.

Lesson assessment

1. What is over population?

   Ans: excessive population which is unsustainable by the space and resources available.

2. Name three countries in Africa with high population sizes.
   Ans: Rwanda, Nigeria, Burundi

3. Give the causes of rapid population growth.

   Ans: -
   - Increased food production and distribution
   - Improvement in public health
   - Gains in education and standard of living

Answers to Self–evaluation Test 2.1

Refer to student's book

1. It is the total number of all the organisms of the same species living in a specific area at a particular time.

2. Refer to Student's Book Fig 2.2.

Answers to Self–evaluation Test 2.2

Refer to student book

1. a) Growth

   b) Population growth

2. Any population growing exponentially starts off slowly, goes through a rapid growth phase, and then levels off once the carrying capacity of the area is reached. Plotting a graph of such a population yields an S-shaped curve. This curve can be divided into three phases: exponential, transitional and plateau.

   Population growth is fastest during the exponential growth phase because (birth rate + immigration) exceeds (death rates + emigration).

   Population growth slows down during the transitional phase because disease, predation and competition set limits to population increase. Disease spreads faster as populations get larger and therefore reduces the number of individuals who can reproduce. Predators can hunt more successfully as the prey population increases, which in turn increases the population of predators (negative feedback). Resources become scarce when a population is large, which in turn increases competition.

   Population growth is zero at the plateau phase because it has reached its carrying capacity, which is the maximum population size that an environment can support. At carrying capacity, populations tend to produce more offspring than can

be supported by the environment. This leads to extreme competition for resources such as food, shelter, nesting space and so on.

3. Refer to Fig 2.4 in Student's Book.

Answers to Self–evaluation Test 2.3

Refer to Student's Book

1.
   - Better education on the effects of overpopulation
   - Introduction of Family planning methods
   - Knowledge of sex education
   - Better government policies
2.
   - Quality education
   - Access to health care
   - Access to water and sanitation
   - Economic security
   - Creating jobs

Summary of this unit

This unit deals with population which involves interpretation of graphs of different population growth. You should therefore effectively use the practical activities and suggested teaching approaches in the teachers' book to guide the learners to acquire the requisite knowledge and desired competences in these areas. Emphasise the fact that taking this unit seriously may lead to careers such as environmentalist.

Additional information to the teacher

- Population density depends on constant environmental factors (abiotic and biotic) which determine its increase or decrease. These are called secondary ecological events which are different from the primary ecological events such as food, shelter and sex mates. The secondary ecological events are classified into categories which are density dependent factors and density independent factors. These factors include climate, level of predation or availability of prey, for example, a very cold winter could result into increased mortality and low natality rate. In the end the population density will suffer. Then on the other hand low predation or abundance of prey results in increased natality and decreased mortality.

  All these factors mentioned act as population density regulatory factors. The environment can be friendly or unfriendly to population growth. Any environmental factor that fails the population from reaching its maximum reproductive potential is called environmental resistance.

- Read further on analysis and interpretation of population

curves. This will give you a better understanding of the subject matter.

- When organising learners into groups consider gender and special educational need learners. The group formation should be well represented to enable learners appreciate diversity amongst them and learn that we are all gifted differently.

Answers to end unit assessment 2

Refer to Student's Book

1. a) Overpopulation occurs when a species' population exceeds the carrying capacity of its ecological niche. It can result from an increase in births, a decline in the mortality rate, an increase in immigration.

   b) Overpopulation affects even areas with low population densities. This is because of shared resources.

2. - Reducing the effects of climate change
   - Involving communities in wealth creation
   - Empowering people especially women and children
   - Providing quality education

3. In developed nations, couples and individuals are already aware and have a choice of family planning methods. They have better medical facilities that offer the same. Their life expectancy is also high.

4. It reduces the population. It mainly affects the productive individuals in the world.

5. a) There is general increase in population, with a sharp decline in the years 1990-1995.

   b) Availability of food, better health care services and good living conditions.

   c) The genocide

   d)
   - Providing equal opportunities to all
   - Intermarriages between communities
   - Mass education
   - Avoiding discrimination and stigmatisation

6. A

7. C

8. B

9. a. Lag phase, Log phase, stationary phase and death phase.

   b. Refer to the content under the characteristics of each phase (SB).

10 . Factors that affect the rate of population growth of an organism are food supply, predation and disease (find explanation in SB).

11. a) It is an upright pyramid with the population reducing as the ages advance.

b) The lower population bracket which are the majority (below 19 years) depend on a reducing adult population (over 30 years). This leads to financial challenges in terms of education, health care and food supply.

c) Education on the use of family planning methods, improving health care services and food production.

d) Human population can be controlled enforcing family planning through different education programs.

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Using Manila paper, write the environmental factors that limit population size. Stick on the class wall. 2. Help in collecting materials required for the practical activities.	1. Do further research in textbooks or the internet about population size. Write short notes then share with other class members. 2. Draw graphs of population of different organisms and interpret.
Remedial questions for slow learners 1. What is population? 2. List factors that limit population size.	**Extended questions for gifted learners** 1. Interpret a sigmoid curve
Answers Low order thinking questions 1. Population is the total number of all the organisms of the same species living in a given area. 2. Food supply, predation, diseases	**Answers to high order thinking questions** 1. Refer to students book

UNIT 3 Nutrients cycle

Key Unit Competence

After studying this unit, learners should be able to describe the water, carbon and nitrogen cycles.

Learning objectives

Table 3.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of the unit, the learner should be able to: • Describe the water, carbon and nitrogen cycles in nature. • Explain the effect of burning fossil fuels and deforestation on concentration of oxygen and carbon dioxide in the atmosphere. • Explain how human activities affect the carbon cycle.	By the end of the unit, the learner should be able to: • Interpret charts of nitrogen, carbon and water cycles. • Justify the use of leguminous plants in crop rotation.	By the end of the unit, the learner should be able to: ▪ Acknowledge the role of microorganisms in nutrient recycling. ▪ Support tree planting programs at home and school.

Pre-requisite of this unit

Learners have learnt about nutrient cycles in senior 1 and senior 2. Review the table nutrient cycle by asking the learners to mention some of the nutrient cycles they learnt in senior 1 and 2. Mention some of the importance of the nutrient cycles by giving examples. Understand that this unit is related to daily activities.

During the lessons, let the learners be aware of the fact that this topic is related to the environment in which they are part of. Let them understand that at this level, they may only need the basic information. Analysis of nutrient cycles in detail involving complicated ecological factors will be learnt in higher levels. This lesson is preparing them to be advocates for protection of the environment.

Background information

A cycle is a series of events that are regularly repeated in the same order. Substances pass through biosphere, lithosphere, atmosphere and hydrosphere. That's why the cycles are called biogeochemical cycles. All substances on earth are cycled, the cycle can be short lived or take a long time, some cycles take just months while others take millions of years. The biosphere is biotic while the rest are abiotic.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need of each student to understand the advantages of planting trees so as not to upset nutrient cycles and educate the masses.

2. Financial education

Let learners be aware of the financial gains involved in planting of trees. When trees grow old, they can be harvested after they have maintained the carbon cycle.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can participate in protecting the environment by becoming an environmentalist when they plant trees.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs and as they engage in group work to discuss the extent of damage done to ecosystems in process of development. This can also be achieved during presentations; you can allow rotational presentation within the group members.

2. Research skills

For example,in Activities 3.1, 3.2, and 3.3 as learners find out in advance various information regarding nutrient cycles. Guide learners on how to find information regarding various activities. Guide the learners on how to come up with summarised notes from a large body of text.

3. *Communication in English*

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class. Encourage learners irrespective of their abilities to participate in group discussion, during presentations and question-and answer-session.

4. *Critical thinking*

Guide learners to discover for themselves various aspects that disrupt nutrient cycles especially developmental activities through probing questions and the videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities.

5. *Lifelong skills*

Reckless developmental activities such as clearing land for various industries without prior assessment can lead to degradation of the environment. This will help them to understand the negative effect of disrupting nutrient cycles.

Key words in this unit and their meanings

A nutrient cycle: This is the movement and exchange of organic and inorganic matter back into the production of living matter.

Micronutrients: These are nutrients required by organisms throughout life in small quantities to maintain a range of physiological functions

Macronutrients: These are food nutrients required in large amounts by living organisms.

Denitrification: This is a process of nitrate reduction performed by anaerobic bacteria that produce molecular nitrogen (N2).

Surface runoff: This is the flow of water that occurs when excess storm water, meltwater or other sources flows over the earth's surface.

Hibernation: This is a state of inactivity in endothermic organisms that is characterized by low body temperature, slow breathing and heart rate and low metabolic rate.

Nitrifying bacteria: These are chemoautotrophic bacteria i.e. (Nitrosomonas, Nitrosococcus, Nitrobacter, Nitrococcus) that grow by consuming inorganic nitrogen compounds.

Putrefaction: This is one of seven stages in the decomposition of the body of a dead animal.

Nitrification: This is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate.

Fossil fuels: These are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms.

Precipitation: This is any product of the condensation of atmospheric water vapour that falls under gravity such as rain and snow.

Condensation: This is the change of the physical state of matter from gas phase into liquid phase, and is the reverse of evaporation.

Evaporation: This is a type of vaporisation of a liquid that occurs from the surface of a liquid into a gaseous phase.

The nitrogen cycle: This is the process by which nitrogen is converted between its various chemical forms.

The carbon cycle: is the biogeochemical cycle by which carbon is exchanged on land, in air and in water.

The water cycle or hydrological cycle: Is the continuous movement of water on, above and below the surface of the earth.

Guidance on the problem statement

This topic is about nutrient cycles. The diagram Fig 3.1 illustrates clearly the nutrient cycle in the environment. You should ask questions that stimulate the learners' imagination about nutrient cycles. Such questions could be:

- What would happen if saprophytic microorganisms are removed from the environment?

  Ans: A lot of nutrients could take a long time to be released from dead organisms thereby stopping the nutrient cycles.

- Which organism is mostly depended on by others?

  Ans: Plants

Guide them into discovering what they will learn in this unit based on their discussions. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as farming, game park rangers, environmentalists, etc.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners explain the nutrient cycles so that learners can start managing the environment. -When watching videos, you may rewind or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations.	• Models of degraded environments can be useful. • Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that short-sighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1.	Introduction, Nutrient cycles –water cycle	2
2.	Carbon cycle	2
3	Nitrogen and Phosphorous cycle	2

Answer of introductory activity

Plants absorb the simple inorganic molecules then used during photosynthesis. Photosynthetic products are eaten by consumer then when consumer and producers die they are decomposed into simple inorganic molecules taken again by producers. this helps in the recycling of the nutrients

Lesson 1: Introduction, Nutrient cycles–water cycle *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Explain the nutrient cycles.
- Explain the water cycle.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts, and textbooks for reference in class.

3. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WiFi in advance to see if it is working.

4. Obtain wall charts on nutrient cycles and other materials in advance.

Teaching Aids

- Charts on the nutrient cycles and water cycle
- Video link: https://www.youtube.com/al-do-HGulk
- Senior 3 Student's Book.

Improvisation: You may come up with your own charts drawn on Manila papers in case your school does not have the charts mentioned above.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Where do clouds come from? (***Ans:*** They are formed from water vapour released by organisms and vapour from water bodies.) Why are nutrients never finished from century to century? (***Ans:*** It's because when organisms die they decompose and release the nutrients into the environment to be used by other organisms.)

Activity 3.1 (Refer to Student's Book .)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out what man has done to increase food production. They can also refer to the Internet.
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in students book on introduction and water cycle.
- Let the learners take note on the findings about water cycle. Give them time write down all factors involved in the water cycle. Summarise the lesson by highlighting the key points which should include the key factor in water cycle like forests, swamps lake and rivers.

Answer for activity 3.1

i) In procedure 2: Underneath the lid there is drop of water

3: The Water from the soil evaporate then drops of water appear on glass container.

ii) -Transpiration and evaporation

- Condensation.

iii) Water is maintained in the environment by water cycle.

iv) Water pollution affects water cycles, the water cycle is the cycle of water moving up from the earth, into the atmosphere, and water falling from the atmosphere to earth. The sun provides all of the energy for the water cycle by evaporating water off of treetops and the ocean's surface. Water from inland areas, evaporates in the ground, and finds its way to the ocean, and just becomes run off and travels to the oceans in liquid form. However, when water evaporates, it comes back in the form of precipitation, or rain. But as it falls, it gathers pollutants from the air, and becomes acid rain. This further pollutes water and its inhabitants, but water pollution does not solely affect the water cycle. This is mainly because when water evaporates, it leaves behind minerals, and even pollutants, and goes up as "clean" water.

Synthesis

The lesson introduces learners to nutrient cycles especially the water cycle. The students become aware of the various factors that play important roles in the water cycle.

Lesson assessment

1. What do you understand by the term nutrient cycle?

   Ans: This is the movement and exchange of organic and inorganic matter back into the production of living matter.

2. Which organisms are involved in water cycle?

   Ans: All organisms especially the trees

3. What is the function of the sun in water cycle?

   Ans: It provides energy that drives water from one state to another in the water cycle.

Lesson 2 : Carbon cycle *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Explain the carbon cycles.
- Understand the effect of mans activities on water cycle.
- Describe the greenhouse effect.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts and textbooks for reference in class.

3. Also ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WiFi https://www.youtube.com/Sd8D7WyVS6A in advance to see if it is working. This link has a video on carbon cycles.

4. Obtain wall charts on carbon cycle other materials in advance

Teaching Aids

- Charts on carbon cycle
- Video link: https://www.youtube.com /Sd8D7WyVS6A
- Senior 3 Student's Book

Improvisation: You may come up with your own charts drawn on Manila papers in case your school does not have charts mentioned above.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Why is the carbon cycle important? (***Ans:*** Carbon cycle maintains the concentration of carbon dioxide in the atmosphere. What would happen if the concentration of carbon dioxide falls down below normal? ***Ans***: The plants will lack food and die. Then all animals (heterotrophs) will die next.

  Activity 3.2 (Refer to Student's Book .)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out what man has done to maintain the carbon cycle. They can also refer to the Internet. https://youtube.com/d70iDxBtnas

- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in the Student's Book on the carbon cycle.

  Let the learners take note on the findings about carbon cycle. Let the students write down all processes involved in the carbon

cycle. Summarise the lesson by highlighting the key points, which should include the key factor in carbon cycle (water) such as forests, swamps, oceans lake and rivers.

Answer for activity 3.2

a) processes are: Respiration, photosynthesis and combustion

b) Respiration and combustion release carbon dioxide which is used by the plants during photosynthesis then release oxygen which is used during respiration and combustion.

c) -Respiration and combustion

-Photosynthesis

d) Industries, burning charcoals……

Synthesis

The lesson introduces learners to the carbon cycle. The human actives should be emphasised as they affect the carbon cycle most. The students become aware of the various factors that play important roles in the carbon cycle.

Lesson assessment

1. Name the three human activities that affect the carbon cycle

   Ans: Deforestation, burning fossil fuel, Respiration

2. Name the organism that maintains the carbon cycle more than others.

   Ans: Plants

3. What is the effect of acid rain?

   Ans: It kills plants.

4. Name two activities that add carbon dioxide to the atmosphere.

   Ans: Deforestation and burning fossil fuel

Lesson 3: Nitrogen and Phosphorous cycle *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Explain the nitrogen and phosphorous cycles.
- Describe the role of bacteria in the nitrogen cycle.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. REMEMBER: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts, and textbooks for reference in class.

3. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi Checkhttps://www.youtube.com/leHy-Y_8nRs advance to see if it is working. This link has a video on nitrogen and phosphorus cycles.

4. Obtain wall charts on nitrogen and phosphorus cycles and other materials in advance.

Teaching Aids

- Charts on nitrogen and phosphorus cycle
- Video link: https://www.youtube.com/leHy-Y_8nRs
- Senior 3 Student's Book

Improvisation: You may come up with your own charts drawn on Manila papers in case your school does not have the charts mentioned above.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

Ask probing questions to introduce the lesson. Such questions may include: Why is the nitrogen important? (***Ans:*** Nitrogen is the major component of protein which is found in all organisms We need nitrogen to make proteins.) Name one important function of phosphorous in the body ***Ans:*** It's involved in manufacture of energy and it's the major component of the skeleton in all vertebrate animals.

Activity 3.3 and 3.4 *(Refer to Student's Book .)*

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out what man has done to maintain nitrogen and phosphorous cycle. They can also refer to the Internet: https://www.youtube.com/leHy-Y_8nRs

- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in students book on the nitrogen and phosphorous cycles.

- Let the learners take note on the findings about the nitrogen and phosphorous cycle. Summarise the lesson by highlighting the key points, which should include the key factor in nitrogen and phosphorous cycles such as leguminous plants, artificial fertilisers and nitrogen fixing bacteria.

Answer for activity 3.4

1. Phosphorus is concentrated in water, soil and sedimentary.

2. When fertilizer or manure (both containing mostly soluble phosphorus) is added to soil, the soil's pool of soluble phosphorus increases. With time, soluble phosphorus is transformed slowly to less-soluble (less plant-available) forms.

   A large amount of the soil's phosphorus is bound in compounds that are formed when the anionic (negatively charged) forms of dissolved phosphorus become attached to cations, such as iron, aluminum and calcium. Attached phosphorus includes "labile," or loosely bound, and "fixed," or tightly bound, phosphorus compounds. Note that phosphorus loosely bound to the soil particles (labile phosphorus) remains in equilibrium with soluble phosphorus. Thus, when plant removal reduces the concentration of soluble phosphorus, labile phosphorus is converted to the soluble form to maintain the equilibrium.

3. It causes eutrophication (a reduction of dissolved oxygen in water bodies caused by an increase of minerals and organic nutrients) of rivers and lakes. This reduced level of oxygen in water ends up suffocating fish.

Synthesis

The lesson introduces learners to nitrogen and phosphorous cycles. The human activities should be emphasised as they affect nitrogen cycle most. The students become aware the various factors that play important roles in nitrogen and phosphorous cycles.

Lesson assessment

1. Name the bacteria involved in nitrogen cycle.

   Ans: Nitrosomonas, Nitrosococcus, Nitrobacter, Nitrococcus

2. Where is phosphorous most concentrated?

   Ans: Sediments in oceans and rocks

3. What is the source of phosphorous to animals?

   Ans: Plants and animals they eat

Answers to Self-evaluation Test 3.1

Refer to Student's Book

1. C
2. D
3. There would be no life.
4. Every step is important.

Answers to Self-evaluation Test 3.2

Refer to Student's Book.

1. Living things carry out the process of gaseous exchange and respiration. The gases involved include oxygen and carbon dioxide, which interchangeably gets in and out. Carbon forms part of the organism, when the organism dies and decomposes carbon dioxide is released back into the environment.
2. A
3. Solar, biogas, geothermal and hydroelectric energy

Answers to Self-evaluation Test 3.3

Refer to Student's Book.

1. A
2. B
3. False

Answers to Self-evaluation Test 3.4

Refer to Student's Book.

1. D
2. A
3. D

Summary of the unit

This unit deals with nutrient cycles, that is water cycle, nitrogen cycle and phosphorus cycle. You therefore should effectively use the practical activities and the suggested teaching approaches in the Teacher's Book to guide learners acquire the requisite knowledge and desired competences in these areas. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well. Emphasise the fact that taking this unit seriously may lead to career such as environmentalist.

Additional information to the teacher

- A nutrient cycle (or ecological recycling) is the movement and exchange of organic and inorganic matter back into the production of living matter. The process is regulated by food web pathways that decompose matter into mineral nutrients. Nutrient cycles occur within ecosystems.
- The nutrient cycle describes how nutrients move from the physical environment into living organisms, and subsequently are recycled back to the physical environment. This movement of nutrients, essential for life, from the environment into plants and animals and back again, is a vital function of the ecology of any region. In any particular environment, the nutrient cycle must be balanced and stable if the organisms that live in that environment are to flourish and be maintained in a constant population. Currently, large parts of humankind

influence the nutrient cycle in such a way that we remove nutrients from the land and discharge them into aquatic environments. On the one hand, this leads to soil depletion on the land, and on the other hand, an overabundance of nutrients and pollution of water sources.

- When organising learners into groups, consider gender and special educational need learners. The group formation should be well represented to enable learners appreciate diversity amongst them and learn that we are all gifted differently.

Answers to end unit assessment 3

Refer to Student's Book.

1. B
2. C
3. a) Phosphorous cannot be found in gaseous state.

   b) It forms part of compounds found in food that organisms eat.

   c) False
4. Boiling water, drying clothes on a hanger or water drying on the floor or surface
5. a) Peas, ground nuts, cashew nuts

   b) They add nitrogen into the soil.
6. The nutrient cycle is the movement and exchange of organic and inorganic matter back into the production of living matter while energy flows in one direction, typically from the sun, through photosynthetic organisms including green plants and algae to herbivores, carnivores and decomposers.
7. a) Photosynthesis, respiration, combustion

   b) Amount of carbon dioxide / CO_2 in air is increasing
8. a) X- respiration

   Y-Combustion/ burning

   b) Algae are photosynthetic organisms, therefore act as a producer.

   c) Tropical forests in tropical rainforest conditions are:

   - warm(er)/hot
   - Damp/moist/wet/humid
   - A lot of microorganisms
   - A lot of material to decay
9. a) Eutrophication of the pond

   b) Nitrogen fertiliser caused the death of fish in the stream.
10. • Reduce mining activities, excess use of organic fertilisers and chemicals

- Protect, conserve and manage the environment
- Control overpopulation

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Participate fully during class and practical activities. You can do this by collecting materials needed for practicals or taking notes during class session.	1. Do further research in textbooks or the Internet about the nutrient cycle. Write short notes then share with other class members. 2. Using Manila paper, draw different nutrient cycles and stick on class wall.
Remedial questions for slow learners 1. What are macronutrients? 2. Name three processes involved in water cycle.	**Extended questions for gifted learners** 1. Illustrate with diagram, the process involved in water cycle.
Answers to remedial questions for slow learners 1. These are nutrients needed in large quantities by plants and animals. 2. Evaporation, condensation, transpiration	**Answers to extended questions for gifted learners** 1. Refer to Student's Book Fig 3.2.

UNIT 4 Effects of human activities on ecosystem 1

Key Unit Competence

After studying this unit, the learners should be able to assess the consequences of uncontrolled human activities on ecosystems.

Learning objectives

Table 4.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • Define the terms pollution and degradation of the environment. • Outline man's activities that affect the environment such as monoculture and intensive livestock farming. • Learn many other destructive activities of man such as road construction and extraction of natural resources.	By the end of this unit, learners should be able to: • Identify polluted and degraded environment • Learn the habits that lead man to destroy the environment. • Analyse the extent of destruction made during constuction of roads and houses.	By the end of this unit, learners should be able to: • Show concern about the lives of all organisms in the ecosystem. • Let students weigh the gains and losses in each man's activity that degrades the ecosystem. • Learn to value wildlife which is destroyed in the name of development.

Pre-requisite

Learners have learnt about ecology and conservation in senior 1 and 2. Review the unit by reminding the learner's some of the human activities on an ecosystem as learnt in senior 1 and senior 2. Give out the main points from the Student's Book.

During the lessons, let the learners be aware of the fact that this topic is related

to the environment in which they are part of. Let them understand that at this level, they may only need the basic information otherwise details of the structure and functioning of ecosystem will be learnt later. This lesson is preparing them to be environmentalists, agriculture officers or game park wardens.

Background information

The human's appetites for needs are disarranging the environment's natural equilibrium. Our production industries are venting smoke and discharging chemicals that are polluting our water. The smoke that is emitted into the atmosphere holds unappealing gases such as carbon monoxide and sulphur dioxide. The high levels of pollution in the atmosphere form layers that are eventually absorbed into the atmosphere. Organic compounds such as chlorofluorocarbons (CFC's) have generated an unwanted opening in the ozone layer which emits higher levels of ultraviolet radiation putting the globe at large threat.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need for each student to take care of the environment and if possible pass the information to other people.

2. Financial education

Let learners be aware of the financial loss involved in long run after destroying the environment for quick gains.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can participate in protecting the environment by becoming an environmentalist.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangements should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs and as they engage in group work to discuss the extent of damage done to ecosystems in process of development. Gifted learners should help in coming up with the presentation contents as slow learners contribute.

2. ***Research skills***

Developed for examples, in activities 4.1, 4.2, 4.3 and 4.4 and as learners find out in advance various information regarding man's activities and pollution.

3. ***Communication in English***

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class.

4. ***Critical thinking***

Guide learners to discover for themselves various aspects of human activities through various probing questions and the videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities.

5. ***Lifelong skills***

Students will understand human activities that lead to pollution of air, land and water. This will help them to avoid such activities and probably discourage others. Learners will pick.

Key words in this unit and their meanings

Hydroponics: It's the of growing plants in nutrients solution.

Cloning: It's a form of asexual reproduction in which an organism can be reproduced from a single cell.

Genetic engineering: It's the science of manipulating DNA (genes) of an organism to produce desired characteristics in that particular organism.

Green house effect: It's a process in which carbon dioxide and other green house gases radiate heat back to earth causing temperature to rise up.

Pollution: It's the introduction of harmful substances into the environment at a higher rate than the rate at which they are removed.

Ecosystem: A unit of the environment together with the organisms. It contains interacting with each other.

Monoculture: Cultivation of one crop usually on a large scale.

Intensive farming: Farming on a small piece of land using modern techniques.

Deforestation: Cutting down trees or forests at a rate exceeding replacement.

Sustainable resources: These are the resources which can be renewed as in the case of agricultural products.

Sustainable development: It's the development which does not damage the environment either by using all the resources or polluting the environment.

Nuclear fallout: These are dangerous radioactive substances that fall back to ground after a nuclear explosion.

Habitat: It's an area where an organism is usually found.

Biodegradable: These are substances that can be broken down by living things.

Guidance on the problem statement

As earlier mentioned, this topic is about the effects of man's activity on the ecosystem. To make students understand the concept of destruction of the environment, let them study the diagram and charts showing people burning charcoal where large scale deforestation is taking place. You should ask questions that stimulate their imagination.

- What will happen if trees are burnt to produce charcoal?
- What will happen to soil and other organisms after deforestation?

Guide them into discovering what they will learn in this unit based on their discussions. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as farming, game park rangers, environmentalists, etc.

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts and explain their effect on the environment.	• Models of degraded environments can be useful.
• When watching videos, you may repeat or pause for the benefit of slow learners.	• Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters.
• Gifted learners to lead in group discussions and do presentations.	• Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

Attention to special educational needs

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Increased food production by modern technology	1
2.	Negative impacts on ecosystem by monoculture	1
3.	Negative impacts on ecosystem by intensive livestock	1
4.	Habitat Destruction	1
5.	Pollution and effects of air pollution	1
6.	Causes and effects of land pollution	1
7.	Effects of water pollution	1
8.	Nuclear fallout	1

Answers of introductory activity

A: Planting trees maintain the environment

B: Mining destructs the environment.

4.1 Effect of human activities on ecosystem

Refer to Student's Book

Lesson 1: Increased food production (To be covered in one period)

Refer to Student's Book

Specific objectives

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

- Explain major activities of man that affect the environment.
- Name and identify methods that have increased food production.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring pamphlets, handouts, and textbooks for reference in class.
3. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as Wifion the link https://www.youtube.com/NQs3at7Q72khttps://www.youtube.com/watch?v=_qmNCJxpsr0 in advance to see if it is working. This

link has a video on food production, which is part of the activities in this lesson.

3. Obtain wall charts and other materials in advance.

Teaching Aids

- Charts on the polluted and degraded environment.
- Video link: https://www.youtube.com/NQs3at7Q72k
- The diagrams in Student's Book.

Improvisation: You may come up with your own charts drawn on Manila papers in case your school does not have the charts mentioned above.

Pre-requisite to the lesson

Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.

Teaching and learning activity

- Ask probing questions to introduce the lesson. Such questions may include: which parts of the environment are most degraded by man activities? (***Ans:*** Land and air) What is the pollutant? (***Ans:*** Chemicals such as insecticides, herbicides smoke from burnt plants)

  Activity 4.1 (Refer to Student's Book)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out what man has done to increase food production. They can also refer to the Internet.
- Let learners have a brief discussion session on their findings then write summary notes. Correct them appropriately. Refer to notes in Student's Book on importance of the monoculture and intensive farming.

  Activity 4.2 (Refer to Student's Book)

  - Let the learners visit the farms and take note of all what is done on the monoculture farm and the intensive livestock farm. They must observe details of man's activities in increasing food production.
  - Let the students write down the tools used on monoculture farms and intensive livestock farms.
  - The tools for monoculture farming are: Tractors, various tillage equipment, planter and fertiliser applicator.
  - Summarise the lesson by highlighting the key points, which should include the impact of increased food production on the society and country at large.

Answer of activity 4.1

i) poverty, unemployment and environmental destruction.

ii) Refer to the unit 2.

iii) Refer to the content under food supply.

Synthesis

The lesson introduces learners to effects of human activities on the ecosystem such as increased food production. The activities carried out during the lesson should help learners identify tools and chemicals used in monoculture farming and intensive livestock farming.

Note: Most of livestock farming in Rwanda is carried out in or near the capital city Kigali.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   Ans: I learnt human activities that affect the ecosystem such as increased food production.

2. What methods are used to increase food production.

   Ans: New methods of agriculture such as monoculture farming and intensive livestock farming.

3. Why are the two methods effective in increasing food production?

   Ans: It's because of the modern tools and chemicals such as insecticides and herbicides used in farming.

Lesson 2: Negative impact on ecosystem by monoculture farming

Refer to Student's Book

Specific objectives

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

- Outline the negative effects of monoculture farming.
- Name some chemicals such as fertilisers, pesticides and herbicides that pollute the environment.
- Describe how use of huge amounts of fossil fuel on monoculture farms can result in climate change.

Preparation for the lesson

1. This lesson will involve individual work, video watching, and group activities You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as Wifi or modem.

3. Test the link: https://www.youtube.com/NQs3at7Q72k in advance to see if it is working. This link has a video on ecosystems which is part of one of the activities in this lesson.

4. Obtain wall charts on structure of the heart and other materials in advance.

Teaching Aids

- Charts on parts structure of the heart and textbooks, on pollution and deforestation
- Video link: https://www.youtube.com/NQs3at7Q72k
- The diagram in Student's Book.

Improvisation: You can organise and draw appropriate diagrams on manila paper illustrating pollution by monoculture farmers. Pollution from excess fertilisers.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is the major role played by tractors in increased production? (***Ans***: They increase size of cultivated area in a short time.)

  Activity 4.3 (Refer to Student's Book)

- Let the learners realise how food supply is not equally distributed in the world.
- Ask learners to name countries which lack adequate food.
- Summarise the lesson by highlighting the key points on the ecosystem.

Refer to the notes in Student's Book. Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

Synthesis

This lesson introduces learners to the effects of human activities on ecosystems. Use the internet, books, environment around the school and visit areas such as national parks, monoculture farms and intensive livestock farms to understand those effects

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Outline organisms found in an ecosystem.

   Ans: Plants, herbivores, omnivores and carnivores

2. State the role plants in ecosystems

   Ans: They produce food for other organisms.

3. How does a man increase food production?

   Ans: By mechanised farming and applying pesticides, herbicides and fertilisers

4. How does modern farming destroy the environment?

   Ans: Use of chemicals such as pesticides and fertilisers pollutes the environment and kills untargeted organism. such as fish.

Lesson 3: Negative impacts on ecosystem by intensive livestock
(To be covered in one period)

Refer to Student's Book
Specific objectives

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

- Outline the negative effects of intensive livestock farming.
- Name some chemicals such as insecticides and pesticides that pollute the environment.
- Describe how use of huge amounts of fossil fuel on intensive livestock farms can result in climate change.

Preparation for the lesson

1. This lesson will involve individual work, video watching and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as Wifi or modem.

3. Test the link: https://youtube.com/NQs3at7Q72k in advance to see if it is working. This link has a video on ecosystems which is part of one of the activities in this lesson.

Teaching Aids

- Charts on parts structure of the heart and textbooks, on pollution.

- Video link: https://www.youtube.com/NQs3at7Q72k
- The diagram in Student's Book

Improvisation: You can organise and draw appropriate diagrams on Manila paper illustrating pollution by intensive livestock farmers. Pollution from excess pesticides and insecticides used on livestock.

Pre-requisite to the lesson

- Ask probing questions to introduce the lesson. Such questions may include: What type of animals are reared by intensive livestock farmers?

(***Ans:*** The animals are mainly cows, pigs, chicken and goats)

Activity 4.3 (Refer to Student's Book)

Teaching learning activities

- Let the learners observe organisms in national parks and understand time, money and manpower used to keep national parks safe.
- Ask learners the type of animals and plants observed.
- Guide learners to ask park rangers useful questions such as. How many times are visitors allowed in the national park? What type of cats are present in the National park.
- Let learners understand the organisms that can be killed if parks are encroached on by farmers especially those practising intensive livestock farming and monoculture farming.
- Summarise the lesson by highlighting the key points on the ecosystem. Refer to the notes in Student's Book. Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do the lesson summary as you guide them.

Synthesis

This lesson introduces learners to the effects of man on ecosystems. Use the internet, books, environment around the school and visit areas such as national parks, monoculture farms and intensive livestock farms to understand those effects.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Outline organisms found in an ecosystem.

   Ans: Plants, herbivores, omnivores and carnivores

2. State the role of animals in ecosystems.

Ans: They produce carbon dioxideand , manure for plants.

3. How does man increase animal products production such as milk?

   Ans: By mechanised farming and applying pesticides and genetic engineering

4. How does intensive livestock farming destroy the environment?

   Ans: Use of chemicals such as pesticides that pollute the environment and kills untargeted organisms such as birds that eat ticks

Lesson 4: Habitat Destruction *(To be covered in one period)*

Refer to Student's Book

Specific objectives

By the end of the lesson, learners should be able to understand how the habitat is destroyed by man's activities such as monoculture farming and intensive livestock farming.

Preparation for the lesson

1. This lesson will be a whole class lesson.

2. Test the link: https://www.youtube.com/watch?v=_qmNCJxpsr0 in advance to see if it is working. This link has a video on destruction of habitats. Obtain wall charts on destroyed habitats

Teaching Aids

- Charts on destructed habitat.
- Video link: https://www.youtubecom/YMpMsSK3VPY
- The diagram in Student's Book.

Improvisation: You may come up with your own chart on habitats which are destroyed drawing on Manila paper in case your school does not have one.

Pre-requisite to the lesson

Ask probing questions to introduce the lesson. Such questions may include. What is habitat?

Ans: Habitat is a natural place where plants and animals live.

Teaching/Learning activities

- By now, learners have rough idea of how habitats are destroyed bGive them a small activity to draw in their notebooks how they think habitats are destroyed mostly during monoculture farming and intensive livestock farming.

Activity 4.4 (Refer to Student's Book)

- Let the learners watch the video on the link: https://www.youtube.com/YMpMsSK3VPY
- Provide learners with the chart on land which was destroyed by man's activity such as cutting trees.

- Summarise the lesson by highlighting the key points about habitat destruction. Better still, you can appoint a gifted learner to give summary points as you guide them. Refer to the notes in Student's Book.

Synthesis

This lesson intends to create awareness of how man destroys habitats especially during economic activities. Learners through watching the video should observe the most destructive behaviour of man during farming.They should then be able to reproduce this in their notebooks and explain how man destroys the environment.

Lesson assessment

Assess whether the learning objectives of the lesson was met by asking questions such as:

1. Which organism affects other organisms living in the same environment? (***Ans:*** Man)
2. Name the activity of man that has caused a lot of destruction.

   (***Ans:*** Farming)
3. Name the chemical used on intensive farming which pollutes the environment.?

   Ans: Pesticides
4. Give three differences between large scale livestock farming and intensive livestock farming

   Ans: (i) Small pieces of land is used in intensive livestock farming than in large scale livestock farming.

   (ii) A lot of chemicals such as pesticides and fertilisers are used more in intensive scale farming than in large scale livestock farming.

   (iii) You need less capital to start intensive livestock farming than in large scale livestock farming.

Lesson 5, 6 and 7: Pollution and its effects of air, land and water (To be covered in three periods)

Refer to Students's Book

Specific objectives

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

Preparation for the lesson

1. This lesson will involve a research activity either in the library or using the Internet or group work.

2. Bring pamphlets, handouts and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as Wifi or modem.

Teaching Aids

- Charts on polluted areas such as industries
- The diagram in Student's Book.

Improvisation: Teacher notes on types of pollution

Pre-requisite to the lesson

- You may begin Lesson 5 by way of a research activity.

  Activity 4.4 and 4.5 (Refer to Student's Book)

- You may begin this lesson 6 and 7 by way of a research activity.

  Activity 4.6 and 4.7 (Refer to Student's Book)

Teaching/Learning activities

- Let learners go to the library and search in textbooks about problem of pollution in the world especially in Rwanda. They can also do Internet searches.
- Back in class, put learners in groups of five depending on the size of the class to harmonize their findings. Let them choose a group leader to do a presentation to the rest of the class.
- After the presentations, guide learners to write short notes and draw the various types of pollution such as air, land and water pollution in their note books. Refer to Student's Book.
- Summarise each lesson by giving a task where the student should look for the causes of pollution and the substances that cause pollution.

Synthesis

This lesson introduces the various types of pollution and the substances that cause pollution. Guide learners through research and discussion to discover the various components of blood and their roles in the circulatory system.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is pollution? (***Ans:*** It is the putting of substances in the environment that harm organisms)

3. Outline the three types of pollution, (***Ans:*** The types are air pollution, land pollution and water pollution)

4. Which activities of man cause pollution (***Ans***: Burning charcoal, releasing industrial gases into the atmosphere, use of excess fertilisers which are carried into water bodies)

Lesson 8: Nuclear fallout and pollution by methane gas *(To be covered in one period)*

Refer to Student's Book

Specific objectives

By the end of the lesson, learners should be able to explain nuclear fallout and its causes.

Preparation for the lesson

1. This lesson will involve a research activity either in the library or using the Internet or group work.
2. Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as Wifi or modem.

Teaching Aids

- Reference materials on Nuclear fallout.
- Videos showing nuclear fallout

Pre-requisite to the lesson

- You may begin this lesson by way of a research activity.

Activity 4.9 (Refer to Student's Book)

Teaching/Learning activities

- Let learners go to the library and search in textbooks about nuclear fallout especially in Russia and Japan. Use of Internet will be very useful in their search.
- They should then come up with safety measures that can reduce nuclear eruptions.
- Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings. Let them choose a group leader to do a presentation on their behalf.
- After the presentations, guide learners to write short notes on nuclear fallout. They must give examples where such incidents happened. e.g in Japan.

Synthesis

This lesson introduces the concept of nuclear fallout and the dangers involved. Through research, learners should find out what other countries are doing to prevent nuclear fallout.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is nuclear fallout? (***Ans:*** These are radioactive particles in the air which were formed from a nuclear explosion.
2. Name two places in the world where nuclear explosions took place. (***Ans:*** Japan during the second

world war and On March 11, 2011 when a nuclear plant at Fukushima Daiichi exploded due to earthquake. Another country is Ukraine Russia where Chernobyl Nuclear plant exploded in 1986.)

3. Name some of the problems caused by nuclear fallout. (***Ans:*** Land is contaminated with radioactive substances All animals can get cancer if they are exposed to such land. A very wide area is usually affected. So cleaning is almost impossible and very expensive.

Answers to Self-Test evaluation 4.1

Refer to the Student's Book

1. • Use of modern machinery such as tractors and combine harvesters.
   - Use of chemical fertilisers on farmland to boost levels of nutrients in the soil.
   - Use of pesticides, insecticides and fungicides to kill pests that feed and damage crops.
   - Use of herbicides to kill weeds.
   - Applying selective breeding to produces variety of plants and animals.
2. Use of chemicals such as insecticides pollute the environment and kills un targeted organism such as fish.

Answers to Self-Test evaluation 4.2

Refer to the Student's Book

1. Monoculture crops have no genetic variability because they are not allowed to reproduce naturally. This exposes their pests and weeds to environmental adaptations and become resistant to chemicals used to control them as the only way to control pests in this set up is to use more chemical control mechanisms.
2. • Susceptible to pest
   - Use of dangerous synthetic chemicals
   - It leads to soil degradation
3. • Drought
   - Extreme weather condition
   - Use of biofuels
   - Conflict
   - Food wastage

Answers to Self-evaluation Test 4.3

Refer to the Student's Book

1. Destruction of habitats leads to alterations of food webs and food chains found in an ecosystem. This alteration can lead to species extinction due to lack of food or change in food preference.

2. • Reduce or QUIT the use of pesticides and fertilisers in your gardens.

- Invest and grow wildlife friendly gardens/patios or balconies and choose wildlife-friendly fencing to allow some access. Volunteer for your local wildlife trust, community garden or conservation group. Ask the local authority to manage their lands in a biodiversity friendly way.
- Reduce, reuse, and recycle, with an emphasis on REDUCE (buy less non-essential stuff). The less habitat conversion will be necessary to get those resources or the energy to make STUFF and the less waste goes into the landfill. Compost what you can ask your local authority for help if you need it.
- Use environmentally friendly personal and household cleaning products, for example, distilled vinegar.
- Buy local, organic food and drink.

Answers to Self-evaluation Test 4.4

Refer to the Student's Book

1. Award the marks according to the argument.

2. • Use of biodegradable pesticides, which breakdown to harmless substances within a few days
   - Controlling pest biologically
   - Reuse and recycle of wastes
   - Incineration

3. No. This is because any contact between the particles and organisms leads to radiation, radiation has a long term effects on human health. It has been linked to leukemia, bone, lung and breast cancer.

Summary of the unit

Ecology is the study of the relations that organisms have with respect to each other and their environment. A place where organisms are normally found is called a habitat. A bacterium feeding on sugar is responding to its environment as a lion responds to its environment when it feeds on a zebra. Man responds to the environment in many ways. Most of these ways degrade the environment. All organisms including man live in units called ecosystems which interact with the environment. It is noted that any ecosystem is made of communities which interact with the environment. Environmental degradation is the most important and dangerous act of man in this century. Man has managed to degrade the environment in the pursuit of social, economic and military development. Degradation is due to pollution of the three categories i.e air,land and water pollution.

Additional Information for the teacher

Some information that may be relevant with regards to effects of man to the ecosystem are given below.

There are a number of agricultural practices in the world which provide food to man. More than a half of the world population depends on traditional farming with little science and technology applied. However, other people use science and technology to farm for better yields. The following are the major types of agriculture in the world.

1. There is a type of agriculture which is dictated by availability of resources. This type is called nomadic farming. This is the practice in which animals are moved from one place to another in search of good pasture and water. Usually its practised in arid and semi arid regions such as North Africa, central Asia and some parts of India.

2. Another one is practised in developing countries such as areas of Africa south of Sahara desert. Brazil and South East Asia. This is shifting cultivation, in which a small area of a forest or bush is cleared by cutting down all the trees and grass. All cut plants are burnt to make the land fertile. That area is used for growing crops after some years then when it becomes less fertile, it is abandoned and another area is selected so that the whole process is repeated. This type of farming is suitable in areas which are sparsely populated. This is most practised farming method in Rwanda. This is easily be observed where cooperative farms are.

3. Commercial farming cultivates the crops for commercial purposes. This is the monoculture farming where only one type of crop is cultivated on a large farm. It's an extensive farming. The main motive of the farmer is to make profit. This type of farming is mainly practised in western countries like Canada and USA. Russia and china do practise this monoculture cultivation.

4. Dairy farming is the rearing of the cattle on large scale on the outskirts of the city to meet the demands of milk and animal products. It is mainly practised in Australia, Argentina, Russia and Denmark and in Europe.

All the above activities result in degradation of the environment when done in excess.

Pollution prevention reduces the amount of pollution caused by industry and agriculture. Its better to increase the efficiency of agriculture processes to reduce

pollutants instead of finding ways of eliminating the pollutant.

Answers to end unit assessment 4

Refer to Student's Book

1. B
2. Acid rain is caused by gases released from industries such as smelting industries.

   When these gases such as carbon dioxide mix with rain ,they form acid rain. Acid rain destroys plants when they absorb acid into their roots.The root cells are killed and plants cannot absorb any more water and they die.

3. (a) Pollution can affect our country in the following ways.
   - People can become sick due taking polluted water and breathing in radioactive substances.

   (b) It's air pollution due to charcoal burning, wood burning and fumes from cars & industries.

   (c) More information should be given to people through videos, radio, TV and teachers at community level.

4. (a) Effects of deforestation are as follows:
   - Destruction of ecosystem by removing food webs of many organisms
   - Increased soil erosion which results into poor soils
   - Reduced rainfall
   - Increased speed of wind which destroys crops and houses.

   (b) Forest guards can be put in place
   - Fencing of some parts of the National park
   - Teaching people about the importances of the National park to the community
   - Puting in place strict punishments for the poachers

5. Habitat destruction is mainly due to:
   - Economic activities such as large scale farming, use of large quintiles of fertilisers and pesticides which are carried to rivers by surface runoff
   - Ignorance when toxic substances are released into the environment especially in Africa where raw sewage is released into rivers.
   - Excess harvesting of resources such as timber.

6. (a) We should work with nature as it's very difficult to control it. We cannot stop soil erosion when trees are cut. Instead we should plant more trees to sustain our demand for wood.

(b) Maintaining biodiversity helps to protect crops by providing alternative food to pests which could eat the food crops.

(c) Protecting the environment is more important as it's difficult to increase the standards of living in a destroyed environment e.g The standards of living will be difficult to maintain in a place when all trees are cut. The place will be a desert.

(d) Solar energy is the best alternative source of energy because it's clean and renewable. Solar energy does not release pollutants into the environment.

(e) Recycling of used items is important because less raw material is extracted from the environment to manufacture new products.

(f) Yes. Global warming is a concern because survival of organisms depends on climate. Any change in the climate especially changes brought by global warming are always a disaster e.g. drought and floods are terrible calamities.

7. (a) It's important to be a member because I may learn new ways of protecting the environment.

(b) I can make people aware of destructive habits that destroy the environment such as using polythene bags, using excess fertilisers instead of manure.

8. Yes, it can. New varieties of plant hybrids (plants from crosses of two different breeds) can be formed that can increase yields. Such plant hybrids can with stand dry season, pests and poor soils.

9. Refer to the Students Book page.

10. Refer to the Student's Book .

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. What do you do with the packets of insecticides after they are used? 2. Present reports on project activities to the class.	1. Do further research in textbooks or the Internet about effects of human activities on ecosystem. Write short notes then share with other class members. 2. Come up with a simple project on how to control water pollution. Use simple available materials. 3. How can we protect agricultural land from urban spread?
Remedial questions for slow learners 1. What is pollution? 2. List three types of pollution. 3. What is a habitat ?	**Extended questions for gifted learners** 1. Explain how human activities can lead to species extinction. 2. How can human beings best protect biodiversity? 3. Explain monoculture and diversity.
Answers to low order thinking questions 1. Pollution is the addition of substances or energy to the environment in quantities that are harmful to organisms. 2. Soil, air, water 3. Habitat is the natural place where plants, animals or other organisms live.	**Answers to high order thinking questions** 1. Unsustainable hunting and harvesting that cause mortality at rates that exceed recruitment of new individuals, land use practices like deforestation, urban and suburban development, agricultural cultivation and water management projects that encroach upon or destroy natural habitat, intentional or unintentional introduction of destructive diseases, parasites, and predators, (ecological damage caused by water, air, and soil pollution.

	2. Reduce or QUIT the use of pesticides and fertilisers in your gardens. Invest and grow wildlife-friendly gardens/ patios or balconies and choose wildlife-friendly fencing to allow some access. Volunteer for your local wildlife trust, community garden or conservation group. Ask the local authority to manage their lands in a biodiversity friendly way. Reduce, reuse and recycle, with an emphasis on REDUCE (buy less non-essential stuff). The less habitat conversion will be necessary to get those resources or the energy to make STUFF, and the less waste goes into the landfill. Compost what you can. Ask your Local Authority for help if you need it. Use environmentally friendly personal and household cleaning products, for example, distilled vinegar. 3. Monoculture crops have no genetic variability because they are not allowed to reproduce naturally. This exposes them to pests and weeds to environmental adaptations which become resistant to chemicals used to control them as the only way to control pests in this setup is to use more chemical control mechanisms.

TOPIC AREA: ECOLOGY AND CONSERVATION

UNIT 5 Effects of human activities on ecosystem 2 (Conservation and sustainability)

Key Unit Competence

After studying this lesson, the learner should be able to assess the outcomes of conservation measures.

Learning objectives

Table 5.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • Define the terms sustainable resources and sustainable development. • Explain the necessity to conserve resources especially fossil fuels and other natural resources. • Explain how organisms become endangered and how they can be conserved.	By the end of this unit, learners should be able to: • Identify means of sustaining resources and ways of implementing sustainable development. • Understand some of the ways to conserve fossil fuel. • Conserve endangered species. • Teach the public about conservation through drama and other means.	By the end of this unit, learners should be able to: • Show concern about resources especially non renewable resources. • Understand to use fuel in a responsible manner without wasting. • Learn to value wildlife which is destroyed for lifestyles and money.

Pre-requisites of the unit

Learners have learnt about ecology and conservation in senior 1 and senior 2. Review this unit by reminding learners on what they learnt about human activities on ecosystem. Remind the learners of the importance of conserving the environment. Highlight some of the points by going through the Student's Book.

During the lessons, let the learners be aware of the fact that this topic is related to the environment in which they are part of. Let them understand that at this level, they may only need the basic information otherwise, details of the structure and functioning of the ecosystem will be learnt later. This lesson is preparing them to be environmentalists, agricultural extension officers or game park wardens and politicians who will set parameters to conserve and sustain resources for sustainable development.

Background information

Survival and development of a country depends on the natural resources that can be harvested. All human beings need resources for social and economic development. Sustainable economic growth is a result of sustainable resources which is the harvesting of resources without damaging the ecosystem. An ecosystem is a community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil) interacting as a system. The resources include tree animals, plants, fossil fuel, minerals and many other natural resources.

Conservation and preservation of natural resources are the principle guides in sustaining the resources and development. Conserving natural resources is the harnessing of nature for social and economic development without wasting the resources and polluting the environment. Then preservation of natural resources is the protecting of the environment in its natural form at all costs. Therefore a balance must be sought between conservation and preservation when developing social and economic factors. Conservation programs such as: **African Wild Dog Conservancy**, **African Conservation Foundation**, **Rwanda gorilla conservation program** and many others are striving to maintain ecosystems by protecting endangered species and vulnerable environments.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need of each student to take care of the environment by conserving resources and promoting sustainable development and pass the information to other people.

2. Financial education

Let learners be aware of the financial gains that can be realised in conserving resources and sustaining development for example, conserving endangered species such as mountain gorilla, rhino

and elephants which bring in foreign exchange by the tourists.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can participate in protecting the environment by becoming an environmentalist. Also emphasise to the learners that anybody, irrespective of their gender, can pursue a carrier in environmental science. Give examples of role models who are successful environmentalist, in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs and as they engage in group work to discuss ways and methods of conserving resources especially fossil fuels. Also during group presentation, you can allow presentations within the group members. Gifted learners should help in coming up with presentation contents as slow learners contribute. You should also allow the slow learners to their presentation as well and correct them where they go wrong.

2. Research skills

You should guide learners on how to do internet searches. Guide the learners to research on various activities. for examples Activities 5.1, 5.2, 5.3 and 5.4, as learners find out in advance various information regarding conservation of resources and sustaining development. Guide the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class. Encourage all learners, irrespective of their abilities, to participate in group discussions, during presentations by asking questions and during questions-and-answer session to either introduce or wrap up a lesson.

4. Critical thinking

Guide learners to discover for themselves various aspects of conserving natural resources and find better ways of

sustaining development in Rwanda through various probing question and videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities.

5. Lifelong skills

Many useful methods of conserving resource will be learnt. Then various ways of sustaining development will be got. Such skills will be of great help in society.

Key words in this unit and their meanings

Sustainable resources: These are the resources which can be renewed as in case of agricultural products.

Sustainable development: It's the development which does not damage the environment either by using all the resources or polluting the environment.

Ecosystem: it is a community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.

Endangered species - these are species that are in danger of extinction, types of plants and animals that are at risk of dying out because their numbers are very to have successful breeding.

Fossil fuel: Fuels formed from the remains of plants and animals that lived in an earlier era (coal, petroleum, natural gas).

Conservation: It's the use of natural resources without wasting them for social and economic development

Preservation: It's the protecting of the environment by the act of saving it from damage.

Wildlife: Wild animals and plants which are not domesticated.

Hydroelectricity: It is production of electricity by means of moving water.

Geothermal: Heat from the Earth's interior produced by heat from the earth's interior.

Thermoelectricity: Electricity produced by the direct action of heat.

Renewable resources: Resources that can be replaced by nature e.g forests are renewable natural resources, but they must be treated with care.

Recycling: This is a process to convert waste materials into reusable material to prevent or reduce the consumption of fresh raw materials, energy usage, air pollution during incineration or burning and water pollution by land filling.

Sewage: Waste water and excrement (feaces) conveyed in sewers.

Effluent: Something which flows out e.g. out flowing branch of a stream.

Acid rain: Polluted rain that contains gases such as carbon dioxide, sulphur dioxide and nitrogen oxides which is caused by air pollution.

Biodiversity: It is the variation in life forms, diversity in ecosystems species or genetic make-up.

Ecotourism: Tourism industry that focuses on ecology and conservation of the environment (by conducting trips to the rainforest, African savannas, etc.)

Guidance on the problem statement

This topic is about the effects of man's activities on the ecosystem putting a lot of emphasis on conservation and sustainability. The learners should appreciate conservation methods and realise the good of sustainable development. There are a number of illustrations in the Student's Book showing materials that can be recycled such as plastics, sewage plant irresponsible activity resulting in deforestation. You should ask questions that stimulate their imagination, for example.

- What is the difference between conservation and preservation?
- Outline the requirements needed to sustain development

Guide them into discovering what they will learn in this unit based on their discussions. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as farming, game park rangers, environmentalists and many others.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Gifted learners to be given heavy tasks requiring more critical thinking while slow learners to begiven tasks which they can manage such as collecting materials for use during practicals among others.	• Assign gifted learners to help fellow learners with special needs. • Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols and sign language interpreters for the deaf.

Support for Multi-ability learning	Support for special needs learning
• Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. Gifted learners to lead in group discussions and do presentations. • Ensure all learners respect other's views irrespective of their shortcomings or talents. • When watching videos, you may rewind or pause for the benefit of slow learners.	• Also arrange learners such that short-sighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available for learners with visual difficulties. • Models of recycling industries can be useful • Provide braille for the deaf learners.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Define biological terms and explain the need to conserve non-renewable resources, limited to fuel.	1
2.	Describe the non renewable resources.	1
3.	Recycling and sewage treatment	1
4.	Conservation of endangered species	3
5.	Requirement of sustainable development	1
6.	Benefits of conservation programmes	1

Answer of introductory activity

The symbol is common. It is used on materials that can be recycled. It is important because it indicate whether a give material can be recycled and reused or not.

5.1 Sustainable resources and development

Refer to Student's Book

Lesson 1: Define biological terms and explain the need to conserve petroleum. *(To be covered in one period)*

Refer to Student's Book

Specific objectives

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

- Define sustainable resources and sustainable development.
- Describe methods of conservation of resources and sustaining of development.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson.

Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts, and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI or modem.

   Test the link: https://www.youtube.com/haZdv4M1qBo?t=41 and https://www.youtube.com/071lUxclTBw In advance to see if it is working. This link has a video on conservation of resources which is part of one of the activities in this lesson.

Teaching Aids

- Charts on parts of the conservation of resources
- Video link: https://www.youtube.com/fFYTz9HqrC8
- The diagram in Student's Book
- **Improvisation:** You may come up with your own charts drawn on Manila paper in case your school does not have conservation charts.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to this lesson.

Teaching/Learning activities

- You may begin a lesson by asking probing questions such as: What is ecosystem? How is ecosystem important? What does sustainable resources and development entail?
- Which resources can be renewed and which ones cannot be renewed?

Ans:

Renewable resources	Non-renewable resources
Timber	Fossil fuel
Solar power	Mineral ores
Hydroelectric power	Stones
Sugar cane or sugar beet	Methane gas

What are the advantages of conserving resources?

Ans (i) Resources are not wasted therefore they can be used for a relatively long time.

(ii) Development is fast and sustained as resources are always available.

(iii) Destruction of the environment is reduced.

Activity 5.1 (Refer to Student's Book.)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out what is sustainable development in Rwanda. The following link will be useful. https://www.youtube.com/fFYTz9HqrC8
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes on page 66 of learner's book on importance of sustainable development.

Activity 5.2 (Refer to Student's Book.)

- This activity is meant to introduce methods of conservation of resources.
- Use charts and videos to make students understand more on conservation methods. The students should outline methods of conserving resources.

The methods are:

a) Protecting endangered species

b) Recycling metals and plastics

Summarise the lesson by highlighting the key points which should include conserving resources.

Synthesis

The lesson introduces learners to the conservation of resources. The activities carried out during the lesson should help learners understand conservation methods and how to conserve resources for sustainable development.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   Ans: I learnt conservation of resources and its advantages.

2. What is the difference between conservation and preservation?

   Ans: Conservation is the use of natural resources without wasting them while preservation is the protection of the natural resources so that they are not harmed.

3. Outline five of the natural resources which must be conserved.

Ans: Mountain Gorilla, Crude oil, Fresh water bodies, forests such as Giswati forest and African wild dogs,

4. Give three methods of conserving natural resources.

   Ans:

   1. Reduce cutting of trees for fuel, instead people should use alternative fuels such as natural gas.
   2. Educate people the importance of protecting the environment especially those living near national parks.
   3. Let people on who conserve the environment get benefits such as jobs and social development e.g. People should get project that earn them money so that they stop depending on the national parks. Then cooperatives should be set up to collect refuse and dispose it off in ways that don't endanger the environment. Create awareness of endangered species to the world such as the Kwita izina ceremony.

Lesson 2: Describe the non-renewable resources (To be covered in one period)

Refer to Student's Book

Specific objectives

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

- Describe what the non-renewable resources are.
- Outline non-renewable resources.

Preparation for the lesson

This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

Bring pamphlets, handouts and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WiFi or modem.

Test the link: https://www.youtube.com/MYC9xGkrAts in advance to see if it is working. This link has a video on conservation of resources which is part of the activities in this lesson.

Teaching Aids

- Charts on non-renewable resources
- Video link: https://www.youtube.com/6_adfcO8clo
- The diagrams in Student's Book.
- **Improvisation:** You may come up with your own charts drawn on Manila paper in case your school does not have conservation charts.

Pre-requisite to the lesson

Introduce the sub-unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:
  - What is a non-renewable resource?

    Ans: Non-renewable resources are resources which cannot be regenerated or renewed fast enough for sustainable development.
- Give three examples of non-renewable resources.

  Ans: Examples of non renewable resources are: fossil fuels, mineral ores and underground water.

Class activity 5.3: (Refer to Student's Book.)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to design suitable posters of conservation.

  The following link will be useful. https://www.youtube.com/fFYTz9HqrC8
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in the learner's book on non- renewable resources.

Class activity 5.4: (Refer to Student's Book.)

- This activity is meant to introduce methods of conservation and use of non-renewable resources.
- Use charts and videos to make students understand conservation methods and how to use fossil fuels.
- Summarise the lesson by highlighting the key points, which should include conserving non-renewable resources and how to use fossil fuels sustainably.

Synthesis

The lesson introduces learners to the conservation of non-renewable resources. The activities carried out during the lesson should help learners

understand conservation methods and how to use fossil fuels for sustainable development.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is fossil fuel?

   Ans: It's the fuel which was made from organisms that died long time ago. Such organisms are extinct.

2. What are the dangers of overusing fossil fuel?

   Ans: When fossil fuel is burnt it releases a lot of greenhouse gases such as carbon dioxide into the atmosphere.

3. Define the term ground water or underground water.

   Ans: Ground water is the water present beneath Earth's surface in soil pore spaces and in the fractures of rock formations.

4. Outline some of the uses of ground water.

   Ans:

   (i) For domestic use such as drinking washing cloths and bathing.

   (ii) It's used for irrigation and on livestock farms.

   (iii) It's used in industries.

Lesson 3: Recycling and sewage treatment *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Explain recycling and sewage treatment.
- Identify material that can be recycled.
- Identify plants in Rwanda which are involved in the recycling process.

Preparation for the lesson

1. This lesson will involve individual work, video watching, and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

3. Test the link: https://www.youtube.com/b7GMpjx2jDQ and https://www.youtube.com/21U1aTG9w7M in advance to see if it is working. This link has a video on recycling

and sewage treatment which can be useful in the class activities.

4. Obtain wall charts on recycling plants and sewage treatment plants and other materials in advance.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement and then narrow down to the lesson

Teaching Aids

- Charts on the plant structure used in sewage treatment
- Video link: https://www.youtube.com/21U1aTG9w7M.

  The diagram in Student's Book.

  Improvisation: You may come up with your own chart on the plant structure used in sewage treatment drawn on Manila paper in case your school does not have one. You can also organise for learners to model the plant structure of sewage treatment as seen in the video using clay or plasticine.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:
  - What is recycling?

Ans: It is a process to convert waste materials into reusable material to prevent or reduce the consumption of fresh raw materials, energy usage, air pollution during incineration or burning and water pollution by land filling.

  - What is the importance of treating sewage?

Ans: It's important for removing contaminants from waste water, primarily from household sewage so that sewage is suitable for disposal or land application.

Activity 5.4 (Refer to Student's Book .)

- Let the learners watch the video carefully. They should describe what is happening to the material being recycled.
- Ask learners the use of recycled material.
- Guide learners to understand the different parts of the sewage plant as it's described in the video. At this point, you can show learners the chart of the sewage treatment plant so that it can be used to identify the parts that make up the sewage plant.
- Summarise the lesson by highlighting the key points on the parts that make up different parts of the sewage plant and their functions. Refer to the notes in Learner's book. Allow learners to write summary notes

as you do your presentation. You can also make this more interactive by inviting gifted learners to do the lesson summary as you guide them.

Synthesis

This lesson introduces learners to the structure recycling plants and sewage treatment plants. Use the charts to guide learners to accurately describe the structure of the sewage treatment plant.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Define the term sustainable resources and sustainable development.

   Ans: Sustainable resources are the resources which can be renewed as in case of agricultural products then sustainable development is the development which does not damage the environment either by using all the resources or polluting the environment.

2. Why should we conserve crude oil products?

   Ans: We should conserve crude oil because it cannot be renewed and we must not use it unnecessarily because it releases greenhouse gases into the atmosphere when it's burnt.

3. Give three items which can be recycled.

   Ans: All material made of:

   (i) Plastics

   (ii) Metal

   (iii) Glass

4. Explain why sewage should be treated before being released into the environment.

   Ans: Untreated sewage can damage the environment in several ways. Some of the ways are:

   (i) When it's released into water bodies, it makes water bodies to lose oxygen so that organisms that depend on that oxygen die. Secondly people who depend on that water can get infected with intestinal worms and liver flukes.

   (ii) When released on land,most of the organisms that come in contact with it die or become sick. Later on exotic plants become fertilised and replace useful plants.

Lesson 4: Conservation of endangered species *(To be covered in three periods)*

Refer to Student's Book.

Specific objectives

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

- Identify endangered species especially in Rwanda.
- Name natural and artificial causes of extinction of species.
- Describe methods of conserving endangered species. Give examples with reference to endangered species in Rwanda.
- Explain how to conserve endangered species.

Preparation for the lesson

This lesson will involve individual work, video watching, and group activities. You will therefore organise the class as need arises during the lesson.

Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi or modem.

Test the links: https://www.youtube.com/Ujm7I3h-CKk and https://www.youtube.com/DojGPBV4U0w in advance to see if it is working. These link have videos on conservation of endangered species which can be useful in the class activities.

Obtain wall charts on endangered organisms and other materials in advance.

Teaching Aids

- Charts on organisms which are endargered.
- Video link: https://www.youtube.com/DojGPBV4U0w. The diagram in the Student's Book.

Improvisation: You may come up with your own chart on the endangered species drawn on Manila paper in case your school does not have one. You can also organise for learners to model endangered species such as mountain gorilla as seen in the student book Fig 5.8 using clay or plasticine.

Pre-requisite to the unit

- Ask probing questions to introduce the lesson. Such questions may include:
  - What is an endangered species?

    Ans: Species that are in danger of extinction, types of plants and animals that are at risk of dying out because their numbers are too few to have successful breeding.

- What is conservation?

  Ans: It's the use of natural resources for social and economic development without wasting them.

  Further Activity (Refer to Student's Book.)

Teaching/Learning activities

- Let the learners watch the video carefully. They should describe various organisms which are endangered.
- Ask learners to outline activities of man which make other species endangered.
- Explain to learners some endangered species which are not common in Rwanda as they are described in the video.
- Describe to learners the different methods of conserving endangered species as they explained in the video: https://www.youtube.com/oqNROoKmPLU
- Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do the lesson summary as you guide them.

Synthesis

This lesson introduces learners to the endangered species in the world and the methods of conserving those endangered organisms. Use the charts to guide learners to understand endangered species.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Which of the two plants and animals is more endangered or disappears faster than the other?

   Ans: Animals. It's because animal products are needed more than those of plants and plants are more abundant than animals.

2. Outline three human activities which cause extinction of organisms.

   Ans: (i) Increased human population

   (ii) Destruction and fragmentation of habitats.

   (iii) Pollution of the environment.

3. When does a species become endangered?

   Ans: A species becomes endangered when its population falls below a critical level.

4. Outline conservation measures for endangered species.

   Ans: (i) Monitoring and protecting species and habitats to assess the species and protect them

   (ii) Education programmes to teach the communities about the importance of diversity species.

   (iii) Captive breeding programmes that enable species to survive in captivity as they wouldn't survive in their natural environment

   (iv) Seed banks are stores of seeds of endangered species for genetic diversity

5. Give two activities done in Rwanda that are intended to conserve endangered species.

   Ans: (i) Giswati forest reserve to conserve endangered species found in the forest.

   (ii) Kwita Izina ceremony intended to conserve mountain gorilla.

Lesson 5: Requirement of sustainable development (To be covered in two periods)

Refer to Student's Book.

Specific objectives

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

- Outline requirements for sustainable development.
- Identify projects and organisations responsible for sustainable development.

Preparation for the lesson

This lesson will involve individual and group activity. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

Search for organisations in Rwanda to visit that will help the learners to understand the requirements for sustainable development.

Teaching Aids

- Charts, textbooks, pamphlets and handouts on sustaining development.
- Video link: https://www.youtube.com/5G0ndS3uRdo and https://www.youtube.com/ZcIDkkEBYdQ

- The diagram Fig 5.10 in Student's Book

Improvisation: You may come up with your own painted diagram of solar panels drawn on Manila papers in case your school does not have the charts.

Pre-requisite to the lesson

Introduce the unit as explained under guidance of the problem statement then narrow down to this lesson.

You may remind learners about conservation of endangered species they learnt about in the previous lessons. Ask questions such as: What is conservation?

(***Ans:*** It's the use of natural resources without wasting them for social and economic development. Name two. endangered species: (***Ans:*** Rhino and Mountain Gorilla. Give an activity in Rwanda which is intended to conserve endangered species. (***Ans:*** Kwita Izina ceremony intended to bring awareness to the people the problem of mountain gorilla is facing)

Teaching/Learning activities

Activity 5.7 (Refer to Student's Book.)

- This is individual learner's activity and group activity. Let them carry out the tasks in this activity then discuss their findings with friends.
- Learners should be helped to make a useful questioner which will be used to collect enough information from the organisations and projects such as RISD. **Remember:** This topic is not about destruction of the environment by man. it's about conservation of resources and sustaining development.

Activity 5.4 (Refer to Student's Book.)

- At this level learners can perform plays portraying conservation of endangered species. See Fig 5.8 in the Student's Book .

Synthesis

This lesson introduces learners to conservation of resources and sustainable development. The activities carried out during the lesson above should help learners understand the methods of conserving the resources for sustainable development.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is Kwita Izina ceremony for

   Ans: It's for making people aware of a problem of killing endangered mountain gorilla species.

2. Outline some of the requirements needed to sustain development in Rwanda.

   Ans: (a) Improve health services by building health facilities and providing health insurance to all people that live in Rwanda.

   (b) Reduce Malaria and AIDS infection through awareness and providing medical services.

   (c) Empower people so that they can participate in decision making.

   (d) Educate people about sustainable development.

3. Give the three factors which must be addressed to achieve sustainable development.

   Ans: The factors are: social issues, environmental awareness and economic growth.

Lesson 6: Benefits of conservation programmes and comparison of human effect on protected to unprotected areas *(To be covered in one period)*

Refer to Student's.

Specific objectives

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

- Explain the benefits of conservation programmes.
- Explain the relationship between conservation and sustainable development.

Preparation for the lesson

- This lesson will involve listening to a resource person either from government or from Non-governmental organization who is an expert on sustainable development in developing country. Learners should be helped to formulate a questionnaire that will help them to ask the relevant questions. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

Teaching Aids

- Charts, Text books such as Student's Book 3.
- Video
- The diagram Fig 5.11 in Student's Book

Improvisation: You may come up with your own drawing on manila paper such as that on renewable resources and use it to explain to students the requirements for sustainable development.

Pre-requisite to the lesson

Learners should be reminded that to have sustainable development, there some inputs which are necessary. In this lesson students are going to know what should be done to sustain development.

Teaching/Learning activities

Activity 5.8 (Refer to Student's Book.)

- Begin this activity by inviting the resource person who knows well about sustainable development. That person is normally an environmentalist from responsible organisation such as Rwanda Environmental Conservation Organisation.
- You can then play the video or let them visit the above website to watch the video in groups.
- Guide learners to describe what they have seen. Ask probing questions such as: What are the effects of conservation in nature?

  Ans: Conservation saves organisms which could be extinct and it also increases and maintains biodiversity in the ecosystem.

  How do we gain from conserving the environment and organisms?

  Ans: By conserving the environment and organisms we maintain a healthy environment which supports us and other organisms. We can get all our requirements such as resources from a conserved environment.
- At this point, you can guide learners to discover the challenges conservationists face during the conservations of the environment. Such challenges include finance as a lot of money is needed to implement some measures. Take an example of conserving Nyungwe and Giswati forests.
- Let learners come up with summary notes on benefits of conserving the environment.

Synthesis

This lesson should create awareness on the vulnerbility of the environment. Learners, through watching the video and through listening to the expert, should appreciate benefits achieved in conserving the environment.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Give the benefits of sustaining the environment.

   Ans: Sustaining the environment enables:

   (i) Social economic development without destroying resources

(ii) Fair distribution of economic resources to all people.

(iii) Maximises consumption of resources without wasting.

2. Give the relationship between conservation of natural resources and sustainable development.

   Ans: Conservation of natural resources reduces wastage of resources so that fewer resources bring huge development in a short time.

3. Which organisms benefit from sustainable development.

   Ans: All organisms benefit from sustainable development because all resources are used fairly well without harming any organism.

Answers to Self-evaluation Test 5.1

Refer to Student's Book.

1. Sustainable development refers to the development that does not waste resources and pollute the environment.

   Conservation and preservation of natural resources are the principal guidance for sustenance.

2. • Reduces the use of non-renewable resources (such as metals and oil) whose prices rise as they become increasingly rare;
   • Allows renewable resources to be used in perpetuity because they are used appropriately (forest and fishery products, other biological resources, etc.);
   • Reduces the enormous costs of decontamination, clean-up and the restoration of environments destroyed by human activity.

3. • By reducing your consumption of over-packaged products
   • By walking, bicycling or using public transport instead of personal car.
   • By sweeping your driveway instead of using the hose, by not watering your lawn, or by not letting the tap run to avoid wasting water
   • By choosing a more energy-efficient automobile

Answers to Self-evaluation Test 5.2

Refer to Student's Book.

1. Reusing
2. A bus ticket
3. Industrial effluent should be treated for safe use on the land that is used as manure or for disposal.

Answers to Self-evaluation Test 5.3

Refer to Student's Book.

1. This is because they are likely to become extinct.

2. • Maintain future possibility plant species.

   • Keep damage to food chains and food webs to a minimum.

   • Protect our future food supply

3. The endangered species is any species which is in danger of extinction throughout all or a significant portion of its range while threatened species is any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Answers to Self-evaluation test 5.4

Refer to Student's Book.

1. The government has to guarantee international cooperation in research, observation and monitoring conservation activities. The government has to encourage activities by local organisations and private organisations.

2. The measures include a new emphasis on training law enforcement officers to fight the illegal trade and forestry personnel to guard against poaching. Educate people on the importance of wildlife.

3. The following are the major requirements of sustainable development in Rwanda:

   • Methods to reduce poverty using cooperatives

   • To improve health services in order to reduce infant mortality rate

   • Reduction of HIV and AIDS

   • Eradication of malaria

   • Education for sustainable development

   • Participation of people in decision making by empowering them

Answers to Self evaluation test 5.5

Refer to Student's Book.

1. Protecting vulnerable environments

   Reducing extinction of species

   Maintaining ecosystem functions.

2. i) Corruption

   ii) Lack of basic knowledge to the people about conservation.

   iii) Poverty

3. C. Development that meets the needs of the present without compromising the ability of future generation to meet their own needs

Summary of the unit

This unit deals with effects of human activities on ecosystem. You therefore should effectively use the practical activities and the suggested teaching approaches in the teacher's book to guide learners acquire the requisite knowledge and desired competences in these areas. At the end of the lessons, you should assess the extent to which the competences have been achieved and attitude change towards conserving the environment by using simple examples such as throwing waste papers in the bins. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well. Also emphasise the fact that taking this unit seriously may lead to careers such as ecologists, environmentalists, game wardens and many others.

Additional information for the teacher

Some information that may be relevant in this topic is given below.

Human activities that influence extinction and endangerment of wild species

Human activities that influence the extinction and endangerment of wild species fall into a number of categories:

- Unsustainable hunting and harvesting that cause mortality at rates that exceed recruitment of new individuals.
- Land use practices like deforestation, urban and suburban development, agricultural cultivation and water management projects that encroach upon and/or destroy natural habitats
- Intentional or unintentional introduction of destructive diseases, parasites, and predators, ecological damage caused by water, air and soil pollution.
- Human-caused global climate change. Alone or in combination, these stressors result in small, fragmented populations of wild flora and fauna that become increasingly susceptible to inbreeding, and to the inherent risks of small abundance, also called demographic instability. Without intervention, stressed populations often decline further and become endangered.

Things to do to save endangered species

Know what species in your area are endangered. This is the first step in making yourself aware and sharing that awareness with others. In most places,

there will be species that are endangered. If you know what species are endangered, you can let everyone around you know so that they are able to act in a way that will not put these animals' lives in danger.

Volunteer your time to protect the wildlife in your area. Wildlife refuges, parks and other places are often homes to very important species. You can help by volunteering at one of these places in order to protect the animals. Thanks to these places and the volunteers that work at them, one person can make a difference. This goes hand-in-hand with the first thing on the list, so once you know what species are endangered, you can volunteer your time in order to help them thrive.

Make certain that your home is not a hazard to wildlife. The first thing you can do is to secure all of your trash so that animals can't get to it. Use locking lids on your trash bins in order to keep your trash from becoming a hazard. Reduce the amount of water you use so that there is more local water for the wildlife. Another thing you can do is to place decals on your windows in order to keep birds from colliding with them. Because a large number of birds die from flying into windows, these decals will help to protect the local wildlife.

Plant native flora. Planting flora that is natural to the area will provide food for the wildlife around you. This is very important because industry often destroys these plants, which leaves the animals in certain places without any food. Do your part by ensuring that as much of this plant life as possible is available to them.

Do not use toxic herbicides or pesticides. Many people want to do what they can in order to have a beautiful looking lawn or garden, but certain herbicides and pesticides are horrible pollutants that wind up causing severe damage to the environment. Find alternative ways to keep your lawn and garden thriving without polluting the environment and having a negative effect on the wildlife in your area.

Watch the road and drive carefully. Particularly if you live or commute in a rural area, roads are one of the biggest hazards that animals face. If you are driving on a road that wildlife is known to cross, make certain to drive slowly and carefully and look out for animals so that you will not hit them. It seems simple, but too many distracted drivers kill too many animals on the roads.

Recycle and buy recycled or reusable products. Simply recycling and buying eco-friendly products can go a long way to help our animal friends. Do not purchase anything that is made of wood that comes from rainforests,

and know the consequences of every product you buy. You might be surprised about what products cause harm to the environments of endangered species, so do your research and know what kind of impact you are having.

Do not purchase illegal products that come from endangered species. This is typically not something that you have to worry about when you are in the United States, but if you travel abroad, there is the chance that you might come across a product being sold in an illegal market that harms endangered species. Do not participate in this. Do not purchase ivory, or any other product that likely required the killing of an endangered animal.

Support zoos and other wildlife parks. I know this sounds strange since most people who want to protect wildlife are against animals being held in captivity. However, zoos and other wildlife parks have actually done a lot to teach humans about the species and even protect them and help them to grow in population. Understanding this means that you understand the importance of these places and what they do to help the situation.

Answers to end unit assessment 5

Refer to Student's Book

1. (a) Sustainable development refers to the development that does not waste resources and pollute the environment while sustainable resources are those which are used or harvested in such a way that they are it is not depleted or permanently damaged.

   (b) D

2. B

3. A sustainable development is defined as the development that meets the needs of the present without compromising the ability of our future generations to meet their own needs.

4. Industrialisation

5. Conserving non-renewable resources helps to reduce green house emissions thereby lowering global warming.

   B. It's expensive

6. (a) Avoid products made from endangered animals. Plant native flowers, bushes and trees in your garden. Volunteer your time to protect the wildlife in your area. Recycle and buy recycled or reusable products.

(b) Unsustainable hunting and harvesting that cause mortality at rates that exceed recruitment of new individuals, land use practices like deforestation, urban and suburban development, agricultural cultivation, and water management projects that encroach upon or destroy natural habitat, intentional or unintentional introduction of destructive diseases, parasites, and predators, (ecological damage caused by water, air, and soil pollution

(c) We humans need these endangered species to survive for our own reasons. Because, these are the nuts and bolts of our planet. As these nuts get loose and fall apart, the whole bio structure of our beautiful planet falls apart.

7. Conservation is the management of nature and the earth's biodiversity, restoration is the practice of renewing degraded, damaged or destroyed ecosystem while stabilization is a type of natural selection that favours the average individuals in a population.

8. Captive breeding is the process of breeding animals in controlled environments within well-defined settings, such as wildlife reserves, zoos and other commercial and non-commercial conservation facilities. Sometimes the process includes the release of individual organisms to the wild, when there is sufficient natural habitat to support new individuals or when the threat to the species in the wild is lessened. Recall that endangered species are those on the verge of extinction and so are more than a very small population. The risks of captive breeding include inbreeding, i.e., mating between two closely related individuals as a result of a small gene pool. Inbreeding may lead to decreased disease immunity and phenotypic abnormalities. With the possibility of inbreeding, populations may undergo genetic drift, where genes have the potential to disappear completely, not only reducing genetic variation but also undermining natural selection by pressuring the remaining population and their predators. In the case of captive breeding prior to reintroduction into the wild, modelling works indicate that the duration of programs.

9. Through sustainable development, sustainable social and economic growth is achieved because there is

management of available resources efficiently. Conservation of natural resources is the use of nature for social and economic development without wasting resources and polluting the environment.

10. **Deforestation:** Humans have always cut down trees throughout history. The world's rainforests are being destroyed at a rate of 78 million acres per year, resulting in vegetation degradation, nutrient imbalance, flooding and animal displacement.

    Pollution: Vehicles, trains and planes emit toxic gases that include carcinogenic particles and irritants, creating air pollution. Humans have also dumped large amounts of pesticides, such as organophosphates, onto crops that migrate into groundwater and bodies of water, poisoning ecosystems. Plants and animals die from exposure to pollutants such as excess nutrients from chemical fertilisers and other harmful chemicals. Pollution is increasing around the world and resulting in loss of biodiversity causing severe damage to self-sustaining ecosystems.

    Land Conversion: Through urban development, the continued rapid construction of road systems and buildings has changed the earth's natural surface, removing soil nutrients, surface vegetation and trees that filter the air and equalize the carbon cycle. Urbanisation also displaces animals and increases environmental pollution from vehicles and factories.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Name non-renewable resources as learnt in class. 2. Present reports on project activities to the class.	1. Do further research in textbooks or the internet about conservation and sustainability. Write short notes then share with other class members. 2. Suggest ways you as an individual can help conserve endangered species.
Remedial questions for slow learners 1. List few renewable resources. 2. Define sustainable development. 3. What is conservation?	**Extended questions for gifted learners** 1. Explain how human activities can lead to species extinction. 2. How important is recycling of waste material to the society?
Answers to remedial questions for slow learners 1. Hydroelectricity, wind, geothermal 2. Sustainable development refers to the development that does not waste resources and pollute the environment. 3. Planned management of a natural resource to prevent exploitation, destruction or neglect.	**Answers to extended questions for gifted learners** 1. Unsustainable hunting and harvesting that causes mortality at rates that exceed recruitment of new individuals, land use practises like deforestation, urban and suburban development, agricultural cultivation, and water management projects that encroach upon or destroy natural habitat, intentional or unintentional introduction of destructive diseases, parasites, and predators, (ecological damage caused by water, air, and soil pollution. 2. Creates employment to the people, clean environment

UNIT 6 Mitosis and Meiosis

Key unit competence

After studying this unit, the learner should be able to explain the different processes of cell division and their implication on living things.

Learning objectives

Table 6.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Remember what DNA is and link it to chromosomes. ▪ Explain the importance of mitosis and meiosis and the stages involved. ▪ State that meiosis is responsible for proper gamete formation. ▪ Outline the differences between mitosis and meiosis.	By the end of this unit, learners should be able to: ▪ Observe from charts and identify the diploid and haploid states of cells. ▪ Understand the problems involved in vegetative reproduction which is accomplished by mitosis only. ▪ To compare mitosis and meiosis cell division.	By the end of this unit, learners should be able to: ▪ Understand that vegetative reproduction depends on mitosis cell division only. ▪ Describe the importance of mitosis cell division in body repair.

Pre-requisites to this unit

In senior 1 and senior 2, the students learnt about cell division. Review the unit by reminding learners of what cell division is, types of cell division which is mitosis and meiosis. Get learners prepared to learn detailed information of cell division more than they did in senior 1 and senior 2.

This unit is linked to the field of agriculture, medicine and other sciences that involve biological research. Let the learner understand that at this stage, they may only need the basic information. Other details will be taught at higher levels.

Background information

This topic deals with mitosis and meiosis which majorly involve growth. Growth of an organism is an irreversible increase in mass. All organisms grow as growth is one of the characteristics of all living organisms. Cells originate from pre-existing cells. During growth, cells must increase in number through the process called cell division. There are two types of cells in most of the multicellular organisms. One type, cells which do not participate in reproduction called somatic cells. Then the cells responsible for reproduction called gametes. Somatic cells increase by Mitosis cell division. Then formation of gametes involves another type called Meiosis cell division. Mitosis takes place in all cells within the body. The following are the functions of mitosis cell division:

(i) Growth

(ii) Repairing of damaged tissues

(iii) Replacing of old cells

(iv) Asexual reproduction e.g. vegetative reproduction in plants and fragmentation and in animals.

Cross-cutting issues to be addressed

1. Standardisation culture

The students will be aware of the mechanisms involved in vegetative reproduction such as cuttings, fragmentations and grafting.

2. Financial education

Emphasise the fact that learners should employ vegetative reproduction for mass production of commercial plants.

3. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a carrier in agriculture and research laboratories of biological sciences. Give examples of role models who are successful specialists in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangement should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs and as they engage in group work and as they observe different stages of mitosis and meiosis cell division and deliberate on their importance in reproduction, growth and body repair.

2. ***Research skills***

Guide learners on how to find information regarding biological systems which depend on the two types of cell division. Consider cancer and mitosis cell division.

3. ***Communication in English***

Group work and presentation tasks such as those in activities 6.2, 6.4 and 6.6 and role play should be used to inculcate this competence.

4. ***Critical thinking***

This competence will be developed by learners answering the probing questions such as those in Activities 6.1, 6.4 and 6.6 and as they discuss the results of the practical activity in their book. Guide learners to discover for themselves the behaviour of chromosomes at each stage of mitosis cell division. This competence will also come about as learners think about their findings in other activities and as they give out their suggestions.

5. ***Lifelong skills***

Understanding how vegetative reproduction occurs and linking it to mitosis cell division helps students to increase yields in agriculture especially the commercial. They can easily train others to increase food production especially in rural areas. Also, make learners aware that they can become Agriculture and medical officers if they take this topic seriously.

Key words in this unit and their meanings

Cytokinesis- This is the process during cell division in which the cytoplasm of a cell divides to form two daughter cells.

DNA- (Deoxyribonucleic acid.)- This is a molecule that carries most of the genetic instructions used in the development, functioning and reproduction of all living organisms.

Chromosome- It is a packed and organised structure containing mostly DNA of all living organisms.

Mitosis-It's part of a cell cycle in which chromosomes in the nucleus are separated into two identical sets of chromosomes and the cytoplasm contents are divided into two sets which are equal.

Meiosis- This is a specialised type of cell division that reduces the chromosome

number by half, that is from diploid number to haploid number.

Homologous chromosomes- These are a set of one maternal and one paternal **chromosomes** that pair up with each other inside a cell during **meiosis**.

Chromatid- This is one copy of a newly copied **chromosome** which is still joined to the other copy by a single centromere.

Chromatin- This is substance found in cell nuclei that forms chromosomes during cell division.

Centromere- This is a constricted region where sister chromatids are attached.

Chiasmata-It's a point of crossing over during meiotic cell division.

Spindles fibers-These are microtubules which are components of the cytoskeleton, found throughout the cytoplasm.

Meristem- This is the tissue in most plants containing undifferentiated cells (meristematic cells), found in zones of the plant where growth can take place, for example, apex and near root tips.

Haploid- It's an organism or cell that comprises of a single set of chromosomes.

Diploid- This is cell containing a double set of chromosomes arranged in homologous pairs within its nucleus. All cells in the body are diploids except gametes.

Crossing over- It's the exchange of genetic material between non-sister chromatids of homologous chromosomes.

Guidance on the problem statement

This topic is about types of cell division. The roles played by the two types which are mitosis and meiosis are well explained. To introduce this lesson effectively, use Student's Book. **Important:** The diagram is meant to introduce the concept of cell division as a process of growth. For this to happen, the original cell must be in existence. Let learners discuss the diagrams in groups (the number per group should depend on the size of the class and abilities of learners). Ask them probing questions such as:

- How does one cell develop into an organ with so many cells?
- Do all cells look alike?
- Which part of a cell controls all its activities?
- Where are chromosomes found?

Based on the answers to the questions above, guide learners into discovering

what they will learn in this unit. Further emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as nursing, medicine among other courses.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Gifted learners to be given heavy tasks which require more critical thinking. • Gifted learners can be performing the actions during practical activities as slow ones make observations and take notes. • Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. • Ensure all learners respect other's views irrespective of their shortcomings or talents.	• Allocate roles like holding charts and dismantling models to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols and sign language interpreters for the deaf. • Also arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1.	Recall genetic material in eukaryotic cell and explain mitosis and meiosis.	2
2.	Describe the stages of mitosis.	3
3.	Outline stages of meiosis with their significance and compare it with mitosis.	3

Answer of introductory activity

Micrographs shows cells with chromosomes in different stages of cell division.

Lesson 1: Chromosomes and introduction to cell division *(To be covered in two periods)*

Refer to Student's Book

Specific objectives

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

- Understand the processes of cell division which are mitosis and meiosis.
- The behaviour of chromosomes during cell division.

Preparation for the lesson

1. This lesson will involve individual work and dissection activity. You will therefore organise the class as need arises during the lesson.

Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Look for slides illustrating mitosis cell division in advance and check the microscope to ensure that they all are in good working condition.

3. Obtain wall charts on mitosis cell division and other materials such as cell models illustrating the behaviour of chromosomes during cell division in advance.

4. Bring pamphlets, handouts and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi or modem.

5. Test the link: https://www.youtube.com/L0k-enzoeOM

Teaching Aids

- Prepared slides, microscopes, roots of onion
- Charts on cell division, textbooks, pamphlets and hand outs
- Video link: https://www.youtube.com/Ygc-cVd1dtM
- Fig 6.1 and 6.2 of Student's Book

Improvisation: You may come up with your own painted diagrams on mitotic and meiotic cell division drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the unit

- Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.
- Ask probing questions to introduce the lesson. Such questions may include:

  What is the use of mitosis cell division?

  Ans: It's used in growth, repairing tissue, replacing old cells and vegetative reproduction.

  What is meiosis cell division?

  Ans: It's a specialised type of cell division that reduces the chromosome number by half. i.e. from diploid number to haploid number.

Teaching / Learning activities

Activity 6.1 (Refer to Student's Book.)

- This is a research activity. Provide learners with the handouts, pamphlets and textbooks and ask them to find out the behaviour of chromosomes during cell division. The following link will be useful. https://www.youtube.com/ofjyw7ARP1c

- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes in Student's Book on the structure of chromosomes.

  Activity 6.2 (Refer to Student's Book.)

- This activity is meant to help learners appreciate how replication of chromosomes takes place.
- Use the twisted wool to make students understand the process of replication.
- The students should observe that from two strands of wool they end up with four untwisted ropes which is similar to what happens to chromosomes during cell division.

Answers to activity 6.2

a) Two (2) sets

b) Four (4). It shows the analogy of this DNA replication.

c) Chromosomes inside the nucleus replicate in a similar manner.

Synthesis

The lesson introduces learners to the concept of cell division. The activities carried out during the lesson should help learners understand the behaviour of chromosomes during cell division.

Lesson assessment

1. In which phase do chromosomes replicate during cell division?

   Ans: Interphase

2. Outline the phases of mitosis cell division

   Ans: They are prophase, metaphase, anaphase and Telophase.

3. In which phase do replicated chromosomes appear?

   Ans: Prophase stage

The process	Mitosis	Meiosis
Prophase	• Chromosomes become visible as two chromatids joined at centromere. • Nuclear membrane and nucleolus disappear. • Spindle fibres form.	• Chromosomes become visible. • Homologous chromosomes pair to form bivalents. • Crossing over takes place to form chiasmata. • Nuclear membrane and nucleolus disappear. • Spindle fibres form.
Metaphase	• Chromosomes move to the equator. • Centromere attaches the spindle fibres.	• Bivalents move to the equator. • Centromere attaches the spindle fibres.
Anaphase	• Sister chromatids separate and move to opposite poles.	• Sister chromatids separate and move to opposite poles.
Telophase	• Spindle fibres break. • Nuclear membranes form around identical nuclei. • Nucleolus reappears. • Cytokinesis takes place and two identical cells form.	• Spindle fibers break. • Nuclear membranes form around non-identical nuclei with haploid no. of chromosomes. • Nucleolus reappears. • Note: Each nucleus has one of the homologous pair.
Summary of products	• Two identical cells with diploid no. of chromosomes.	• Two non-identical cells each with a haploid no. of chromosomes.

Lesson 2 : Mitosis *(To be covered in three periods)*

Refer to Student's Book

Specific objectives

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

- Describe the stages of mitosis cell division.
- Explain the behaviour of chromosomes at each stage of mitosis.

Preparation for the lesson

1. This lesson will involve individual work and dissection activity. You will therefore organise the class as need arises during the lesson.

   Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

1. Look for slides illustrating mitosis cell division in advance and check the microscope to ensure that they all are in good working condition.

2. Obtain wall charts on mitosis and meiosis cell division and other materials such as cell models illustrating the behaviour of chromosomes during cell division in advance.

3. Bring pamphlets, handouts and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi or modem.

4. Test the link: https://www.en.wikipedia.org/wiki/Mitosis in advance test to see if it is working. This link has notes on mitosis cell division. This is part of one of the activities in this lesson.

Teaching Aids

- Prepared slides, microscopes, roots of onion
- Charts on cell division, textbooks, pamphlets and handouts.
- Video link: https://www.youtube.com/Ygc-cVd1dtM
- The diagrams in Student's Book.

Improvisation: You may come up with your own painted diagrams on mitotic cell division drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

- Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  What is the use of mitosis cell division?

  Ans: It's used in growth, repairing tissues, replacing old cells and in vegetative reproduction.

  What is the longest stage in which the cell replicates its organelles?

  Ans: It's the interphase stage.

  Activity 6.3 (Refer to Student's Book.)

- This activity is meant to differentiate between the phases of mitosis cell division.
- Use charts and videos to make students understand the difference between mitosis phases.
- The students should outline main phases of mitosis cell division.

a) The phases are interphase, prophase, metaphase, anaphase and telophase.

- Summarise the lesson by highlighting the key points which should include main phases of mitosis cell division.

Refer to Student's Book.

- Give the learners time to attempt Self-evaluation Test 6.1.

Synthesis

The lesson introduces learners to the phases of mitosis cell division. The activities carried out during the lesson should help learners understand the behaviour of chromosomes at each phase of mitosis cell division.

Lesson assessment

1. What is mitosis cell division?

   Ans: It's part of a cell cycle in which chromosomes in the nucleus are separated into two identical sets of chromosomes and the cytoplasm contents are divided into two sets which are equal.

2. Name the cell which does not divide by mitosis cell division only.

   Ans: Gamete cells such as pollen grains and ovules in plants and sperms and ova in humans.

3. What are the major functions of mitosis cell division?

   Ans: The functions are: growth, body repair, replacing old cells and vegetative reproduction.

Lesson 3: Meiosis *(To be covered in three periods)*

Refer to Student's Book.

Specific objectives

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

- Describe the stages of meiosis cell division.
- Explain briefly the behaviour of chromosomes at each stage of meiosis.
- State the significance of meiosis cell division.

Preparation for the lesson

1. This lesson will involve individual work, video watching, research work and group activities. You will therefore organise the class as need arises during the lesson.

   Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring pamphlets, handouts and textbooks for reference in class. Also ensure that the Internet is working if you have a computer laboratory or any other form of

Internet connectivity such as WiFi or modem.

3. Test the link: https://www.en.wikipedia.org/wiki/meiosis in advance to see if it is working. This link has notes on meiosis cell division. This is part of one of the activities in this lesson.

4. Obtain wall charts on meiosis cell division and other materials in advance.

Teaching Aids

- Prepared slides, microscopes, roots of onion
- Charts on cell division, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/16enC385R0w
- The diagrams in Student's Book

Improvisation: You may come up with your own painted diagrams on meiotic cell division drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

- Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  What is the use of meiosis cell division?

  Ans: It's used to reduce the chromosomes number by half. i.e. from diploid number to haploid number.

  Activity 6.4 (Refer to Student's Book.)

- This activity is meant to investigate the stages of meiosis cell division.
- Use the anthers from the flower to prepare a temporary slide and observe stages of meiosis using the microscope. The students should outline main phases of meiosis cell division.

  Ans: The phases are interphase, prophase, metaphase, anaphase and telophase.

- Summarise the lesson by highlighting the key points. Refer to Student's Book.

Synthesis

The lesson introduces learners to the process of meiosis cell division. The activities carried out during the lesson should help learners understand the behaviour of chromosomes at each phase during meiotic cell division.

Lesson assessment

1. What is the major function of meiosis cell division?

   Ans: The major function is to reduce the number of chromosomes from the diploid number to haploid number.

2. Name the cells which undergo meiotic cell division.

   Ans: The cells which are involved in reproduction called gametes.

3. What are the homologous chromosomes?

   Ans: They are a set of one maternal and one paternal chromosome that pair up with each other inside a cell during meiosis.

4. In which stage of meiosis cell division does crossing over take place?

   Ans: Prophase stage

Answers to Self-evaluation Test 6.1

Refer to the Student's Book.

1. B
2. C
3. D

Answers to Self-evaluation Test 6.2

Refer to the Student's Book

1. This is because after the nucleus divides, the cytoplasm also divides which results into two cells that can exist independently.
2. A
3. A
4. 2, 10

Answers to Self-evaluation Test 6.3

Refer to the Student's Book

1. Meiosis produces 4 non-identical daughter cells; each daughter cell has half the chromosomes as the parent cell.
2. A
3. B

Summary of the unit

This unit deals with cell division. You should therefore effectively use the practical activities and suggested teaching approaches in the teacher's book to guide the learners to acquire the requisite knowledge. Supervise and go through learners your work as they do Test Competence 6 and Self evaluation test and award them marks according to their performance. Plan remedial activities where necessary for slow learners and give extra activities for the gifted ones.

Additional information to the teacher

The essential stages that take place during meiosis.

- Two successive divisions without any DNA replication
- Formation of chiasmata
- Segregation of homologous chromosomes
- Separation of sister chromatids

Prophase I

Prophase I is typically the longest phase of meiosis. During prophase I, homologous chromosomes pair and exchange DNA (homologous recombination). This often results in chromosomal crossover. This process is critical for pairing between homologous chromosomes and hence for accurate segregation of the chromosomes at the first meiosis division. The new combinations of DNA created during crossover are a significant source of genetic variation, and result in new combinations of alleles, which may be beneficial. The paired and replicated chromosomes are called bivalents or tetrads, which have two chromosomes and four chromatids, with one chromosome coming from each parent. The process of pairing the homologous chromosomes is called synapsis. At this stage, non-sister chromatids may cross-over at points called chiasmata (plural; singular chiasma). Prophase I has historically been divided into a series of substages which are named according to the appearance of chromosomes.

Leptotene

The first stage of prophase I is the leptotene stage. Individual chromosomes each consisting of two sister chromatids become "individualized" to form visible strands within the nucleus. The two sister chromatids closely associate and are visually indistinguishable from one another.

Zygotene

The zygotene stage occurs as the chromosomes approximately line up with each other into homologous chromosome pairs. In some organisms, this is called the bouquet stage because of the way the telomeres cluster at one end of the nucleus. At this stage, the synapsis of homologous chromosomes takes place. Individuals of a pair are equal in length and in position of the centromere thus pairing is highly specific and exact. The paired chromosomes are called bivalent or tetrad chromosomes.

Pachytene

At this point a tetrad of the chromosomes has formed known as a bivalent. This is the stage when homologous recombination, including chromosomal crossover

(crossing over), occurs. Non-sister chromatids of homologous chromosomes may exchange segments over regions of homology. Sex chromosomes, however, are not wholly identical, and only exchange information over a small region of homology. At the sites where exchange happens, chiasmata form. The exchange of information between the non-sister chromatids results in a recombination of information; each chromosome has the complete set of information it had before, and there are no gaps formed as a result of the process.

Diplotene

The chromosomes themselves uncoil a bit, allowing some transcription of DNA. However, the homologous chromosomes of each bivalent remain tightly bound at chiasmata, the regions where crossing-over occurred. The chiasmata remain on the chromosomes until they are severed at the transition to anaphase I.

Diakinesis

Chromosomes condense further during the diakinesis stage. This is the first point in meiosis where the four parts of the tetrads are actually visible. Sites of crossing over entangle together, effectively overlapping, making chiasmata clearly visible. Other than this observation, the rest of the stage closely resembles prometaphase of mitosis; the nucleoli disappear, the nuclear membrane disintegrates into vesicles, and the meiotic spindle begins to form.

Answers to end unit assessment 6
(*Refer to the Student's Book)*

1.	A	2.	B
3.	D	4.	B
5.	C	6.	C
7.	iv, i, iii,ii	8.	B
9.	C	10.	C

11. a) Differences Between Mitosis and Meiosis

Cell Division

- **Mitosis:** A somatic cell divides once. Meiosis: A reproductive cell divides twice.

Daughter cell number

- **Mitosis:** Two daughter cells are produced. Each cell is diploid containing the same number of chromosomes, as the parent cell.
- **Meiosis:** Four daughter cells are produced. Each cell is haploid containing one half the number of chromosomes as the original cell.

Genetic composition

- **Mitosis:** The resulting daughter cells in mitosis are genetically identical). No recombination or crossing over occurs.

- **Meiosis:** The resulting daughter cells contain different combinations of genes. Genetic recombination occurs as a result of the random segregation of homologous chromosomes into different cells and by the process of crossing over.

Length of prophase

- **Mitosis:** During the first mitotic stage, known as prophase, chromatin condenses into discrete chromosomes, the nuclear envelope breaks down and spindle fibres form at opposite poles of the cell. A cell spends less time in prophase of mitosis than a cell in prophase I of meiosis.

- **Meiosis:** Prophase I consists of five stages and lasts longer than prophase of mitosis. The five stages of meiotic prophase I are leptotene, zygotene, pachytene, diplotene and diakinesis. These five stages do not occur in mitosis. Genetic recombination and crossing over take place during prophase I.

Tetrad formation

- **Mitosis:** Tetrad formation does not occur.

- **Meiosis:** In prophase I, pairs of homologous chromosomes line up closely together forming what is called a tetrad. A tetrad consists of four chromatids (two sets of sister chromatids).

Chromosome alignment in metaphase

- **Mitosis:** Sister chromatids (duplicated chromosome comprised of two identical chromosomes connected at the centromere region) align at the metaphase plate (a plane that is equally distant from the two cell poles).

- **Meiosis:** Tetrads (homologous chromosome pairs) align at the metaphase plate in metaphase I.

Chromosome separation

- **Mitosis:** During anaphase, sister chromatids separate and begin migrating centromere first toward opposite poles of the cell. A separated sister chromatid becomes known as daughter chromosome and is considered a full chromosome.

- **Meiosis:** Homologous chromosomes migrate toward opposite poles of the cell during anaphase I. Sister chromatids do not separate in anaphase I.

12. 30, mitosis

13. a) True

    b) False

    c) True

d) True

e) False

f) True

i) Meiosis is a type of cell division that involves the halving of chromosomes in the daughter cells as compared to the mother cell.

ii) Mitosis is a type of cell division in which the daughter cells have the same diploid number of chromosomes as the mother cell.

iii) Haploidy is a state in which daughter cells have half the number of chromosomes as in the parent cell.

iv) Diploidy is a state in which cells have complete sets of paired chromosomes.

v) Cytokinesis is the process of Division of the cytoplasm during cell division.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Observing and drawing various stages of meiosis and mitosis. 2. Come up with an acronym for the stages of meiosis and mitosis. 3. Use Manila paper to write the difference between meiosis and mitosis.	1. Do further research in textbooks or the Internet about mitosis and meiosis.Write short notes then share with other class members. 2. Write a poem about the significance of meiosis and mitosis. Use simple words. Recite it to the class.
Remedial questions for slow learners 1. Give four stages of mitosis. 2. What is cell division?	**Extended questions for gifted learners** 1. Draw a flowchart of a generalised process of mitosis. 2. In simple words, explain what happens during crossing over.

Answers to remedial questions for slow learners	Answers to extended questions for gifted learners
1. Interphase, prophase, metaphase anaphase and telophase. 2. It is the process by which a parent cell divides into two or more daughter cells.	1. Refer to Student's Book Fig 6.7. 2. Crossing over begins when one chromatid is cut through, making a break in the double-stranded DNA (recall that each DNA strand is a double helix of nucleotides). A nuclease enzyme then removes nucleotides from each side of the DNA strand, but in opposite directions, leaving each side with a single-stranded tail.

UNIT 7 Heterotrophic nutrition

Key unit competence

After studying this unit, the learner should be able to explain Heterotrophic nutrition.

Learning objectives

Table 7.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • Identify different forms of heterotrophic nutrition. • Describe the different forms of teeth and care taken to keep teeth healthy. • Describe digestion of food in man. • Explain absorption and assimilation of food. • Explain the causes of digestive disorders.	By the end of this unit, learners should be able to: • Observe wall charts of teeth and digestive system of man and their models. • Draw and label the digestive system of man and different types of teeth. • Take care of digestive disorders such as constipation and diarrhoea.	By the end of this unit, learners should be able to: • Show concern about the hygiene of the digestive system. • Show awareness of digestive disorders such as constipation and diarrhoea. • Take care of his/her teeth. • Develop habit of regular health check up.

Pre-requisites of this unit

Learners have learnt about nutrition in senior 1 and senior 2. Remind them of what they learnt by asking questions such as: What is nutrition? Name two types of nutrition. Prepare the learners psychologically to know that this unit deals with one of the types of nutrition which is heterotrophic nutrition and focuses mainly on structure and function of human teeth, types of heterotrophic nutrition and digestion.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to Entrepreneurship, Economics and Medicine. The link comes

in when you consider the price of food which is digested and the money spent on buying toothpaste which keeps teeth health and strong.

Background information

When organisms digest organic compounds which are already made, it's said that they feed by holozoic nutrition. All heterotrophs have to digest the organic compounds (food) before they are taken into their body except parasites which feed on already digested food. Since heterotrophs cannot make their own food, they depend on autotrophs for their nutrients.

All heterotrophs (except blood and gut parasites) have to convert solid food into soluble compounds capable of being absorbed (digestion) where the soluble products of digestion of the organism where complex materials (assimilation) are broken down for the release of energy (respiration). All heterotrophs depend on autotrophs for their nutrition. Heterotrophic plants have only 4 types. The main types of heterotrophic nutrition are: holozoic nutrition, saprotrophic nutrition, parasitic nutrition and symbiotic nutrition.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need to seek medical healthcare in standard and quality hospitals whenever they have problems with their digestive systems.

2. Financial education

Emphasise the fact that learners should practise good hygiene to avoid conditions and disease of teeth and the digestive system in order to avoid spending money on treatment.

3. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a career in medicine. Give examples of role models who are successful chest specialists in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and assign physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs and as they engage in group work and as they observe the parts of the alimentary canal of man and deliberate on its importance and functions of its various parts.

2. ***Research skills***

Guide learners on how to find information regarding the diseases of digestive system to bring out this competence in learners.

3. ***Communication in English***

Group work and presentation tasks such as those in activities 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9 and 7.10 should be used to inculcate this competence.

4. ***Critical thinking***

This competence will be developed by learners answering the probing questions such as those in Activities 7.2, 7.3 and 7.6 and as they discuss the results of the practical activity in their book. Guide learners to discover for themselves the different parts of the digestive system of a rabbit in activity 7.5. This competence will also come about as learners think about their findings in other activities and as they give out their suggestions.

5. ***Lifelong skills***

Practising hygiene of the teeth, gum and the digestive system in general creates a habit of taking care of oneself. Learners can also pass this habit to others through training. Also, make learners aware that they can become medical practitioners if they take this unit seriously.

Key words in this unit and their meanings

Autotrophism: It's the type of nutrition where organisms make their own food from simple substances such as carbon dioxide and water.

Heterotrophism: It's the type of nutrition where organisms get ready-made food from the environment.

Holozoic nutrition: It's the type of nutrition where organic matter is ingested and digested.

Saprophytic nutrition: It's the type of nutrition where organisms feed on dead organic matter.

Parasitic nutrition: It's a type of nutrition where an organism depends on another organism for food.

Ingest: It is the putting of food into the mouth.

Egest: It is the expelling of undigested material through the anus.

Host: It is an organism which provides food to the parasite.

Endoparasite: It is a parasite which stays inside the host permanently.

Ectoparasite: It is a parasite which stays on the surface of a host organism.

Heterodont: These are teeth of different types and sizes e.g. human teeth.

Homodont: These are teeth of the same type and size e.g. some snake teeth.

Dentition: It's the characteristic arrangement of teeth in the mouth.

Deciduous or milk teeth: These are the first set of teeth that grow in the mouth.

Cusps: These are ridges found on top of premolar and molar teeth.

Wisdom tooth: It's the last molar tooth to grow.

Enamel: It's the hardest part of the teeth that covers the surface.

Dental caries: Sometimes called dental cavities are the holes formed on teeth due to acids from bacteria in the mouth.

Periodontal membrane: It's the membrane which separates the jawbone from the cement part of tooth.

Dental floss: It's a piece of strong thread that removes food between one tooth and another.

Periodontal disease: This is a general term for diseases and bacterial infections of the gums and teeth that cause much damage and can result in loss of teeth.

Dissection: It's the cutting up of body parts of an animal or plant for the purpose of careful examination so that analysis can be done.

Scalpel: It's a small sharp knife used in dissection.

Buccal cavity: It's the area behind the teeth that stops at the opening of the gullet.

Digestion: It's a process by which complex food substances are broken down into simple soluble substances which can be absorbed.

Mastication: It's the breaking of food into smaller pieces by the teeth in the mouth while mixing it with saliva.

Bolus: It's chewed food mixed with saliva ready to be swallowed.

Parotid gland: It's a salivary gland located in the upper part of the buccal cavity.

Sub-maxillary gland: It's a salivary gland located under the tongue.

Sublingual gland: It's a salivary gland located at the lower jaw on sides of the tongue.

Pharynx: It's the area at the back of the mouth or at the opening of the gullet or oesophagus.

Oesophagus: It's the tube that carries food from the mouth to the stomach.

Epiglottis: It's a tissue that closes the trachea or wind pipe during swallowing so that food particles do not enter the lungs.

Uvula: It's a soft tissue that closes the opening of the nose so that food does not enter the nose.

Peristalsis: It's the automatic movement that pushes the food along the alimentary canal from the oesophagus to the rectum.

Cardiac sphincter: It's a ring of muscle or valve that closes the upper side of the stomach.

Pyloric sphincter: It's a ring of muscle or valve that closes the lower side of the stomach.

Chyme: It's the semi solid food mixed with gastric juice ready to leave the stomach to the duodenum.

Gastric gland: It's a gland located in the stomach that produces gastric juice.

Gastric pits: These are the openings of the gastric glands.

Gastrin Hormone: It's a hormone produced by the stomach walls responsible for the stimulation of the gastric gland to produce gastric juice.

Coagulation: It's the solidifying of a liquid such as milk or blood.

Emulsification: It's the physical breaking down of fats into small droplets for easy digestion.

Succus entericus: It's the intestinal juice that contains digestive enzymes and mucus in the ileum.

Villi (singular: Villus): These are fingerlike projections on the inner surface of the ileum which are responsible for food absorption.

Ileo-colonic sphincter muscle: It's the muscle that controls the movement of food from the ileum to the colon.

Assimilation: It's the process of turning absorbed food into body tissues and energy.

Faeces: These are formed in the large intestine from material which is not absorbed or undigested.

Flatus: It's a mixture of gases formed by bacteria in the colon which is normally let out through the anus during farting.

Defecation: It's the act of releasing faeces from the rectum through the anus to the outside.

Constipation: It's a digestive disorder in which evacuation of the bowels is difficult and does not occur regularly.

Diarrhoea: It's a condition when faeces are watery.

Guidance on the problem statement

This topic is about heterotrophic nutrition and its importance in the body. As a way of introducing the concept of heterotrophic nutrition refer, learners to diagrams in their book.

Important: You may need to link this topic to that of autotrophic nutrition for learners to understand it better. The diagrams are meant to introduce the concept of different methods of heterotrophic nutrition. Students have to observe the structure and arrangement of teeth on the three diagrams. Let learners discuss the diagrams in groups (the number per group should depend on the size of the class and abilities of learners).

Ask them probing questions such as:

- How does diagram a differ from diagram b and c?
- Suggest the type of food eaten by each organism whose skull is shown in the diagram.
- What is the function of teeth in each diagram?

Based on the answers to the questions above, guide learners into discovering what they will learn in this unit. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as nursing, medicine among other courses.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts and explain their functions. • Gifted learners can be performing the actions during practical activities as slow ones make observations and take notes. For example, in activity 12.2, they can perform the dissection. • Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. • Ensure all learners respect other's views irrespective of their shortcomings or talents.	• Allocate roles like holding charts and dismantling models like the lung model to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols and sign language interpreters for the deaf. • Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1.	Different forms of heterotrophic nutrition	2
2.	Structure and function of human teeth	3
3.	Digestive system of man up to the duodenum	3
4.	Digestion in the ileum and colon	2
5.	Digestive disorders and good health	2

Answer of introductory activity

A: Herbivores like cows feed on grass. they have strong molar and premolar.

B: Carnivores like dogs have long and sharp canine.

C: Omnivores like Human. Have developed three different types of teeth (incisive. Premolar and molar).

7.0 : Heterotrophic nutrition

Refer to Student's Book.

Lesson 1: Forms of heterotrophic nutrition *(To be covered in two periods)*

Refer to Student's Book

Specific objectives

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

- Explain the different forms of nutrition.
- Identify organisms feeding with each type of nutrition.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Look for the skulls of a sheep, dog and human being. In case those skulls are not available, look for models in advance.
3. Obtain wall charts on heterotrophic nutrition and other materials in advance.

Teaching Aids

- Skull of a sheep or a cow, dog and a human being
- Charts of heterotrophic nutrition, textbooks, pamphlets and handouts.
- Video link: https://www.youtube.com/watch?v=dBGKnbnZQTo

- The diagram in Student's Book

Improvisation: You may come up with your own painted diagrams of mentioned skulls drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson:

Learners should know that heterotrophic nutrition is divided into 3 groups according to the way nutrients are taken in. Students are going to know the differences between those types.

Teaching/Learning activities

Activity 7.1 (Refer to Student's Book.)

- Begin this activity by identifying the following organisms spider, frog, butterfly and cockroaches.
- You can then play the video: https://www.youtube.com/dBGKnbnZQTo
- Guide learners to describe what they have seen. Ask probing questions such as:
  - Why does a spider feed differently from a cockroach? **Ans**: The spider is a carnivorous animal which has poison to kill the prey while the cockroach is an omnivorous animal which feeds mainly on decaying matter.
  - What are the major differences between grass eaters and meat eaters? **Ans**: Animals which feed on grass do not have canine teeth while the canines of meat eaters are well developed.
- Let learners come up with summary of different types of heterotrophs.

Answer for activity 7.1

Cockroaches are omnivorous scavengers and consume any organic food source available to them. Although they prefer sweets, meats and starches, they are also known to consume other items such as hair, books and decaying matter.

Spider feed on small insect small insects

Butterflies are known for their completely liquid diets, whether they are sampling nectar from all sorts of different flowers

Frog catches an insect.

For the different mode of feeding refer to the content

Synthesis

This lesson should create awareness of the different types of heterotrophic nutrition. Learners through watching the video and through listening to the expert should appreciate the relationship between structure of mouth parts and feeding habits.

Lesson assessment

1. Outline the three types of heterotrophic nutrition.

Ans: Holozoic, saprophytic and parasitic nutrition.

2. Give one difference between holozoic and saprophitic nutrition.

   Ans: During Holozoic nutrition digestion of food takes place inside the body while in saprophatic nutrition digestion takes place outside so that semi-digested food is ingested.

3. What is the difference between autotrophic nutrition and heterotrophic nutrition?

   Ans: Autotrophic nutrition is the type of nutrition in which simple compounds are taken in to build complex substances used as food. On the other hand heterotrophic nutrition involves taking in complex substances which are broken down into simple substances during feeding.

4. Give examples of organisms that feed by parasitic nutrition.

   Ans: Intestinal worms, lice, ticks, plasmodium

Lesson 2: Structure and function of human teeth *(To be covered in three periods)*

Refer to Student's Book.

Specific objectives

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

- Identify the types and functions of human teeth.
- List common dental diseases and their treatment.
- Describe the proper care of teeth in terms of diet and regular brushing.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Look for the skulls of a sheep, dog and human being. In case those skulls are not available, look for models in advance.

3. Obtain wall charts on structure of teeth and other materials such as models of skulls in advance.

Teaching Aids

- Skull of a sheep or a cow, dog and a human being
- Charts of human teeth, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/ZeUlh9Cou38
- The diagram in Fig 7.6 in Student's Book

Improvisation: You may come up with your own painted diagrams of human teeth drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson:

Learners should know that human teeth are divided into 4 types according to the way they break food into smaller pieces. Students are going to know and identify the differences between those types.

Teaching/Learning activities

Activity 7.2 (Refer to Student's Book.)

- Begin this activity by identifying the four different types of teeth in human beings.
- Guide learners to describe what they have seen.

Ask probing questions such as:

- How many types teeth have you counted? ***Ans:*** 16 in the upper jaw and other 16 in the lower jaw.
- How many types of teeth have you observed? ***Ans:*** There are four types which are incisors, canines, premolars and molars.

- Let learners come up with summary notes on the types of teeth in human beings and draw their figures and label the various parts.

Synthesis

This learner should be aware of the different types of teeth. Learners through watching the video and through listening to an expert should appreciate the relationship between structure of teeth and their function.

Lesson assessment

1. What does the term heterodont and homodont mean?

   Ans: Heterodont is the dentition when teeth are of different types and sizes while homodont is a dentition where all teeth are of the same type and size.

2. How many types are teeth do human beings have?

   Ans: There are four types which are: incisors, canines, premolars and molars.

3. State the function of each type of teeth found in man.

   Ans: Incisors cut food. Canines tear food, premolars crush food and molars grind food.

4. What do you understand by the term oral hygiene?

   Ans: It's the cleanliness of the mouth and proper care for the teeth and mouth.

5. Which part of tooth is hardest?

   Ans: It's the outermost part called enamel.

6. Give two major dental diseases.

   Ans: Dental caries and periodontal diseases

7.3: The digestive system

Lesson 3: Digestive system of man

(To be covered in three periods)

Refer to Student's Book.

Specific objectives

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

- Describe different parts of the alimentary canal.
- Describe the process of digestion in various parts of the alimentary canal.
- Explain the two types of digestion i.e. physical and chemical digestion.
- Outline stages of digestion i.e. in the stomach and duodenum and give the names of enzymes and what they do in the alimentary canal.

Preparation for the lesson

- This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson.

  Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

- Look for rabbits, dissecting sets, dissecting trays and models of the alimentary canal of man in advance.
- Obtain wall charts on structure of the alimentary canal of man.

Teaching Aids

- Live rabbit, dissecting sets and models of the human alimentary canal.
- Video link: https https://www.youtube.com/ZeUlh9Cou38
- Diagram Fig 7.14 in Student's Book.

Improvisation: You may come up with your own painted diagrams of the human alimentary canal.

Pre-requisite to the lesson:

Learners should know that human alimentary canal is divided into several sections, namely: mouth, stomach, duodenum, ileum, colon and rectum. Students are going to know the functions of each part of the alimentary canal.

Teaching/Learning activities

Activity 7.5 (Refer to Student's Book.)

- Begin this activity by dissecting the rabbit.

- You can then play the video: https://www.youtube.com/v7SjOROTRag
- Guide learners to describe what they have seen. Ask probing questions such as:
  - Which part of the alimentary canal is the longest? ***Ans:*** The small intestine

  Name the blood vessel that joins the small intestine to the liver. ***Ans:*** Hepatic portal vein
- Let learners come up with summary notes on human alimentary canal and its functions.

Synthesis

This lesson should create awareness of the structure of the alimentary canal. Learners, through the practical activity and watching the video, should appreciate the relationship between structure of different parts of the alimentary canal and their functions.

Lesson assessment

1. What is the difference between physical and chemical digestion?

   Ans: Physical digestion breaks down food into smaller pieces without changing chemical composition while chemical digestion breaks down food into smaller parts which are chemically different.

2. What is the function of the tongue during digestion?

   Ans: The tongue turns food from one side of the mouth to another during mastication and pushes to the back of the mouth the food which is ready for swallowing.

3. Explain the movement of bolus along the oesophagus.

   Ans: When the bolus is pushed to the back of the mouth, it enters the oesophagus and moves automatically downward towards the stomach.

4. What happens to the food when it enters the stomach?

   Ans: Food in the stomach is churned and mixed with gastric juice. The hormone contains pepsin enzyme which digests proteins to peptides. After churning bolus is changed into chyme which is pushed into the duodenum.

5. Name the enzyme which activates trypsinogen to active trypsin.

   Ans: Enterokinase enzyme

6. Which food types are digested in the duodenum?

Food digested	Enzyme	End product
Starch	Pancreatic amylase	Glucose
Lipids	Lipase	Fatty acids and Glycerol
Proteins	Trypsin	Peptides
Peptides	Peptidase	Amino acids

7.4 Digestion in the ileum and large intestine

Lesson 5: Digestion in the ileum and colon. *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Describe the structure of the ileum and the villus.
- Explain digestion and absorption of food in the ileum.
- Explain absorption of water and mineral salts in the colon.

Preparation for the lesson

- This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
- Look for rabbits, dissecting sets, dissecting trays, and models of the alimentary canal of man in advance.
- Obtain wall charts on structure of the alimentary canal of man.

Teaching Aids

- Live rabbit, dissecting sets and models of human alimentary canal
- Video
- The diagram in Fig on 7.20 in Student's Book

Improvisation: You may come up with your own painted diagram of the villus.

Pre-requisite to the lesson:

Learners should know that the ileum is modified for absorption by having many folds and villi to increase the surface area. Students are going to know how the ileum and the colon work.

Teaching/Learning activities

Activity 7.7 (Refer to Student's Book.)

- Begin this activity by opening appropriate web videos where you will get animations about absorption of digested food in the ileum.
- Guide learners to describe what they have seen. Ask probing questions such as:

- Which part of the alimentary canal is modified for absorbing digested food? ***Ans:*** The small intestine
- What is the main function of the colon? ***Ans:*** It absorbs mineral salts and water.

Let learners come up with summary notes on absorption and assimilation.

Synthesis

This lesson should create awareness of the structures of the alimentary canal which are involved in absorption of digested food, water and mineral salts. Learners, through watching the videos, should appreciate the relationship between absorption and assimilation.

Lesson assessment

1. Give the different parts of the alimentary canal which are involved in absorption.

   Ans: The ileum absorbs digested food while the colon absorbs water and mineral salts and provides medium for bacteria which manufactures additional vitamin K.

2. What is the difference between absorption and assimilation?

   Ans: Absorption is the movement of digested food from the ileum into the blood stream while assimilation is the process of turning absorbed food into body tissues and energy.

3. Outline the modifications of the ileum that makes it suitable to absorb digested food.

   Ans (i) It's very long and highly folded.

   (ii) It has structures called villi which increase surface area for absorption.

4. Which organism has bacteria in the caecum that produces an enzyme called cellulase?

   Ans: All herbivores which feed on plants that contain cellulose.

5. What causes a disease called appendicitis?

   Ans: It's caused by food that enters the appendix and fails to come out.

7.5 and 7.6 Digestive disorders and Health practices for the digestive system

Refer to Student's Book

Lesson 6: Digestive disorders and health practices for digestive system *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Explain digestive disorders and their causes.
- Know how to maintain good health of the alimentary canal.
- Explain absorption of water and mineral salts in the colon.

Preparation for the lesson

- This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson.

Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

- Look for the website www.health.state.mn.us.
- Obtain wall charts on hygiene of alimentary canal.

Teaching Aids

- Charts illustrating various methods of hygiene
- Video link: https://www.youtube.com/1jRJSGoKS2E

Improvisation: You may come up with your own painted diagram of various methods of hygiene.

Pre-requite to the lesson:

Learners should know some common disorders that can result from poor feeding. Then they should also understand ways of maintaining hygiene.

Teaching/Learning activities

Activity 7.8 and 7.9 (Refer to Student's Book.)

- Begin this activity by opening appropriate web videos where you will get animations about healthy practices.
- You can then play the video: https://www.youtube.com/oLTGhs1qToU
- Guide learners to describe what they have seen. Ask probing questions such as:

What is a digestive disorder?

Ans: It's a disease in the digestive tract.

- Give three health practices that can reduce digestive disorders. ***Ans***: Eating high fibre food to increase speed of food movement in the digestive tract. Then eating small amounts of food on regular basis. Lastly, maintain a regular schedule for defecations.

Let learners come up with notes on digestive disorders and health practices of the alimentary canal.

Synthesis

This lesson should help learners to understand the causes of digestive disorders and healthy practices.

Answers for activity 7.6

1. This is because the optimum temperature for this enzyme to work properly ranges between 32°C and 37°C.

2. Its PH is between 6.5 to 7 because it works better in neutral medium.

Lesson assessment

1. Name two digestive disorders which are common in Rwanda.

   Ans: Constipation and diarrhoea

2. Explain why people should eat food with high fibre content.

   Ans: To increase the speed of food movement in alimentary canal so as to avoid constipation.

3. Give three practices that can cause food poisoning.

   Ans: (a) Poor personal hygiene

   (b) Improper handling of food and poor storage systems

   (c) Contamination with insecticides

4. What is ORS?

   Ans: Oral rehydration salts

Answers to Self-evaluation Test 7.1

Refer to Student's Book.

1. This is a type of nutrition in which animals obtain ready made foods from their environment.

2.
   - Store bread in a dark place at room temperature.
   - Prevent your bread from becoming moist.
   - Consider freezing your bread. Add ingredients that contain oil to bread made at home.

3.
   - Parasite
   - Saprophyte
   - Autotroph
   - Symbiosis

4.
   - Use of pesticides
   - Deworming the livestock

Answers to Self-evaluation Test 7.2

Refer to Student's Book.

1. (a) Enamel

   (b) Phosphorus, iron, potassium, calcium, vitamin A,B,D and E

   (c) Plaque is made up of bacteria and saliva. When plaque get in between the teeth, the bacteria feed on sugary substances in

food left between teeth. As a result, an acid is formed as a byproduct of this process. This acid slowly dissolves and corrodes part of the enamel.This results into formation of cavity.

2. Teeth mechanically break down food into smaller particles that can further be divided into finer particles by the enzymes.

Answers to Self-evaluation Test 7.3

Refer to Student's Book.

1. (a) Digestion is the process of breaking down food by mechanical and enzymatic action in the alimentary canal into substances that can be used by the body.

   (b)
   - It kills bacteria that may be present in food. In this way, it helps to protect the body against some bacterial infections.
   - It changes the inactive pepsinogen to active pepsin.
   - It provides the optimum pH for the enzyme pepsin to be most active.
   - C Pepsin-it's an enzyme which catalyses the breakdown of protein into smaller peptides through hydrolysis.
   - Rennin- it's function is to make liquid milk to curdle.

2. D

3. a) Peristalsis

   b) Contraction of muscles, Relaxation of muscles

   c) Circular muscle, thick-walled muscle

   d) This allows for mixing of food therefore the process of digestion continues.

Answers to Self-evaluation Test 7.4

Refer to Student's Book.

1. D
2. C
3. E

Answers to Self-evaluation Test 7.5

Refer to Student's Book.

1. Healthy eating means eating a variety of foods that give you the nutrients you need to maintain your health, feel good and have energy. These nutrients include protein, carbohydrates, fat, water, vitamins, and minerals.

2.
   - Consuming food from approved sources.
   - Proper handling, preparing and storing of food.
   - Good personal hygiene habits.
   - Using properly cleaned and sanitised eating and cooking utensils and equipments.

Summary of the unit

This unit deals with heterotrophic nutrition. It covers forms of heterotrophic, proper care of the teeth, types and functions of human teeth, the process of digestion, absorption and assimilation. There are four types of teeth. The chisel-shaped incisors are used for biting; the pointed canines for tearing and flattened, ridged premolars are used for grinding and crushing food. The digestive system begins at the mouth. The teeth break up food by mechanical means, increasing the surface area available for the action of the digestive enzymes. The alimentary canal is adapted in different ways for digestion to take place.

You should therefore effectively use the practical activities and the suggested teaching approaches in the teachers' book to guide learners to acquire knowledge and desired competences in these areas. At the end of the lessons, you should assess the extent to which the competences have been achieved and attitude change towards the topic. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well.

Additional information for the teacher

Some information that you may find relevant in this topic is given below.

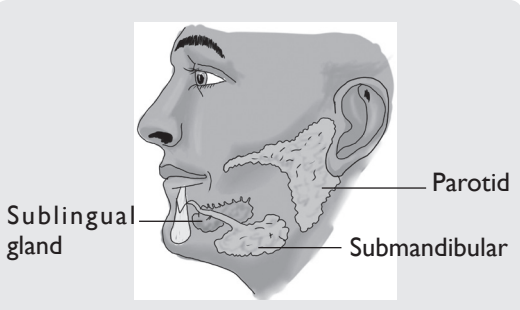
Saliva and salivary glands

Saliva functions initially in the digestive system to moisten and soften food into the formation of a bolus. The bolus is further helped by the lubrication provided by the saliva in its passage from the mouth into the oesophagus. Also of importance is the presence in saliva of the digestive enzymes amylase and lipase. Amylase starts to work on the starch in carbohydrates, breaking it down into the simple sugars of maltose and dextrose that can be further broken down in the small intestine. Saliva in the mouth can account for 30% of this initial starch digestion.

As well as its role in supplying digestive enzymes, saliva has a cleansing action for the teeth and mouth. It also has

an immunological role in supplying antibodies to the system, such as immunoglobulin A. This is seen to be key in preventing infections of the salivary glands, importantly that of parotitis.

There are three pairs of main salivary glands all of which mainly serve the digestive process and also play an important role in the maintenance of dental health and general mouth lubrication, without which speech would be impossible. The main glands are all exocrine glands, secreting via ducts. All of these glands terminate in the mouth. The largest of these are the parotid glands – their secretion is mainly serous. The next pair is underneath the jaw, the submandibular glands. These produce both serous fluid and mucus. The serous fluid is produced by serous glands in these salivary glands which also produce lingual lipase. They produce about 70% of the oral cavity saliva. The third pair is the sublingual glands located underneath the tongue and their secretion is mainly mucous with a small percentage of saliva.



Answers to end unit assessment 7.

(Refer to Student's Book.)

1. C

2. D

3.

B	**R**	O	S	E	A	T	**C**	**R**	**O**	**W**
A	**A**	G	S	B	H	I	N	D	I	B
N	**B**	N	**G**	**I**	**N**	**G**	**E**	**R**	C	L
Y	**B**	A	N	H	B	E	**C**	**O**	**W**	F
A	**I**	M	U	S	H	R	O	O	**M**	**F**
N	**T**	G	B	E	R	M	W	F	**I**	**O**
E	**L**	**E**	**P**	**H**	**A**	**N**	**T**	S	**C**	**X**
T	S	A	E	Y	N	P	H	**B**	**E**	**E**
C	**A**	**R**	**R**	**O**	**T**	U	L	S	I	X

Autotrophs		Heterotrophs
Carrot	Carnivorous	crow, fox, tiger, mice
Rose		
Ginger	Omnivorous	Banyan, mushroom
	herbivorous	cow, elephant, bee, rabbit, mice

4. True

True

True

False

5. a) Check Fig 7.13 Student's Book.

b. i. Liver

ii. stomach

iii. pancreas

iv. liver

6.

Column A	Column B
Rectum	Faeces
Gall bladder	Bile juice
Stomach	Mucus
Tongue	Taste buds
Small intestine	Villi

7. The colour changes from brown to blue black. This is because rice has starch whether raw or boiled. Starch changes colour to blue black on addition of iodine.

8. Hard surface. The teeth have hard surface because the crown of the teeth are covered by the tooth enamel.

   The sensory nerves fibre that have nerve endings that makes the tooth sensitive to temperature and pain.

   Different types of teeth have different shapes which are which are adapted to different functions. Incisors have the sharpest edges that makes them good for cutting. Molars have large and broad surface which makes them efficient for grinding.

9. a) A= Enamel

B= Dentone

C= Nerves

D= Blood vessels

   b) Molar. Because of the broad surface

   c) Bacteria

   d) Tooth decay may lead to persistent pain, which affects

   one's appetite, studies, work, sleep, or even general health. When there is severe tooth decay, the bacteria may spread from the pulp to the surrounding periodontal tissues via the apex of the tooth, leading to inflammation or even the formation of dental abscess.

10. Periodontal membrane that allows the tooth to move slowly to avoid breaking during chewing.

Name of enzyme	Gland secreting enzyme	Substrate	Products	Optimum pH
Amylase	Salivary glands	Starch	Maltose	neutral
HCl	Gastric gland	Protein	Amino acid	acidic
Lipase	Pancreas	Triglyceride (Lipid)	Glycerol and fatty acids	Basic

11. It kills bacteria that may be present in food. In this way, it helps to protect the body against some bacterial infections.

    Its pH is between 1 and 2.5. This is the optimum pH for the enzyme pepsin to be most active.

12. Egestion is the process of voiding or discharging undigested food as faeces. Excretion is the process of eliminating or expelling metabolic waste.

13. a) A = epithetion

    B = Blood capillaries

    C= Lacteal

    b) Small intestine

    c) The villi are many in number therefore increasing the surface area for digestion.

    The villi have numerous blood capillaries which aid in absorption of large amount of food materials.

14. a) Boys need protein to optimise growth, development and muscle mass.

    b) Women need more iron than men to make up for the amount of iron they lose in their menstrual period.

14. c) In case the woman has problem in bones or teeth.

15. Food contamination can be caused by:

- Chemicals such as pesticides, certain cleaning compounds and sometimes by use of improper containers for cooking or storing food.
- Improper handling, preparing and storing of food.
- Poor personal hygiene habits.
- Improperly cleaned and sanitized eating and cooking utensils and equipment.
- Contamination of food, utensils and equipment from flies, roaches and other insects and pests.
- Use of foods from unapproved sources.

16. a) i, ii and iii Refer to the content under forms of heterotrophic nutrition

b) i. Pancreas

ii. Amylase catalyze the breakdown of starch into maltose.

iii. At $0^{o}C$ will be inactive, around $37^{0}C$ will be working effectively because of optimum temperature then above $37^{0}C$ to $60^{0}C$ will be denatured.

c) there must be broken down into small particles in order to be absorbed in the wall of small intestine.

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Draw and name human digestive system. 2. Using charts and pictures, name the different parts of the alimentary canal.	1. Do further research in textbooks or the internet about digestive system and health practices for digestive system. 2. Using plasticine, model the digestive system of human beings and label the various parts. 3. Come up with the simple available items that can be used in cleaning teeth.

Remedial questions for slow learners	Extended questions for gifted learners
1. List forms of heterotrophic nutrition. 2. What is digestion? 3. Name four types of teeth.	1. What are some of the evolutionary advantages among animals with a complete digestive tract? 2. Which organs of the body are part of the human digestive system? 3. What are peristaltic movements? What is their role in human digestion?
Answers to remedial questions for slow learners	**Answers to extended questions for gift learners**
1. Holozoic, saprophytic, symbiotic and parasitic 2. The process of breaking down food by mechanical and enzymatic action in the alimentary canal into substances that can be used by the body. 3. Incisors, canines, molars and premolars	1. A complete digestive tract allows animals to continuously feed without waiting for waste to be eliminated before beginning to digest new foods. In this way, the absorption of larger amounts of nutrients is possible and therefore bigger and more complex species can develop. Digestive tracts with two openings also make digestion more efficient, since they provide different sites with different physical and chemical conditions (mouth, stomach, bowels) for the action of different complementary digestive enzyme systems. 2. The digestive system, also known as the gastrointestinal system, is composed of the digestive tract organs plus the digestive adnexal glands. The digestive tract is composed of the mouth, pharynx, oesophagus, stomach, small intestine (duodenum, jejunum, ileum), large intestine (caecum, colon, rectum) and anus.
	3. Peristalsis is the process of synchronized contractions of the muscular wall of the digestive tract. Peristaltic movements may occur starting at the oesophagus up until and including the bowels. Peristaltic movements are involuntary and they have the function of moving and mixing food along the digestive tube. Peristaltic movement deficiency can lead to the interruption of food traffic inside the bowels, leading to severe clinical consequences such as megacolon (abnormal enlargement of the colon) and megaesophagus (enlargement of the esophagus).

UNIT 8 Circulatory system in humans

Key unit competency

After studying this unit, the learner should be able to describe the circulatory system in man.

Learning objectives

Table 8.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should: • Define the circulatory system as a system of blood, vessels, and the heart. • Describe single and double circulation and give the differences between the two. • Describe the structure of a mammalian heart and movement of blood. • Understand the function of ECG and pulse rate. • Describe heart diseases. • Describe the structure of blood vessels and their functions. • List and state the functions of the components of blood. • State the roles of blood clotting. • Describe the lymphatic system and its function.	By the end of this unit, learners should: • Apply to explain how valves work during blood flow. • Compare relative thickness of left and right ventricle and relate the structure of the blood vessels to their functions. • Demonstrate the effect of physical activity on the pulse rate. • Compare the components of blood as seen under light microscope, micrographs and charts.	By the end of this unit, learners should: • Appreciate importance of having transport system. • Accept possible risk factors such as diet, stress, smoking, age and gender in relation to cardio vascular diseases. • Adopt a culture of maintaining physical fitness and health.

Pre-requisites of this unit

Learners have learnt about all circulatory systems in humans in senior 1 and senior 2. Review the topic by reminding the learners about what a circulatory system entails. Mention the types of circulatory system with examples. Prepare learners psychologically to know this unit gives details of the two types of circulation they learnt in senior 1 and senior 2.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to Entrepreneurship, Economics, Agriculture, Physical education and Medicine. The link comes in when you consider the price of medicine taken due to sickness from heart diseases and the money spent on buying food for a balanced diet.

Background information

The requirements of animals to sustain life must be removed from one part of the body to another. Nutrients, oxygen, hormones, antibodies, etc must be transported to cells while waste products must be eliminated from cells and transported to the outside. At the end homeostasis is also maintained.

Small organisms like hydra, amoeba, planaria do not need a transport system. Transporting material in them is accomplished by simple diffusion, active transport and osmosis. In bigger organisms like animals, there is a need for a transport system because the surface area to volume ratio is very low whereas in small animals it's very high. The transport systems are the circulatory systems.

Cross-cutting issues to be addressed

1. ***Standardisation culture***

Bring to the attention of learners the need to seek medical healthcare in standard and quality hospitals whenever they have problems with their circulatory systems.

2. ***Financial education***

Emphasise the fact that learners should practise a lot of physical exercise and take a balanced diet to avoid conditions and diseases of heart and circulatory system in general in order to avoid spending money on treatment.

3. ***Gender education***

Emphasise to learners that anybody irrespective of their gender can pursue a career in medicine. Give examples of role models who are successful chest specialists in the area where the learners come from.

4. ***Inclusive education***

All learners should be encouraged to participate during lessons and practicals.

Special arrangement should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs and as they engage in group work and as they observe the parts of the alimentary canal of man and deliberate on its importance and functions of its various parts.

2. ***Research skills***

Guide learners on how to find information regarding the diseases of the circulatory system to bring out this competence in learners.

3. ***Communication in English***

Group work and presentation tasks such as those in activities 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9 and 8.10 should be used to inculcate this competence.

4. ***Critical thinking***

This competence will be developed by learners answering the probing questions such as those in Activities: 8.7, 8.8 and 8.9 and as they discuss the results of the practical activity in their book. Guide learners to discover for themselves the different parts of the heart in activity 8.3. This competence will also come about as learners think about their findings in other activities and as they give out their suggestions.

5. ***Lifelong skills***

Practising hygiene of the circulatory system in general creates the habit of taking care of oneself. Learners can also pass this habit to others through training. Also make learners aware that they can become medical practitioners if they take this topic seriously.

Key words in this unit and their meanings:

Double circulation: It's the type of circulation where blood passes through the heart twice before going back to the body.

Single circulation: It's the type of circulation where blood passes through the heart once before going back to the body.

Coronary heart disease: (CHD), also known as ischemic heart disease (IHD), is a group of diseases that includes sudden coronary death.

Lymphatic system: This is part of the

circulatory system made of lymphatic vessels that carry a clear fluid called lymph towards the heart.

Closed circulatory system: It's the type of circulation in which blood does not come in contact with other tissues.

Open circulatory system: It's the type of circulation in which blood comes in contact with other tissues.

Haemocoel: It's a space through which blood passes when it leaves the heart in most of the invertebrates.

Ostia: It's an opening in the heart of arthropods through which blood returns to heart from the haemocoel.

Pulmonary circulation: It's the part of the circulatory system which carries deoxygenated blood away from the heart, to the lungs, and returns oxygenated (oxygen-rich) blood back to the heart.

Systemic circulation: It's the circulation that supplies blood to the rest of the body except to the lungs.

Pericardium: It's a membrane that surrounds the heart.

Septum: It's a tissue which separates the right side of the heart from the left side.

Atrioventricular valves: These are the valves that allow blood to flow from atria to ventricles.

Tricuspid: It's the atrioventricular valve that allows blood to flow from the right atrium to right ventricle and stops the back flow of blood into the right atrium.

Bicuspid: It's the atrioventricular valve that allows blood to flow from the left atrium to the left ventricle and stops the back flow of blood into the left atrium.

Semi lunar valve: It's a valve that allows blood to flow into the aorta and stops the backflow of blood into the left ventricle.

Diastole: It's a time during which the heart chambers relax.

Systole: It's the time during which the heart chambers contract.

Sphygmomanometer: This is the instrument that measures arterial pressure.

Endothelium: Is the inner lining of the circulatory system especially the blood vessels.

Pulse: This is the heartbeat, rhythmic expansion and contraction of the heart.

Embolism: This is the lodging of an embolus, which may be a blood clot, fat globule, gas bubble or foreign material in the bloodstream.

Stroke: This is when poor blood flow to the brain results in cell death.

Venules: These are small veins that join the capillaries.

Arterioles: These are small arteries that join the capillaries.

Serum: It's blood without fibrinogen.

Fibrinogen: It's a blood protein responsible for blood clotting.

Plasma: It's the colourless watery fluid of blood and lymph containing no cells and in which erythrocytes and leukocytes and platelets are suspended.

Erythrocytes: Red blood cells

Leukocytes: White blood cells

Thrombocytes: These are cells commonly called platelets responsible for blood clotting.

Lymphocytes: This is a type of white blood cells is responsible for the immunity of the body.

Antigen: This is any substance that causes an immune system to produce antibodies against it.

Blood type (also called blood group): This is a classification of blood based on the presence or absence of antigens on the surface of red blood cells.

Agglutination: It's the sticking together of blood components.

Blood transfusion: It's the transfer of blood from one person to another.

Donor: Is a person who donates his or her blood willingly.

Recipient: Is a person who receives donated blood.

Universal donor: Is a person who can donate blood to people of different blood groups.

Universal recipient: Is a person who can receive blood from all donors.

Thrombus: Or blood clot, is the final product of the blood coagulation.

Guidance on the problem statement

This topic is about the circulatory system of vertebrate animals especially man and its functions in the body. As a way of introducing the concept of circulatory system, refer learners to diagrams in their book. **Important:** You may need to link this topic to that of respiration for learners to understand it better. The diagrams are meant to introduce the learner to the picture of circulatory organs and tissues. Students have to observe the structure and arrangement of blood vessels. Let learners discuss the diagrams in groups (the number per group should depend on the size of the class and abilities of learners). Ask them probing questions such as:

- What are the major differences between the three blood vessels?

- How many chambers does the human heart have?

Based on the answers to the questions above, guide learners into discovering what they will learn in this unit. Further, emphasise the need for taking this topic seriously in the course of the lessons as it can lead to careers such as nursing, medicine among other courses.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts of the heart and blood vessels and explain their functions. • Gifted learners can be performing the actions during practical activities as slow ones make observations and take notes. For example, in activity 8.3. • Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. • Ensure all learners respect other's views irrespective of their shortcomings or talents.	• Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols and sign language interpreters for the deaf. • Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1.	Introduction and types of circulatory systems	2
2.	Circulatory system of man and functioning of the heart and blood vessels	4
3.	Heart rate, coronary heart diseases, benefits of balanced diet and exercises	2
4.	Components of blood and blood groups	3
5.	Lymphatic system	1

8.0 Circulatory system in humans

Lesson 1: Introduction and types of circulation *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Explain what the circulatory system is.
- Describe different types of circulatory systems.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Look for the models and diagrams of different types of circulatory systems in advance.

Teaching Aids

- Charts of circulatory systems, textbooks, pamphlets and handouts
- Video link: https https://www.youtube.com/HZ9Et5TyJXM
- The diagrams in Senior 3 Student's Book

Improvisation: You may come up with your own painted diagrams of mentioned circulatory systems drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

Learners should know that there are 2 types of circulatory systems. Students are going to know that in some cases blood comes in contact with the tissues while in others it's enclosed.

Teaching/Learning activities

- Ask probing questions such as: What is the main difference between an open circulatory system and a closed one?

  Ans: The main difference is that in open circulatory system blood come in contact with the cells whereas in closed circulatory system it does not.

- Why don't single celled organisms need a circulatory system as the multicellular organisms?

  Ans: Unicellular organisms have a large surface area to volume ratio which enables them to get nutrients and oxygen more easily.

Activity 8.1 and 8.2 (Refer to Student's Book.)

- Arrange the learners for the above activity to be done. Supervise as they do.

- You can then play the video: https://www.youtube.com/HZ9Et5TyJXM
- Give the summary by using the outlined points on Students' Book.

Synthesis

This lesson should create awareness of the different types of circulatory systems. Learners through watching the video appreciate the relationship between blood and tissue.

Lesson assessment

1. Give the two types of circulatory systems.

   Ans: Open and closed circulatory systems

2. What is the major functional difference between the open and closed circulatory system?

   Ans: The direction of bloodflow in open circulatory system is not well defined and in closed circulatory system the bloodflow is well defined.

3. What is Haemocoel?

   Ans: It is the space through which blood flows when it leaves the heart in most invertebrates.

4. Name three organisms with open circulatory system and three with a closed circulatory system.

   Ans: Most of the invertebrates such as insects, worms and some molluscs have an open circulatory system. All vertebrates such as fish, snakes and human beings have a closed circulatory system.

Lesson 2: Human circulatory system *(To be covered in four periods)*

Refer to Student's Book.

Specific objectives

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

- Describe the circulatory system of man.
- Explain how the heart functions.
- Outline different types of blood vessels and their functions.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Look for the models and diagrams of the heart and blood vessels in advance.

Teaching Aids

- Charts of human heart and blood vessels, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/CjNKbL_-cwA
- Senior 3 Student's Book

Improvisation: You may come up with your own painted diagrams of the human heart and blood vessels drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

Learners should know that the circulatory system of man is made up of heart, blood vessels and blood. Students are going to know that the closed circulatory system is formed by two systems which are single and double circulatory systems.

Teaching/Learning activities

- Ask probing questions such as:
  - On which chamber of the heart is the aorta attached?

  Ans: Left ventricle

  How many blood vessels are found in the heart?

  Ans: There are three types: Artery capillaries and veins

  Activity 8.3 (Refer to Student's Book.)

- Guide and supervise as learners carry out the above activity.
- You can then play the video: https://www.youtube.com/_qmNCJxpsr0. Let learners present their findings in class. Lead in discussing their findings.
- Based on their findings, use the outlined points on students book to clarify more. Let learners take notes as you discuss.
- Finalise this by giving learners time to do Self-evaluation Test 8.2 in Students Book.

Synthesis

This lesson should create awareness of the different types of blood vessels and the basic structure of the human heart. Learners through watching the video appreciate the circulatory system of man

Lesson assessment

1. How many chambers does a human heart have?

   Ans: Four chambers which are right and left atrium and right and left ventricle

2. Write the three types of blood vessels.

   Ans: The three types are: Artery, vein and capillary

3. Outline the structural and functional differences between the three types of blood vessels.

Ans:

Structure	Artery	Capillary	Vein
Fibrous layer	Present and thick	Absent	Present and thin
Muscular layer	Present	Absent	Present
Elastic layer	Present	Absent	Present
Endothelium	Present	Present	Present
Valves	None	None	Present
Functional differences:			
	Transports oxygenated blood from heart except pulmonary artery.	Site of exchange of nutrients with waste products and oxygen with carbon dioxide.	Transports de-oxygenated blood to heart except pulmonary vein.
	Can manage high blood pressure.	Can manage high blood pressure.	Can manage high blood pressure.
	Blood moves at high speed.	Blood moves at low speed.	Blood moves at low speed.

4. What is the function of valves?

Ans: The function of valves in the circulatory system is to prevent backflow of blood especially when blood pressure is lowered as in the case of veins.

Lesson 3: Coronary heart diseases and blood vessels *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Explain the heart rate of man.
- Explain the effect of exercises on the rate of a human heart.
- Describe the coronary heart diseases.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Look for the models and diagrams of the heart and blood vessels in advance.

Teaching Aids

- Charts of human heart and blood vessels, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/CIvA71cQJmQ
- Senior 3 Student's Book

Improvisation: You may come up with your own painted diagrams of the human heart and blood vessels drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

Learners should know that heart rate can be affected by a number of factors such as age, sex, health status and coronary heart diseases. Students are going to know that poor diet and lack of exercise are the major cause of heart diseases.

Teaching/Learning activities

- Ask probing questions such as:

  How many heartbeats did you count in a minute when sited?

  Ans: 75 beats.

  What are the major causes of coronary heart disease?

  Ans: Lack of exercises and eating unbalanced diet

Activity 8.6 (Refer to Student's Book.)

Activity 8.7 (Refer to Student's Book.)

Activity 8.8 (Refer to Student's Book.)

- Guide and supervise learners as they carry out the above activities.
- You can then play the video : https://www.youtube.com/_qmNCJxpsr0 Let learners present their findings in class. Lead in discussing their findings.
- Based on their findings, use the outlined points in students' book to clarify more. Let learners take notes as you discuss.
- Finalise this by giving learners time to do Self-evaluation Test 8.3 in Student's Book.

Synthesis

This lesson should create awareness of the different types of heart diseases and how they are caused. Learners through watching the video appreciate the effect of poor diet and lack of exercise on coronary heart diseases.

Lesson assessment

1. What is a coronary heart disease?

   Ans: This is a disease in which a waxy substance called plaque builds up inside the coronary artery.

2. What activities can affect the heart rate?

   Ans: (i) Exercises

   (ii) Smoking

   (iii) Coronary heart diseases

3. Outline some coronary heart diseases.

   Ans:
   - Arteriosclerosis
   - Thrombosis
   - Atherosclerosis

Lesson 4: Components of blood and blood groups *(To be covered in three periods)*

Refer to Student's Book.

Specific objectives

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

- Describe the composition of blood.
- Explain the function of different components of blood.
- Explain the four blood groups and rhesus factor.
- Explain how blood transfusion is done.
- Preparation for the lesson.
- This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson.

  Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
- Look for the models and diagrams of the blood cells in advance.

Teaching Aids.

- Charts of blood cells and plasma, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/noMsCGRkwSE
- Senior 3 Student's Book

Improvisation: You may come up with your own painted diagrams of the human blood cells drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson

Learners should know that blood is composed of different components. They must know the functions of the different components. Students will learn why transfusion of blood must be done with care to avoid killing people. They should also realise the importance of Rhesus factor in blood transfusion.

Teaching/Learning activities

Activity 8.9 (Refer to Student's Book.)

Activity 8.10 (Refer to Student's Book.)

- Guide and supervise as learners carry out the above activities.

- You can then play the video: https://www.youtube.com/noMsCGRkwSE. Let learners present their findings in class. Lead in discussing their findings.
- Guide learners to describe what they have found. Ask probing questions such as:
  - How many types of cells have you noted?

    Ans: Three types which are red blood cells, white blood cells and platelets.
  - What is rhesus factor?

    Ans: It's an inherited antigen on the surface of red blood cells.
  - What are the major precautions taken when going to carry out blood transfusion?

Ans. The blood groups of the donor and the recipient must be known. Then also rhesus factors of both must match.

Another important precaution is checking blood of the donor if its free of HIV and Hepatitis.

- Based on their findings, use the outlined points on students' book page 140 to 146 to clarify more. Let learners take notes as you discuss.
- Finalise this by giving learners time to do Self-evaluation Test 8.5 in Student's Book.

Synthesis

This lesson should create awareness of the different types of blood components and the care that must be taken during blood transfusion. Learners through watching the video understand how safe blood transfusion is done.

Lesson assessment

1. What are the components of blood?

   Ans: Red blood cells, white blood cells, platelets, plasma

2. Outline the function of Red blood cells, white blood cells and platelets.

   Ans: Red blood cells carry oxygen from lungs to tissues.

   White blood cells protect the body by removing the antigens that can cause diseases.

   Platelets make blood to clot when a blood vessel is punctured so that bloodflow stops.

3. What is blood transfusion?

   Ans: It's the transfer of blood from one person (the donor) to another called the recipient.

Lesson 5: Lymphatic system *(To be covered in one period)*

Refer to Student's Book .

Specific objectives

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

- Describe the lymphatic system.
- Explain the function of different components of lymph.

Preparation for the lesson

1. This lesson will involve individual work and practical work in groups. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Look for the models and diagrams of lymphatic system in advance.

Teaching Aids

- Charts of lymphatic system, textbooks, pamphlets and handouts
- Video link: https://www.youtube.com/I7orwMgTQ5I
- The diagrams in Senior 3 Student's Book

Improvisation: You may come up with your own painted diagrams of the lymphatic system drawn on Manila paper in case your school does not have the charts.

Pre-requisite to the lesson:

Learners should know that lymph is composed of different components. They must know the functions of the different components especially in relation to the immune system. Students will learn how lymph is formed in capillary beds and how it is transported.

Teaching/Learning activities

Ask probing questions such as:

- Where does lymph come from? **Ans**: It comes from blood.
- What is the name of vessels in which lymph fluid is carried?

  Ans: Lymphatic vessels

  Activity 8.12 (Refer to Student's Book.)

- Guide and supervise learners as they carry out the above activity.
- You can then play the video: https://www.youtube.com/I7orwMgTQ5I Let learners present their findings in class. Lead in discussing their findings.
- Based on their findings, use the outlined points in students' book to clarify more. Let learners take notes as you discuss.
- Finalise this by giving learners time to do Self-evaluation Test 8.7 on Student's Book.

Synthesis

This lesson should create awareness of the formation of lymph and its importance in the immune system. Learners through watching the video understand how lymph moves in the body and returns to the main circulatory system.

Lesson assessment.

1. What is lymph?

   Ans: Lymph is the fluid that circulates throughout the lymphatic system. The lymph is formed as interstitial fluid from blood capillaries.

2. Compare lymph and blood.

   Ans:

Blood	Lymph
All blood cells present.	Only white blood cells are present.
It's found in blood vessels only.	It's found in both blood vessels and lymphatic vessels.
It's red in colour.	It's yellow in colour.

3. Outline the organs which are part of the lymphatic system.

   Ans: - Thymus gland
   - Spleen
   - Lymph nodes

Answers to Self-evaluation Test 8.1

Refer to Student's Book.

1. Cell to cell diffusion
2. Blood aids in transport of nutrients and oxygen to all cells and removal of carbon dioxide and other wastes. It aids in transport of hormones too.
3. This is because they have a small body cavity that is useful in transportation of oxygen.

Answers to Self-evaluation Test 8.2

Refer to Student's Book.

1. To transport blood through the blood vessels delivering nutrients and oxygen to all body cells.
2. In double circulatory system the blood passes through the heart twice before completing a full circuit, while in single circulatory system, the blood passes only once through the heart for each complete circuit of the body.
3. The left ventricle. It pumps blood to the whole of the body except lungs.
4. B

Answers to Self-evaluation Test 8.3

Refer to Student's Book.

1. Yes, genes can pass on the risk of cardiovascular disease.
2. This is because of the anxiety that triggers the heart to beat faster.

3. Exercise and other physical activities produce endorphins — chemicals in the brain that act as natural painkillers.

Answers to Self-evaluation Test 8.4

Refer to Student's Book.

1. Pulmonary vein, aorta
2. Endothelium
3. Valves, larger lumen

Answers to Self-evaluation Test 8.5

Refer to Student's Book.

1. B
2. True, true, false, true
3. Bone marrow, oxygen and carbon (IV) oxide
4. i) Increases the surface area for transportation of oxygen (ii) to transport oxygen (iii) to enable more haemoglobin to be packed.
5. These are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders.

6) a) Blood is flowing from wrist to the armpit.

b) In order to stop blood in veins to move upwards.

c) In this case blood flows back and can return back quickly because has low pressure.

Answers to Self-evaluation Test 8.6

Refer to Student's Book.

1. D
2. This is because some units of donor blood may not fully match the recipient's even though they have some blood type and Rh types. Before a person can get a transfusion of red blood cells, a cross–match must be done to make sure that donor blood is compatible with recipient's.
3. Universal donor – O

   Universal recipient – AB
4.

Recipient	O	A	B	AB
O	✓	✓	✓	✓
A	X	✓	X	✓
B	X	X	✓	✓
AB	X	X	X	✓

Answers to Self-evaluation Test 8.7

Refer to Student's Book.

1. D
2. A
3. B

Summary of the unit

This unit is all about circulatory system in humans. The unit describes the types of circulation, the heart, blood cells and blood vessels. You should therefore

effectively use the practical activities and the suggested teaching approaches in the teacher's book to guide learners to acquire the requisite knowledge and desired competences in these areas. Emphasise the fact that taking this unit seriously may lead to careers like being a medical doctor.

Additional information for the teacher

Symptoms of coronary heart disease

Coronary heart disease can lead to shortness of breath. If the heart and other organs are getting too little oxygen, the patient may start panting. Any exertion may be very tiring.

Heart attack, or myocardial infarction, happens when the heart muscles do not have enough blood, and therefore oxygen. The muscles die, and a heart attack occurs. This is also known as coronary thrombosis.

A heart attack commonly occurs when a blood clot develops from plaque in one of the coronary arteries. The clot, if it is big enough, can stop the supply of blood to the heart.

Symptoms of a heart attack include:

- Chest discomfort and mild pain, or a crushing chest pain
- Coughing
- Dizziness
- Shortness of breath
- Face seems gray
- An overall feeling of being unwell and a sense of terror that life is coming to an end
- Nausea and vomiting
- Restlessness
- Perspiration and clammy skin

The first symptom is normally chest pain that spreads to the neck, jaw, ears, arms, and wrists, and possibly the shoulder blades, the back and the abdomen.

Changing position, resting or lying down brings no relief. The pain is often constant, but it can come and go. It can last from a few minutes to many hours.

People with diabetes and those aged over 75 years may experience a "silent heart attack" in which there is no pain at all.

A heart attack is a medical emergency. It can result in death or permanent damage to the heart muscle.

If anyone has signs of a heart attack, it is crucial to call the emergency services immediately.

Risk factors for coronary heart disease (CHD)

The following factors increase the risk:

- As people age the risk increases.
- Men are more likely to develop

CHD, although the risk for women is still significant, especially after the menopause.

- Having a parent who developed CHD before the age of 60 years increases the risk of developing it.
- Uncontrolled hypertension, or high blood pressure, causes arteries to thicken and narrow, reducing blood flow.
- High blood cholesterol increases the chance of plaque building up, and this makes atherosclerosis more likely.
- Lack of exercise increases the risk, as does poor diet, including consumption of processed meat, trans fats and fast foods.
- Long-term emotional and mental stress have been linked with damage to arteries.
- Components of metabolic syndrome, such as diabetes type II and obesity, are linked to a higher risk of developing CHD.
- Smoking increases the risk. Tobacco can increase inflammation and cause more cholesterol to deposit in coronary arteries. A woman who smokes 20 cigarettes a day is six times more likely to develop CHD as a woman who has never smoked. Men who smoke regularly are three times more likely to develop CHD compared with men who have never smoked. Some risk factors include:
- High levels of homocysteine, an amino acid produced by the body. Studies have linked it to a higher incidence of CHD.
- High levels of fibrinogen, a blood protein involved in the blood clotting process. Excess levels may encourage the clumping of platelets, resulting in the formation of clots.

Causes of coronary heart disease

CHD is believed to start with injury or damage to the inner layer of a coronary artery.

This damage causes fatty plaque deposits to build up at the site of the injury. These deposits, or atheromas, consist of cholesterol and other cellular waste products, and the accumulation is called atherosclerosis.

If pieces break off or rupture, platelets will clump in the area, attempting to repair the blood vessel. This clump can block the artery, reducing or blocking bloodflow and leading to a heart attack.

Diagnosing coronary heart disease

A patient should be ready to explain their medical history and symptoms, and to undergo a physical examination.

A number of tests can help to diagnose CHD.

An electrocardiogram (ECG) records the electrical activity and rhythms of the heart. Electrodes are attached to the skin, and impulses are recorded as waves appear on a screen. This may also reveal any damage to the heart from a heart attack.

A Holter monitor is a portable device that the patient wears under their clothes for 2 days. It records all the electrical activity of the heart, including the heartbeats. It has a button that can be pressed if symptoms are felt. It records the heart rhythms that were present at that moment. Some abnormalities may indicate a problem with bloodflow.

An echocardiogram is an ultrasound scan that checks the pumping heart. It uses sound waves to provide a video image. It can show the percentage of blood pumped out of the patient's left ventricle, the main pumping chamber, with each heartbeat.

This is called the ejection fraction. It is crucial for determining how well the heart is pumping.

A stress test may involve the use of a treadmill or medication that stresses the heart. Imagining techniques can show whether there are any blockages in the heart arteries that could underlie heart failure.

In coronary catheterisation, a dye is injected into the heart arteries through a catheter that is threaded through an artery, often in the leg or arm, to the arteries in the heart. An x-ray then detects narrow spots or blockages revealed by the dye.

If a blockage is found, a balloon may be pushed through the catheter and inflated, to squash the clot and improve blood flow. A stent may be placed to keep the artery dilated.

CT scans can help the doctor to visualize the arteries, detect any calcium within fatty deposits that narrow coronary arteries, and to characterise other heart abnormalities.

Nuclear ventriculography uses tracers, or radioactive materials, to show the heart chambers. The material is injected into the vein. It attaches to red blood cells and passes through the heart. Special cameras or scanners trace the movement of the material.

Blood tests can measure blood cholesterol levels, especially in patients who are over 40 years old, have a family history of heart or cholesterol-related conditions, are overweight and have high blood pressure or another condition, such as an underactive thyroid gland, or any condition which may elevate blood levels of cholesterol.

Treatment options for coronary heart disease

CHD cannot be cured, but with today's technology, it can be managed effectively.

Treatment involves lifestyle changes, and possibly some medical procedures and medications.

Lifestyle recommendations include quitting smoking, eating a healthy diet, exercising regularly and minimizing stress. Excess sugar has recently been linked to a higher risk of dying from heart disease.

Medications

Statins can reduce cholesterol levels. Statins are the only medication demonstrated to have a positive impact on outcomes in CHD, but if a person has another underlying cholesterol disorder, they may not work.

Low-dose aspirin reduces blood clotting, lowering the risk of angina or a heart attack.

Beta blockers reduce blood pressure and heart rate, especially in a person who has already had a heart attack.

Nitroglycerin patches, sprays or tablets, control chest pain by reducing the heart's demand for blood by widening the coronary arteries.

Angiotensin-converting enzyme (ACE) inhibitors lower blood pressure and help to slow or stop the progression of CHD.

Calcium channel blockers widen the coronary arteries, allowing greater blood flow to the heart and reducing hypertension.

Surgery

Surgery can open or replace blocked arteries, if the blood vessels have become very narrow, or if symptoms are not responding to medications.

In percutaneous coronary revascularisation, also known as angioplasty and stent placement, a catheter is inserted into the narrowed part of the artery. A deflated balloon is passed through the catheter to the affected area.

When the balloon is inflated, it compresses the fatty deposits against the artery walls. A stent, or mesh tube, may be left in the artery to help keep it open. In some cases, the stent releases a medication.

In coronary bypass surgery, the surgeon uses a blood vessel from another part of the body to create a graft that can bypass the blocked artery. The graft may come from the leg or an inner chest-wall artery.

Laser surgery involves making several tiny holes in the heart muscle, which encourage the formation of new blood vessels.

In rare cases a heart transplant may be carried out, if the heart is badly damaged and treatment is not working.

Answers to end unit assessment 8
(Refer to Student's Book.)

1. C
2. D
3. D
4. a) Heart pumps blood to the lungs to release carbon dioxide and then oxygenate the blood. It is then pumped to the rest of the body.

   b) Arteries - Transport oxygenated blood from the heart (except in pulmonary artery which contains deoxygenated blood). Arteries have:

   - thick muscular wall
   - much elastic tissue
   - small lumen relative to diameter
   - not permeable
   - valves in pulmonary artery and aorta only
   - blood flowing under high pressure (10-16kPa)
   - blood moves in pulses
   - blood flows rapidly

   Veins transport deoxygenated blood back to the heart (except in pulmonary vein which carries oxygenated blood)

   - thin muscular wall
   - little elastic tissue
   - large lumen relative to diameter
   - not capable of constriction
   - not permeable
   - valves throughout all veins
   - blood under low pressure (1kPa)
   - no pulses
   - blood flows slowly

5. • As people age the risk increases.
   • Men are more likely to develop CHD, although the risk for women is still significant, especially after menopause.
   • Having a parent who developed CHD before the age of 60 years increases the risk of developing it.
   • Uncontrolled hypertension, or high blood pressure, causes arteries to thicken and narrow, reducing blood flow.
   • High blood cholesterol increases the chance of plaque building up, and this makes atherosclerosis more likely.
   • Lack of exercise increases the risk, as does poor diet, including consumption of processed meat, trans fats and fast foods.

- Long-term emotional and mental stress have been linked with damage to arteries.
- Components of metabolic syndrome, such as diabetes type II and obesity, are linked to a higher risk of developing CHD.
- Smoking increases the risk.

6. No, there is need to check on the Rhesus factor too.
7. Lymph, blood
8. Smoking, age, lack of exercise
9.
   - Do physical exercises regularly.
   - Do not smoke.
   - Eat foods with low or no cholestrol content.
   - Go for regular medical check ups.
   - Eat a balanced diet regularly.
10. (i) An arteriole
    ii) White blood cells
    iii) Tissue fluid
    iv) Useful substances in liquid Y get into the cell as liquid Y drains back into the blood at the venule end of the capillary where the pressure is lower.
    v) Nutrients / oxygen
    vi) There is less protein in liquid Y compared to blood plasma.
    vii) Higher pressure at the arteriole end of capillary network
    viii) Through lymphatic capillaries and other lymphatic vessels
11. (a) Exercise
    (b) 59
    (c) 7 minutes
    (d) climatisation
    (e) increases
12. i) Check on the label of x and y axis. Mark a line graph with all the units plotted.
    ii) There is more demand for oxygen than at lower elevation.
    iii) They should train at higher attitude.
13. i) Check on the label of x and y axis. Mark line graph with two distinguished lines.
    ii) Exercise hormone
    Age
    Altitude
    iii) The faster the heartbeat the more and faster pumping of blood by heart.
    v) Check their graphs.
    iv) Award marks based on explanation.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. At your free time, using charts that are hang on the wall, remind yourself more about the structure of the heart. 2. Help in collecting materials required for practicals. 3. Use Manila paper to write about coronary heart disease and stick on the class wall.	1. Do further research in textbooks or the Internet about circulatory system in humans. Prepare power point and present to the rest of the class. 2. Compare the circulatory system of humans and that of other animals, write the similarities and differences. Share with other class members.
Remedial questions for slow learners 1. Name the types of circulatory system. 2. What are blood vessels? 3. Name three blood vessels.	**Extended questions for gifted learners** 1. In what ways can technology be used to collect and analyze cardiovascular data? 2. What factors can influence heart rate?
Answers to remedial questions for slow learners 1. Closed and open 2. Blood vessels are tube like structures which form continuous channels through the body. 3. Artery, vein and capillary	**Answers to extended questions for gifted learners** 1. Technology can be used to collect and analyse cardiovascular data because there are machines such as an EKG which is a test that checks for problems with the electrical activity of your heart and there is also the echocardiogram which is a test in which ultrasound is used to examine the heart. So many types of technology provide us with the cardiovascular data to collect and analyse. 2. Age, gender, physical activity level, body temperature, diet, exercise, caffeine and other drugs, stress hormones, thyroid hormones, respiration rate, herbs, emotions, hydration level, altitude, exercise

UNIT 9 Cellular respiration

Key Unit Competence

After studying this unit, the learner should be able to compare energy yield in aerobic and anaerobic respiration.

Learning objectives

Table 9.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of the unit, the learner should be able to: • Explain that the body needs energy in form of ATP to carry out metabolic reactions. • Define cellular respiration as the process by which energy in food is converted into the energy for an organism to do biological work.	By the end of the unit, the learner should be able to: • Explain that the body needs energy in form of ATP to carry out metabolic reactions. • Define cellular respiration as the process by which energy in food is converted into the energy for an organism to do biological work.	By the end of the unit, the learner should be able to: • Recognise that the accumulation of lactic acid in active muscles during vigorous exercises leads to itching, clump and nausea.
• Write simple chemical equations for aerobic and anaerobic reactions using glucose as a substrate. • Describe the effect of lactic acid in muscles during exercise. • Describe the role of anaerobic respiration in yeast during brewing and baking.	• Write simple chemical equations for aerobic and anaerobic reactions using glucose as the substrate. • Describe the effect of lactic acid in muscles during exercise. • Describe the role of anaerobic respiration in yeast during brewing and baking.	• Appreciate the need and benefit of physical exercises.

Pre-requisites of this unit

Learners have learnt about cellular respiration in senior 1 and senior 2. Remind them of what they learnt by asking questions such as: What is respiration? List importance of respiration. Prepare the learner to know that this unit will give detailed information about respiration as per the syllabus. Mention that the unit will touch unit on role of ATP, types of respiration and application of respiration.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to chemistry especially alcoholic fermentation. Let them understand that at this level, they may only need the basic information otherwise; details of this will be learnt at higher level.

Background information

All living organisms need energy to carry out their life activities. They need energy for growth, repair of worn out tissues and for reproduction. Energy is needed for physical or mechanical work such as a bird building a nest or a student planting trees. Energy is also needed for certain other purposes which may not be so obvious such as building up of proteins from amino acids within cells and moving substances across the cell membrane. In this unit we are going to look at how organisms form energy in their bodies.

Cross cutting issues to be addressed:

1. ***Inclusive learning***

All learners should participate actively in their study groups whether disabled or normal.

2. ***Environment and sustainability***

Make learners aware of the need to conserve biodiversity and the environment at large. Remind the students that the oxygen we use during respiration is from the green plants. Without them, there wouldn't be life.

Generic competences covered

1. ***Communication***

As the learners work together in groups, they are able to develop communication skills.

2. ***Critical thinking***

This is as a result of answering the discussion questions provided as the lesson goes on.

3. ***Cooperation and interpersonal skills***

Learners develop interpersonal skills through having time to share together during the discussion

Key words in this unit and their meanings

- Aerobic respiration-The type of respiration that takes place in the presence of oxygen.
- Anaerobic respiration-The type of respiration that takes place without oxygen.

- ATP-Adenosine Tri Phosphate
- Anaerobes-Organisms that respire anaerobically
- Aerobes-Organisms that respire aerobically
- Oxygen debt-this is the amount of oxygen required to break down the lactic acid

Guidance on the problem statement

This topic is about the process of respiration in living organisms. Introduce this chapter by asking students if they have heard of respiration before. Ask them if respiration is similar to breathing? You will need to explain to students that respiration is more than just breathing. Use the activity 9.1 in Students' Book to help learners understand the process of respiration in all living things. ATP is an essential part in respiration; you will need to explain to students that ATP is a currency of energy for living cells. You should as well differentiate between aerobic and anaerobic respiration by way of examples. You can give the organisms that undergo each type of respiration mentioned above.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts and explain their functions. • When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations.	• Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1.	Role of ATP in metabolism	2
2.	Aerobic respiration	2
3.	Anaerobic respiration	2
4.	Application of anaerobic respiration	2

Answer of introductory activity

Combustion of fuel in a car in presence oxygen gives energy to the car to move the same way in the cell break down of glucose in presence of oxygen gives energy to living organisms to carry out different activities.

Lesson 1: Role of ATP in metabolism*(to be covered in two periods)*

Refer to the Student's Book.

Specific objectives

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

- Define respiration.
- State where respiration takes place in the cell.
- Explain the meaning of ATP.
- Identify the role of ATP in the body.
- Outline the components of ATP.

Preparation for the lesson

1. This is generally a research lesson. Learners are expected to be provided with textbooks, pamphlets, charts and access to the Internet.
2. Let the students research in their textbooks to find out the answers to the questions you have given them. They should note down the answers to these questions in their notebooks.
3. Ask the students to turn to their neighbours and share the facts. Ask them to say, I agree with……. if the answers are corresponding. They should also say, I do not agree with…... if the answers are not corresponding as compared to their own.
4. Use the students' ideas gathered from their research to further explain the facts about ATP.

Teaching Aids

- Use charts showing the nature of ATP, textbooks, pamphlets and handouts about ATP and how it is formed.
- Computers with internet can also be used for researching about respiration and ATP.

Pre-requisite to the lesson

- Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which body processes do you know? (**Ans:** excretion, respiration, circulation, reproduction) What is their role

in human body? (**Ans**: Removal of wastes, production of energy, transportation, procreation)

- Can you explain to me the meaning of ATP?

(**Ans**: Adenosine tri phosphate)

- Let the students research in their textbooks to find out the answers to the questions you have given them. They should note down the answers to these questions in their notebooks.
- Let the learners carry out activity 9.1 and activity 9.2 Student's Book. Guide and supervise them during the practicals. Let them note down their findings.
- Ask the students to turn to their neighbours and share the facts. Ask them to say, I agree with……. if the answers are corresponding. They should also say, I do not agree with…... if the answers are not corresponding as compared to their own.
- Use the students' ideas gathered from their research to further explain the facts about ATP. Refer to Student's Book to clarify further.

Synthesis

The lesson introduces learners to the process of respiration in the body. The activities carried out during the lesson should help learners identify the meaning of respiration, the importance of ATP and how it is manufactured in the body.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What do you understand by the term respiration?

   (***Ans:*** It is the process by which food is oxdised in the body to release energy.)

2. Give the meaning of the abbreviation ATP.

   (***Ans:*** Adenosine Tri Phosphate)

3. Why is ATP important in the body?

   (***Ans:*** It is a currency of storage of energy in the body.)

Lesson 2: Aerobic respiration *(to be covered in two periods)*

Refer to the Student's Book.

Specific objectives

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

- Define aerobic respiration.

- Write a chemical equation for aerobic respiration.
- Give the products of aerobic respiration.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs of various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Use charts showing the aerobic respiration
- Computers with Internet
- Student's book

Pre-requisite to the lesson

Introduce the unit as explained under guidance the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson such as: What is aerobic respiration?

  Ans: It is a type of respiration which takes place in the presence of oxygen.

  Refer to activity 9.3 in the Student's Book.

- Supervise the students as they do Activity 9.3. Students can also be given an extra activity to identify and research about examples of organisms which respire aerobically.
- Based on their findings, lead in discussing more about aerobic respiration. Refer to Students' Book to clarify more.

Synthesis

The lesson is meant to introduce the idea that organisms require oxygen for respiration. All activities should be meant to impart learners with this idea, you should specifically explain the products of aerobic respiration, give examples of organisms that respire aerobically and also talk about pollution of the environment by the carbon dioxide from respiration.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Define aerobic respiration.

   (***Ans:*** It is the type of respiration that takes place in the presence of oxygen.)

2. Can you name some of the aerobes in the school environment?

(***Ans:*** cow, sheep, man, hen)

3. What are the products of aerobic respiration?

   (***Ans:*** Carbon dioxide,water and ATP)

4. Where in the cell does this type of respiration take place?
   (***Ans:*** Mitochondria)

Lesson 3: Anaerobic respiration *(to be covered in two periods)*

Refer to the Student's Book.

Specific objectives

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

- Define anaerobic respiration.
- Write a chemical equation for anaerobic respiration.
- Give the products of anaerobic respiration.
- Explain oxygen debt and why it is experienced.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson.

   Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Use charts showing the nature of ATP, textbooks, pamphlets and handouts about anaerobic respiration.
- Computers with Internet can also be used for making research about anaerobic respiration.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson such as What is anaerobic respiration?

  Ans: It is a type of respiration which takes place in the absence of oxygen.

  Refer to Activity 9.4 and 9.5 in the Student's Book.

- Supervise the students as they do the above activities. Students can also be given an extra activity to identify and research about examples of organisms which respire anaerobically.
- Based on their findings, lead in discussing more about anaerobic

respiration. Refer to Students' Book to clarify more.

Synthesis

The lesson is meant to introduce the idea that some organisms do not require oxygen for respiration. All activities should be meant to impart learners with this idea. Compare the efficiency and products of aerobic and anaerobic types of respiration.

By the end of the lesson, students should be able to appreciate the advantage of aerobic over anaerobic respiration. They should also be able to give examples of organisms that are anaerobes.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

- Define anaerobic respiration. (***Ans:*** It is the type of respiration that takes place in the absence of oxygen.)
- Can you name some of the anaerobes in the school environment?
  (***Ans***: Bacteria and fungi)
- What are the products of anaerobic respiration?

  (***Ans:*** Carbon dioxide,ethanol,lactic acid and ATP)
- Where in the cell does this type of respiration take place?

  (***Ans:*** Mitochondria)

Lesson 4: Applications of anaerobic respiration *(to be covered in two periods)*

(Refer to the Student's Book.)

Specific objectives

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

- Explain the importance of anaerobic respiration.
- Explain some of the applications of aerobic respiration.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.
3. You will let the students open up a discussion with the whole class. They should listen and contribute to the discussion.
4. Let the students further research on other applications in which anaerobic respiration can be used.

5. Listen to the students as they present about these applications and add any they might have left out.

Teaching Aids

- Charts
- Computers with Internet
- Student book

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Introduce the lesson by guiding the learners to Activity 9.6. Let them present their findings and lead in discussing their findings.
- You will ask students to pair up. Give them time to discuss on how beer is manufactured in a brewery. Let them note down the procedures in their books.
- The following guiding questions will improve the discussion between students.
  - Which ingredients do we use to manufacture beer?
  - How do we call the process of manufacturing beer?
  - What is the role of yeast during beer making?
  - Which gas is produced along with beer?
- Refer to Student's Book page ,Use the outlined points to clarify more.
- Use table 9.1 in students' book to compare aerobic and anaerobic respiration.

Synthesis

The lesson is meant to introduce the idea that some organisms do not require oxygen for respiration. All activities should be meant to impart learners with this idea. Compare the efficiency and products of aerobic and anaerobic types of respiration. By the end of the lesson, students should be able to appreciate the advantage of aerobic over anaerobic respiration. They should also be able to give examples of organisms that are anaerobes.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

- What are the importances of anaerobic respiration?
- (***Ans:*** Manufacture of beer, used in the dairy industry,used to treat sewerage)
- Give the different applications of anaerobic respiration.
- (***Ans:*** formation of biogas, used in agriculture etc)

Answers to Self-evaluation Test 9.1

(Refer to the Student's Book.)

1. From the mitochondria
2. It is formed after the binding of one **phosphate** molecule (phosphorylation) to one **ADP (adenosine diphosphate)** molecule.
3. ADP and phosphate molecule.
4. The process by which food is broken down in all living cells to release energy.

Answers to Self evaluation Test 9.2

(*Refer to the Student's Book.)*

1. Mitochondria of the cell
2. It increases
3. **X** is oxygen,**Y** is carbon (IV) oxide
4. Aerobic respiration

Answers to Self evaluation Test 9.3

(*Refer to the Student's Book.)*

1. B
2. It is paid through heavy breathing after the exercise.
3. Aerobic respiration requires the use of oxygen while anaerobic respiration takes place in the absence of oxygen.

Answers to Self-evaluation Test 9.4

(*Refer to the Student's Book.)*

1. a) Yeast

   b) Formation of beer
2. It is from the decaying organic matter. It used to generate energy for cooking and lighting.
3. - Used to fix nitrogen in the soil
   - Decomposition of organic matter
   - Used in fermentation process
   - Used to treat sewerage
   - Used in education research

Summary

This unit was about learners gaining knowledge and understanding about the process of respiration, the nature and importance of ATP, the types of respiration and their applications. You should have effectively used the suggested activities and the teaching approaches in the teachers book to help learners acquire this competence. At the end of the lessons, you should assess the extent to which the competence was achieved and plan remedial activities where necessary.

Additional Information for the teacher

Steps of cellular respiration

1. **Glycolysis**; In glycolysis, glucose—a six-carbon sugar—undergoes a series of chemical transformations. In the end, it gets converted into two molecules of pyruvate, a three-carbon organic molecule. In these

reactions, ATP is made, and NAD+\text{NAD}^+NAD+N, A, D, start superscript, plus, end superscript is converted to NADH\text{NADH}NADHN, A, D, H.

2. **Pyruvate oxidation**; Each pyruvate from glycolysis goes into the mitochondrial matrix—the innermost compartment of mitochondria. There, it's converted into a two-carbon molecule bound to Coenzyme A, known as acetyl CoA. Carbon dioxide is released and NADH\text{NADH}NADHN, A, D, H is generated.

3. **Citric acid cycle**: The acetyl CoA made in the last step combines with a four-carbon molecule and goes through a cycle of reactions, ultimately regenerating the four-carbon starting molecule. ATP, NADH\text{NADH}NADHN, A, D, H, and FADH2\text{FADH}_2FADH2F, A, D, H, start subscript, 2, end subscript are produced and carbon dioxide is released.

4. **Oxidative phosphorylation**; The NADH\text{NADH}NADHN,A,D,H and FADH2\text{FADH}_2FADH2F, A, D, H, start subscript, 2, end subscript made in other steps deposit their electrons in the electron transport chain, turning back into their "empty" forms (NAD+\text{NAD}^+NAD+N, A, D, start superscript, plus, end superscript and FAD\text{FAD}FADF, A, D). As electrons move down the chain, energy is released and used to pump protons out of the matrix, forming a gradient. Protons flow back into the matrix through an enzyme called ATP synthase, making ATP. At the end of the electron transport chain, oxygen accepts electrons and takes up protons to form water.

Glycolysis stages of cellular respiration—pyruvate oxidation, the citric acid cycle, and oxidation can take place without oxygen in a process called fermentation. The other three phosphorylation—require oxygen in order to occur. Only oxidative phosphorylation uses oxygen directly, but the other two stages can't run without oxidative phosphorylation.

Each stage of cellular respiration is covered in more detail in other articles and videos on the site. Try watching the overview video, or jump straight to an article on a particular stage by using the links above.

Answers to end unit assessment 9

(Refer to the Student's Book.)

1. E
2. C
3. C
4. This is because aerobic cellular respiration only takes place when oxygen is present.
5. To produce energy needed for movement excretion, growth, reproduction and also for their maintenance.
6.

Characteristics	Process
Less energy produced.	Anaerobic respiration
Occurs in both plants and animals.	Aerobic respiration
Complete breakdown of glucose molecule.	Aerobic respiration
By product formed is lactic acid.	Anaerobic respiration

7. false, false, true, false
8. a) It turns milky.

   b) i) Boiled to kill microorganisms.

   ii) Cooled to provide favourable temperatures for enzyme action.

   c) i) To avoid air from entering into the suspension

   ii) To avoid air from the environment from turning lime water milky.

   d) Anaerobic respiration.

   e) - Bread making.
   - Beer making.
   - Manufacture of yoghurt.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Using Manila paper, draw a table to distinguish between aerobic and aerobic respiration. 2. Help in collecting materials required for practicals.	1. Do further research in textbooks or the internet about cellular respiration. Write short notes then share with other class members. 2. Think of a project that would involve either aerobic or anaerobic respiration.
Remedial questions for slow learners 1. What is aerobic respiration? 2. Write the word equation for aerobic respiration.	**Extended questions for gifted learners** 1. Using a table, differentiate between anaerobic and aerobic respiration.
Answers to remedial questions for slow learners 1. This is a type of respiration that takes place in the presence of oxygen. 2. $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$ + Energy	**Answers to extended questions for gifted learners** 1. Refer to table 9.1 in the Student's Book.

UNIT 10 Skin and homeostatic mechanisms

Key unit competence

After studying this unit, the learner should be able to explain homeostatic mechanisms and the role of skin in temperature control.

Learning objectives

Table 10.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, the learner should be able to: • Define homeostasis as the maintenance of constant internal environment. • Explain the concept of control by negative feedback. • Explain how the pancreas is both an exocrine and an endocrine gland.	By the end of this unit, the learner should be able to: • Draw and label parts of the human skin. • Interpret graphs for glucose tolerance in a person with normal glucose metabolism and a diabetic.	By the end of this unit, the learner should be able to explain: • The skin and temperature control. • Controlling the internal environment. • Negative feedback. • Control of blood glucose level.
• Describe the control of the glucose content of the body by the liver, and by insulin and glucagon from the pancreas. • Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, vasodilatation and vasoconstriction of arterioles supplying skin surface capillaries and the coordinating role of the brain.		

Pre-requisites of this unit

Learners have learnt about homeostatic mechanism in senior 1 and senior 2. Remind them of what they learnt by asking them to define homeostasis and also give examples of homeostasis. Review the topic by naming some of the organs and the hormones involved in homeostasis. Also give a brief role of homeostasis using the skin as an organ involved.

During the lessons, strive to bring to the awareness of learners the fact that this topic is about skin and homeostatic mechanism. Let them understand that at this level, they may only need the basic information otherwise, details of the unit content would be learnt at higher levels in Animal Physiology.

Background information

This unit is all about skin and homeostatic mechanisms. Organisms have different methods of regulating their body temperature. Some rely on physiological mechanisms to maintain the internal body temperature within narrow optimum ranges despite temperature changes in their external environments. These are the homoeothermic animals. When the surrounding temperature is too low, they generate enough heat energy within the body through metabolic reactions like cell respiration to warm their bodies. For this reason, they are termed as endothermic animals. Examples are birds and mammals.

Animals that do not have physiological mechanisms to maintain constant body temperatures are poikilothermic. Their body temperatures vary with the temperature of the surrounding. Many of these animals are still able to maintain warm bodies mainly during the day. They use behavioural methods to keep fairly constant temperatures during the day, for example, the lizards bask in the sun to warm their bodies, and move into the shade to cool off. Such organisms that gain heat from the external surroundings to warm the body are called ectotherms.

Cross cutting issues to be addressed:

1. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a career in human physiology, medicine. Give examples of role models who are successful doctors or gynaecologists in the area where the learners come from.

2. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print

text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic competences covered

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs as they engage discussion. During presentations, you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentations as slow learners contribute.

2. ***Research skills***

Guide the learners on how to find information regarding various activities done in class. Guide the learners on how to come up with summarised notes from a large body of texts.

3. ***Communication in English***

As learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in the discussions, presentations and during questions and answer sessions.

4. ***Critical thinking***

This will be developed by learners as they answer the probing questions. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. ***Lifelong skills***

Advise learners that content learnt in these lessons would be applicable in their life. Also make learners aware that they can become doctors and particularly human physiologist if they take this topic seriously.

Key words in this unit and their meanings

Homoeothermic: These are animals which regulate their internal temperatures to suit the external changes.

Poikilothermic: These are animals which do not have physiological mechanisms to regulate their body temperatures.

Ectotherms: These are animals which gain or lose heat depending on the temperature of their surroundings.

Homeostasis: This is the maintenance of the internal environment of cells under almost constant conditions.

Melanin: This is a pigment which contributes to the colour of the skin.

Sebum: This is an oily secretion of the sebaceous glands in the skin.

Thermoregulation: All mechanisms done by the body to regulate body temperature in the required ranges.

Hyperthermia: This refers to abnormally high temperatures acquired by the body.

Hypothermia: This refers to abnormally low temperatures acquired by the body.

Hormones: These are chemical substances which are released into the blood and are transported to various body tissues and organs. They carry a specific message.

Guidance on the problem statement

This topic is about the skin and its role in thermoregulation. You will introduce this topic by asking the learners about the skin. Let them tell you anything they know about it. Remind the students that, the skin is the most wide spread organ of the body covering almost all parts of the body. Inform the students about animals that have skin and those that do not have. Remember to explain to them the difference between endothermic and ectothermic organisms and give them examples of each. Explain the homeostatic role of the skin in thermoregulation. Let the students understand that taking good care of their skin is important if they are to remain healthy.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts and explain their functions. • When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations.	• Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1	Introduction to homeostasis	2
2	Skin structure	2
3	Parts of the skin and its general functions	2
4	Water balance in the body	2
5	Control of blood glucose level	2

Lesson 1: Introduction to homeostasis *(to be covered in two periods)*

Refer to the Student's Book.

Specific objectives

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

1. Define homeostasis.
2. Explain the need for homeostasis in the body.
3. Give examples of some homeostatic mechanisms of the body.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Use charts showing the skin, pancreas and the kidney, textbooks, pamphlets and handouts about the skin and its functions.
- Computers with internet can also be used for researching about homeostatic mechanisms.

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  Define the term homeostasis.

(***Ans:*** The process by which the body regulates internal factors to remain at a constant.)

What are some factors the body needs to regulate in order to remain healthy?

(***Ans:*** Temperature, glucose level, water and ions)

What are some of the homeostatic organs of the body?

(***Ans:*** Skin, kidney, pancreas)

- Refer to Student's Book to clarify the discussed points.

Synthesis

The lesson introduces learners to homeostatic mechanisms of the body. The activities carried out during the lesson should lead learners to understanding the meaning of the term homeostatic and why the body needs to regulate its internal medium. The learners should also be able to identify problems related to poor regulatory mechanisms.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Define homeostasis.

   (***Ans:*** The process of keeping the internal environment in balance)

2. What are the two feedback mechanisms used by the body?

   (***Ans:*** Positive and negative feedback)

3. Identify factors that the body needs to regulate.

   (***Ans:*** Temperature, sugar/glucose, solutes other than sugar, water)

4. Give examples of organisms which are endothermic.

   (***Ans:*** Birds, mammals)

5. What are the functions of the pancreas in homeostasis?

   (***Ans:*** Produces hormones insulin and glucagon which regulate blood sugar level)

Lesson 2: Structure of the skin *(to be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Draw the structure of the skin.
- Identify the different parts of the skin.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson.

Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Organise to have the charts in place before the lesson.

3. Provide reference materials.

Teaching Aids

- Charts showing the skin, textbooks, pamphlets and handouts about the skin structure
- Computers with Internet can also be used to search for diagrams of the skin
- Microscope

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/learning activities

Ask probing questions to introduce the lesson. Such questions may include:

- Which is the biggest organ in the body?

  Ans: Skin
- What are the two main layers that make up the skin?

  Ans: epidermis, dermis

Activity 10.1 (Refer to Student's Book.)

- Organise the students and supervise them as they do Activity 10.1. Let the learners write their findings and present to the class through their group leaders.
- Lead in discussing their findings. Refer to Student's Book. Summarise by mentioning the main parts of the skin.

Synthesis

This lesson is meant to instil students with drawing skills of biological diagrams. The activities laid out in this lesson should lead the learner to appreciate the structure of the skin and be able to state and identify the different parts of the skin as a homeostatic organ.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Identify the different parts of the skin.

   (***Ans:*** Dermis, endodermis, subcutaneous fat layer, hair follicle, etc)

2. Draw a diagram to show the structure of the skin.

   Ans: Refer to Student's Book

Lesson 3: Functions of the skin *(to be covered in two units)*

Refer to the Student's Book.

Specific objectives

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

- Give the functions of parts of the skin.
- Give the general functions of the skin.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Charts showing the skin, textbooks, pamphlets and handouts about the skin structure
- Computers with Internet can also be used to search for diagrams of the skin
- Student's Book

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Do you normally sweat after doing vigorous exercises?

  Ans: Yes

  What is the function of melanin in our skin?

  Ans: To protect the body from ultra violet radiation

  Activity 10.2 (Refer to Student's Book.)

- Organise the students and supervise them as they do activity 10.2. Let the learners write their findings and present to the class through their group leaders.
- Lead in discussing their findings. Refer to Student's Book. Summarise by mentioning the main parts of the skin. Give the learners time to write short notes.
- Finalise by instructing the students to attempt Self-evaluation Test 10.1.

Synthesis

This lesson is meant to introduce students to the basic parts of the skin and how they function. This will collectively

bring about the general functions of the skin in organisms. It will guide learners to identify the functions of the skin as a thermoregulatory and excretory organ, more so, the skin will be greatly appreciated as a sense organ.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

a) Give the functions of the following parts of the skin.

   i) Subcutaneous fat layer

      (***Ans:*** It helps in thermoregulation through insulation of the body.)

   ii) Sweat glands

      (***Ans:*** To secrete sweat)

   iii) Sebaceous glands

      (***Ans:*** To secrete sebum)

b) What are the general functions of the skin in:

i) Thermoregulation? (***Ans:*** Protects the body against loss of heat)

ii) Immunity? (***Ans:*** Protects the body against entry of microorganisms)

iii) Sensitivity? (***Ans:*** It is sensitive to touch.)

Lesson 4: Controlling the internal environment, water balance in the body

Refer to the Student's Book.

Specific objectives

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

- Identify the organ responsible for water balance in the body.
- Identify the hormone responsible for water balance.
- State ways in which the body gains and loses water.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Charts showing the skin, textbooks, pamphlets and handouts about the kidney structure

- Computers with internet can also be used to search for diagrams of the kidney
- Photographs showing the kidney
- Fresh kidney from a dissected mammal

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What are osmoreceptor cells?

  Ans: Special cells in the brain that detect changes in water balance or osmotic pressure

- Lead in discussing water balance. Refer to Student's Book. Summarise by mentioning the main parts of the skin. Give the learners time to write short notes.
- Finalise by explaining more using Fig 10.5 in Student's Book.

Synthesis

This lesson is meant to introduce to students the morphological characteristics of the skin. It is also meant to make learners aware that the kidney is used for water balance in the body and it works in conjunction with hormones like ADH. Through this lesson learners should also be made aware of the problems that arise when the kidney is not functioning properly and also when the skin interfered with.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Identify the function of the kidney in the body.

   (***Ans:*** It balances the amount of water in the body.)

2. Why is it a problem if you lose too much urine than usual?

   (***Ans:*** You become dehydrated.)

3. What advice would you give to a person who is dehydrated?

   (***Ans:*** To increase the amount of water he or she consumes)

4. What is the role of hormone ADH in the body?

   (***Ans:*** It allows balance of water in the body by regulating water loss and water reabsorption.)

Lesson 5: Control of blood glucose level (to be covered in two periods)

Refer to the Student's Book.

Specific objective

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

- State the normal blood sugar level.
- Identify the organ for blood glucose balance in the body.
- Explain sugar metabolism in the body.
- Identify the cause of diabetes mellitus in man.

Preparation for the lesson

1. This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Charts showing the pancreas, textbooks, pamphlets and handouts about the pancreas and its role in sugar metabolism
- Computers with internet can also be used.
- Photographs showing the pancreas.
- A dissected mammal

Introduction to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Why is glucose important in the body?

  Ans: It is the source of energy for cell respiration.

  What is diabetes mellitus?

  Ans: It is a condition in which the pancreas fails to produce insulin or produces inadequate amounts of insulin.

  Activity 10.4 (Refer to Student's Book.)

- This is a practical and discussion activity on the use of glucometer. Let the learners carry out activity 10.4 under your supervision.
- Let the learners study the charts and diagrams in reference books to familiarise with the glucometer.
- Lead in discussing the learners findings. Use the outlined points in Student's Book.

- Finalise by instructing learners to attempt Self-evaluation Test 10.3.

Synthesis

This lesson is aimed at introducing the concept of glucose regulation in man. Students should be made aware of the dangers of excess blood sugar and how it may result into diabetes melitus if not corrected. Explain to students the healthy habits they can practise to avoid the dangers of high blood sugar levels.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

i) What is the normal level of glucose in blood?

(***Ans:*** 90-100mg per 100ml of blood)

ii) Which organ is responsible for the regulation of blood glucose level? (***Ans:*** The pancreas)

iii) Identify the two hormones that are produced by the pancreas and meant to regulate blood sugar level.

(***Ans:*** Glucagon and insulin)

iv) How does the body deal with excess sugar in the body?

(***Ans:*** It converts the excess sugar to glycogen and stores it in the body. It can also burn the excess sugar to produce energy in the body)

v) Identify the characteristics of a diabetic person.

(***Ans:***-Dehydration, constant passing of urine, constant thirst, loss of weight)

Answers to Self-evaluation Test 10.1

Refer to Student's Book.

1. This is the process of regulating and keeping the internal environment at a constant level.
2. A
3. D
4. B
5. Refer to Student's Book.
6. Vasoconstriction, vasodilation and shivering

Answers to Self-evaluation Test 10.2

Refer to Student's Book.

1. Production of large volumes of dilute urine
2. B
3. C
4. D
5. stimulus,sensor, control and effector

Answers to Self-evaluation Test 10.3

Refer to Student's Book.

1. This is because insulin is a protein and can be digested if taken orally.
2. E
3. C
4. - Dehydration
   - Passing large volumes of dilute urine.
   - loss of weight.
   - persistent hunger.

Summary of the unit

The unit deals with skin and homeostatic mechanisms. You should therefore effectively use the practical and suggested teaching approaches in the Teacher's Book to guide the learners acquire the requisite knowledge and desired competences in these area. Encourage learners to spread the knowledge they learnt about diabetes to the community. Plan remedial activities where necessary for slow learners and give extra activities to gifted learners.

Additional information for the teacher

Many diseases are the result of the failure of one or more homeostat(s).Almost any functional component of any homeostat can malfunction, either as a result of an inherited defect, or an acquired disease. Some of the homeostats have inbuilt redundancies, which insures that life is not immediately threatened if a component malfunctions; but in other cases malfunction of a homeostat causes severe disease, which can be fatal if not treated. Here only a few well known examples of homeostat dysfunction are described.

Type I diabetes

Mellitus is probably the best known example. Here the blood glucose homeostat ceases to function because the beta cells of the pancreatic islets are destroyed. This means that the glucose sensor is absent and its effector pathway (the insulin level in the blood) remains unchanged at zero. The blood glucose concentration therefore rises to very high levels, while the body's proteins are degraded into amino acids which are turned at a very high rate into glucose, via gluconeogenesis, by the liver. The condition is fatal if not treated.

The plasma ionised calcium homeostat can be disrupted by the constant, unchanging, over-production of parathyroid hormone by a parathyroid adenoma resulting in the typically features of hyperparathyroidism, namely high plasma ionized Ca^{2+} levels and the resorption of bone, which can lead to spontaneous fractures. The abnormally high plasma ionized calcium

concentrations cause conformational changes in many cell-surface proteins (especially ion channels and hormone or neurotransmitter receptors) giving rise to lethargy, muscle weakness, anorexia, constipation and labile emotions.

The body water homeostat can be compromised by the inability to secrete ADH in response to even the normal daily water losses via the exhaled air, the faeces, and insensible sweating. On receiving a zero blood ADH signal, the kidneys produce huge unchanging volumes of very dilute urine, causing dehydration and death if not treated.

As organisms age, the efficiency of their control systems are reduced. The inefficiencies gradually result in an unstable internal environment that increases the risk of illness and leads to the physical changes associated with aging.

Answers to end unit assessment 10.

(*Refer to Student's Book.*)

1. D
2. A
3. A
4. B
5. B
6. Under strenuous activities
7. Exercise that uses your upper body, such as cross-country skiing, usually causes an increased heart rate response. This greater response is because your arms contain smaller blood vessels and when they are constricted during exercise, your heart has to work harder to deliver enough oxygen to the muscles they supply.
8. It is thermoregulation that maintains a stable internal body temperature regardless of external influence.
9. It's important because it helps to keep the body healthy and free from disease.
10. - To visit the doctor regularly for medical check up.
    - To always take foods with low sugar content
    - To do exercise
    - To increase the quantity of water intake.
11. a) This is the process by which the body regulates and keeps the internal environment at a constant.

    b) i) A feedback that brings back the deviant factor back to normal e.g. insulin reduces the high glucose level of blood back to normal.

    ii) A feedback that amplifies/

enhances the deviant factor e.g hormone oxytocin amplifies the contraction of the uterus during birth.

12. a) The skin

b) It is used in thermoregulation, an organ sensitive to touch, protection of the body.

c) A-Sebaceous glands

B-Hair

C-Blood capillaries

D-Subcutaneous fat layer

13. a) i) Glucose is being absorbed from the small intestines.

ii) Glucose is being taken up by other parts of the body through respiration.

b) Because the liver is the storage organ of sugar

c) i) Hepatic artery

ii) Between 4.0 to 6.0 mmol/LH

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Help in practical activity by collecting the materials required for the practical. 2. Ask more questions to get clarification on the topic.	1. Do further research in textbooks or the Internet about skin and homeostatic mechanism. Write short notes then share with other class members. 2. Come up flow chart explaining more about homeostatic.
Remedial questions for slow learners 1. Name aspects of the body's internal environment that need to be kept constant.	**Extended questions for gifted learners** 1. Draw a cross section of a mammalian skin.
Answers to remedial questions for slow learners 1. Temperature, osmotic pressure, chemical constituents and level of carbon dioxide	**Answers to extended questions for gifted learner** 1. Refer to Students Book Fig 10.2.

UNIT 11 Response and coordination in plants

Key Unit Competence

To be able to explain response to light and gravity by plants and understand the importance of tropisms in plants.

Learning objectives

Table 11.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of the unit, the learner should be able to: • State examples of plant responses. • Define gravitropism or geotropism as a response in which parts of a plant grow towards or away from gravity. • Define phototropism as a response in which parts of a plant grow towards or away from the direction from which light is coming.	By the end of the unit, the learner should be able to: • Apply knowledge of plant responses to light and gravity to explain the roles played by responses in the life of the plant. • Analyse the forms of responses shown by plant shoot and root systems.	By the end of the unit, the learner should be able to: • Appreciate the importance of responses by plants to light and gravity to maintain life of the plant in places with limited light and other requirements.
• Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth by auxins. • Describe the role of auxin in controlling shoot growth by diffusion through the plant and unequally distributed in response to light and gravity stimulating cell elongation. • Identify other forms of plant responses.	• Carry out an investigation on the response of plant shoot towards light and gravity. • Research about other forms of plant responses and their importance to plants.	

Pre-requisites of this unit

Learners have learnt about response and coordination in plants in senior 1 and senior 2. Remind them of what they learnt by asking them to define response and coordination and also to give importance of response and coordination in plants. Prepare the learners to know that this unit will give detailed information about response and coordination as per syllabus. Mention that the unit will touch on plant response, role of auxin and other forms of plant response.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to agriculture. Let them understand that at this level, they may only need the basic information otherwise; details of it will be learnt at a higher level.

Background information

Living organisms are able to respond both to internal and external stimuli. Coordination is the process where living organisms give the correct responses at the correct time to a particular stimulus. This allows the organism to adapt to change and increase their chance of survival.

Plants perceive stimuli that are important to their survival in the environment. The various external stimuli that plants respond to include light, water, gravity, chemicals, temperature and contact. Plants respond to these stimuli by growing or moving towards or away from their direction. Plant responses that involve growth are called tropisms while those that involve movement are called taxis. If the response is towards the stimulus, it is a positive response. if it is away from the stimulus, then it is a negative response.

The specific responses of plants to a variety of stimuli are given in the table below:

Tropisms	Stimuli
Phototropism	Light
Hydrotropism	Water
Geotropism	Gravity
Thigmotropism	Touch
Aerotropism	Air

Cross cutting issues to be addressed

1. ***Inclusive learning***

All learners should participate actively in their study groups whether disabled or not.

2. ***Financial education***

Learners will be made aware of the economic applications of plant growth hormones like auxins in agriculture.

For example the use of Auxins in weed control and breaking of seed dormancy.

3. Peace and values education

This is achieved as you bring to the attention of learners the need to accommodate other people's views. Discipline should be observed at all times in study groups since some cases can make learners diverge from the main objectives.

Generic competences covered

1. Communication

As the learners work together in groups, they are able to develop communication skills.

2. Critical thinking

This is as a result of answering the discussion questions provided as the lesson goes on

3. Cooperation and interpersonal skills

Learners develop interpersonal skills through having time to share together during the tour around the school.

Key words in this unit and their meanings

Stimulus: This is something that causes a physiological response.

Response: A reaction of a plant or part of a plant towards a certain stimulus.

Phototropism: Phototropism is the growth or movement response of a cell or an organism to light

Geotropism: This is the growth or movement response of a cell or a plant towards gravity.

Thigmotropism: This is the growth or movement response of a cell or a plant towards touch.

Chemotropisms: This is the growth or movement response of a cell or a plant towards chemicals.

Hydrotropisms: This is the growth or movement response of a cell or a plant towards water.

Plumule: This is the part of the seed that grows into the shoot system.

Radicle: This is the part of the seed that grows into the root.

Nastic responses: These are responses towards stimulus but which are non-directional.

Auxins: This is a family of plant hormones produced at the growing regions of the plant.

Gibberelins: These are plant hormones that stimulate stem elongation.

Guidance on the problem statement

As a way of making learners familiarise with plant responses, you will use a short introductory activity comprising of the following questions.

- Why do you think plant shoots grow towards light?
- Do roots grow towards light?
- Why is it important for roots to grow down into the soil?

You will ask learners to search for examples of plant hormones from textbooks and the Internet. Let them also find out how hormones are important in plant growth and development. This will help you to explain to students how different stimuli affect distribution of hormones and how this in turn affects growth and development of plants. This can be done by use of simple experiments on potted plants.

You will guide learners to discover other types of plant responses and in each case the specific stimulus responsible for such a response. Guide the students by showing them examples to allow them differentiate between nastic responses and tropic responses.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations. • Ensure that all learners respect others' views irrespective of their shortcomings.	• Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that short-sighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1	Plant responses	2
2	Role of auxins in controlling shoot growth	4
3	Other forms of plant responses	2

Lesson 1: Plant responses *(to be covered in two periods)*

Refer to the Student's Book.

Specific objective

By the end of the lesson, learners should be able to state examples of plant responses.

Preparation for the lesson

- This is a class activity that will involve an experiment and discussion.
- You will guide the learners during the discussion and through the practical experiment.

Teaching aids

- Potted plants
- Student's Book
- Internet
- Containers
- Cotton wool, pins and clamps
- Bean and pea seeds

Pre-requisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/learning activities

- Introduce the topic by reminding learners about plant responses they have already learned. They should be able to recall plant responses.
- Ask probing questions to introduce the lesson. Such questions may include:

  Give examples of:

  I. Stimuli (***Ans:*** Light, water, touch, chemicals, gravity)

  II. Responses (***Ans:*** Tropisms, nastic movements)

  Explain the following types of plant responses.

  I. Phototropism (***Ans:*** Growth response towards light)

  II. Hydrotropism (***Ans:*** Growth response towards water)

  III. Thigmotropism (***Ans:*** Growth response towards touch)
- Bring to learners' attention the pictures of plant responses in the Student's Book .They should be able to identify them and link the type of tropism and the stimuli.
- Provide learners with materials for Activity 11.1 to investigate gravitropism and phototropism.
- They should be in groups of four. The experiment will take a couple of days to observe intended results.
- Instruct them to come up with a report of their findings and present it to the rest of the class.

- Build on their findings to explain the types of plant responses and their stimuli as they take notes.
- Instruct learners to attempt Self-evaluation Test 11.1.

Synthesis

This lesson introduces the concept of plant response to learners. It should be brought in order that the student grasps the meaning of the key terminologies i.e. stimulus and response. This will lead to the understanding of other forms of plant responses and what causes them. You are also supposed to identify the benefits of such responses especially in the process of plant growth and development.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is tropism?

   Ans: It is the turning of all or part of an organism in a particular direction in response to an external stimulus.

2. Name three types of tropism.

   Ans: Phototropism, hydrotropism, gravitropism

Lesson 2: Role of auxins in controlling shoot growth *(to be covered in four periods)*

Refer to the Student's Book.

Specific objective

By the end of the lesson, learners should be able to explain the role of auxin in controlling shoot growth.

Lesson preparation

1. This is a class activity that will involve a research and class discussion.
2. You will guide the learners during the research and discussion.

Teaching aids

- Computers with Internet
- Student's Book
- Charts, chalkboard diagrams
- Pictures

Prerequisite for the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/learning activities

1. Learners are already aware of hormones in animals and how they work. They should be able to link the same to plants.
2. Organise learners into groups and provide them with reference books to do research on the role of auxin in controlling shoot growth.
3. Instruct them to write a report which they will present in class.

4. Build on their reports to explain the various roles of auxins to plant responses.

5. End the lesson by instructing learners to attempt Self-evaluation Test 11.2.

Synthesis

The lesson is aimed at introducing the idea of plant hormones and how they control responses. You will explain to students the meaning of hormones and how auxins as an example control growth and therefore responses in plants. There is need to explain the concentration of auxins in plant parts and how this is affected by the direction of light and gravity.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What are auxins?

   Ans: They are hormones produced at shoot tips and root tips which then diffuse away.

2. How does auxin influence growth?

   Ans: By making the cells permeable to useful substance for growth, increasing the metabolic rate of cells to produce more energy

Lesson 3: Other forms of plant responses

Refer to Student's Book.

Specific objective

By the end of the lesson, learners should be able to identify other forms of plant responses.

Lesson preparation

1. This is a class activity that will involve a research and a class discussion.

2. You will guide the learners during the research and discussion.

Teaching aid

- Reference books
- Computer with Internet
- Notebooks
- Charts and diagrams

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/learning activities

1. Organise learners into groups and provide them with reference materials to do research on other forms of plant responses.

2. Instruct them to write a report and do a presentation on their findings.

3. Have a class discussion from their findings to explain other plant responses. For clarification refer to the outlined points on students book.

4. End the lesson by instructing learners to attempt Self-evaluation Test 11.3 and Test your Competence 11.

Synthesis

This lesson will introduce to students other forms of responses in plants that were not tackled in the last lesson. Students need to be explained to the different forms of responses that exist in plants and how they come about. The different stimuli that provoke these responses should also be dealt with in this lesson.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Name other forms of response tropism excluded.

   Ans: Nastic responses

Answers to Self-evaluation Test 11.1

Refer to Student's Book.

1. True
2. C
3. D
4. a) Hydrotropism, b)phototropism. c) Growth towards light which is useful in photosynthesis

   d) Auxin

   e) They can: (1) regulate the chemical composition of the plant and/or the color of fruit, (2) initiate or terminate the dormancy of seeds, buds, and tubers, (3) promote rooting and propagation, (4) control plant or organ size, (5) promote, delay, or prevent flowering,

Answers to Self evaluation Test 11.2

Refer to Student's Book.

1. Auxins migrate away from some plant part when in contact with solid objects.
2. The shoot or tip
3. B
4. a) Graph

   b) Auxins are mostly made in the tips of the shoots and roots, and can diffuse to other parts of the shoots or roots. Shoots and roots respond differently to high concentrations of auxins: cells in shoots grow more whereas cells in roots grow less.

   c) Plant growth hormones (auxins) can be used as selective weed killers. This means the weed is absorbing nutrients from the soil at a much higher rate, and so the weeds absorb the weed killer in much larger quantities than beneficial plants which cause them to die.

Answers to Self-evaluation Test 11.3

Refer to Student's Book.

1. A response to non-directional movement of a part of a plant in response to external stimulus.

2. Nastic response

3. B

Answers to end unit assessment 11

(Refer to Student's Book.)

1. C

2. a) They accumulate more to the side that is not having light causing it to grow faster.

   b) They accumulate on the lower side (opposite to the pull of gravity).

3. True

4.

Tropisms	**Stimuli**
Phototropism	Light
Hydrotropism	Water
Geotropism	Gravity
Thigmotropism	Touch
Aerotropism	Air

5. a) The plant will grow taller and expose its leaves towards sunlight so as to carry out photosynthesis.

   b) It allows plant root development into the soil for water and mineral salt absorption.

6. True

7. Move towards the side opposite to light.

8. It allows such a plant to protect itself especially from herbivores and pests.

9.

Tropism	**Nastic**
The direction of movement is determined by the position of the origin of the stimulus.	The direction of movement is determined by the anatomy of the plant.
The movement is in a direction either toward or away from the origin of the stimulus.	The movement is determined by the position of the origin of the stimulus.
Changes that occur are generally irreversible.	Changes that occur are temporary; they are reversible and repeatable.

10. - It helps plants to capture insects which they use as a source of nitrogen in case the plants are growing in nitrogen deficient environments.

    - It also helps plants to protect themselves from herbivores which might want to eat them.

11. a) High levels of auxin concentrations stimulate shoot growth in roots-it-also inhibits growth.

b)
- Auxins can be used to stimulate germination in dormant seeds.
- Auxins can also be sprayed on short plants to make them taller.
- High concentrations of auxins can be used to kill weeds.

12. IAA, plant, elongation, response, light and gravity,adventitious roots, lateral buds, fruit, parthenogenesis is, bud, diffuse

Summary to the unit

This unit deals with response and coordination in plants. Living organisms are able to respond to both internal and external stimuli. Coordination is the process whereby a living organism gives the correct response at the correct time to a particular stimulus. You should therefore use practical activity and suggested teaching approaches. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones.

Additional information to the teacher

- Read further. This will give you a better understanding of the subject matter.
- When organising learners into groups consider gender and special educational need learners. The group formation should be well represented to enable learners appreciate diversity amongst them and learn that we are all gifted differently.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Participate fully during practicals and during class. 2. Illustrate different types of tropism. Stick them on your locker for reference.	1. Do further research in textbooks or the Internet about response and coordination in plants. Write short notes then share with other class members. 2. Come up with an acronym which will help you to remember different response.
Remedial questions for slow learners 1. What is phototropism? 2. Name types of tropism.	**Extended questions for gifted learners** 1. Explain the behaviour of auxins when exposed to unidirectional light.
Answers to low remedial questions for slow learners 1. Response of plants towards light. 2. Phototropism, gravitropism, hydrotropism	**Answers to extended questions for gifted learners** 1. They accumulate more to the side that is not having light causing it to grow faster.

UNIT 12 Responses and coordination in animals

Key unit competence

After studying this unit, learners should be able to relate structures of nervous and endocrine systems to their functions.

Learning objectives

Table 12.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, the learner should be able to: • State the components of coordinated behaviour in an organism. • Identify components of the human nervous system. • Define nerve impulse. • Identify neurons. • Describe a simple reflex arc. • Explain the difference between voluntary and involuntary actions. • Recall and outline the structure and functions the five senses. • Explain the importance of hormonal communication. • Identify the location of endocrine glands and functions of other secretions.	By the end of this unit, the learner should be able to: • Analyse the structures of different neurons. • Carry out an investigation to determine the time to react to stimulus. • Demonstrate role of antagonistic muscles. • Distinguish between rods and cones. Compare endocrine and exocrine glands. • Design a model showing a reflex arc. • Locate human endocrine glands on a provided diagram.	By the end of this unit, the learner should be able to: • Appreciate the importance of coordinated behaviour in organisms. • Show resilience when making observations in investigations. • Be aware of other forms of responses shown by different organisms. • Appreciate the importance of reflexes in learning.

Pre-requisite of this unit

Learners learnt about respose and coordination in animals in senior 1 and senior 2. Review the unit by asking what response and coordination is. By giving examples, explain further how response and coordination relate. Unlike senior 1 and senior 2, where learners learnt response and coordination in both plants and animals, prepare the learners to learn detailed response and coordination in animals as per syllabus.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to physics and the learner will gain knowledge on optics and sound. Let them understand that at this level, they may only need the basic information otherwise; details of response and coordination in animals will be learnt at a higher level.

Background information

Animals are different from plants because of their ability of locomotion. This ability probably developed as they have to search for food, unlike the plants that are autotrophic. Since they move from one place to another, the animals have to continuously encounter changes in their environment. In order to maintain a steady state within the body (homeostasis), all animals should be able to perceive these changes and adapt to them.

With increasing complexity in their structure, the number and types of cells in the animal body increased. Thus it became necessary to have some coordinating mechanism. Two systems have been developed for better control and coordination of the various activities of the organisms. These systems are the nervous system and the endocrine system.

Cross-cutting issues to be addressed

1. ***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.

2. ***Gender education***

Emphasise to learners that anybody irrespective of their gender can pursue a career in medicine. Give examples of role models who are successful doctors in the area where the learners come from.

3. ***Inclusive education***

All learners should be encouraged to participate during lessons and group activities. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and

allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

During group discussions and pair work, let learners engage one another by giving a chance for all to participate. This can also be achieved during presentations; you can allow rotational presentation within the group members.

2. ***Research skills***

Guide learners on how to find information regarding various topics such as components of the human nervous system. Guide the learners on how to come up with summarised notes from a large body of text.

3. ***Communication in English***

Developed as learners participate in pairs and group work in performing skits and as they perform to the rest of the class. Encourage learners irrespective of their abilities to participate in group discussion, during presentations and question-and -answer session.

4. ***Critical thinking***

Guide learners to discover this skill for themselves as they work in groups. This is achieved as learners find out the answers to the questions you give to them.

Key words in this unit and their meanings

Stimulus: It is any change in the environmental conditions which can bring about a change in the activity of an organism e.g. chemical change, light.

Receptors: These are structures or organs that receive stimuli e.g. skin, eye, ears, tongue, and nose. They are also known as sense organs.

Response: Reaction of the organism, it is the change in the activity of an organism in reaction to a stimulus, e.g. blinking the eyes, walking away from too much light.

Internal environment: It is the immediate surroundings of the cells which is mainly tissue fluid.

External environment: It is the immediate surroundings of an organism.

Effectors: These are structures that aid animals to react to stimuli i.e. they carry out a response. They can be glands or cells.

Axon: This is a long cytoplasmic extension running from the cell body.

An impulse This is an electrical message transmitted along nerve fibre.

A synapse: This is a specific functional point that links one neuron to another or it is a means by which a nervous impulse is passed from one neuron to another.

A reflex action: This is a sudden, automatic and uncontrolled response of parts of the body to a stimulus e.g. knee jerk.

A reflex arch: This is described as the path taken by a nerve impulse in a reflex action.

A conditioned reflex is a reflex action triggered by a certain stimulus which the animals learn to associate with a different stimulus.

A hormone is an organic chemical substance which is produced in small quantities and transported by blood to target organs where it exerts its effects.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations. • Ensure that all learners respect other's views irrespective of their shortcomings.	• Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with visuals difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson Number	Lesson title	Number of periods
1	Components of the human nervous system.	1
2	The brain parts and function	2
3	Structure and function of nerve cells/neurones	1
4	The synapse and transmission of impulse across the synapse	1
5	The reflex arc and reflex actions	2
6	The simple reflex action	1

Lesson Number	Lesson title	Number of periods
7	Conditioned reflex action	1
8	Voluntary and involuntary actions	2
9	The human senses- external structure of the eye	1
10	Internal structure of the eye	1
11	Structure and function of the ear	1
12	The tongue, nose and the skin	2
13	Hormonal control in coordination	1

Lesson 1: Need for coordination and components of the human nervous system *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define coordination, irritability, stimulus, response, receptors and effectors.
- State the components of the nervous system in humans.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Obtain wall charts on the human nervous system in advance.
3. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

Teaching Aids

- Charts
- Senior 3 Student's Book
- Internet

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson like: state examples of stimuli that humans respond to

(***Ans:*** Light, temperature, sound, pain and touch) What is sensitivity? (***Ans:*** The ability of an organism to detect changes in the environment and respond appropriately to them)

Activity 12.1 and 12.2 (Refer to Student's Book.)

- This is a discussion activity that will involve learners defining terms in coordination and identifying components of the human nervous system from the charts provided.
- Let learners have a brief discussion session on the terms defined and what they have identified from the charts and present their work to the rest of the class.
- Summarise the lesson by highlighting what makes up the central nervous system and the peripheral nervous system. Refer to Student's Book.

Synthesis

The lesson introduces learners to coordination and response in human beings. Learners should relate their ability to respond to stimuli to the components of the nervous system.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is the function of the nervous system?

   Ans: To send information or messages to and from the brain and spinal cord to and from other body parts.

2. State the components of the coordinating system in the human body.

   Ans: The nervous system and the hormonal/endocrine system.

3. What makes up the nervous system?

   Ans: Central nervous system and peripheral nervous system.

4. Which of the following is the correct definition of irritability?

   A. Part of the body that responds to stimuli

   B. How an organism detects changes in its environment

   C. Ability of an organism to detect changes in the environment

   D. Ability of an organism to detect changes in the environment and respond appropriately

   Ans: D

Lesson 2: Components of the human nervous system *(To be covered in one period)*

(Refer to Student's Book.)

Specific objectives

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

- Name the major parts of the human brain.
- Explain the functions of the main parts of the brain.

Preparation for the lesson

1. This lesson will involve group discussion. You will therefore organise the class as need arises during the lesson.

   Remember: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Obtain charts of the human brain.

3. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

Teaching Aids

- Reference books
- Charts
- Internet

Improvisation: You may organise to have a Youtube video on the structure and function of the human brain. https://www.youtube.com/watch?v=EeE7Fpg061I

Prerequisite to the lesson

Introduce this unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions would include What is the major organ of the nervous system encased in the skull? (***Ans:*** Brain) What is the importance of the great folding of the cerebrum? (***Ans:*** To increase surface area for packaging more neurons)
- Organise the learners into groups and let them discuss the functions of the different parts of the brain and present their work to the rest the class.
- At this point, play the Youtube video and emphasise on the main roles of the parts of the brain.
- Summarise the lesson by question-answer evaluation. Ask learners to state one function of each part of the brain.
- Finalise by asking learners to make notes on functions of parts of the brain and spinal cord.

Synthesis

This lesson introduces learners to the brain structure and function. Learners should appreciate the role of the

major parts of the brain in important physiological processes.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. The human brain is divided into three main parts. What are they called?

   Ans: fore brain, mid brain and hind brain

2. State the parts of the brain that carry out the following functions.

   a) Responsible for memory thinking and intelligence.

   b) Controls coordination of body movement and posture.

   c) Responsible for involuntary actions like breathing, heartbeat and swallowing.

   Ans:

   a) Cerebrum

   b) Cerebellum

   c) Medulla oblongata

3. Name the part that:

   a. Protects the brain externally

   b. Protects the brain internally.

   c. Separates right and left cerebral hemispheres.

   Ans:

   a. Cranium (skull)

   b. Meninges

   c. Corpus callosum

4. State the function of the cerebrospinal fluid.

   Ans:

   - Nourishes the tissues of the brain
   - Cushions the brain against mechanical shock
   - Removes waste from the brain

Lesson 3: Structure and function of neurons *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- State the three types and functions of neurones.
- Identify parts of a neurone and their functions.
- State structural differences between sensory and motor neurones.

Preparation for the lesson

1. This lesson will involve group work. **Remember:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Obtain reference materials in time.

Teaching Aids

- Charts
- Senior 3 Student's Book

Improvisation: You may avail charts of the three different types of neurones accompanied with adaptations to their functions.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to this unit.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include What do neurons carry? (***Ans:*** Messages in electric form). Why are neurons specialized cells? (***Ans:*** They are structurally modified by having an elongated axon along which the impulse flows.)

  Activity 12.3 (Refer to Student's Book.)

- Put learners into groups considering their abilities. Let them carry out this discussion activity.
- At this point, provide learners with the charts to help them compare structure of the neurons.
- Let learners draw well labelled diagrams of the neurons and write notes on their functions.
- Summarise the lesson by highlighting features of the motor and sensory neurons that increase the speed of impulse transmission. Clarify using the outlined points in Student's Book.
- Finalise by asking learners to write notes on functions of parts of a neuron.

Synthesis

This lesson introduces learners to the structure and function of the different neurons and their role as functional units of the nervous system.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Identify which neuron is;

   a. Efferent

   b. Connector

   c. Afferent

   Ans:

   a. Motor neuron

b. Relay neuron

c. Sensory neuron

2. Name the part of a neuron that is described by the following statements.

a. A nerve filament that arises from the cell body and extends up to a meter

b. A fatty substance that insulates the neuron loss of impulse

c. Interruptions along the axon that propagate speed of impulse transmitted

Ans:

a. Axon

b. Myelin sheath

c. Nodes of Ranvier

Lesson 4 : The synapse and transmission of a nerve impulse across the synapse *(To be covered in one period)*

The Refer to Student's Book

Specific objectives

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

- Define a synapse.
- Describe how an impulse is transmitted across a synapse.

Preparation for the lesson

1. This lesson will involve individual work and general class discussion.
2. Provide reference materials in advance.
3. Check for Internet connection in advance.

Teaching Aids

- Internet
- Senior 3 Student's Book

Improvisation: You may organise to have a Youtube video on structure of synapse and transmission of impulse across the synapse. https://www.youtube.com/watch?v=WhowH0kb7n0

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Introduce the lesson by asking learners probing questions like: A synapse allows impulses to be transmitted from one neuron to the other. It is therefore _____.

a. Bridge

b. gap

c. special neuron

d. relay neuron

(Ans; b.***)***

- Provide learners with reference material and other requirements

in time and ensure that the Wifi working or have a modem.

- Play the Youtube video and explain the transmission of an impulse across the synapse.
- Let the learners write brief notes on the synapse and transmission of impulse across the synapse.
- Summarise the lesson by highlighting the importance of synapses in transmission of impulses and learning. Refer to Student's Book.
- Finish the lesson by asking learners to attempt Self-evaluation Test 12.2.

Synthesis

This lesson intends to create awareness to the learners on the presence of synapses and their role in the unidirectional transmission of impulses.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What triggers the release of the chemical substance at the synaptic knob? (***Ans***: Arrival of an impulse at a synapse in the form of action potential)
2. How is it that synapses allow impulses to move in one direction only? (***Ans:*** the synaptic knobs are found on only one side of the neuron.)
3. How does an impulse move across the synapse? (***Ans:*** Arrival of an impulse at the pre-synaptic neuron triggers release of neurotransmitter substance from synaptic vessicles. The chemical substance (acetylcholine) diffuses across the synaptic cleft and attaches on receptors on the post synaptic neuron; hence, an action potential is generated.)

Lesson 5: The reflex arc and reflex actions *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define a reflex action.
- State the characteristics of a reflex action.
- State the components of a reflex arc.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as Wifi or modem.

Teaching Aids

- Charts
- Reference books
- Computers connected to the internet

Improvisation: You may organise to have a Youtube video on withdrawal reflex. https://www.youtube.com/watch?v=tP4cCMMSfX0

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions would include: State the components of a reflex arc. (***Ans:*** Receptor, sensory neuron, relay neuron, motor neuron, effector)
- In a reflex action, the responses are very quick and rapid. What is the survival value of this? (***Ans:*** Help to get the body away from danger)

Activity 12.4 (Refer to Student's Book.)

- Let the learners carry out activity 12.4 and discuss.
- At this point play the Youtube video to aid the learners understand the concept of the reflex arc. Lead in discussing their findings. Refer to Student's Book. Let the learners make brief notes.

Synthesis

This lesson introduces learners to the reflex actions and the pathway followed by impulses in reflex actions. Learners should relate the nature of reflex actions to its survival value in keeping the body away from danger or harm.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is a reflex action?

   Ans: A rapid and automatic response towards stimuli.

2. Describe the withdrawal reflex.

   Ans: A receptor is stimulated resulting to generation of a nerve impulse which is carried along the nerve fibre of a sensory neuron to the spinal cord. The relay neuron picks up the impulse and transmits it to the motor neuron. The motor neuron relays the impulse to the effector (biceps muscles) which contract causing withdrawal if the hand.

Lesson 6: The simple reflex action

(To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- State examples of simple reflex action.
- Trace the path of an impulse in a diagram showing the simple reflex action.
- Describe how a simple reflex action occurs.

Prerequisite for the lesson

1. This lesson will involve learners working in pairs.

   Remember: When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Learners will discuss instances in life when they experienced rapid responses.

Teaching Aids

- Senior 3 Student's Book
- Reference materials
- Computer connected to the internet

Improvisation: You may prepare an animation on the Student reflex as an example of simple reflex action. https://www.youtube.com/watch?v=-vx0c0l1hil

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which part of the central nervous system mediates a simple reflex action? (***Ans:*** Spinal cord) At what point is an impulse generated? (***Ans.*** When the receptor cells detect the stimulus)
- Arrange the learners in pairs and let them discuss the rapid responses they have experienced and note them down.
- At this point, play the Youtube animation video on Student reflex and emphasise how a simple reflex action occurs.
- Let learners write notes on simple reflex action. Refer to Student's Book.
- Summarise the lesson by highlighting the importance of simple reflex action in our day-to-day lives.

Synthesis

This lesson introduces learners to simple reflex action and how it occurs. Learners

should be able to apply the information they have learnt in occurrences when they exhibited rapid responses as a result of presence of a stimulus.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Which of the following is not an example of a simple reflex action?

   a. Student reflex

   b. Thinking reflex

   c. Knee jerk reflex

   d. Newborn reflex

   Ans: b

2. Which of the following statements describes a simple reflex action?

   a. A rapid voluntary response to a stimulus

   b. A slow involuntary response to a stimulus

   c. A rapid involuntary response to a stimulus

   d. A slow voluntary response to a stimulus

   Ans: c

3. Why is it important that simple reflex actions are mediated by the spinal cord and not the brain?

   Ans: To get the body away from danger as fast as possible to avoid harm

Lesson 7: Conditioned reflex action *(To be covered in one period)*

The Refer to Student's Book.

Specific objectives

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

- Define conditioned reflex action.
- State examples of conditioned reflex.
- Describe Pavlov's experiment.

Preparation for the lesson

1. This lesson will involve general class discussion and individualized work.

   Remember: When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Provide reference materials in advance.

Teaching Aids

- Senior 3 Student's Book
- Computers connected to the Internet

Improvisation: You may pin manila paper on the wall where learners will write what they learnt through repeated practice.

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Introduce the lesson by asking learners probing questions. Such questions may include: What enables a person to be able to do something that requires practice?
- ***(Ans:*** Learning which comes about as a result of repeatedly doing that activity)
- Which part of the central nervous system mediates a conditioned reflex?

  (***Ans:*** The brain)
- Lead in discussing the passage on Student's Book.
- At this point, you could ask a representative of each pair to write on the Manila paper hang on the wall the activities they have come up with.
- Discuss with the class the Pavlov's experiment and explain the primary, secondary stimulus and the change of sensory components.
- Summarise the lesson by highlighting the sequence of events in the conditioned reflex action. Refer to Student's Book.
- Finish the lesson by asking learners to attempt Self-evaluation Test 12.3.

Synthesis

This lesson intends to create awareness to the learners of how the conditioned reflex comes about. Learners should relate the role of conditioned reflex in their day-to-day lives and especially its importance in their learning process.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Which of the following is not an example of conditioned reflex?

   Ans:

   a. Learning to play a guitar

   b. Salivating at the sight of food

   c. Plant's shoot growing away from gravity

   d. Avoiding food of a certain taste.

   Ans: c

2. Using the words primary and secondary, describe a conditioned reflex.

   Ans: A learned reaction to a secondary stimulus that replaces a primary stimulus/ a learned reaction to a secondary stimulus that is linked to a primary stimulus.

Lesson 8: Voluntary and involuntary actions *(To be covered in two period)*

Refer to Student's Book.

Specific objectives

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

- Define voluntary and involuntary actions.
- Explain the differences between voluntary and involuntary actions.

Preparation for the lesson

1. This lesson will involve general class discussion and individual work.
2. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as Wifi or modem.

Teaching Aids

- Reference books
- Internet

Improvisation: You may organise to have a youtube video on the differences between voluntary and involuntary actions. https://www.youtube.com/watch?v=V-XSaj6_Mqw

Introduction to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions would include: What are some of the actions that you do because you voluntarily decide? (***Ans***: Walking, opening your arms, talking, etc.) What processes occur in your body without your control? (***Ans***: breathing, heartbeat, swallowing food, etc)
- Introduce the lesson by question-answer method.
- At this point, play the Youtube video and emphasise on the differences between voluntary and involuntary actions.
- Summarise the lesson by asking learners to write notes on voluntary and involuntary actions and the differences between the two. Refer to Student's Book.

Synthesis

This lesson introduces learners to voluntary and involuntary actions and the differences. The learners should be able to tell which actions they have control over and the ones they don't.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Fill the gaps in the statements given with either voluntary or involuntary.

   a. Reflex actions are …… reactions to stimuli.

   b. Movement of parts of the body involve …….. actions.

   Ans:

   a. involuntary

   b. voluntary

Lesson 9: The human senses: external structure of the eye *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Name the sense organs in their bodies.
- Describe the external structure of the eye.

Preparation for the lesson

1. This lesson will involve learners working in pairs. **Remember:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

3. Obtain reference materials in time.

Teaching Aids

- Charts
- Senior 3 Student's Book

Improvisation: You may avail charts with structure of the human eye.

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Name the five senses. (***Ans:*** Touch, smell, sight, taste and hearing) What is the importance of having the eyebrows and eye lashes? (***Ans:*** They trap dust particles and prevent them from entering the eyes.)
- Introduce the lesson by noting on the board the five sense organs and their functions. Involve the learners by question-answer.
- Guide the learners to work in pairs and observe the external features they can see in the partner's eyes.
- At this point, provide learners with the charts of the human eye.
- Discuss with the learners using the charts and let them note down the external structures of the eye.
- Summarise the lesson by highlighting the functions of the external structures of the eye.

- Finalise by asking learners to draw a well labelled diagram of the human eye and the functions of the external structures of the eye.

Synthesis

This lesson introduces learners to the sense organs. Learners should appreciate the roles played by the sense organs in their day-to-day lives.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Where are the eyes located?

   Ans: In the sockets at the front part of the skull

2. State the functions of the tear glands.

   Ans:

   i) Produce tears that moisten the eyeball and prevent it from drying out.

   ii) Tears contain enzyme lysozyme which destroys bacteria in the eye.

Lesson 10: The internal structure of the eye *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Name the internal structures of the human eye.
- Describe the functions of the internal structures of the eye.
- Explain how to determine the distance of the blind spot.

Preparation for the lesson

1. This lesson will involve group activities.
   Remember: When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Provide reference material in time.

3. Ensure that the Internet is working or provide modems.

Teaching Aids

- Internet
- Cameras
- Plain printing papers
- The notes in Senior 3 Student's Book.

Improvisation: You may organise to have flash cards with functions of the different internal structures of the eye.

Introduction to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Introduce the lesson by asking learners probing questions like:

Which part is the aperture that allows light to enter the eye.

(***Ans:*** Pupil

What would happen if excess light was to enter the eye?

Ans: Sensitive internal structures of the eye like photoreceptor cells would be destroyed.

- Provide learners with reference material and other requirements in time and ensure that the Wifi is working or have a modem.
- Guide the learners to discuss the functions of the internal structure of the eye.
- Give each group a set of flash cards for them to write the structure of the eye whose function is described.
- At this point, let the learners carry out activity 12.7 of the Student's Book.
- Let the learners present their work of Activity 12.7 to the rest of the class. Lead the discussion. Refer to Student's Book.
- Finish the lesson by asking learners to write notes on adaptations of the different internal structures of the eye to their functions.

Synthesis

This lesson intends to bring the learners' attention to the internal structures of the eye and how each is adapted to their functions.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Name the part of the eye described by the following statements.

    a. A curved transparent layer at the front part of the eye covered in tears

    b. A pigmented tissue on the inner part of sclera that nourishes the eye

    c. A clear watery fluid in the interior chamber of the eye

    d. Contains muscles that contract and relax to alter the size of the Pupil.

    Ans:

    a. Cornea

    b. Choroid

    c. Aqueous humour

    d. Iris

2. Which parts of the eye refract light?

   Ans: Cornea, lens

3. Differentiate between fovea and blind spot.

   Ans:

   Fovea: A part that contains cones where most light is focused and very clear images are formed

   Blind spot: Does not contain any photoreceptor cells; hence no images are formed if light from an object is focused here.

Lesson 11: Structure and function of the ear. *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- State the main roles of the ear.
- Describe the adaptations of the different structures of the ear to their functions.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **Remember:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as Wifi or modem.

Teaching Aids

- Metallic rods
- Meter rules
- Beakers
- Whistle/ flute
- Drum
- Charts
- Reference books

Improvisation: You may organise to have a Youtube video on mechanism of hearing.

https://www.youtube.com/watch?v=toGCC6SrKw8 or

https://www.youtube.com/watch?v=pCCcFDoyBxM

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions would include: State the two

main functions of the ear. ***Ans:*** Hearing, maintenance of balance and posture. What is the shape of the outer ear? Does it have any significance? (***Ans***: funnel – shaped to collect sound waves and direct them to the auditory canal)

Activity 12.9 (Refer to Student's Book.

- Let the learners carry out activity 12.9. Discuss and present their results to the rest of the class.
- At this point play the Youtube video to aid the learners understand the mechanism of hearing.
- Summarise the lesson by highlighting the adaptations of the structures of the ear to their functions.
- Finalise by asking learners to make notes on structure and function of the human ear. Refer to Student's Book.

Synthesis

This lesson introduces learners to the sensory organ responsible for hearing. Learners should be able to relate the adaptations of the different structures of the ear to their functions.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State the part of the ear described by the following statements.
   a. Outermost cartilaginous part that directs sound to the auditory canal
   b. A membrane in that middle ear that vibrates
   c. Spiral part responsible for hearing

   Ans:

   a. Pinna
   b. Tympanic membrane
   c. Cochlea
2. State the functions of the following parts.
   a. Semicircular canals
   b. Auditory nerve

   Ans:

   a. Maintenance of body balance
   b. Transmit impulse generated from the photoreceptor cells to the brain

Lesson 12: The tongue, nose and skin *(To be covered in two periods)*

Refer to Student's Book

Specific objectives

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

- State the functions of the tongue, nose and skin.

- Describe the structure of the tongue, nose and skin.

Preparation for the lesson

1. This lesson will involve learners working in pairs. **Remember:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Learners will determine parts of the tongue that taste different substances provided and discuss.

Teaching Aids

- Food substances
- Clean drinking water
- Senior 3 Student's Book

Improvisation: You may prepare printouts of the diagram of the tongue indicated on the parts and the different tastes they detect.

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Other than taste, state two other functions of the tongue. (***Ans:*** Aid in mechanical processing of food, aid in speech). State the other function of the nose other than being a pathway for passage of air. (***Ans:*** Filtering air to get rid of dust particles) What enables the skin to detect touch and temperature changes? (**Ans:** Presence of receptor cells)
- Let the learners carry out activity 12.10 of the Student's Book and present their work to the rest of the class.
- At this point, provide learners with the printouts of unlabelled structure of the tongue and let them refer to what they have done in activity 12.10 to label the part for the different tastes.
- Let learners present their work to the rest of the class.
- Summarise the lesson by highlighting the importance of the nose and tongue in enabling the body to avoid harmful situations.
- Finalise by asking learners to write notes in the Learners Book about structure and function of the tongue, nose and skin.
- Give learners assignment to research on hormonal control in coordination.

Synthesis

This lesson introduces learners to the other sense organs important in detecting stimuli in the environment. The learner should be able to relate the functions of the nose and the skin in

enabling them to get away from harmful situations.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Explain why:

    a. Taste of glucose cannot be detected if glucose powder is sprinkled on a dry tongue.

    b. Sense of smell is very poor when the nose is blocked due to cold.

    Ans:

    a. There is no liquid medium to enable the chemoreceptors in the tongue to bind onto receptor molecules.

    b. The cold causes swelling and inflammation of the nose which impairs sense of smell.

2. Name the type of receptors in the in the skin and their functions.

    Ans:

    Thermoreceptors - detect temperature

    Mechanoreceptors - detect physical forces like pressure

Lesson 16: Hormonal control in coordination *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define endocrine system.
- Locate endocrine organs in a given diagram of a human.
- Explain the effects of over secretion and under secretion of adrenaline and thyroxin.

Preparation for the lesson

1. This lesson will involve learners working in pairs. **Remember:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. After discussion, learners will discuss their findings on hormonal control in coordination.

Teaching Aids

- Internet
- Senior 3 Student's Book

Improvisation: You may prepare a power point presentation on role of hormones in coordination and applications of hormones in food production.

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Introduce the lesson by asking learners probing questions. Such questions may include: What does endocrine mean?

  (***Ans:*** Secrete within or internally into the bloodstream)

  Pancreas is both endocrine and exocrine. Explain.

  (***Ans:*** It secretes insulin and glucagon hormones directly into the bloodstream and also produces pancreatic juice that is delivered through the pancreatic duct.

- Let the learners discuss in groups their findings from research activity 12.9 and present their work to the rest of the class.
- At this point, you could run the power point presentation and emphasise on the effects of over secretion and under secretion of hormones.
- Summarise the lesson by highlighting the differences between endocrine and nervous system and the role of hormones in regulating growth and physiological processes in the body.
- Finish the lesson by asking learners to attempt the Self-evaluation Test 12.5. Give learners assignment to research and write notes on application of hormones in food production.

Synthesis

This lesson intends to create awareness to the learners on the role of hormones in coordination. Learners should relate the important roles played by hormones in growth and regulation of physiological processes in the body.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is an endocrine organ?

   Ans: A ductless organ or gland that secretes substances directly into the bloodstream.

2. Of the endocrine organs, which is the master gland?

   Ans: Pituitary gland

3. Fill the table below with appropriate answers.

Hormone	**Where produced**	**Function**
(i)	(ii)	Controls secretion of bile and pancreatic juice
Growth hormone	(iii)	(iv)

Ans:

i) Secretin

ii) Duodenum

iii) Anterior lobe of pituitary gland

iv) Stimulates growth of bones

Answers to Self evaluation Test 12.1

(Refer to Student's Book.)

1) A

2) D

3) B

Answers to Self-evaluation Test 12.2

(Refer to Student's Book.)

1. A

2. B

3. D

Answers to Self-evaluation Test 12.3

(Refer to Student's Book.)

1. C

2. C

3. A

Answers to Self-evaluation Test 12.4

Refer to Student's Book.

1. B

2. D

3. D

4. Choroid layer

5. Cochlea

6. (a) Bright light can destroy light sensitive cells in the eye (lens).

   (b) Cataract, long-sightedness, shortsightedness

Answers to self evaluation Test 12.5

(Refer to Student's Book.)

1. Endocrine glands are ductless glands that is they do not have any duct and hence release their secretions directly into the blood.The secretion of endocrine glands called hormones and hormones are released directly into the blood which is part of the circulatory system.

2. This is because iodine aids in the synthesis of thyroid hormones by the thyroid glands.

3. It helps in maintaining energy level.

Summary of this unit

This unit majorly explains about the nervous system. The nervous system of human beings consist of central and peripheral nervous system. It also explain more on sense organs which include eye, ear, nose, tongue and skin. It also gives details of hormonal control and coordination.

Additional information to the teacher

Summary of coordination and response

All organisms are able to sense changes in their environment called stimuli and

respond to them. The part of the body that senses the stimulus is a receptor, and the part that responds is an effector.

- The human nervous system contains specialised cells called neurons. The brain and spinal cord make up the central nervous system (CNS), which coordinates responses to stimuli.
- Reflex actions are fast, automatic responses to a stimulus. They involve a series of neurons making up a reflex arc. A sensory neurone takes the impulse to the CNS and a motor neurone takes it from the CNS to an effector.
- Receptors are generally found within sense organs.
- The receptors in the eye are rod and cone cells, found in the retina. Rods respond to dim light and cones to bright light. Cones give colour vision.
- The cornea and lens focus light rays onto the fovea, the part of the eye where cone cells are most densely packed.
- The shape of the lens is changed by the contraction or relaxation of the ciliary muscles. When focusing on a distant subject, the muscles relax so that the suspensory ligament are pulled taut and the lens is pulled into a thin shape. When focusing on a near object, the muscles contract and the lens falls into its natural, more rounded shape.
- Muscles can pull when they contract but they cannot push. A pair of muscles is therefore needed to pull in different directions, e.g. at the elbow joint. They are antagonistic muscles.
- Hormones are chemicals made in endocrine glands and carried in the blood plasma. Adrenaline is secreted by the adrenal glands, and bring about changes that supply the muscles with extra glucose. This gives the energy for contraction for 'fight or flight'.

Answers to end unit assessment 12

(Refer to Student's Book.)

1. B
2. B
3. A
4. D
5. B
6. C
7. C
8. B
9. False
10.

Responses in plants	Responses in animals
They are slow	Are fast or quick/rapid
Involve growth hormones	Does not necessarily involve growth hormones

11. a. They produce insufficient insulin or are unable to produce insulin hence they cannot regulate blood sugar levels.

b. Type I diabetes- brought about by the inability of the body to produce insulin due to the destruction of insulin producing cells by the immune system.

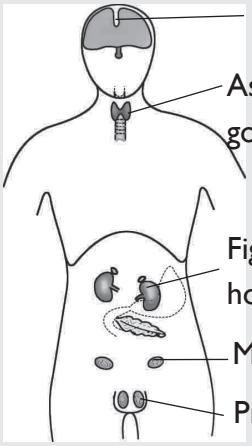
Type II diabetes- comes about due to the inability of the body to utilize insulin

c. - Birth defects
- Increase in cancerous growths
- Developmental disorders in adolescents

d. They have hormone mimicking effects e.g. rBGH increases insulin like growth factor in the body.

They may also cause growth rate abnormalities.

12.



13. Produce hormones that control other glands.

14. i) Simple reflex

ii) Biceps muscle

iii) Motor neuron

15.

Endocrine gland	Hormone secreted	Target organ	Function
Anterior lobe of the pituitary gland	Human growth hormone	All cells	Stimulates growth of bones
	Thyroxine hormone		Controls body metabolic rates
		All cells of the body	Increase the calcium ions in the body
Adrenal glands			Prepares the body for fight or flight
	Insulin	All cells	– Reduces blood sugar
	Glucagon		– Increases blood sugar
Ovary	Oestrogen		– Responsible for female secondary sexual characteristics
	Progestrone		Maintains pregnancy
Testis	Testosterone		– responsible for the male secondary sexual characteristics

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Participate fully during class and practical activities. You can do this by collecting materials needed for practicals or taking notes during class session. 2. Using Manila paper and marker pen, draw different sense organs.	1. Do further research in textbooks or the Internet about response and coordination in animals. Write short notes and share. 2. Using school computers, come up with slides explaining different forms of response and coordination in animals.
Remedial questions for slow learners 1. Name the sense organs	**Extended questions for gifted learners** 1. Using a table show how hormones are produced by endocrine and their effects.
Answers to remedial questions for slow learners 1. Eye, ear, nose, tongue and skin.	**Answers to extended questions for slow learners** 1. Refer to table 12.3 in Student's Book

UNIT 13 Asexual and sexual reproduction

Key Unit Competence

After studying this unit, learners should be able differentiate between sexual and asexual reproduction and give an example in each case.

Learning objective

After studying this unit, learners should be able to differentiate between sexual and asexual reproduction and give an example in each case.

Table 13.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Define asexual reproduction. ▪ Define sexual reproduction. ▪ Define fertilisation. ▪ State the chromosomal state of gametes and zygote. • Discuss the advantages and disadvantages of sexual reproduction.	By the end of this unit, learners should be able to: ▪ Demonstrate different forms of asexual reproduction from information provided. ▪ Plant ornamental plants around the school garden using cuttings. ▪ Compare asexual and sexual reproduction in terms of the quantity of yield.	By the end of this unit, learners should be able to: ▪ Appreciate the importance of asexual reproduction in crop plants such as potatoes and cassava.

Pre-requisites of this unit

Learners have learnt about asexual and sexual reproduction in senior 1 and senior 2. Review the topic by asking the learners to differentiate between asexual and sexual reproduction by giving examples. Use examples to show benefits and disadvantages of both sexual and asexual reproduction.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to biochemistry. Let them understand that at this level, they may only need the basic information otherwise details of the physiological processes involved in asexual and sexual reproduction will be learnt at higher level in physiology and biochemistry.

Background information

Mature living organisms produce new individuals of the same kind ensuring continuation of a species. Reproduction involves formation of new cells through cell division; mitosis and meiosis. Mitosis is the basis for asexual reproduction while meiosis occurs in sexual reproduction during formation of sex cells or gametes which are haploid. Asexual reproduction results to offspring that are genetically identical to parents unlike sexual reproduction which results to variation among members of the same species.

Cross-cutting issues to be addressed

1. ***Standardisation culture***

Bring to the attention of learners the need to seek medical attention in healthcare facilities that offer quality service for testing or screening of infections. Emphasise to the learners that bacteria multiplies rapidly by asexual reproduction and their effect if untreated could be fatal.

2. ***Financial education***

Emphasise the fact some microorganisms may reproduce asexually by means of spores that could be found on surfaces and contaminated food; hence learners should practise high standards of personal hygiene since treatment of the infections or food poisoning would have serious financial implications.

3. ***Gender education***

Emphasise to learners that anybody irrespective of their gender can pursue a career in physiology and biochemistry. Give examples of role models who are successful doctors in the area where the learners come from.

4. ***Inclusive education***

All learners should be encouraged to participate during lessons and practicals. Special arrangements should be done to take care of learners with special needs. For example, provide braille for blind

learners, large print text for those with vision problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

Developed as learners interact in pairs and as they engage in group work discussing types of reproduction and as they examine reproductive structures.

2. ***Research skills***

Learners will be expected to carry out research on advantages and disadvantages of asexual reproduction and present their work for assessment.

3. ***Communication in English***

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class.

4. ***Critical thinking***

Guide learners to discover for themselves the identification of reproductive structures using the specimen provided during practical activities or when they answer probing questions asked during the lessons. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. ***Lifelong skills***

Advise learners to learn more on economical modes of asexual reproduction like vegetative propagation that they could use in future to increase crop productivity. Also make learners aware that they can become professional biological scientists if they take this topic seriously.

Key words in this unit and their meanings

Conjugation- It is a form of asexual reproduction that involves direct cell to cell transfer of genetic material.

Fertilisation - It is the fusion of male and female gametes to form a zygote.

Gamete - This is a reproductive cell containing half the number of chromosomes.

Meiosis- This is a type of cell division that results to formation of haploid cells; having half number of chromosomes i.e. gametes. This is the basis of sexual reproduction.

Mitosis - This is a type of cell division that results to the formation of a cell having the same genetic constitution as the mother cell.

Perennating organ- This is the part of a plant that is adapted to sustaining an organism through adverse or unfavourable conditions and is capable of developing into one or more new plants.

Propagation - This involves using part of an organism to develop new organisms.

Reproduction- This is a process by which living organisms give rise to new individuals of the same kind.

Spore- This is an enclosed single or many-celled reproductive structure that is adapted to withstand harsh conditions and can give rise to new organisms.

Guidance on the problem statement

As earlier mentioned, this topic is about modes of reproduction, asexual and sexual as the means by which organisms pass their genetic information to individuals in the new generation. As a way of introducing the concept of reproduction, provide learners with charts and computer animations to help them identify different modes of reproduction; Activity 13.1.

IMPORTANT: Help learners to culture bread mould to use the specimen in relating to sporulation.

Attention to learners with special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ Slow learners can be helped to understand the differences between binary fission and budding. ▪ Give fast learners additional task to research on mode of sexual reproduction.	▪ All learners whether able or disabled should participate actively in the class activity. ▪ Physically challenged learners should be given priority in the learning process. In the group work, disabled learners should be given lighter duties like recording observations; while the rest go to the field to collect specimen. ▪ Learners with visual problems should be placed at the front of the class. ▪ Remember disability is not inability!

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Introduction and asexual reproduction	2
2.	Other modes of asexual reproduction	2
3.	Asexual reproduction by vegetative reproduction	2
4.	Advantages and disadvantages of asexual reproduction	2
5.	Sexual reproduction- gamete formation and fertilisation	1
6,	Comparison between sexual and asexual reproduction	1
7.	Advantages and disadvantages of sexual reproduction	1

Lesson 1: Introduction and asexual reproduction; binary fission and budding *(to be covered in two periods)*

Refer to the Student's Book.

Specific objectives

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

- Define reproduction
- Describe different modes of asexual reproduction

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Obtain wall charts and computer animations on the modes of asexual reproduction and other materials in advance.
3. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi or modem.

Teaching Aids

- Youtube link; https://www.youtube.com/watch?v=V4QYi3x-Yhk or https://www.youtube.com/watch?v=2WNoErUFAvI
- The diagrams in Senior 3 Student's Book

Prerequisite to the unit

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Does asexual reproduction involve gametes?

- *(**Ans**: No, new individuals arise from a single parent.)* How does the genetic constitution of an organism formed by asexual reproduction compare with that of the parent? *(**Ans**: Both have similar genetic constitution since the new organism is formed through mitotic division.)*

Activity 13.1 (Refer to Student's Book.)

- This is a discussion activity that will involve learners studying diagrammatic representation of different modes of asexual reproduction.
- Let learners have a brief discussion session on what they have identified.
- At this point, play the Youtube video then let learners write summary notes. Correct them as is appropriate. Refer to notes on Student's Book.
- Summarise the lesson by highlighting the striking feature of each mode of asexual reproduction discussed.

Synthesis

The lesson introduces learners to different modes of reproduction and types of asexual reproduction. Learners will need to apply concepts of mitosis and meiosis to understand the basis of asexual and sexual reproduction.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   ***Ans**: That there are two main modes of reproduction; sexual and asexual.*

2. What is the first stage of asexual reproduction in both binary fission and budding?

   ***Ans**:The nucleus first divides into two.*

3. How many cells are formed when a cell divides by binary fission?

   ***Ans:** Two*

Lesson 2: Other modes of asexual reproduction *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Explain how organisms reproduce by sporulation and vegetative propagation.
- State parts of the plants used for vegetative propagation.

Preparation for the lesson

1. This lesson will involve individual and group activities. You will therefore organise the class as need arises during the lesson.

REMEMBER: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Obtain the specimens of grown bread mould and other apparatus to be used in time

3. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

Teaching Aids

- Reference books
- Bread mould
- Light microscope
- Hand lens
- Slides

IMPROVISATION: You may organise to have permanent slides of **Mucor** or **Rhizopus** that learners can view in case some structures are not clearly visible in the specimen.

Introduction to the unit

Introduce the lesson as explained under **guidance on the problem statement** then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions would include: What conditions are required for growth of fungus on a substrate? *(**Ans**: Moisture, food substance and adequate temperature)* What is the functional unit of a fungus? *(**Ans**: Hyphae)*

Activity 13.3 (Refer to Student's Book.)

- Organise learners into groups and provide them with specimen, hand lenses, slides and light microscope.
- Let the learners observe the specimen and draw well labelled diagrams. Refer to figure 13.5 .
- Let the learners make brief notes from Student's Book.
- Summarise the lesson by highlighting the main points in sporulation. You can also make this more interactive by inviting a member from each group to present their work to the rest of the class.

Synthesis

This lesson introduces learners to asexual reproduction by spore formation; let the learners use hand lenses and the microscope to observe and identify the reproductive structures.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Fungi grow on substrates, what is a substrate?

   ***Ans**: Substance that provides source of food to be utilised by the fungus*

2. Explain how a fungus reproduces?

   ***Ans**: A mature sporangium bursts and releases spores. When the spore lands on a suitable substrate, they germinate and grow to form new mycilia hence another fungus is formed.*

Lesson 3: Asexual reproduction by vegetative propagation (To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Identify structures for vegetative reproduction in plants.
- Explain how each vegetative structure gives rise to new individuals.

Prerequisite for the lesson

1. This lesson will involve group work. **REMEMBER**: When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Obtain the specimen to be used in the practical activity on time.

3. Check if this is working https://www.youtube.com/watch?v=VN_p20dDrnY

Teaching Aids

- Sugar cane cuttings
- Potato tubers
- Yams
- Grass rhizomes
- Senior 3 Student's Book

IMPROVISATION: You may come up With a You Tube video to enable learners to link the real specimen with how it is used in propagation of new plants.

Prerequisite to the unit

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: From what part of the plant are stem cuttings obtained? *(**Ans**: Roots or stems of parent plants)* In which of the following plants is vegetative propagation done using parts of the leaves? A. Kales B. Bryophyllum C. Brassica D. Maize *(**Ans**: B)*

Activity 13.3 (Refer to Student's Book.)

- Put learners into groups considering

their abilities. Let them carry out the above activity.

- Provide hand lenses in case learners need to view details of some structures of specimen provided.
- At this point, you can introduce the lesson by explaining to the learners what a vegetative part is then play the YouTube video.
- Let learners write notes on natural and artificial propagation.
- Summarise the lesson by highlighting points of the vegetative structures from which the new plants grow. Refer to the notes in Student's Book.
- Finalise by giving learners assignment to come up with examples of plants from their home area that are grown by vegetative propagation. Give the learners time to do self evaluation test 13.1.

Synthesis

This lesson introduces learners to asexual mode of reproduction in plants through vegetative propagation. Learners should be able to explain how the new plants grow through vegetative propagation and give local examples they are familiar with.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Which of the following includes artificial method of propagation?

   A. Grafting

   B. Cutting

   C. Cloning

   D. Both A and C

   ***Ans**: D*

2. State examples of natural vegetative propagation.

***Ans**: Corms, rhizomes, bulbs and suckers*

Lesson 4: Advantages and disadvantages of asexual reproduction *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

By the end of the lesson, learners should be able to describe the advantages and disadvantages of asexual reproduction.

Preparation for the lesson

1. This lesson will involve group work. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Check if the computers and the internet are working properly.

Teaching Aids

- Internet
- Manila papers
- Maker pens
- Senior 3 Student's Book

IMPROVISATION: You may prepare power point presentations on advantages and disadvantages of asexual reproduction and project in class in case learners do not present some points.

Prerequisite to the lesson

Introduce the lesson by asking learners probing questions like: Which plants do not produce viable seeds and rely on vegetative propagation? ***Ans****: Bananas, sugarcane and potato)*

Teaching/Learning activities

Activity 13.4 (Refer to Student's Book.)

- Let the learners discuss advantages and disadvantages of asexual reproduction and present their work to the rest of the class.
- Provide learners with reference material and other requirements in time and ensure that the WiFi is working or provide a modem. Give them time to research more.
- Summarise the lesson by highlighting the main advantages and disadvantages of asexual reproduction. Let the learners take summary notes. Refer to the notes in Student's Book.
- Finish the lesson by asking learners to attempt Self-evaluation test 13.2 in Student's Book.

Synthesis

This lesson intends to create awareness to the learners of some of the advantages and disadvantages of asexual reproduction which they would consider in future in case they need to apply the information in farming.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. With regard to genetics, state one advantage and one disadvantage of asexual reproduction. *(**Ans**: Advantage- Good qualities of parental plants are retained by the offspring. Disadvantage- The plants produced would lack beneficial variations like hybrid vigor.)*
2. State one advantage and one disadvantage of asexual reproduction with regard to rate of reproduction. *(**Ans**: Advantage- Rapid increase of population of plants would be an easier way of solving food shortage. Disadvantage- Overcrowding of crops would result to competition for resources, hence poor growth of plants.)*

3. Plants produced solely by asexual reproduction would be faced with risk of extinction, explain. *(**Ans**: Since these plants lack advantageous variations that would enable them withstand adverse environmental conditions, they could easily be wiped out of the ecosystem by conditions like disease outbreak and unfavourable climate.)*

Lesson 5: Sexual reproduction-gamete formation and Fertilisation (To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Explain how gametes are formed in plants and animals.

Preparation for the lesson

1. This lesson will involve individual and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WiFi or modem.

Teaching Aids

- Reference books
- Permanent slides of different stages of meiotic division
- Charts and pictures showing sexual reproduction

IMPROVISATION: You may organise to have a You Tube video that you will play on gamete formation to aid in understanding the concept of gamete formation.

Prerequisite to the unit

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson

Teaching/Learning activities

1. Ask probing questions to introduce the lesson. Such questions would include: What is the state of gametes with regard to chromosome number? *(**Ans**: Haploid)*

   How many cells are formed at the end of the meiotic process? *(**Ans**: 4)*

Activity 13.6 (Refer to Student's.)

2. Inform the learners to work in pairs. Let the learners discuss in pairs how male and female gametes are formed.

3. At this point describe conjugation as a form of sexual reproduction using an example.

4. Let the learners make brief notes from Student's Book.
5. Summarise the lesson by highlighting striking difference between conjugation and fusion of gametes in plants and animals.

Synthesis

This lesson introduces learners to the process of gamete formation and Fertilisation in sexual reproduction. Let them understand the need for gamete formation with regard to maintaining of genetic stability in a species.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. State a name given to organs where gametes are formed in humans.

   Ans: *Gonads*

2. What names are used to refer to: i) Formation of spermatozoa ii) Formation of ova?

   Ans: *i) Spermatogenesis ii) Oogenesis*

3. In what structures are the following formed in plants? i) Pollen grains ii) Egg cells (***Ans***: *i) Anther ii) Ovary.*

4.. If gametes have half number chromosomes, how is the diploid nature of the organism restored? (***Ans***: *During fertilisation when the gametes fuse)*

Lesson 6: Advantages and disadvantages of sexual reproduction *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

By the end of the lesson, learners should be able to describe the advantages and disadvantages of sexual reproduction.

Preparation for the lesson

1. This lesson will involve learners working in groups. **REMEMBER**: When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Provide reference materials in advance.

Teaching Aids

- Internet
- Manila papers
- Marker pens
- Senior 3 Student's Book

IMPROVISATION: You may prepare power point presentations on advantages and disadvantages of sexual reproduction and project in class in case learners do not present some points.

Prerequisite to the unit

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson

Teaching/Learning activities

1. Introduce the lesson by asking learners probing questions such as: Which of the following is a disadvantage of sexual reproduction?

   - Offspring are produced more quickly than if by asexual means.
   - A lot of energy is needed for making gametes and finding mates.
   - Offspring are genetically different.
   - Advantageous variation enables offspring to survive different environmental conditions.

   *(**Ans**: B)*

2. Explain why sexual reproduction is more conducive for evolution.

   *(**Ans**: Variations arising from sexual reproduction offer increased genetic diversity.)*

Activity 13.7 (Refer to Student's Book.)

- Let learners discuss advantages and disadvantages of sexual reproduction and present their work to the rest of the class.
- Provide learners with reference material and other requirements in time and ensure that the WiFi is working or provide a modem.
- Summarise the lesson by highlighting the main advantages and disadvantages of sexual reproduction. Let the learners take summary notes. Refer to the notes in Student's Book.
- Finish the lesson by asking learners to attempt Self-evaluation test 13.3 in the Student's Book.

Synthesis

This lesson intends to create awareness to the learners of some of the advantages and disadvantages of sexual reproduction hence appreciate the role of sexual reproduction in their lives.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. With regard to genetics, state one advantage and one disadvantage of sexual reproduction.

   *(**Ans**: Advantages: Results in variations, hence offspring possess more improved qualities from both parents. Disadvantage- non-disjunction during gamete formation may result to genetic defects.)*

2. State one advantage and one disadvantage of asexual reproduction with regard to rate of reproduction. *(**Ans**: Advantage-fewer offspring are formed at a time hence low competition for available resources. Disadvantage-Rate of reproduction is slow hence fewer new individuals are produced.)*

Lesson 7: Comparison between sexual and asexual reproduction

(To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Compare asexual to sexual reproduction.

Preparation for the lesson

1. This lesson will involve learners working in pairs. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

Teaching Aids

- Senior 3 Student's Book

IMPROVISATION: You may prepare flash cards written on one alternative of a comparison between asexual and sexual reproduction. Provide the learners with empty flash cards on which the learners will write the other alternative of the comparison once you flash your card.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: How many parents are involved in asexual and sexual reproduction? *(**Ans**: Asexual - 1 Sexual - 2)*
- State the type of cell division responsible for formation of new individuals in: i) asexual reproduction ii) sexual reproduction. *(**Ans**: i) Mitosis ii) Meiosis)*
- Arrange the learners in pairs and let them discuss comparison between asexual and sexual reproduction. Provide learners with reference materials.
- Let learners write notes on comparison between asexual and sexual reproduction.
- Summarise the lesson by highlighting the differences between asexual and sexual reproduction. Refer to the notes in Student's Book.

Synthesis

This lesson introduces learners to differences between asexual and sexual reproduction. Learners should be able to clearly describe striking features of asexual and sexual reproduction and compare the two modes of reproduction.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. ……creates genetic diversity in asexual reproduction while …… and …… creates genetic diversity in sexual reproduction.

   *(**Ans**: mutations. Crossing over during prophase I and independent assortment of genes.)*

2. Explain why offspring produced by sexual reproduction are not completely similar to their parents in every away.

   *(**Ans**: Because the new individuals are formed by mixing of parental genes)*

Answer to Self-evaluation test 13.1

Refer to Student's Book.

1. Refer to table 13.1 of students book
2. (i) Stem, (ii) root, (iii) leaves, (iv) stem

   (v) root (vl) stem
3. C
4. D
5. Increase in production

Answer to Self-evaluation test 13.2

Refer to Student's Book.

1. There might be risk of food and space competition.
2. It's altering the size of population therefore interfering with the species habitat.
3. It allows for different organisms to have the ability to take different forms.

Answers to self evaluation test 13.3

Refer to Student's Book.

1. Refer to students book table 13.1.
2. C
3. lion, fern
4. (i) beans, hibiscus, maize, sunflower

   (ii) Sugar cane, grass, bananas, pineapples
5. Refer to the Student's Book.

Summary of the unit

This unit deals with sexual and asexual reproduction. You should therefore use practical activities and other suggested teaching approaches in the Teachers' Book to guide learners to acquire knowledge and desired competences in these areas. Plan remedial activities where necessary for slow learners and

give extra activities for gifted learners. Emphasise to the learners the benefits of this topic such as different careers and also they can put into practice what they learnt in class in real-life situation.

Additional information to the teacher

Some information that you may find relevant in this topic is given below.

Other forms of asexual reproduction

Fragmentation is a form of asexual reproduction where a new organism grows from a fragment of the parent. Each fragment develops into a mature, fully grown individual. Fragmentation is seen in many organisms. Animals that reproduce asexually include annelid worms. Many fungi and plants also reproduce asexually. Some plants have specialized structures for reproduction via fragmentation such as gemma in liverworts. Most lichens, which are a symbiotic union of a fungus and photosynthesis algae or bacteria, reproduce through fragmentation to ensure that new individuals contain both symbiont. Clonal Fragmentation in multicellular or clonial organisms is a form of asexual reproduction or cloning where an organism is split into fragments. Each of these fragments develops into mature, fully grown individuals that are clones of the original organism.

Agamogenesis

Agamogenesis is any form of reproduction that does not involve a male gamete. Examples are scorpions, lizards and apoximis. Parthenogenesis is a form of agamogenesis in which an unfertilized egg develops into a new individual. Parthenogenesis occurs naturally in many plants. Apomixis in plants is the formation of a new sporophyte without fertilisation. It is important in ferns and in flowering plants, but is very rare in other seed plants.

Alternation between sexual and asexual reproduction

Some species alternate between the sexual and asexual strategies, due to an ability known as heterogamy, depending on conditions. Alternation is observed in several rotifer species and a few types of insects, such as aphids which will, under certain conditions, produce eggs that have not gone through meiosis, thus cloning themselves. A few species of amphibians, reptiles, and birds have a similar ability. For example, the freshwater crustacean Daphnia reproduces by parthenogenesis in the spring to rapidly populate ponds, then switches to sexual reproduction as the intensity of competition and predation increases. Another example are monogonont rotifers, which reproduce via cyclical parthenogenesis. At low population densities females produce

asexually and at higher densities a chemical cue accumulates and induces the transition to sexual reproduction. Many protists and fungi alternate between sexual and asexual reproduction.

For example, the slime mold Dictyostelium undergoes binary fission (mitosis) as single-celled amoebae under favorable conditions. However, when conditions turn unfavourable, the cells aggregate and follow one of two different developmental pathways, depending on conditions. In the social pathway, they form a multicellular slug which then forms a fruiting body with asexually generated spores. In the sexual pathway, two cells fuse to form a giant cell that develops into a large cyst. When this macrocyst germinates, it releases hundreds of amoebic cells that are the product of meiotic recombination between the original two cells.

The hyphae of the common mold (*Rhizopus*) are capable of producing both mitotic as well as meiotic spores. Many algae similarly switch between sexual and asexual reproduction. A number of plants use both sexual and asexual means to produce new plants. Some species alter their primary modes of reproduction from sexual to asexual under varying environmental conditions.

Answers to end unit assessment 13.

Refer to Student's Book.

1. C
2. A
3. ii
4. D
5. C
6. B
7. A
8. A
9. B
10. B
11. Asexual
12. Cuttings - involves vegetative plant parts from stems or roots that contain one or more buds; which then grow to form new plants

    Grafting - vegetatively joining two plants (one the scion) onto another plant called the root stock
13. (provide diagrams of vegetative plant parts for propagation)

14.

Asexual reproduction	Sexual reproduction
Mitosis is the basis for formation of new individuals.	Meiosis is the basis for formation of gametes.
Involves one parent.	Involves two parents.
Zygote is not formed.	A zygote is formed.
New individual formed is typically similar to parent.	New individual formed possess variations.
Rate of reproduction is fast under suitable conditions and many new individuals are formed.	Rate of reproduction is slower and fewer individuals are formed.

15. Gametes, Fertilisation, haploid, diploid, haploid, diploid, unique, Fertilisation.

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Using manila paper, draw plants that reproduce asexually. 2. Help in collecting materials required for practicals.	1. Do further research in textbooks or the Internet about asexual and sexual reproduction. Share your results with the whole class. 2. Come up with a project you can use to convince farmers to carry out asexual reproduction in their farms.
Remedial questions for slow learners 1. What is reproduction? 2. List the two types of reproduction learnt in this unit.	***Extended questions for gifted learners*** 1. Using a table, differentiate between sexual and asexual reproduction. 2. With reference to mobility, explain how asexual reproduction is beneficial.
Answers to remedial questions for slow learners 1. The production of offspring by a sexual or asexual process. 2. Asexual and sexual	***Answers to extended questions for gifted learners*** 1. Refer to table 13.1 in the Student's Book. 2. It does not need mobility therefore, organisms that often stay in one place do not need to move to other places just to produce offspring.

UNIT 14 Sexual Reproduction in flowering plants

Key Unit Competence

After studying this unit, the learner should be able to describe how sexual reproduction occurs in flowering plants.

Learning activities

This is divided into two sections: learning objectives and links to other subjects.

Table 14.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Identify and draw the sepals, petals, stamens, filaments and anthers, carpels, style, stigma, ovary and ovules, of an insect-pollinated flower. ▪ Describe the anthers and stigmas of a flower. ▪ State the functions of the sepals, petals, anthers, stigmas and ovaries.	By the end of this unit, learners should be able to: ▪ Analyse the structural adaptations of insect-pollinated and wind-pollinated flowers. ▪ Compare insect pollinated and wind pollinated flowers.	By the end of this unit, learners should be able to: ▪ Appreciate the dependence of flowering plants on insects and wind for pollination.

Knowledge and understanding	Skills	Attitudes and values
▪ Define pollination, self-pollination and cross-pollination. ▪ Discuss the implications to a species of self-pollination and cross-pollination. ▪ Describe fertilisation. ▪ State the agents of dispersal of fruits and seeds. ▪ Describe the mechanisms of dispersion of seeds and fruits. ▪ Explain the importance of fruit and seed dispersal. ▪ Explain the conditions necessary for germination.	▪ Investigate the environmental conditions that affect germination of seeds, limited to the requirement for water, oxygen and a suitable temperature. ▪ Classify fruits and seeds according to the mechanisms by which they are dispersed. Distinguish between the pollen grains of insect-pollinated and wind-pollinated flowers.	

Prerequisites of this unit

Learners have learnt about sexual reproduction in flowering plants. Review the unit by reminding the learners of some of the terms used in sexual reproduction in plants takes place within the flower, and there are agents of pollination which facilitates fertilization.

During the lessons, strive to bring to the awareness of learners the fact that this topic is about the process of sexual reproduction in flowering plants. Let them understand that at this level, they may only need the basic information otherwise, details of the topic's content would be learnt at higher levels in plant physiology or plant breeding.

Background information

Sexual reproduction in plants just like in animals involves the fusion of gametes. The male structures of the flower called the stamen comprise of anther and filament. The anthers produce pollen grains which contain the male gametes. The female structures of the flower called the pistil comprise of the stigma, the style and the ovary. The ovaries bear the ovules which contain the egg cell. Flowers may be pollinated by either insects or wind; they therefore have structural modifications to adapt them to their mode of dispersal. Fertilization follows after pollination resulting to formation of seeds and fruits which are dispersed from the parent plant.

Cross-cutting issues to be addressed

1. Standardisation culture Bring to the attention of learners the importance of maintaining quality of plant produce by always buying quality and seeds approved by bureau standards from accredited suppliers.

2. Financial education

Emphasise the fact that learners' knowledge of sexual reproduction in plants can be used later in e.g. life plant breeding or crop farming which can earn the government revenue as well as economic stability.

3. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a career in farming and plant breeding. Give examples of role models who are successful farmers or horticulturalists in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs as they engage discussion on structure of a flower and pollination. Also during group presentations, you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentation content as slow learners contribute.

2. Research skills

Guide the learners on how to find information regarding various topics. Also guide the learners on how to come up with summarised notes from a large body of text. You should also guide learners on how to do internet searches for the various content areas they are looking for.

3. Communication in English

Developed as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in group discussions and during presentations by asking questions.

4. Critical thinking

Guide learners to discover on their own as they work in groups using flowers to find out how they are adapted to their

modes of pollination; and how fruits and seeds are adapted to their modes of dispersal.

5. Lifelong skills

Advice learners that content learnt in these lessons would be applicable in future for those who will take farming or maintaining flower gardens for aesthetic value. Also make learners aware that they can become research scientists and particularly plant breeders if they take this topic seriously.

Key words in this unit and their meanings

Anemophilus- These are flowers that are pollinated by wind.

Androecium- This is the male part of a flower.

Bisexual- This is a flower having both male and female structures.

Dispersal- This is the movement of seeds and fruits away from the parent plant.

Entomophilus- These are flowers that are pollinated by insects.

Fruit- This is the seed bearing structure formed from a flower after fertilisation.

Germination- This is a process by which a seed grows into a seedling.

Gynoecium- This is the female part of a flower.

Inflorescence- These are clusters of flowers formed on a modified shoot.

Parthenocarpy- This is the formation of fruits without Fertilisation.

Pericarp- These are fruit walls comprising of epicarp/ exocarp, mesocarp and endocarp.

Pollination- This is the transfer of pollen grains from anther to stigma of a flower.

Tetrad- This is a haploid cell formed from meiotic division of a pollen mother cell.

Unisexual- The state of a flower having either male or female structures, not both.

Guidance on the problem statement

As earlier mentioned, this topic is about sexual reproduction in flowering plants: Just like in animals, reproduction in plants also involves the fusion of male and female gametes. Flowers are the reproductive structures in plants. As a way of introducing the concept of reproduction in plants, refer learners to Activity 14.1 of their book. **IMPORTANT**: The activity is meant to introduce the concept of structure of the flower as the reproductive structure in plants. Let the learners discuss the parts they see in the different flowers.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ Slow learners can be helped to cut the longitudinal section of the flower and identify the ovules in the ovary. ▪ Give fast learners additional tasks to research on types of ovaries.	▪ All learners whether disabled or not should participate actively in the class activity. ▪ Physically challenged learners should be given priority in the learning process. In the group work, disabled learners should be given lighter duties like recording observations; while the rest go to the field to collect specimen. ▪ Learners with visual problems should be placed at the front of the class. ▪ Remember disability is not inability!

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Introduction and structure of a flower	2
2.	Agents of pollination	2
3.	Types of pollination	1
4.	Fertilisation and seed formation	2
5.	Dispersal and its importance	1
6.	Adaptations of seeds and fruits to their mood of dispersal	1
7.	Germination	1

14.1 Structure of a flower

Lesson 1: Structure of a flower *(To be covered in 2 periods)*

Refer to Student's Book.

Specific objectives

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

- Draw a well-labelled diagram of a flower.
- Explain the functions of the different parts of a flower.

Preparation for the lesson

This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER**: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

1. Organise for learners to collect the different flower specimens in time.
2. Provide reference materials.

Teaching Aids

- Flowers
- Hand lenses
- Scalpels
- Senior 3 Student's Book

IMPROVISATION: You may come up With a You Tube video to show parts of a flower in case the flowers available are not large enough for dissection. https://www.youtube.com/watch?v=rBGx97TpvTU

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What makes up the pistil? *(**Ans**: Stigma, style and ovary)* Which part of a flower attracts bees? *(**Ans**: Petals)* Which structure produces pollen grains? *(**Ans**: Anthers)*

Activity 14.1 (Refer to Student's Book.)

- This is a practical and discussion activity on identifying the different structures of a flower and their functions.
- Let the learners collect the flowers and place on the working benches.
- At this point, play the You Tube video to help guide the learners to carry out activity 14.1.
- Let learners carry out activity 14.1 under your supervision.
- Guide the learners to write notes on function of different parts of the flower.
- Summarise the lesson by highlighting functions of the main parts of a flower.
- End the lesson by instructing learners to attempt Self-evaluation Test 14.1.

Synthesis

The lesson introduces learners to the reproductive structure in plants, the flower and functions of the different parts. The lesson should help the learners appreciate the role of flowers in reproduction.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What name is given to flowering plants?

   ***Ans**: Angiosperms*
2. Which part of the flower houses egg cells or flowers?

   ***Ans**: Ovary*

3. Name the leaf- like structures that protect a flower during bud stage.

   Ans: *Sepals*

4. …… becomes the seed after fertilisation.

   Ans: Ovule

14.2 Pollination

Lesson2: Pollination *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define pollination.
- Describe features of wind and insect pollinated flowers.
- Differentiate between self pollination and cross pollination.

Preparation for the lesson

1. This lesson will involve group discussions and presentations. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring reference textbooks and the flower specimen before the beginning of the lesson.

Teaching Aids

- Flowers
- Hand lenses
- Students' reference book

IMPROVISATION: You may organise to print out pictures of wind and insect pollinated flowers that can be hang on the walls.

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

What features of a flower would attract an insect?

(***Ans***: *Brightly coloured petals, nice scent and presence of nectar)*. Which group of plants produce flowers that are mainly pollinated by wind?

(***Ans***: *Grass)*

Name four insects that pollinate flowers. (***Ans:*** *Bees, wasps, butterflies, ants, moths, beetles, flies)*

Activity 14.2 and 14.3 (Refer to Student's Book.)

- Guide the learners as they do activity 14.2 and 14.3. Remind them to note down their findings.

- Organise the learners into groups and provide them with reference materials.
- At this point, you may guide the learners to carry out activity 14.2 and fill the features of the flowers in table 14.1.
- Let the learners present their discussion briefly to the rest of the class.
- Summarise the lesson by highlighting the outstanding features of insect and wind pollinated flowers.

Synthesis

This lesson introduces learners to ways flowers are pollinated; emphasise to the learners that the features possessed by these flowers are adaptations to suit their specific modes of pollination.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What name is given to organisms that aid in the pollination process?

   Ans: *Pollinators*

2. Which animal pollinates a large number of flowers?

   Ans: Bees

3. State one similarity and one difference between insect pollinated and wind pollinated flowers.

   Ans: *Similarity- They both produce pollen grains hence they have anthers; and both produce seeds hence they both have ovaries.*

   Difference- Insect pollinated flowers have large conspicuous petals while wind pollinated flowers have small dull inconspicuous flowers.

4. Why do wind pollinated flowers produce many small pollen grains?

   Ans: *So that they are light and airborne and can be easily carried by wind. The pollens are many to increase chances of pollination.*

Lesson 3: Types of pollination *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Explain the difference between self pollination and cross pollination.
- Describe the features of wind pollinated and insect pollinated.

Preparation for the lesson

1. This lesson will involve group work. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Bring reference textbooks and the flower specimens before the beginning of the lesson.

Teaching Aids

- Flowers
- Hand lenses
- Senior 3 Student's Book

IMPROVISATION: You may come up with a You Tube video to demonstrate the process of self pollination and cross pollination. https://www.youtube.com/watch?v=L-kuvnCMZEk

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is striking feature of pollinated flowers? *(**Ans**: they are small, dull and lack scent)* How do bisexual flowers hinder self pollination? *(**Ans**: having stigma and anthers maturing at different times, stigma being incompatible with pollen from the same flower such that the pollen tube fails to germinate and stigma being located above the anthers.)*

Activity 14.4 and 14.5 (Refer to Student's Book.)

- Put learners into groups considering their abilities. Let them carry out these activities then present their findings to the rest of the class.
- Provide learners with access to internet in case they need to research on the differences between self pollination and cross pollination.
- At this point, you can play the YouTube video to enable learners internalise how self pollination and cross pollination takes place.
- Guide learners to write notes on types of pollination.
- Summarise the lesson by highlighting implications of self pollination and cross pollination to a plant. Also give examples of plants in the learners' locality that are self pollinated and those that are cross pollinated.
- Finalise by giving learners a task to attempt self-assessment test 14.2 and to write in table form the advantages and disadvantages of self pollination and cross pollination.

Synthesis

This lesson introduces learners to the two types of pollination. Emphasise to learners the implications of self and cross pollination to a plant and mechanisms

put in place by the plants to hinder self pollination.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. More genetic variability is observed if a plant undergoes _____ pollination.

   Ans: *Cross*

2. State whether these statements are true or false.

   a) Growth of pollen tube enables self and cross pollination to take place.

   b) When stigma and anther mature at the same time, self pollination is likely to occur.

   c) Self pollination occurs between stamens and carpels of the same plant.

   Ans: *a) False b) True c) True*

3. State the typical example of a plant that is:

   a) Self pollinated

   b) Cross pollinated

   Ans: *a) Maize b) Pawpaw*

4. Explain two advantages of self pollination and cross pollination.

Ans:

Self pollination

- Pollination would still take place even when the number of flowers are very few or individual plants are far apart.
- The process is not dependent on external factors.

Cross pollination

- Results to genetic variation, hence the plants produced have hybrid vigour (i.e. increased yield, early maturity, resistance to diseases and harsh environmental conditions.)
- Is a solution in cases where plants are self-sterile.

14.3 Fertilisation and seed formation

Lesson 4: Fertilisation and seed formation *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define pollination.
- Describe the process of double fertilisation in flowering plants.

Teaching Aids

- Charts
- Computer animations
- Senior 3 Student's Book

IMPROVISATION: You may provide You Tube videos to show growth of pollen tube and of male gametes to the ovary movement. https://www.youtube.com/watch?v=bUjVHUf4d1I

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. In which structure are the male gametes found? *(**Ans**: Pollen grain)* Through which part do the male gametes travel to reach the ovary? *(**Ans**: Style)* Which structure in the ovary contains the egg cell? ***Ans:*** *Ovule* What do the following structures become after fertilisation? i) Zygote ii) Triploid primary endosperm. ***Ans**: i) Embryo ii) Endosperm*

Activity 14.6 (Refer to Student's Book.)

- Let the learners observe the charts animations or computer animations.
- Ask leading questions to learners to test if they can relate it to the process of fertilisation.
- At this point, play the YouTube video to put more emphasis on the process of double fertilisation.
- Summarise the lesson by highlighting the unique feature of double fertilisation limited to angiosperms.
- Finalise by asking a gifted learner to state the structures that are formed by the fertilized ovule, integuments, endosperm and ovary walls after fertilisation.

Synthesis

This lesson intends to inform learners on the process of the fertilisation and the events that follow to result in seed formation in flowering plants; especially the unique feature of flowering plants.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is the role of tube nucleus in fertilisation?

   *(**Ans**: Guides the growth of pollen tube through the style as it is followed behind by the male nuclei)*

2. State what happens to the tube nucleus when the pollen tube reaches the embryo sac.

   ***Ans**: It disintegrates and paves way for passing of male nuclei into the embryo sac.*

3. State a name for each of the following structures formed after fertilisation.

i) A diploid structure ii) A triploid structure

*(**Ans**: i) Zygote ii) Endosperm)*

4. What is double fertilisation?

   ***Ans:** A process where one male nucleus fuses with an egg cell to form a zygote while the other male nucleus fuses with the two central polar nuclei to form a triploid primary endosperm.*

5. What type of cell division result in formation of the embryo? Explain.

   ***Ans**: Mitosis-The zygote undergoes mitotic division resulting to increase in number of cells; hence cotyledons, plumule and radical are formed.*

14.4 Dispersal and its importance

Lesson 5. Dispersal and its importance *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define dispersal.
- Describe the different types of fruits.
- Explain the importance of dispersal.
- State the modes of dispersal.

Preparation for the lesson

1. This lesson will involve group discussion. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Provide assorted fruits and reference materials on time.

Teaching Aids

- Fruits
- Hand lenses
- Knife
- Senior 3 Student's Book

IMPROVISATION: You may avail charts showing parts of a fruit and a flow chart on different types of fruits.

Prerequisite to the unit

Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What part of flower forms the fruit wall/ pericarp? **(Ans: Ovary wall)**

- Name the three agents of dispersal. *(**Ans**:Wind, water and animal)*

Activity 14.7(Refer to Student's Book.)

- This is a practical and discussion activity on identifying the different types of fruits and parts of a fruit.
- With your guidance, let the learners group the fruits you have provided them into different categories.
- Guide the learners to write notes on the different types of fruits and draw a well labelled diagram of a cross-section through a succulent fruit. Refer to learners' book.
- Summarise the lesson by highlighting how fruits are formed.
- Finalise the lesson by asking the learners to write down importance of dispersal.

Synthesis

The lesson introduces learners to dispersal of fruits and seeds. The learners should be able relate dispersal to the importance.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Define dispersal.

   ***Ans**: Refers to the movement of fruits and seeds away from the parent plant.*

2. State one disadvantage of dispersal.

   ***Ans**:The seeds may land in a place with unfavourable conditions as compared to where the parent is growing.*

3. Explain what happens to seeds to just before dispersal.

   ***Ans:** They lose a lot of water up to 90% and enter into a period of dormancy.*

4. What is one characteristic of seed dormancy?

   ***Ans**: Very minimal chemical and metabolic reactions, no growth*

Lesson 6: Adaptations of fruits and seeds to different modes of dispersal *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Describe mechanisms of seed and fruit dispersal.
- Describe how seeds and fruits are suited to their modes of dispersal.

Preparation for the lesson

1. This lesson will involve group discussions and presentations. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks and the different fruit specimen before the beginning of the lesson.

3. Prepare handouts to guide learners through the practical.

Teaching Aids

- Fruits
- Hand lenses
- Students' reference book

IMPROVISATION: You may organise to have a You Tube video on the mechanisms of dispersal. https://www.youtube.com/watch?v=vxX4sT04wvs

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  Other than water, animal and wind, state the other mode of pollination *(**Ans**: Self explosive mechanism)*

  Which groups of plants are dispersed by self explosion?

  Ans: *Legumes*

  In which ways are fruits dispersed by animals adapted?

  ***Ans**: Brightly coloured*

  - Have nice scent.
  - Seed coats are very hard to be digested.
  - Have hook- like structures that stick on clothes or animal fur/ hair.

Activity 14.7 (Refer to Student's Book.)

- Guide the learners to carry out the above activity. Organise the learners into groups and provide them with reference materials and the different seeds and fruits.
- Guide the learners to identify the mode of dispersal using a given example of a seed or fruit provided.
- At this point, play the You Tube video for learners to relate what they have and what happens in real life.
- Let the learners present their discussion briefly to the rest of the class.
- Summarise the lesson by highlighting the main features of seeds and fruits dispersed by wind, water or animals.

Synthesis

This lesson introduces learners to the adaptations of seeds and to different

modes of dispersal. Learners should be able to relate the adaptive features of seeds and fruits to the modes of dispersal.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State the structural adaptations of seeds and fruits to dispersal by wind.

   Ans:

   - *Hairy structures to make them light*
   - *Wing-like structures to increase surface area and enable them glide in air*
   - *Parachute like structures to enable them to be easily carried by wind*

2. Describe self explosive mechanism of dispersal.

   Ans: *The fruit body has lines of weakness. On drying up, pressure builds inside causing the fruit body to split along the lines of weakness scattering the seeds away from the parent plant.*

Lesson 7: Germination *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define germination.
- Explain the conditions necessary for germination.
- Explain epigeal and hypogeal germination.

Preparation for the lesson

1. This lesson will involve group work. **REMEMBER**: When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Obtain the requirements for the practical activity in time.

3. Provide germinated beans or peas and maize for demonstration of epigeal and hypogeal germination.

Teaching Aids

- Conical flasks
- Cotton wool
- Pyrogallic acid
- Water
- Senior 3 Student's Book

IMPROVISATION: You may prepare charts showing epigeal and hypogeal germination just in case the seedlings to be used for demonstration do not grow in time.

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What are the three main parts of a seed? (***Ans***. *Embryo, food store and seed coat)*

  What conditions are necessary for germination to occur? (***Ans***:*Warmth, water and oxygen)*. What is the name given to the baby plant inside the seed? *(**Ans**: Embryo)*

  Activity 14.8 (Refer to Student's Book.)

  - Put learners into groups considering their abilities. Let them carry out this activity then present their findings to the rest of the class.
  - At this point, you can play the You Tube video to enable learners internalise how epigeal and hypogeal germination takes place. Also refer to the chart.
  - Guide learners to write notes on conditions necessary for germination and types of germination. (Refer to Student's Book.)
  - Summarise the lesson by highlighting steps involved in germination.
  - Finalise by giving learners a task to attempt self-assessment test 14.4.

Synthesis

This lesson introduces learners to the process of germination and the role played by seeds in the growth of the new plant. Learners need to internalise the function of each factor required for germination.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Describe the role of oxygen in germination.

   Ans: *It is used during respiration to oxidize food and release energy required by the embryo for growth.*

2. Arrange the following steps of germination in order.

   (i) Seed coat splits apart.

   (ii) Food stored is oxidized to release energy for growth of embryo.

   (iii) Seed takes in water.

   (iv) Root and shoot grow.

   Ans: *iii), i), ii), iv)*

3. What are foliage leaves;

   Ans:*They are tiny leaves at the end of the shoot when the seedling germinates.*

Answers to self evaluation test 14.1

(Refer to Student's Book.)

1. C

2. Anther

3. B

4. Refer to Fig 14.2 of Student's Book

5. Anthers, filament

6. Anthers produce pollen grains, stigma receives pollen grain, petals protect the plant from mechanical damage.

7. Are short-lived nuclei lying near the egg in the mature embryo sac of a flowering plant. The synergies are part of the egg apparatus and are thought to help the pollen nucleus reach the egg cell for fertilization.

Answers to Self evaluation test 14.2

(Refer to Student's Book.)

1. Pollination is the transfer of pollen grain to the stigma. Cross and self.

2. To allow cross pollination to take place easily.

3. There will be low production of the crop.

4. Its stickiness

5. D

6. The wastage of pollen grain is less, it does not depend on any other external carrier.

7. Refer to Fig 14.9 students book.

8. Insects and wind

Answers to Self evaluation test 14.3

(Refer to Student's Book.)

1. A

2. D

3. Mango, rice

4 When pollen grain lands on the stigma it begins to send out a tube. This tube then grows down through the style to the ovary. When it reaches an ovule, it releases male cells from the pollen grains. A male cell unites with a female cell in the ovule. This process is called fertilisation and a fertilised ovule is a seed.

5. Refer to Fig 14.11 on students' book.

Answer to Self evaluation test 14.4

(Refer to Student's Book.)

1. Germination is the development of a seed into a seedling.

2. Activates the enzymes

3. Epigeal, hypogeal

4. C

5. B

6. Reduces competition among species as it will grow somewhere else where the species are scarce.

7. One important function of most seeds is delayed germination, which allows time for dispersal and prevents

germination of all the seeds at the same time. The staggering of germination safeguards some seeds and seedlings from suffering damage or death from short periods of bad weather or from transient herbivores. It also allows some seeds to germinate when competition from other plants for light and water might be less intense.

8. (a) Store food

   (b) Breaks down food stored in the cotyledon and endosperm into simpler forms

Summary of the unit

This unit deals with sexual reproduction in flowering plants. You therefore should effectively use the practical activities and the suggested teaching approaches in the Teacher's Book to guide learners to acquire the requisite knowledge and desired competences in these areas. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well. Emphasise the fact that taking this unit seriously may lead to careers such as horticulturalist and also a farmer.

Additional information to the teacher

Types of Flowering Plants

There are two types of flowering plants. These classification was based on:

- The physical structure of roots, stem and leaves.
- Types of seeds - Monocot and Dicot.

MONOCOTS

General characteristics of monocots.

- They are one-seeded plants.
- The leaves of monocotyledons have parallel veins.
- They are herbaceous plants.
- The parts of the flowers of monocotyledons are arranged in threes or more. It may contain flowers with three petals, flowers with six petals and the stamens also follow this pattern.
- Monocotyledons make a seed with a seed coat.
- Monocot examples are grass, corn, rice and wheat.

DICOTS

General characteristics of dicots.

- They are two-seeded plants.
- The leaves of dicotyledons have veins in network.
- Dicotyledon seeds also contain an embryonic plant.
- The flowers of dicotyledons have petals and other parts of flower arranged in four or five or six. It may contain flowers with four petals, flowers with five petals, flowers with six petals and the stamens also follow this pattern.
- The seed is protected by a seed coat. Dicot examples are beans, sunflower and roses.

Answers to end unit assessment 14

(Refer to Student's Book.)

1. D
2. C
3. C
4. B
5. A

Feature	Adaptation
Hard test	Prevent digestion of seed
Hollow	Trap air and make the seed buoyant
Line of weakness	Breaks open when dry to allow seeds to be dispersed
Long flexible stalk onto which the fruit body is attached	To be easily shaken by wind and allow seeds to be scattered away from the parent plant

6.

- Coconut- has fibrous mesocarp to trap air and make the fruit bouyant.
- Bean pod- It has a line of weakness along which the fruit body splits open and scatters seeds away from the parent plant.
- Black jack- It has hook-like structures that stick onto hair, fur or clothes of animals passing.
- Jacaranda- The presence of wing-like structures to increase surface area and make the fruit light to be easily carried by wind.

7. a) Insect

   b) • Brightly coloured petals

   • Bees visiting the flower

   c) Stigma located above anthers

   • a) A b) B c) C

8. Embryo a
   Cotyledon b
   Micropyle c
   } Label on the diagram.

9. They wither and fall off.

10. Large and rough pollen that easily sticks on the insect's body.

11.

Epigeal germination	**Hypogeal germination**
Cotyledons are brought above the soil surface.	Cotyledons remain below the soil surface.
Cotyledons turn green and photosynthesize for the young seedling.	Cotyledons do not photosynthesize.
Energy is derived from oxidation of food stored in cotyledons.	Energy is derived from oxidation of food stored in the endosperm.

12. a) Hard seed coat- corrosion or removal of testa

    b) Low concentration of hormones that promote germination-addition of dormancy breaking hormones like gibberellins

    c) Unsuitable temperature-exposure to alternating high and low temperature

    d) Immature embryo-allow more time for embryo to mature

13. **(Provide indicated/ or suitable diagrams for each of the following.)**

    a) Brightly coloured to attract animals (***Ripe mango***)

    b) Hook-like structures to stick onto clothes, hair or fur of passing animals ***(Black jack)***

    c) Succulent with sweet scent to attract animals ***(Orange that has been cut open)***

    d) Hard testa to prevent digestion by enzymes ***(Cut tomato to expose seeds)***

14. ***Requirements***

    - Water
    - Cotton wool
    - Boiling tubes

- Kidney bean seeds
- Pyrogallic acid

Procedure

1. Label the boiling tubes A to D.
2. Into A, put dry cotton wool and some seeds.
3. Into B, put wet cotton wool with some pre-soaked seeds.
4. Into C, put wet cotton wool, pre-soaked seeds and put in a fridge at 0°C.
5. Into D, put wet cotton wool, small test tube containing pyrogallic acid.
6. Leave the setup undisturbed for a few days and make your observations.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Using Manila paper, draw flower and label. Hang it on the class wall. 2. Help in collecting materials required for practicals.	1. Do further research in textbooks or the Internet about sexual reproduction in flowering plants. Share your results with the whole class. 2. Come up with an acronym that distinguishes male parts of the flower and female parts of the flower.
Remedial questions for slow learners 1. Name two types of germination. 2. What is germination?	***Extended questions for gifted learners*** 1. Explain the importance of seed and fruit dispersal. 2. Using a table, differentiate between sexual and asexual reproduction. 3. With reference to mobility, explain how asexual reproduction is beneficial.

Answers to Remedial questions for slow learners	***Answers to Extended questions for slow learners***
1. Hypogeal,epigeal 2. Germination is the process of seeds growing into plants.	1. Reduced overcrowding of seedlings which would otherwise grow around the parent plant resulting to competition for resources. 2. Seeds may be dispersed to new areas with more suitable conditions than where the parent plants are growing.

UNIT 15 Sexual reproduction in human beings

Key Unit Competence

After studying this unit, the learner should be able to describe how sexual reproduction occurs in human beings.

Learning objectives

This is divided into two sections: learning objectives and links to other subjects

Table 15.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Identify and name on diagrams of the male reproductive system: the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts. ▪ Identify and name on diagrams of the female reproductive system: the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts.	By the end of this unit, learners should be able to: ▪ Describe the ante-natal care of pregnant women and the harm from smoking and alcohol consumption.	By the end of this unit, learners should be able to: ▪ Advocate for good ante-natal care of pregnant women.

Knowledge and understanding	Skills	Attitudes and values
▪ State the adaptive features of sperm. ▪ State the adaptive features of egg cells. ▪ Define fertilisation. ▪ State the functions of the umbilical cord, placenta, amniotic sac and amniotic fluid. ▪ Outline the growth and development of the foetus in terms of increasing complexity in the early stages and increasing size towards the end of pregnancy.	▪ Interpret charts for the hormonal control of the menstrual cycle.	

Pre-requisites of this unit

Learners learnt about sexual reproduction in human beings in senior 1 and senior 2. Review this unit by asking the learners to name the type of reproduction exhibited by human beings. Remind them of some of the key words used in reproduction in human beings as learnt in senior 1 and senior 2. Prepare the learners psychologically to know that the unit deals with more detailed information about reproduction in human beings compared to what they learnt in senior 1 and senior 2.

During the lessons, strive to bring to the awareness of learners the fact that this topic is about the process of sexual reproduction in animals. Let them understand that at this level, they may only need the basic information otherwise, details of the topic's content would be learnt at higher levels in animal physiology.

Background information

Sexual reproduction in animals involves the fusion of gametes. Humans, like all mammals, reproduce sexually. The male gamete and the female gamete fuse to form a new individual. The male and the female reproductive systems are structurally suited to carry out their function. The sperm are formed through the process called spermatogenesis while eggs are formed through oogenesis. These gametes are haploid and when they fuse, the diploid nature of chromosomes in the zygote is restored.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the importance of seeking medical attention from qualified doctors or gynaecologists in case they have any conditions or diseases of affecting the reproductive system.

2. Financial education

Emphasise the fact that learners need to take good care of their reproductive health. Emphasise that other than a person being naturally sterile, sterility could even be caused by STIs like gonorrhoea and the cost of getting a test tube baby is very high.

3. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a career in human physiology, medicine or gynaecology. Give examples of role models who are successful doctors or gynaecologists in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs as they engage discussion on processes involved in sexual reproduction in humans. During presentations, you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentations as slow learners contribute.

2. Research skills

Guide the learners on how to find information regarding various topics such as role of hormones in development of secondary sexual characteristics in males and females. Guide the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in the discussions, presentations and during question-and-answer sessions.

4. ***Critical thinking***

This will be developed by learners as they answer the probing questions. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. ***Lifelong skills***

Advise learners that content learnt in these lessons would be applicable in their reproductive life in future. Also, make learners aware that they can become doctors and particularly gynaecologists if they take this topic seriously.

Key words in this unit and their meanings

Blastocyst- Hollow ball of cells formed from the zygote after a series of mitotic divisions

Egg – Female gamete

Implantation- Attachment of the blastocyst onto the uterus

Lactation – Production of milk by mammary glands

Menstruation- Periodic shading of the endometrium in the form of blood and tissue debris

Miscarriage- Loss of pregnancy before end of 23 weeks or six months

Myometrium- Middle uterine layer comprising of smooth muscles

Ovulation- Release of mature egg from the ovary

Parturition- The process of giving birth

Placenta- An organ found in mammals through which substances exchange between the mother and foetus and is made up of embryo and maternal tissues

Progesterone- A pregnancy hormone that maintains the uterus and is secreted by the ovary and placenta.

Semen- Fluid containing mature sperm cells and seminal fluid.

Umbilical cord - A rope- like organ that links the embryo to the placenta.

Guidance on the problem statement

As earlier mentioned, reproduction is a characteristic of living things. This topic is about sexual reproduction in human beings and involves two mature individuals, male and female. The mature individuals possess reproductive organs called gonads that produce gametes, i.e. sperm cells and ova. **IMPORTANT**: Use Activity 15.1 to introduce the topic. Let the learners discuss the functions of the different parts of the male and female reproductive systems.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. ▪ Ensure all learners respect others' views irrespective of their shortcomings or talents. ▪ Gifted learners to be given heavy tasks requiring more critical thinking while slow learners to be given tasks which they can manage such as collecting materials for use during practicals.	▪ All learners whether able or disabled should participate actively in the class activity. ▪ Physically challenged learners should be given priority in the learning process. In the group work, disabled learners should be given lighter duties like recording, observations, while the rest go to the field to collect specimen. ▪ Learners with visual problems should be placed at the front of the class. ▪ **Remember** disability is not inability!

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Structure and function of the male reproductive system	2
2.	Adaptations of the sperm cell	1
3.	Structure and function of the female reproductive system	2
4.	Adaptations of the ovum	1
5.	The menstrual cycle	2
6.	Role of sex hormones in secondary growth	1
7.	Fertilisation and implantation	1
8.	Pregnancy, antenatal care and birth	2

15.1 Male and female reproductive system

Lesson 1: Structure and function of the male reproductive system

(To be covered in 2 periods)

Refer to Student's Book.

Specific objectives

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

- Label indicated parts on a diagram of the male reproductive system.
- Explain the function of parts of the male reproductive system.

Preparation for the lesson

1. This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER**: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Charts
- Worksheets
- Senior 3 Student's Book
- You Tube tutorials

IMPROVISATION: You may arrange to have permanent slides of the male reproductive system.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which part of the male reproductive system produces the gametes? *(**Ans**:Testis)*
- What is the role of smooth muscles in the tube that carries spermatozoa? *(**Ans**: Contract to enable sperm cells to be conducted out of the testis.)*

Activity 15.1 (Refer to Student's Book.)

- This is a practical and discussion activity on identifying the different parts and functions of the male reproductive system.
- Let the learners carry out activity 15.1 under your supervision.
- Let the learners study the charts and diagrams in reference books to familiarize with the labelled parts on the male reproductive system.
- At this point, issue a work sheet with male reproductive system structure to the groups to ascertain if the learners can be able to identify the

unlabelled parts. Guide the learners to write notes on function of different parts of the male reproductive system.

- Summarise the lesson by highlighting the main functions of the testis.
- Finalise by instructing learners to draw a well labelled diagram of the male reproductive structure in the Student's Book.

Synthesis

The lesson introduces learners to the male reproductive structure in humans. The lesson should enable learners, especially males, to familiarise with the structure and functions of their reproductive system.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. …….. and …….. are responsible for carrying semen from the male reproductive system to the female's vagina.

   Ans: *Penis and urethra*

2. What is the function of seminal vesicles?

   Ans: *They produce secretions that contain nutrients to nourish the sperm cell.*

3. Name the sac that holds the testis.

   Ans: *Scrotum*

4. Why does the scrotum hang outside the body?

   Ans*: To provide suitable temperature for spermatogenesis*

Lesson 2: The sperm and its adaptations to its function *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Label parts of the sperm cell.
- Describe the structural adaptations of the sperm cell.

Preparation for the lesson

1. This lesson will involve individualised work and discussing in pairs. You will therefore organise the class as need arises during the lesson. **REMEMBER**: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring reference textbooks and photomicrographs of the human sperm before the beginning of the lesson.

Teaching Aids

- Photomicrographs
- Students' reference book

IMPROVISATION: You may arrange to have permanent slides of the sperm.

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  Is a spermatozoan a specialized cell? Explain *(**Ans**:Yes. It is structurally modified to have a tail to propel it to the ovum for fertilization to occur.)* What is the chromosome number and state of the sperm cell? *(**Ans:** 23, haploid)*

Activity 15.1 (Refer to Student's Book.)

- Organise the learners to work in pairs and provide them with reference materials.
- At this point guide learners to use the photomicrographs and reference book to note down some structural features they see present in the sperm cell but absent in a typical animal cell.
- Let the learners give you the points and note them on the board then discuss those structural features as adaptations.
- Let the learners write notes on structure and adaptations of the sperm cell to its function.
- Summarise the lesson by highlighting the roles of the tail, lytic enzymes and mitochondria in the sperm cell. Refer to students book.

Synthesis

This lesson introduces learners to the structure, function and adaptations of the male gamete. Emphasise to the learners the adaptations of the sperm as a specialised cell.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Where are male gametes produced?

   ***Ans**:Testes*

2. State whether the following statements are true or false.

   (a) Sperm cells are motile.

   (b) Sperm cells have muscles that contract and relax to propel it.

   (c) The chromosome number in the sperm cell is the same as that of the body cell.

Ans:

(a) True

(b) False

(c) False

3. State the functions of the following in the sperm cell:

   (a) Mitochondria

   (b) Nucleus

   Ans:

   (a) Produce energy for propelling the sperm cell forward

   (b) Contains genetic information of the cell

Lesson 3: The female reproductive system *(To be covered in 2 periods)*

Refer to Student's Book

Specific objectives

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

- Label indicated parts on a diagram of the female reproductive system.
- Explain the function of parts of the female reproductive system.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson.

   REMEMBER: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Organise to have the charts in place before the lesson.

3. Provide reference materials.

Teaching Aids

- Charts
- Worksheets
- Internet
- Senior 3 Student's Book

IMPROVISATION: You may arrange to have permanent slides of cross-sections through the ovary and the female reproductive system.

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which part of the female reproductive system produces the gametes *(**Ans:** Ovary)*
- What is the role of smooth muscles in the fallopian tube? *(**Ans**: Contract and relax to push the egg through)*

Activity 15.1 (Refer to Student's Book.)

- This is a practical and discussion activity on identifying the different parts and functions of the female reproductive system.
- Let the learners carry out Activity 15.1 under your supervision.
- Let the learners study the charts and diagrams in reference books to familiarize with the labelled parts of the female reproductive system.
- At this point, issue a work sheet with female reproductive structure to the groups to ascertain if the learners can be able to identify the unlabelled parts. Guide the learners to write notes on function of different parts of the female reproductive system.
- Summarise the lesson by highlighting the main functions of the ovary.
- Finalise by instructing learners to draw a well labelled diagram of the female reproductive structure in Student's Book.

Synthesis

The lesson introduces learners to the female reproductive structure in humans; the lesson should enable learners, especially females, to familiarise with the structure and functions of their reproductive system.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Which of the following is not a part of the female reproductive system?

   (a) Uterus

   (b) Cervix

   (c) Vas deferens

   Ans:*Vas deferens*

2. What is the other name for fallopian tube?

   Ans: *Oviduct*

3. What is the name of the structure that contains vestibular glands that secrete mucus for lubrication during coitus?

   Ans: *Vulva.*

Lesson 4: Adaptations of the female gamete *(To be covered in one period)*

Refer to Student's Book.

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

- Label parts of the egg cell.
- Describe the structural adaptations of the egg cell.

Preparation for the lesson

1. This lesson will involve individualised work and discussing in pairs. You will therefore organise the class as need arises during the lesson. **REMEMBER**: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks and photomicrographs of the female gamete before the beginning of the lesson.

3. Make sure the computers and Internet are working, just in case they will be used in class. Test if this is working: https://www.youtube.com/watch?v=HUopApcRKTE

Teaching Aids

- Photomicrographs
- Students' reference book
- Computer and Internet

IMPROVISATION: You may organise to have a You Tube vide on comparison between male and female gamete.

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  What is the chromosome number and state of the egg cell? ***(Ans:*** *23, haploid)*

- Is an egg cell motile?

  *(**Ans**: No, it is not motile.)*

- What is the structural adaptation of the ovum to nurture the zygote before implantation?

  *(**Ans**: It has dense cytoplasm to provide nutrients to the zygote.)*

  Activity 15.1 (Refer to Student's Book.)

  - Organise the learners to work in pairs and provide them with reference materials.
  - At this point guide learners to use the photomicrographs and reference book to note down some structural features they see present in the egg cell but absent in a typical animal cell.
  - Let the learners give you the points and note them on the board; then discuss those structural features as adaptations.
  - Let the learners write notes on structure and adaptations of the egg cell to its function.
  - Summarise the lesson by highlighting the roles of the different structures of the egg cell.

Synthesis

This lesson introduces learners to the structure, functional adaptation of the female gamete. Emphasise to the learners the adaptations of the ovum as a specialised cell.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Where are female gametes produced?

   Ans: *Ovary.*

2. Fill the table below.

Feature	Egg cell/ovum	Sperm cell
Shape		
Motility		
Number produced		
Chromosome		

Ans:

Feature	Egg cell/ovum	Sperm cell
Shape	*Rounded*	*Spindle shaped*
Motility	*Non-motile*	*Motile*
Number produced	*One every month*	*Produced in thousands*
Chromosome	*An X*	*Either X or Y*

15.2 The menstrual cycle

Lesson 5: The menstrual cycle *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define menstrual cycle.
- Describe the role of hormones in the menstrual cycle.

Preparation for the lesson

1. This lesson will involve individualised work and discussing in pairs. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts and computer animations in advance showing the menstrual cycle.

Teaching Aids

- Charts
- Computer animations
- The notes in Senior 3 Student's Book

IMPROVISATION: You may provide a YouTube video that describes menstrual cycle.

https://www.youtube.com/watch?v=vXrQ_FhZmos and https://www.youtube.com/watch?v=Vl2wRbO8LZU

Prerequisite to the lesson

Introduce the lesson as explained under guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. These questions include: At what age does menstruation begin? *(**Ans**: 12, but the age could vary in some individuals. Hence it may begin between 8-15 years.)*
- What sign indicates that menstruation has started? ***Ans**: Discharge of blood from the vagina*
- Which part of the female reproductive system produces the debris and blood during menstruation?

  ***Ans**: Uterus*

Activity 15.2 (Refer to Student's Book)

- Let the learners discuss the menstrual cycle in Activity 15.2 and present their work to the rest of the class.
- Let the learners observe the charts, animations or computer animations.
- Explain to the learners the role of hormones involved in the menstrual cycle.
- At this point, play the YouTube video to highlight important concepts in the menstrual cycle.
- Summarise the lesson by highlighting in point form the roles played by Follicle Stimulating Hormone (FSH), Luteinising Hormone (LH), oestrogen and progesterone.
- Finalise by asking learners to write notes in the Student's Book.

Synthesis

This lesson intends to inform learners on the process of the menstrual cycle and especially the girls to relate to the changes that take place in their bodies from the onset of puberty.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. When is the first day of the menstrual cycle? (***Ans***: *The day menstruation begins)*

2. State two roles of each of the following hormones in the menstrual cycle? a) Follicle stimulating hormone b) Oestrogen

Ans:

(a) – Stimulates follicle cells to secrete oestrogen

– Causes growth of Graafian follicle

(b) – Repairs walls of endometrium after menstruation

– At its highest levels, it stimulates the pituitary gland to secrete luteinizing hormone

15.3 Sex hormones

Lesson 6: Role of hormones in development of secondary sexual characteristics *(To be covered in 1 period)*

Refer to Student's Book.

Specific objectives

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

- Define sex hormone.
- Name the hormones involved in the development of secondary sexual characteristics in males and females.
- Describe the roles of the sex hormones in males and females.

Preparation for the lesson

1. This lesson will involve group discussion. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Ensure the Internet is working or provide modems. Test this https://www.youtube.com/watch?v=PIEuvD2RV5U if it is working.

Teaching Aids

- Internet.
- Senior 3 Student's Book

IMPROVISATION: You may run some You Tube videos that illustrate the secondary changes brought about by oestrogen and progesterone. Use https://www.youtube.com/watch?v=PIEuvD2RV5U and https://www.youtube.com/watch?v=hQK3Ew-csCA

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Define sex hormone.

  *(**Ans**: Chemical substance produced by gonads that affects the growth and function of reproductive organs as well as the development of secondary sexual characteristics)*

- What is puberty?

  *(**Ans**: A stage in the development of boys and girls when they reach sexual maturity and become capable of reproduction)*

- Which parts of a girl's body increase in size under the influence of sex hormones?

  *(**Ans**: Long bones, breasts and hips)*

  Activity 15.3 (Refer to Student's Book.)

- This is a discussion activity on identifying the characteristics that develop in boys and girls under the influence of sex hormones.

- Let the learners discuss as indicated in Activity 15.3 and present their work to the rest of the class.

- At this point, play the YouTube videos for learners to relate to the lesson content.

- Guide the learners to write notes on roles of oestrogen and progesterone in the development of secondary sexual characteristics. Refer to Student's Book.

- Summarise the lesson by highlighting the changes that boys and girls go through at puberty.

- Finalise the lesson by asking the learners to attempt Self-evaluation test 15.3.

Synthesis

The lesson introduces learners to the characteristics that develop due to the effect of sex hormones. The learners should appreciate what they go through as adolescents and learn how to adjust and cope with them.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Which parts of the male increase in size under the influence of testosterone.

   Ans:

   - *Shoulders*
   - *Voice box or larynx*
   - *Muscles*
   - *Long bones*
   - *Penis*

2. Which of the following hormones cause development of secondary sexual characteristics in females? A. Luteinising hormone B. Progesterone C. Oestrogen

   ***Ans**: C - Oestrogen*

3. State two physiological processes controlled by sex hormones in females.

   ***Ans**: Menstruation and pregnancy*

15.4 Fertilisation and implantation

Lesson 7: Fertilisation and implantation *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define fertilisation.
- Describe how fertilisation occurs in humans.
- Explain the process of implantation.
- State the roles of the umbilical blood vessels and the placenta.

Preparation for the lesson

1. This lesson will involve group discussions and presentations. You will therefore organise the class as need arises during the lesson.

   REMEMBER: When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks and charts before the beginning of the lesson.

3. Check this https://www.youtube.com/watch?v=btp4jCYZ5K4 if it is working.

Teaching Aids

- Charts
- Computer animations
- Students' reference book
- Internet

IMPROVISATION: You may organise to have a Youtube video on the mechanisms of dispersal. https://www.youtube.com/watch?v=btp4jCYZ5K4

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

  What facilitates the movement of the released ovum along the fallopian tube?

  *(**Ans**: Wafting motion of cilia lining the*

oviduct and contraction of the smooth muscles)

Which part of the sperm penetrates the egg?

*(**Ans**: The head)*

What nourishes the sperm as it swims towards the egg?

***Ans**: Dissolved nutrients in the seminal fluid*

Activity 15.4 (Refer to Student's Book.)

- Organise the learners into groups and provide them with reference materials.
- Let the learners discuss the process of fertilisation and implantation and present their work to the rest of the class.
- At this point, play the You Tube video for learners to relate what they have learnt with the animation of the process of fertilisation and implantation.
- Summarise the lesson by highlighting the stages of development from the zygote to the embryo.
- Finalise by asking learners to write notes in the Student's Book.

Synthesis

This lesson introduces learners to the process of fertilisation and implantation. The concept of life beginning at conception should be emphasised to learners and how a single cell grows and eventually develops to a zygote.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Where does successful fertilisation occur in the female body?

   ***Ans:** Oviduct/fallopian tube*

2. What enables the sperm to penetrate the ovum?

   ***Ans:** The lytic enzymes in the acrosome that dissolve the zona pellucida*

3. What happens to the zygote immediately after fertilisation?

   ***Ans**: It undergoes mitotic division and increases in size.*

4. State the name of the following:

   (a) Solid ball of cells that moves to the uterus.

   (b) Hollow ball of cells that moves to the uterus and implants.

   Ans:

   (a) Morula

   (b) Blastula

5. Can more than one sperm fertilize an ovum? Explain.

Ans: *No. The outer membrane immediately changes and becomes impermeable after first sperm hence blocking penetration by another sperm.*

6. What structure is formed at the site of implantation?

   Ans*: Placenta*

7. State the function of: a) umbilical artery b) umbilical vein

   Ans: *a) Transport nitrogenous waste products from foetus to mother b) Transport nutrients to the foetus*

15.5 Pregnancy, ante-natal care and birth

Lesson 8: Pregnancy, ante-natal care and birth *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define pregnancy.
- Explain the care that a pregnant woman should receive.
- Describe the developmental stages of the foetus during the gestation period till birth.

Preparation for the lesson

1, This lesson will involve group work and discussion. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Provide reference materials and references.

Teaching Aids

- Charts
- Computer animations
- Notes in Senior 3 Student's Book
- Internet

IMPROVISATION: You may prepare charts showing different stages of foetal development.

Prerequisite to the lesson

Introduce the unit as explained under the guidance on the problem statement then narrow down to this lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions include:

  What is gestation period? *(**Ans**: The period between pregnancy and birth)*

  The zygote undergoes mitosis to form …….. *(**Ans:** an embryo)*

  How long is the pregnancy period of human beings? *(**Ans**: 9 months/40 weeks)*

Activity 15.5 (Refer to Student's Book.)

- Put learners into groups considering their abilities. Let them carry out this activity then present their findings to the rest of the class.
- At this point, you can play the You Tube video to enable learners internalise the developmental stages of the human pregnancy. Also refer to the chart.
- Guide learners to write notes on developmental stages during gestation. (Refer to Student's Book.)
- Summarise the lesson by highlighting the developmental stages from zygote to foetus.
- Finalise by describing the events that occur during birth of the baby and ask learners to attempt Self-evaluation test 15.4 .

Synthesis

This lesson introduces learners to the developmental stages of pregnancy in humans and how the zygote grows to an embryo and eventually to a foetus. Learners should appreciate the role of mitosis in growth of the embryo.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1, What enables the blastocyst to embed into the uterine wall?

   Ans: *Chorionic villi*

2. What is the role of the placenta?

   Ans:

   - It is a site where exchange of substances occurs between mother and foetus.
   - It produces hormone progesterone which sustains pregnancy.

3. Which hormone causes contraction of the uterine wall to cause expulsion of the foetus at birth?

   Ans: *Oxytocin*

4. What else occurs at birth to allow passing of the baby's head at birth?

   Ans: *Dilation of the cervix*

5. Which nutrient ions should be supplied richly in a pregnant woman's diet?

   - *Calcium*
   - *Iron*

6. What should a pregnant woman avoid?

   - *Smoking*
   - *Drinking*
   - *Walking in high heels*
   - *Wearing tight clothes*

Answers to Self-evaluation test 15.1

(Refer to Student's Book.)

1.

(a) Scrotum

(b) Fallopian tube

(c) Vagina

2. *Vagina–>cervix–>uterus–>uterine tube-->peritoneal cavity*

3.

Sperm	Ova
The head has an acrosome containing lytic enzyme. Large number of mitochondria. Long whip like tail. Sperms are produced in large numbers.	It is bigger in size. It contains cytoplasm to survive.

4. Refer to Student's Book Fig 15.8.

Answers to Self-evaluation test 15.2

(Refer to Student's Book.)

1. This is because it is prepared for implantation and supplied with dense network of capillary.

2. B

3. This ensures that the thick endometrium layer in the uterus is maintained and no new follicle develops.

Answers to Self-evaluation test 15.3

(Refer to Student's Book.)

1. Formation of gametes

   Development of secondary sexual characteristics.

2. These are physical characteristics developing at puberty which distinguish between the sexes but are not directly involved in reproduction.

3.

Females	Males
• Growth of breasts • Growths of hips • Growth of pubic hair	• Growth of pubic hair • Deep voice • Big size of penis

Answers to Self-evaluation test 15.4

Refer to Student's Book.

1. Menstruation takes place(the shedding off of the uterine wall)

2. This is possible because after one sperms enters the ovum, the egg membrane changes its structure to prevent other sperms from entering the ovum.

3. The most common cause of blocked fallopian tubes is a chlamydia infection that has been left untreated. The abnormal growths of muscular tissue in the

womb that can block the fallopian tubes or stop a fertilised egg from implanting. When the tissue that lines the womb grows outside the womb it can obstruct the fallopian tubes and prevent fertilisation.

4. - Allows waste to pass from the placental blood vessels into the blood vessel of the mother
   - Supply of oxygen
   - Supply of nutrients to the foetus

Answer to Self-evaluation test 15.5

(Refer to Student's Book.)

1. Gestation period, myometrium
2. Oxygen, nutrients
3. Deoxygenated
4. Refer to students book.
5. Alcohol, drugs that are not prescribed by doctors
6. Refer to Fig 15.14 of Student's Book.

Summary of the unit

This unit deals with reproduction in human beings. It explains the function of different parts of both the male and female reproductive system. You should therefore effectively use the practical activities and the suggested teaching approaches in the Teacher's Book to guide the learners to acquire the requisite knowledge and desired competences in the area. Plan remedial activities where necessary for slow learners and give extra activities for gifted learners.

Additional information for the teacher

Assisted Reproductive Technology ("ART")

In Vitro Fertilization (IVF)

IVF involves harvesting mature eggs from the mother. This is not an easy process. The mother must undergo hormonal treatments to produce multiple eggs, which then must be removed (under anaesthesia) from her ovaries.

Harvesting sperm from the father

Harvesting is usually no problem, but often the sperms are defective in their ability to fertilize. Mixing sperm and eggs in a culture vessel culturing the fertilized eggs for several days until they have developed to at least the 8-cell stage. Placing two or more of these into the mother's uterus (which her hormone treatments have prepared for implantation). Only about one-third of the attempts result in a successful pregnancy).

Intracytoplasmic Sperm Injection (ICSI)

Successful IVF assumes the availability of healthy sperm. But many cases of infertility arise from defects in the father's sperm. Often these can be overcome by directly injecting a single sperm into the egg.

Ooplasmic Transfer

Infertility in some cases may stem from defects in the cytoplasm of the mother's egg. To circumvent these, cytoplasm can be removed from the egg of a young, healthy woman and injected along with a single sperm into the prospective mother's egg.

Answers to end unit assessment 15

(Refer to Student's Book .)

1. (B)
2. (B)
3. (C)
4. Zygote
5. Oxytocin
6. Spermatogenesis is the process of formation of mature male gametes (sperm) while oogenesis is the process of formation of mature female gametes.
7.
   (a) Provide a site for exchange of substances between the mother and foetus
   (b) Conduct sperm cells out of the testis
   (c) Temporarily store sperm and nourish them as they mature
   (d) Produce secretions that neutralise the acidity of vagina
8. Produce secretions that neutralise acidity of urethra hence protecting sperm cells
9.
   - Has finger-like projections at the end called fimbriae that enable uptake of released ovum
   - Has cilia which waft to push the released egg
   - Has smooth muscles that contract and relax to push the ovum
10.
   - Contract
   - Dilate
   - Expelled as an 'afterbirth'
11. (i), (iii), (ii)
12.
   (a) Both are formed through mitosis.
   (b) They are produced through meiosis which results into variation.

(c)

Sperm	Ova
▪ The head has an acrosome containing lytic enzyme. ▪ Large number of mitochondria ▪ Long whip like tail ▪ Sperms are produced in large numbers.	▪ It is bigger in size. ▪ It contains cytoplasm to survive.

(d) They differ in genetic composition because both ova and sperm contribute to gene formation.

(e) i) To provide a conducive temperature for the sperms,

ii) Scrotum

13.

(a) One vein and two arteries

(b) Vein has oxygenated blood artery has deoxygenated blood.

(c) Amniotic fluid

(d) It will act like shock absorber and protect the lung from mechanical injury

(e) The placenta has membranes, which separates the blood vessels from the mother and the foetus. These membranes are thin and hence allow dissolved oxygen, glucose and amino acids. Blood from the embryo is directed to the placenta capillaries through umbilical arteries.

(f) Menstrual cycle is the shedding of the uterine lining that would otherwise have housed a growing embryo in pregnancy. When a woman becomes pregnant, the uterine wall is necessary to house the embryo and is retained inside the womb.

(g) Progesterone

14.

Hormone	Site of production	Effect
FSH		*Causes growth of Cowper's gland*
Oestrogen		
Luteinising hormone		
	Placenta *Ovary*	

15. (a) Umbilical cord, placenta, embryo, amnion, chorion, amniotic cavity and uterine wall

(b) Gives the foetus physical support, acts as a shock absorber therefore protecting the foetus from mechanical damage, lubricates the foetus and prevents it from dehydrating

16.

(a) Kidney, ureter, fallopian tube, funnel of fallopian tube, ovary, uterus, cervix, vulva

(b) Vagina

(c) Erythropoietin

(d) A

(e) A and B

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Using Manila paper, write the female reproductive organs with their functions. Stick on the class wall. 2. Using reference materials, compare the reproductive system of human beings and that of other animals. Are they the same?	1. Do further research in textbooks or the Internet about reproduction in human beings. Write short notes then share with other class members. 2. Using specific programmes create videos and movies showing reproduction system in human beings. Share and watch it with your classmates. 3. Using the plasticine, model both male and female reproductive system.
Remedial questions for slow learners 1. What is reproduction? 2. State two types of reproduction.	***Extended questions for gifted learners*** 1. Draw a female reproductive system.
Answers to remedial questions for slow learners 1. The production of offspring by a sexual or asexual process 2. Asexual and sexual	***Answers to extended for gifted learners*** 1. Refer to Student's Book page 283.

UNIT 16 Social factors that affect good health

Key Unit Competence

After studying this unit, the learner should be able to describe social factors that affect good health and apply the information gained in familiar unfamiliar contexts.

Learning objectives

Table 16.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Describe factors that affect good health with regard to good housing, food inspection, clean water and hygiene. ▪ Describe the use of antibiotics for the treatment of bacterial infection. ▪ State how bacteria develop resistant to antibiotics. ▪ State why antibiotics kill bacteria but do not affect viruses. ▪ Explain how development of resistant bacteria such as MRSA can be minimised, limited to using antibiotics only when essential and ensuring treatment is completed.	By the end of this unit, learners should be able to: • Demonstrate factors that affect good health, with reference to good housing, food inspection, clean water and hygiene. • Carry out research on common drugs, their effects and ways of avoiding abuse.	By the end of this unit, learners should be able to: • Appreciate the organisation and functioning of public health services.

▪ Describe the effects of excessive alcohol and marijuana consumption. ▪ State the role of liver in the breakdown of alcohol and other toxins. ▪ State the effect of excessive alcohol consumption on the liver. ▪ Explain how tobacco smoking can cause chronic obstructive pulmonary disease (COPD), lung cancer and coronary heart disease.		• Campaign against drug and substance abuse.

Pre-requisites of this unit

Review the topic by reminding the learners of what social factor is. Mention some of the key words as you explain the meaning based on the unit. Prepare the learners to learn more and practise in real life what they will acquire after this unit.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to social factors that affect good health. Let them understand that at this level, they may only need the basic information otherwise details of public health and infections will be learnt at higher level in sexuality education.

Background information

Good health is very important to enable an individual live a long and satisfying life. It is therefore a state in which an individual is able to function well mentally, spiritually, physically and socially. It is important to practise good health since it affects personality, attitude and lifestyle of an individual.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need to seek medical attention from approved pharmaceutical outlets to avoid consuming fake or expired medication. Learners should take drugs prescribed by the medical personnel.

2. Financial education

Emphasise the fact that learners need to practise good health habits to avoid contracting diseases that they would spend a lot of money treating every often.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can pursue

a career in public health. Give examples of role models who are successful public health officers in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

Developed during group discussions and pair work, let learners engage one another by giving a chance for all to participate. This can also be achieved during presentations; you can allow rotational presentation within the group members.

2. Research skills

Guide learners on how to find information regarding various topics such as factors that affect good health. Guide the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in pairs and group work in performing skits and as they perform to the rest of the class. Encourage learners irrespective of their abilities to participate in group discussion during presentations and question-and -answer session.

4. Critical thinking

Guide learners to discover for themselves as they work in groups and reinforce the intension to practise safer sex. This is also achieved when learners answer probing questions.

5. Lifelong skills

Advise learners to practise good health habits in their day-to-day life. Also, make learners aware that it is their personal responsibility to practise personal hygiene and drink clean water to maintain good health.

Key words in this unit and their meanings

Drug- Any substance or medication that alters the physiological state of the body when ingested

Drug abuse-Habitual excessive use of drugs resulting to addiction or dependence

Health- A state of well being resulting from complete physical, mental and social wellbeing

Hygiene- Practices that bring about safe and healthy environment that prevents diseases through cleanliness.

Pathogen-Sisease causing microorganisms including bacteria, fungi and viruses

Inspection- Careful examination of something

Guidance on the problem statement

As earlier mentioned, this topic is about factors that affect good health thereby determining how well a person lives. Good health is a state in which a person is able to function well mentally, physically, socially and spiritually. Use activity 16.1 on page 303 of Student's Book to introduce the topic.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ When watching videos, you may repeat or pause for the benefit of slow learners. ▪ Gifted learners to lead in group discussions and do presentations. ▪ Ensure that all learners respect others views irrespective of their shortcomings.	▪ Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. ▪ Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. ▪ Also arrange learners such that short-sighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Factors that affect good health	2
2.	Public health services	1
3.	Medicinal drugs- antibiotics	2
4.	Drug abuse	1

Answers for introductory activity

The situation C is the one that provides an environment that can promote good health. The physical exercise helps the body to eliminate the metabolic waste and promote also the maintenance of good condition of muscles hence promoting good health.

16.1 Factors that affect good health

Lesson 1- Factors that affect good health *(To be covered in 2 periods)*

Refer to Student's Book.

Specific objectives

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

- State and explain the factors that affect good health.
- Explain the effect of maintaining good personal hygiene.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Internet
- Senior 3 Student's Book

Prerequisite to the lesson

1. Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is the importance of good health? (***Ans:*** *Enables one to express their full potential in the environment in which they are living)*

  Activity 16.1 (Refer to Student's Book.)

- This is a discussion activity on factors that affect good health. Let learners carry out discussion activity 16.1 and present their work to the rest of the class.
- Let the learners write notes on factors that affect good health in the Student's Book.
- Summarise the lesson by highlighting factors that affect good health.
- End the lesson by instructing learners to attempt Self – evaluation test 16.1.

Synthesis

The lesson introduces learners to factors that affect good health. The learner should be able to relate their living conditions and explain how some of the factors affect good health in their home.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State some important uses of water.

   Ans:

   - For personal hygiene
   - Cooking
   - Cleaning
   - Washing

2. How can quality of clean water be maintained?

   Ans: Preventing contamination of water at its source.

2. How can one maintain hygiene?

   Ans: *Keeping our bodies and the environment clean*

16.2 Public health services

Lesson 2: Public health services *(To be covered in two periods)*

Refer to Student's Book .

Specific objectives

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

- State the organisation of public health services.
- Explain the functioning of public health services.

Preparation for the lesson

- This lesson will involve individual research work. Bring reference textbooks to class and ensure the Internet is working or provide modems. Also, ensure that the groups are organised in time before the beginning of the lesson.

Teaching Aids

- Internet
- Students' reference book

IMPROVISATION: You may organise to provide handouts with more

information on factors that affect good health for learners to extract more information from them.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Why are public health services categorized?

  ***Ans**: To allow efficient provision of health care services*

- State two roles of public health service officers?

  (***Ans:** They design policies, assess health of the community and people at risk, ensuring that people have affordable care for health and prevention of disease.)*

  Activity 16.3 (Refer to Student's Book.)

- Let the learners coalesce points from their research in Activity 16.3 and present the work to you.

- Summarise the lesson by highlighting the functions of public health services.

- Finalise by asking learners to write short notes in the Student's Books. Give them time to do Self evaluation test 16.2.

Synthesis

This lesson introduces learners to the roles of public health services. Learners should relate to state of public health in the environment they live in.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State the levels of organization of public health services.

   Ans:

   - *Public health agencies*
   - *Public safety bodies*
   - *Healthcare providers*
   - *Environment bodies*
   - *Humanitarian agencies and charity organisations.*

2. What are the functions of public health services?

   Ans:

   - *Protect the public from environmental health hazards*
   - *Prevent and reduce chronic illnesses and injuries*
   - *Respond to disease breakouts*

16.3 Drugs

Lesson 3: Medicinal drugs-antibiotics *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define the term drug.
- Explain how antibiotics kill bacteria.

Prerequisite for the lesson

1. This lesson will involve group work. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Learners will discuss in the first period and come up with a skit that depicts effective ways of communication in difficult situations.

Teaching Aids

- Questionnaires
- Students' reference book

IMPROVISATION: You may prepare recorded information from a questionnaire you prepared on drug abuse.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

(Activity 16.4 (Refer to Student's Book.)

- Organise the field trip to a health centre near the school.
- Have the learners prepare the questionnaires they will use in time.
- Put learners into groups considering their abilities. Let them carry out this activity.
- At this point, explain how antibiotics kill bacteria.
- Summarise the lesson by highlighting how bacteria develop resistance.
- Finalise by asking learners to write notes.
- Give learners research work Activity 16.5.

Synthesis

This lesson introduces learners to medicinal drugs (antibiotics) and drug abuse. Learners should explain why antibiotics kill bacteria but not viruses. They should also appreciate the need to use antibiotics only when prescribed and to follow instructions very carefully. Emphasise to the learners that antibiotics should be taken in full dose.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. How does an antibiotic work?

   Ans: *By blocking vital processes in the bacteria, for example breaking down its cell wall and killing it*

2. Differentiate between narrow spectrum and broad spectrum antibiotic.

   Ans : *Narrow spectrum antibiotic only destroy a few types of bacteria, e.g. penicillin, while broad spectrum destroy a large number of bacteria, e.g. amoxicillin.*

Lesson 4: Drug abuse *(To be covered in two periods)*
Refer to Student's Book.
Specific objectives

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

- State the effects of excessive consumption of alcohol.
- Explain the harmful effects of the different components of tobacco smoke.
- State the side effects of taking marijuana.

Preparation for the lesson

1. This lesson will be a discussion and presentation lesson.
2. Provide reference materials in advance.
3. Check if this is working https://www.youtube.com/watch?v=gP-hx9qPZiU

Teaching Aids

- Internet
- The notes in Senior 3 Student's Book

IMPROVISATION: You may provide learners with a You Tube video on drug abuse to provide more information to the learners.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/Learning activities

1. Ask probing questions to introduce the lesson. Such questions may include: Name drugs that are commonly abused.

   Ans*: Alcohol, tobacco, Marijuana*

2. What should be done to reduce cigarette smoking?

   (***Ans:*** *Putting up posters andTV adverts to show the dangers of smoking)*

(Activity 16.6 (Refer to Student's Book.)

- Let the learners carry out activity 16.6.
- Provide learners with internet or modems.
- Let the learners present their work to the rest of the class.
- Summarise the lesson by highlighting the effect of cigarette smoking, alcohol abuse and use of Marijuana.
- Let the learners take summary notes. Refer to the notes in Student's Book.

Synthesis

This lesson intends to create awareness to learners on the effects of drug abuse. Learners should be able to link long term use of drugs to detrimental effects on health or eventual death.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What are the effects of the different components of cigarette smoke to health? ***Ans:***
   - *Nicotine – It's a stimulant of the central nervous system and therefore it causes addiction.*
   - *Carbon monoxide-It binds with haemoglobin hence reduces affinity of red blood cells to carry oxygen.*
   - *Carbon particles - Irritate the lungs resulting to chronic obstructive pulmonary disease including emphysema and chronic bronchitis*
   - *Tar - Contains chemicals that cause cancer of the trachea, bronchus and lungs among others*
2. What are the effects of pregnant woman using tobacco and alcohol?

   Ans:

   - *Could result to stillbirth. Causes low birth weight*
   - *Pre-term delivery could occur*
   - *Smoking could result orofacial clefts in infants*
3. State two effects of use of marijuana on an individual's learning.
   - Difficulty in thinking and learning due to decreased concentration.
   - Intakes of large amounts cause hallucinations hence affect learning.

Answer to Self-evaluation test 16.1

(Refer to Student's Book.)

1. *Hygiene keeps away disease causing microorganisms.*

2. *It is important to dry hands thoroughly after washing because some bacteria remain on hands after washing, and these bacteria are more easily spread via wet hands than dry ones.*

3. *B*

Answer to Self-evaluation test 16.2

(Refer to Student's Book.)

1. Award marks according to explanation.

2. Preventive not curative services

Answer to Self-evaluation test 16.3.

1. It possess danger for both smokers and non smokers. Refer to students book.

2. It can be harmful to the liver. People who drink excessive amounts of alcohol for a long time can develop diseases such as liver inflammation or liver cirrhosis.

Summary of the unit

This unit deals with the social factors that affect good health. Someone is said to be in good health when he or she is of full strength and vigour as well as freedom from signs of disease. Safe sex is sexual activity engaged by two people who have taken precaution to protect them against sexually transmitted diseases such as HIV.

Additional information to the teacher

There are two types of health, which include:

a) Physical health

1. **Structural health** - This refers to sound bones, muscles, organs, etc. That the structures in the body are performing the functions they were made for properly. Structural health is associated with a person's height/ weight ratio, their BMI (body mass index), their resting pulse rate (heart rate) and recovery time after doing exercise.

2. **Chemical Health** - Good chemical health means that the chemicals in the person's body are correct, that tissues contain the right balance of nutrients, etc. and there are no toxic chemicals.

b) Mental health

Mental health refers to people's cognitive and emotional well-being. A person who enjoys good mental health does not have a mental disorder. According to WHO, mental health is "a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community".

Answers to end unit assessment 16

(Refer to Student's Book)

1. C

2. B

3. D

4. Cholera

5. i) This depends with an individual because more often than not; one continues drinking more and more and eventually becomes addicted.

   ii) Liver- It is the organ that detoxifies toxins in the body.

   iii)

   - Help them get away from the source of alcohol by putting them in a rehab centre.
   - Put them on treatment for withdrawal symptoms.
   - Help them establish clear goals to stop drinking.
   - Help them find new meaning in life and a better focus.

6.

- Prevent diarrhoeal diseases like cholera that could be fatal.
- Conserve basic human dignity.
- Alleviate poverty in the society since more time would be spent in economic activities.

7.

   (a) These are practices that bring about a safe and healthy environment and prevent diseases through cleanliness.

   (b)

   - Poor working relations if personal hygiene is bad.
   - One can contract infectious diseases due to poor personal hygiene like not washing hands hence missing days of work.

8.

   (i) To ensure that all the pathogenic microorganisms are eliminated completely.

   (ii) Methicillin Resistant Staphyllococcus Aurensis (MRSA)

   (iii) Multi- Drug Resistant TB

   - Persistent coughing lasting more than three weeks
   - Coughing up blood
   - Weight loss that is not intended
   - Night sweats, fever and chills

- Fatigue

iv) The viruses cannot exist on their own and requires human processes to survive. As a result targeting the virus means targeting the host.

9. i) Poor housing- results to respiratory diseases and injuries

ii) Lack of clean water-contaminated water causes transmission of waterborne diseases.

iii) Poor hygiene- unclean and unsafe environment results to injuries and transmission of infectious diseases.

10.

- They design policies concerning health of community members.
- Access health of the community and people at risk
- Ensuring that people have affordable care for health and prevention of disease

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Present the findings on activities to the class. 2. Research on other factors that affect good health.	1. Do further research in textbooks or the internet about social factors that affect good health. Write short notes then share with other class members. 2. Come up with drawings showing the effects of drug abuse and alcohol. 3. Write a poem about social factors that affect good health.
Remedial questions for slow learners 1. Name factors that affect good health. 2. List commonly abused drugs.	***Extended questions for gifted learners*** 1. Using examples, differentiate between drugs and drug abuse. 2. Explain how the following hinderspractice of safe sex. (Peer pressure, drug abuse, ignorance, practice of sex for financial gain)
Answers to remedial questions for slow learners 1. Housing and food 2. Cocaine, marijuana, alcohol and tobacco	***Answers to extended questions for gifted learners*** 1. Refer to Student's Book.

UNIT 17 Decision-making regarding sexual relationships

Key unit competency

After studying this unit, the learner should be able to identify potential legal, social and health consequences of sexual decision-making.

Learning objectives

Table 17.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • Identify a range of risk reduction strategies for effectiveness and personal preference • Explain risk reduction strategies that offer dual protection against both unplanned pregnancy and STIs, including HIV.	By the end of this unit, learners should be able to: ▪ Analyse factors that affect sexual decision-making ▪ Demonstrate communication and decision-making skills in relation to safer sex	By the end of this unit, learners should be able to: • Show resilience against engaging in unsafe sexual practices. • Communication, negotiation and refusal skills can help young people to resist unwanted sexual pressure or reinforce the intention to practise safer sex, including the correct and consistent use of condoms and contraceptives.

Prerequisite of this unit

Learners have learnt about decision making regarding sexual relationships in senior 1 and senior 2. Review the unit by asking learners to name general factors that influence decision making. Mention shallowly how peer pressure, alcohol and drug abuse, ignorance, misleading influence decision making in general.

During the lessons, strive to bring to the awareness of learners the fact that this topic is about sexual decision-making and its related consequences.

Let them understand that at this level, they may only need the basic information otherwise details of development of the varied sexual behaviours in the human population will be learnt at higher level in sexuality education.

Background information

Sexuality is more than just sex and includes: biological sex, gender, sexual orientation, thoughts, values, attitudes and sexual behaviours among others. Each individual has thoughts, attractions and values that are unique. Some individuals are very sexual while others have no feelings of sexual attraction at all. Our sexuality affects how and to whom we express ourselves. We read information about sex and sexuality in newspapers and magazines and even watch on television. However, most of it may be inaccurate, confusing or harmful. It is necessary to learn more about sex and sexuality in order to have control of our sexual health.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need to avoid risky and unprotected sexual behaviours that could lead to contraction of STIs including HIV. Also emphasise the importance of purchasing original and contraceptives approved by the bureau of standards to ensure protection against unwanted pregnancies and transmission of STIs including HIV.

2. Financial education

Emphasise to the learners that practice of safer sex through protection is cheaper than dealing with unintended pregnancies or treatment of STIs including HIV.

3. Gender education

Emphasise to learners that anybody irrespective of their gender can pursue a carrier in sexuality education or peer counselling. Give examples of role models who are successful sex therapists or professional counsellors in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

During group discussions and pair work, let learners engage one another by giving a chance for all to participate. This can also be achieved during presentations, you can allow rotational presentation among the group members.

2. Research skills

Guide learners on how to find information regarding various topics such as factors hindering practice of safe sex. Guide the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in pairs and group work in performing skits and as they perform to the rest of the class. Encourage learners irrespective of their abilities to participate in group discussion, during presentations and question and answer session.

4. Critical thinking

Guide learners to discover for themselves as they work in groups how to resist unwanted sexual pressure and reinforce the intension to practise safer sex. This is also achieved when learners answer probing questions.

5. Lifelong skills

Advise learners to practise abstinence and avoiding indiscriminate and unprotected sex to ensure that learners develop a habit of communicating effectively with the intention to practise safer sex to avoid unintended pregnancies and STIs including HIV. Learners can also pass this habit to others through clubs that promote communication, advising and counselling them. Also make learners aware that they can become sex therapists or even professional counsellors if they take this topic seriously.

Key words in this unit and their meanings

Communication - Means of passing in information to an intended audience

Condom - A rubber sheath worn on an erect penis and is used to prevent unintended pregnancies and transmission STIs including HIV

Contraceptive - Hormonal medication made of estrogen and progesterone that is used to prevent pregnancies

Monogamy- The state of having only sexual partner or wife

Abstain- Restrain oneself from doing or enjoying something

Peer pressure- A feeling that one must do the same things as other people of one's age and social group in order to be liked or respected by them

Drug abuse - Refers to the harmful or hazardous use of psychoactive substances

Guidance on the problem statement

As earlier mentioned, this topic is about sexual decision – Making and how to make the sexual decisions with the intention to promote safer sex and avoid unintended pregnancy as well as transmission of STIs including HIV. Use Activity 17.1 in the Student's Book to introduce the topic.

Support for Multi-ability learning	Support for special needs learning
• When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations. • Gifted learners to be given heavy tasks that require more critical thinking while slow learners are given easy tasks which they can manage.	• Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. • Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also, arrange learners such that shortsighted ones are at the front and longsighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Factors hindering practice of safer sex	2
2.	Effective sex communication	1
3.	Effective communication in difficult situations to minimize transmission of STIs and HIV	2
4.	Strategies for dual protection against both unplanned pregnancies and STIs including HIV	1
5.	Difficult situations relating to sexual relationships	2

17.1 Factors hindering practice of safer sex

Lesson 1- Factors hindering practice of safer sex *(To be covered in 2 periods)*

Refer to Student's Book.

Specific objectives

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

- Define safe sex.
- Describe factors that hinder practice of safe sex.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Internet
- Senior 3 Student's Book

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is the importance of practicing safe sex? (***Ans:*** *Prevent unplanned pregnancies and transmission of STIs including HIV.)*

  What is the greatest challenge to teenagers in practising safe sex? (**Ans:** *Peer pressure and ignorance)*

  Activity 17.1 (Refer to Student's Book.)

- This is a discussion activity on factors that hinder the practise of safe sex.
- Let learners carry out discussion Activity 17.1 and present their work to the rest of the class.
- Let the learners write notes on factors that hinder the practise of safe sex.
- Summarise the lesson by stating the challenges that hinder the practise of safe sex.

Activity 17.2 (Refer to Student's Book.)

- End the lesson by instructing learners to attempt Self – evaluation test 17.1.

Synthesis

The lesson introduces learners to the challenges that could hinder them from practising safe sex. The learners as individuals rank these factors in order from the most challenging to the least to enable to be more aware of themselves and enable them make the right sexual decisions.

Summarise the phrase that adolescents can use to communicate effectively with regard to sexual matter.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. At what stage are young people more vulnerable to peer pressure?

   Ans: *Adolescence*

2. Why do adolescents give in to peer pressure?

   Ans: *The need to belong to a particular age group or social group*

3. What other challenges hinder the practice of safe sex?

   Ans: *Alcohol and drug abuse, misleading information, sex for financial gain and ignorance*

4. What is effective communication?

   Ans: *Effective communication involves passing information in a way that it is received and its intended meaning is understood by the recipient.*

5. Why should teens in a relationship talk to their partners before engaging in any sexual activity?

   Ans:

   - To establish sexual boundaries
   - To decide if they should be tested for STIs and HIV
   - To find out if their partner has engaged in risky sexual behaviours before

17.2 Strategies for dual protection against both unplanned pregnancies and STIs including HIV

Lesson 3: Strategies for dual protection against both unplanned pregnancies and STIs including HIV *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

- By the end of the lesson, learners should be able to state means of protecting oneself from unplanned pregnancies.
- Describe methods that offer dual protection against unplanned pregnancies and transmission of STIs including HIV.

Preparation for the lesson

1. This lesson will be a discussion and presentation lesson.
2. Provide reference materials in advance.

Teaching Aids

- Internet
- The notes in Senior 3 Student's Book

IMPROVISATION: You may provide learners with handouts with diagrams of several contraceptives to guide the learners in discussion activity 17.4 in the Student's Book.

Prerequisite to the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Are condoms 100% effective in preventing unintended pregnancies and transmission of STIs including HIV? (***Ans:*** *No, some infections such as genital warts and herpes are transmitted through close skin contact; a condom may also break if not worn properly or stored poorly.)*
- What is dual protection? (***Ans***: *Protection against unintended pregnancies and transmission of STIs including HIV.*

(Activity 17.4 (Refer to Student's Book.)

- Let the learners discuss means of protecting against unintended pregnancies and STIs including HIV.
- Provide learners with handouts with diagrams of contraceptives.
- Let the learners present their work to the rest of the class.
- Summarise the lesson by highlighting the most effective means for dual protection against unintended pregnancies and STIs including HIV.

- Let the learners take summary notes. Refer to the notes in the Student's Book.

Synthesis

This lesson intends to create awareness to the learners of the means used to prevent unintended pregnancies. Learners have to think deeper and state the means that will prevent both unintended pregnancies and transmission of STIs including HIV.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is the effect of drugs and alcohol on an individual's ability to make decisions regarding protection against transmission of STIs? (***Ans:*** *They cloud one's judgement and prevent them from making good decisions hence putting them at greater risk of transmitting STIs including HIV.)*

2. Which two means offer dual protection? *(**Ans:** Abstinence, male and female condoms)*

Answer to Self-evaluation test 17.1

(Refer to Student's Book.)

1.

   a) True

   b) False

   c) False

2. Peer pressure, alcohol and drug abuse, ignorance

Answer to Self-evaluation test 17.2

(Refer to Student's Book.)

1. Award according to learners explanation.

2. It does not protect against STIs because of no interference with the penis and the birth canal.

Summary of the unit

This unit deals with decision making regarding sexual relationships. You therefore should effectively use the suggested teaching approaches in the teachers book to guide learners acquire the requisite knowledge and desired competencies in this area. Accept contribution from the learners, either through suggestion or questions. Learners that require special attention should be given time for counselling.

Additional information for the teacher

Steps to take before you make any big decisions in your relationships:

1. Set your own standards:

Think about what you are willing or not willing to do before you get into tricky situations. If you think your decision

might be compromised by drinking alcohol see Alcohol & Drugs.

2.Think about what's important to you:

Deciding what's important to you can be influenced by your parents, family, teachers, youth workers, friends, or religion. You might also be influenced by your own experiences or the experiences of people close to you.

3. Look at who is influencing you:

Think of who might be influencing your decision. How are they influencing your decision? Why are they influencing your decision? Do they have your best interests at heart? Should you allow this person to have this influence on you or not?

4. Check where you're at:

Remember, if you are feeling good about yourself, you are more likely to make good decisions for yourself. If you are feeling under confident you are more likely to give in to pressure.

5. Ask yourself:

- Do I have to decide now?
- Is this what I want for myself right now?
- What are the consequences for me?
- Have I talked about this with anyone else?

Who to talk to about sex

If you have questions about sex (whether or not you're thinking about having a sexual relationship) young people should talk to the parents or guardians, a trusted adult such as a school counsellor, someone from the religious centre or youth group or your health care provider. It's a good idea to discuss all of the choices and any concerns you may have so that you can make healthy decisions. Deciding whether or not to have sex can be a difficult decision, so it's always good to have someone to talk to.

Answers to end unit assessment 17

(Refer to Student's Book.)

1. D
2. B
3. A
4. B
5. One gives in to peer pressure to fit into a certain age group or social group hence increasing chances of transmitting STIs including HIV.
6.
   a) True
   b) False
   c) True

7.

- IUDs
- Implants like norplants
- Oral contraceptive pills
- Diaphragm cap/ Cervical cap

8. Women-especially younger women are at a higher risk since the cervical opening is not thick enough to form a barrier. Gender – based violence also exposes women more.

9.

- Unprotected sex
- Sex with multiple partners
- Use of drugs and alcohol

10. a)

(i) Hormonal medications that prevent pregnancies

(ii) An inter-uterine device that prevents implantation; it could be copper based hormonal.

(iii) A contraceptive pouch that prevents mixing of body fluids during sexual intercourse

(iv) A cup-shaped hollow device that is inserted into the vagina and prevent entry of sperm into the uterus

b) They are not 100% effective.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Research on other methods of preventing unplanned pregnancies. 2. Based on the unit discussion, mention some of the career that you can pursue.	1. Do further research in textbooks or the Internet about decision making regarding sexual relationships. Write short notes then share with other class members. 2. Write a poem about decision making, relationship include and recite it to the class.
Remedial questions for slow learners 1. Name factors hindering practice of safe sex.	***Extended questions for gifted learners*** 1. Explain how the following hinders practice of safe sex. (Peer pressure, drug abuse, ignorance, practice of sex for financial gain)
Answers to remedial questions of slow learners 1. Peer pressure, drug abuse, ignorance, practice of sex for financial gain.	***Answers to extended questions for slow learners*** 1. Refer to Student's Book .

UNIT 18 HIV and AIDS (Stigma, Treatment, Care and Support)

Key Unit Competence

After studying this unit, learners should be able to explain the importance and key elements of living positively with HIV.

Learning objective

Table 18.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • State rights of People living with HIV (PLHIV). • State the lifestyle that can be adopted by persons with HIV to live longer. • Explain the importance and key elements of living positively with HIV.	By the end of this unit, learners should be able to: • Conduct research to identify human rights of People Living With HIV (PLHIV). • Organise drama and club aiming at supporting people living with HIV.	By the end of this unit, learners should be able to: • Recognise the importance of and their own responsibility in non – discrimination against PLHIV (People living with HIV). • Know that everyone has a right to confidentiality about their health status, and should not be required to disclose their HIV status. • Understand that people living with HIV should be able to express love and feelings and to marry or enter into long-term commitments and to start a family, if they choose to do so.

Pre-requisites of this unit

Learners have learnt about health and diseases in senior 1 and senior 2. Review this unit by mentioning some of the common diseases. Remind the learner that this unit will focus mainly on HIV and AIDS (stigma, treatment, care and support). Briefly explain to the learners how stigma, treatment, care and support are related in relation to HIV and AIDS

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to HIV and AIDS infection in biology. Let them understand that at this level, they may only need the basic information otherwise, details of HIV infection and the body response to the virus will be learnt at higher level in immunology.

Background information

HIV and AIDS-related stigma is a complex concept that refers to prejudice, discounting, discrediting and discrimination directed at persons perceived to have HIV, as well as their partners, friends, families and communities.

As the treatment of HIV has continued to reduce mortality and increase the number of clinically stable patients, the primary care approach to HIV-infected patients has evolved. In addition to the management of HIV infection, a renewed emphasis on general preventive medicine has emerged. The following aspects of care are discussed:

- Medical history and physical examination
- Laboratory assessments and diagnostic testing
- Health maintenance and preventive care
- Coordination of care
- Use of chronic care services

For treatment considerations, which includes recommendations regarding initiation of ART, selection of an ART regimen, monitoring for ART-specific side effects, optimizing treatment adherence and changing regimens.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need to avoid sex. Also emphasise the need to seek medical healthcare in standard and quality hospitals whenever they have signs and symptoms of sexually transmitted infections or problems with their immune systems.

2. Financial education

Emphasise the fact that learners should practise abstinence and avoid indiscriminate sexual behaviours that could put them at a risk of contracting HIV since treatment of the infection would have serious financial implications.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can pursue a carreer in medicine or counselling. Give examples of role models who are successful immunologists or professional counsellors in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and practicals. Special arrangement should be done to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. Cooperation and interpersonal management and life skills

As learners interact in pairs and as they engage in group work discussing ways of promoting non-discrimination of PLHIV. They will also be expected to talk to PLHIV who will tell their story and the learner is expected to report.

2. Research skills

Students will be expected to identify organisations in Rwanda that run education and campaign programs to curb the spread of HIV and find out ways of curbing spread of HIV and how to promote positive living.

3. Communication in English

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class.

4. Critical thinking

Guide learners to discover for themselves the various stages of development of AIDs through research and discussion activities, probing questions and the videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. Lifelong skills

Advise learners to practise abstinence and avoiding indiscriminate and unprotected sex to ensure that learners develop a habit of taking care of their health. Learners can also pass this habit to others through advising and counselling them. Also make learners aware that they can become doctors and particularly immunologists or even professional counsellors if they take this topic seriously.

Key words in this unit and their meanings

HIV - Human Immunodeficiency Virus.

AIDS - Acquired Immunodeficiency Syndrome

Infection - Invasion into the body and multiplication of pathogenic microorganisms

Stigma - A mark of shame or disgrace associated with a certain condition circumstance or person

Spermicide - A substance that is used as a contraceptive to kill spermatozoa; it is normally applied before intercourse

Immune system - A protection mechanism comprising of biological structures and processes that defend the body against pathogenic microorganisms

Depression - A disorder that results to low mood, persistent loss of interest and feeling of sadness

Anti-retroviral - Drugs that are used to suppress HIV virus and prevent progression into AIDS

Guidance on the problem statement

As earlier mentioned, this topic is about HIV and AIDS infection; stigma, treatment, care and support. As a way of introducing the concept of stigmatisation, refer learners to the Fig. 18.1 in their book on cycle of stigmatisation. **IMPORTANT:** Help learners to clear myths and misconceptions about HIV and AIDS. The diagram is meant to introduce the concept of stigmatisation. Let the learners discuss in pairs what the diagram illustrates.

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various stages of HIV and AIDS on the charts as gifted learners name the parts and explain their functions. • When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations.	• Allocate gifted learners to help fellow learners with special needs. • Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. • Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Introduction and rights of people living with HIV	1
2.	Sexuality education and programs promoting positive living with HIV	1
3.	Support groups and mechanisms for PLHIV	1
4.	Habitat destruction	1

Answers for introductory activity

For scenario A, the person gets tested and find out that he is negative and continued his work. Scenario the person is HIV positive and later becomes sick.

18.1 Rights of people living with HIV

Lesson 1: Rights of people living with HIV

Refer to Student's Book.

Specific objectives

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

- State the rights of people living with HIV.
- Discuss myths and misinformations that people believe about HIV and AIDS.

Preparation for the lesson

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Obtain wall charts on the cycle of stigmatisation and other materials in advance.

Teaching Aids

- Research link: http://www.ohchr.org/EN/Issues/HIV/Pages/HIVIndex,aspx or https://www.avert.org/professionals/hiv-social-issues/stigma-discrimination.

Prerequisite to the lesson

- Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:

How is HIV contracted? (***Ans:*** *Through: unprotected sexual intercourse with an infected person, blood transfusion with unscreened blood that has the virus, sharing contaminated sharp objects like syringes, needles and razor blades or from mother-to-child at birth)*

What are some of the myths associated with HIV and AIDS?

(***Ans:*** *HIV and AIDS is a curse or a result of witchcraft, one gets infected with HIV when they associate with infected persons, HIV is only transmitted through sexual intercourse, HIV is associated with irresponsible behaviour and deserves to be punished, HIV and AIDS is associated with death)*

Activity 18.1 (Refer to Student's Book.)

- This is a research activity. Explain to the learners how to refer to the Internet.
- Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes.
- Let the learners write notes on rights of PLHIV and myths associated with HIV and AIDS.
- Summarise the lesson by highlighting the key points, which should include the rights of PLHIV.
- End the lesson by instructing learners to attempt Self – evaluation Test 18.1.

Synthesis

The lesson introduces learners to the rights of PLHIV. The research carried out by the learners and the information given on myths associated with HIV and AIDS should enable learners to demystify prior misinformation.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   Ans: That PLHIV have rights and should not be discriminated against

2. State some of the rights of PLHIV?

   Ans: No one may be forced to take HIV test, children who are HIV-positive should be allowed to attend school, test results may not be shown to any other person without the permission of one who took the test.

3. What are some of the HIV –related discrimination and stigma?

   Ans: PLHIV may be shunned by society, denied jobs or get poor treatment at healthcare facility.

Lesson 2: Sexuality education and programs promoting positive living with HIV *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Promote programs that help to sensitise the community about HIV and AIDS.

Preparation for the lesson

1. This lesson will involve individual group activities. You will therefore organize the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Bring reference textbooks to class. Also ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

3. Guide learners to research on the available campaign programmes in the country to curb the spread of HIV and promote positive living.

4. Obtain pamphlets and other materials in advance.

Teaching Aids

- TV adverts
- Bill boards
- Pamphlets
- Radio

IMPROVISATION: You may organise the learners to come up with a skit on sexuality education or ways of promoting positive living for people with HIV and AIDS.

Teaching/Learning activities

- What are some of the HIV prevention strategies running in Rwanda? *(**Ans:** 1. Mass media 2. Male circumcision initiative by the Rwandese Ministry of Health 3. Initiative to eliminate transmission of HIV from mother-to-child by 2015.*

- State some of the vulnerable groups that HIV education and prevention campaigns should be directed to.*(**Ans**: Sexually active youth, Sex workers, HIV-positive persons engaging in indiscriminate sexual behaviour and women with partners that are already HIV-positive)*

  Activity 18.2 (Refer to Student's Book.)

- Organise the learners into groups and provide them with pamphlets, reference books and Internet.

- Let them research on education and campaign programmes to curb the spread of HIV in Rwanda.
- At this point, you may run some TV adverts or radio on prevention of HIV Aids.
- Let the learners present their discussion briefly to the rest of the class.
- Summarise the lesson by highlighting the key points on HIV prevention campaigns, public education programmes and ways of promoting positive living. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

Synthesis

This lesson introduces learners to the sexuality education and programmes promoting positive living; therefore use internet and pamphlets to guide learners to accurately describe ways that education campaign programs use to prevent the spread of HIV.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State three aims of HIV education campaigns.
   Ans: *Address HIV testing, prevention, treatment, care to promote positive living and research*
2. What does positive living involve?
   Ans: *Refer to Student's Book.*

Lesson 3: Support groups and mechanisms for PLHIV *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Describe support mechanisms for PLHIV.

Preparation for the lesson

1. This lesson will involve group work. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Learners will discuss previously collected information from talks on stigma and support for PLHIV.
3. Obtain pamphlets and journals on how different institutions provide support for PLHIV in advance.

Teaching Aids

- Pamphlets and journals
- Notes in Student's Book

IMPROVISATION: You may come up with audio or video presentations on support mechanisms or PLHIV.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include:What are some of the effects of stigma and lack of support on PLHIV? *(**Ans:** Stress, loneliness, anxiety, confusion, bitterness and depression)* State some of the impacts of support for PLHIV *(**Ans:** Reduced mortality, reduced morbidity, improved quality of life and self-esteem, increased retention in care)*

  Activity 18.4 (Refer to Student's Book.)

- Put learners into groups considering their abilities. Let them carry out this activity.
- Provide learners with the pamphlets and journals.
- At this point, you can introduce the lesson by discussing reasons for setting up support groups.
- Let learners write notes on needs for PLHIV and why support groups are set up.
- Summarise the lesson by highlighting organizations in Rwanda that support PLHIV. Refer to the notes in Student's Book.
- Finalise by giving learners the task of coming up with a list on support groups in their locality and what they do.

Synthesis

This lesson introduces learners' to the needs of PLHIV and support programs. Use research and talks to guide learners to find more information on support for people living with HIV and AIDS.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What support do people living with HIV need?

   Ans: *Emotional, spiritual, psychological, physical and clinical support*

2. State some of the common needs of PLHIV.

   Ans: *Counselling, social acceptance, nutritional help, medical, spiritual and community support.*

Lesson 4:The Non- discrimination against PLHIV *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

By the end of the lesson, learners should be able to describe ways of promoting non-discrimination against PLHIV.

Preparation for the lesson

1. This lesson will be a discussion and presentation lesson.
2. Provide reference materials in advance.

Teaching Aids

- Weblink: https://www.youtube.com/watch?v=BTcsZI7u4DY&list=PLY018GggFCXMzS2s-wPxLiOpzwVsr39if&index=6
- The notes in the Student's Book

IMPROVISATION: You may provide Youtube videos on promoting non-discrimination against PLHIV and project to the whole class prior to group discussions.

Teaching/Learning activities

- Introduce the lesson by asking learners probing questions like: What are the effects of stigma and discrimination on PLHIV? ***Ans****: (Secrecy, shame, victimisation, job loss, loss of property, lack of care and support)*

  Activity 18.5 (Refer to Student's Book.)

- Let the learners discuss ways of promoting non-discrimination and inclusion against PLHIV in the community and present their work to the rest of the class.
- Provide learners with reference material.
- Summarise the lesson by highlighting discrimination that PLHIV face and the effects. let the learners take summary notes. Refer to the notes in Student's Book.

Synthesis

This lesson intends to create awareness to the learners some of the challenges and discrimination that PLHIV face and ways of promoting non-discrimination in the community. They should be able to come up with some of their own ways of promoting non-discrimination and inclusion for PLHIV.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What are some of the forms of discrimination that PLHIV face? *(**Ans:** Prejudice, negative attitude, denial of proper medical care, abuse, harassment and violence)*
2. What strategies of management of PLHIV are crippled by discrimination? *(**Ans:** Voluntary Counselling and Testing-VCT, accessing HIV care and proper use of ARVs)*

Answers to Self-Evaluation Test 18.1

(Refer to Student's Book.)

1. C
2. B
3. Yes, this is possible if they follow medical practitioners instruction and also when they give birth under the supervision of a medical practitioner.
4. There is loss of income and livelihood, reputation, marriage and hope.

Answers to Self-Evaluation Test 18.2

(Refer to Student's Book.)

1. Avoiding sex before marriage, PLHIV to take antiretroviral therapy (ART), persons living with HIV should not be discriminated
2. This is to avoid getting more viral load from other person infected with HIV.

Answers to Self-Evaluation Test 18.3

(Refer to Student's Book.)

1. Award marks according to the answer given.
2. Yes

Answers to Self-Evaluation Test 18.4

(Refer to Student's Book.)

1. Fear of discrimination results in PLHIV isolating themselves from friends or experiences to avoid disclosure. PLHIV unwilling to disclose their HIV status to friends and family
2. By accepting people PLHIV the way they are

Summary of the unit

HIV is a sexually transmitted infection that may also be transmitted through other means such as breast feeding, transfusion of infected blood, among others. PLHIV suffer from stigma and discrimination. PLHIV have rights and should be respected, having HIV does not mean loss of self worth. Education programs and campaigns are important in order to reduce HIV infection rates. All members of the community need to be informed about HIV although vulnerable groups should be targeted first.

Additional information for the teacher

Expressions and forms of stigma

Social stigma

Isolated from community. Any interest may be morbid curiosity or mockery rather than genuine concern. Loss of social role or identity and loss of standing and respect.

Physical stigma

Isolated, shunned, abandoned. Expressed through: Separate living space, eating utensil and violence

Verbal stigma

Gossip, taunting, scolding

Institutionalised stigma

Barred from jobs, scholarships, visas, denial of health services, police harassment

The consequences and impact of stigma

People living with HIV and AIDS frequently lose their jobs or livelihoods as well as opportunities for marriage and childbearing. And where no HIV programmes exist, they may also receive poor care from the health sector.

In most resource-constrained settings, people with HIV and AIDS frequently have to turn to their families for care. But even though most HIV-infected people receive loving treatment from their families, there are occasions when family members refuse to provide care, whether out of fear of transmission, out of anger, judgement and moral condemnation, fear of experiencing the stigma of others, or a combination of these factors. Poverty compounds the impact of such stigma because it limits the amount of care a given family is able to provide, especially when someone is seen as "a hopeless case".

Consequences of stigma for HIV and AIDS treatment and prevention efforts

Impact on testing and disclosure

HIV and AIDS-related stigma also discourages people to get tested or, when they do get tested, from returning for their test results. People especially avoid clinics known to be HIV testing sites. People also commonly reported that they believed that the fact that they had been tested would eventually reach the rest of the community.

People live with the knowledge that they have HIV for years without telling even their most intimate partners for fear of stigma and its consequences, which can include physical violence and or abandonment.

Answers to end unit assessment 18

(Refer to Student's Book.)

1. A 2. C

3 a) The number PLHIV increased from the year 2001 to the year 2002. There was a decrease in the number of PLHIV in the year 2002 to 2003. In 2003 to 2008 the number of PLHIV remained constant which was followed by a constant increase in number of PLHIV the year 2009-2014.

b) The increase was caused by stigma and not enough facilities to care for PLHIV, there after the support from government improved the condition of PLHIV and also there was reduction of new infections by HIV.

c) Decentralisation of drugs dependent treatment

- Provision of free voluntary counselling and testing services
- Goverment allows NGOs dealing with HIV and AIDS to oparate in the country
- Educating people on HIV and AIDs

4. a) HIV is a virus while AIDS is a condition or disease that develops

when HIV virus has caused damage to the immune system.

b) Family fall out, hopelessness

5. Abstinence

6. a) Balanced diet rich in: vitamins, vegetables, legumes, extra protein and less fat and sugar

b) Award according to explanation.

7. a)

- Starting appropriate treatment at the appropriate time
- Taking medication as required
- Eating a balanced diet
- Avoiding bad health habits like smoking

b) Just because one is HIV-positive does not make them less human; they should be accorded every human right.

c) PLHIV can date and even marry but will be required to be honest to their partner and disclose their status before engaging in any sexual activity; responsibility and trust.

8.

- Billboards
- TV adverts
- Radio

9.

- False-HIV-positive children have the same rights as any other child to attend school and learn; their HIV status should be used to discriminate against them.
- False-HIV cannot be transmitted through air or body surface without open wounds.

10.

Rights of PLHIV	**How the issue should be addressed**
Confidentiality and privacy	Information concerning another person's HIV status should be kept confidential and not be disclosed without their consent.
Health and support services, public benefits, medical scheme.	PLHIV have a right to treatment and proper care from health facilities. They should therefore be accorded equal opportunity to access quality medical health cover and treatment.
Education on HIV and AIDs	PLHIV should be informed about the infection, how to take ARVs and how to maintain proper health habits among others.
The responsibility of media	Media should avoid showing portraits of PLHIV, they should give information in a positive manner that does not portray PLHIV as victims. They should also seek consent before conducting any interviews and not use hidden cameras.

Right to safer sex	Facilitation of education campaigns to emphasise use of protection for safer sex and providing dispensable condoms in healthcare centres or public toilets.
Right of prisoners	Anti-retroviral drugs should be availed to them and they should be supplied with balanced diet rich in fruits and vegetables.
Liberty, autonomy, security of prisoners and freedom of movement	PLHIV should be allowed to move freely without being restrained from going to certain places.

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Use Manila paper provided by the teacher to write the abbreviated HIV and AIDS and their full meaning. 2. Take notes on presentation done in class and discuss with your friends.	1. Do further research in textbooks or the Internet about HIV and AIDS. Write short notes then share with other class members. 2. With the help of your teacher, organise for a presentation on HIV and AIDS to the community around.
Low order thinking (LOT) questions for slow learners 1. Mention three common needs of PLHIV. 2. List three advantages of GMO. 3. List three types of pollution. 4. What is a habitat?	***High order thinking (HOT) questions for gifted learners*** 1. Is there a cure for HIV and AIDS? 2. What are scientists currently doing on the cure of HIV and AIDS?

Answers to remedial for slow learners questions	***Answers to exended for giffted learners thinking questions***
1. Health and medical supplies and skilled medical services. 2. Counselling to reduce isolations and promote acceptance.	1. There is currently no cure for HIV/AIDS. But there are treatments for people living with HIV/AIDS. If you have HIV/AIDS, you can take combinations of medicines called ARV. The drug are designed to strengthen the immune system to keep HIV from developing into AIDS or to relieve AIDS symptoms. 2. Scientists are tirelessly working in the laboratory to come with the cure.

UNIT 19 Sexual behaviour and sexual responses

Key Unit Competence

After studying this unit, the learner should be able to describe common sexual behaviours and how to make responsible decisions.

Pre-requisites of this unit

This is divided into two sections: learning objectives and links to other subjects.

a) Learning objectives

Competence based curriculum embraces three categories of learning objectives, ,that is, knowledge and understanding, skills acquisition and attitude and values. At the end of the unit, learners should have knowledge and understanding of the various concept areas, acquire the necessary skills, change their attitude towards various life aspects and subscribe to certain values that are acceptable in the society where they live. Therefore emphasise attainment of these three objective areas during the learning process.

Table 19.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: • Identify common sexual behaviours. • Describe abstinence and contraceptives used to prevent unintended pregnancies. • Explain the meaning of transactional sexual behaviour.	By the end of this unit, learners should be able to: • Demonstrate effective communication of personal needs and sexual limits. • Organize a dialogue for communication exercises in pairs for negotiation skills for safer sex.	By the end of this unit, learners should be able to: • Recognise possible consequences of engaging in sexual activity and their personal responsibility • Be aware of own sexual limits, everyone has the responsibility to report sexual harassment and coercion, which are violations of human rights. • Adopt assertiveness and negotiation skills to help one to resist unwanted sexual pressure or reinforce the intention to practise safer sex.

b) Links to other subjects

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to different sexual behaviours exhibited by human beings. Let them understand that at this level, they may only need the basic information otherwise, details of development of the varied sexual behaviours in the human population will be learnt at higher level in psychology.

Background information

Sexual behaviours in the human population are varied and this depends mainly on the inherited sexual response patterns and pressure exerted by the society. The sexual orientation of an individual i.e. the enduring pattern of sexual attraction towards other persons could be romantic or sexual attraction towards the opposite sex, same or both. To ensure safe sex, protection must be used to prevent unintended pregnancies and transmission of STIs including HIV.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the attention of learners the need to avoid risky and unnatural sexual behaviours that could lead to contraction of STIs including HIV. Also emphasise the need to seek medical healthcare in standard and quality hospitals whenever they show any symptoms of STIs.

2. Financial education

Emphasise the fact that learners should practise abstinence and avoid indiscriminate sexual behaviours that could put them at a risk of contracting HIV: since treatment of the infection would have serious financial implications.

3. Gender education

Emphasise to learners that anybody, irrespective of their gender, can pursue a career in medicine or counselling. Give examples of role models who are successful gynaecologists or professional counsellors in the area where the learners come from.

4. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Co-operation and interpersonal management and life skills***

Developed as learners interact in pairs as they engage in a game of identifying different forms of sexual behaviours.

2. ***Research skills***

Learners will be expected to research and write a report on consequences of sexual decisions which they will present for assessment.

3. ***Communication in English***

As learners participate in pairs and group work in performing skits and as they perform to the rest of the class.

4. ***Critical thinking***

Guide learners to discover for themselves as they work in pairs the risk levels of the different sexual behaviours. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. ***Lifelong skills***

Advise learners to practise abstinence and avoiding indiscriminate and unprotected sex to ensure that learners develop a habit of taking care of their health. Learners can also pass this habit to others through clubs that promote communication, advising and counselling them. Also make learners aware that they can become doctors and particularly gynaecologists or even professional counsellors if they take this topic seriously.

Key words in this unit and their meanings

Arousal–State of sexual excitement in anticipation of sexual activity

Genetic predisposition–increased probability of developing a disorder due to genetic constitution of an organism

Submissive–An individual that allows himself to other peoples' demand

Sexuality–How a person expresses themselves as a sexual being

Sexual harassment–Sex discrimination that involves bullying and coercion

Guidance on the problem statement

As earlier mentioned, this topic is about common sexual behaviour and how to make responsible sexual decisions. As a way of introducing the concept of sexual behaviours, refer learners to the Fig. 19.1 in their book on aspects of human sexual behaviours. **IMPORTANT:** The diagram is meant to introduce the concept of factors that determine common sexual behaviours. Let the learners discuss in pairs what the diagram illustrates.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Common sexual behaviours	1
2.	Prevention of unintended pregnancies and HIV	1
3.	Preventing transactional sexual activity and other sexually abusive relationships	1
4.	Communication skills in consensual and safer sex	2

19.1 Sexual behaviours and making responsible decisions

Lesson 1: Common human sexual behaviours

Refer to Student's Book.

Specific objectives

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

- Describe different human sexual behaviours.
- State the risk associated with the different sexual behaviours.

Preparation for the lesson

1. This lesson will involve working in pairs and group activities. You will therefore organize the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Obtain the card boards and other materials in advance.

Teaching Aids

- Cardboards
- Marker pens
- The diagram in Student's Book

Teaching/Learning activities

- Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.
- Ask probing questions to introduce the lesson. Such questions may include: State the four main types of sexual orientations. *(**Ans:** Heterosexuality, bisexuality, homosexuality and asexuality.)*

What is sexual identity? *(**Ans:** A person's perception of his or her own sex rather than their sexual orientation)*

Activity 19.1 (Refer to Student's Book.)

- This is a discussion activity on identifying common sexual behaviours and their risk levels.

- Let the learners write notes on common human sexual behaviours.
- Summarise the lesson by highlighting risks associated with each of the sexual behaviours identified.
- End the lesson by instructing learners to attempt self – evaluation test 19.1.

Synthesis

The lesson introduces learners to the common sexual behaviours exhibited in the human population and the risks associated with them.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   Ans: *That human beings exhibit varied sexual behaviours*

2. List the types of human sexual behaviours

   Ans: *Self-masturbation, male-female sexual activity, group sex, non-penetrative sex, transactional sex, homosexuality and lesbianism*

Lesson 2: Prevention of unintended pregnancies and HIV

(To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Define abstinence.
- Explain the use of condoms and contraceptives in preventing unintended pregnancies.

Preparation for the lesson

1. This lesson will involve group discussions and presentations. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Bring reference textbooks to class. Also ensure that the groups are organised in time before the beginning of the lesson.
3. Obtain printed handouts with content on ways of preventing pregnancies in time and other materials in advance.

Teaching Aids

- Internet
- Student's reference book

IMPROVISATION: You may organize handouts containing information on ways of preventing pregnancies and HIV.

Teaching/Learning activities

- What is the best way of preventing unwanted pregnancies and transmission of HIV? *(**Ans:** Abstinence.)* Which type of contraceptive prevents both unwanted pregnancies and HIV? *(**Ans:** Condoms)*

Activity 19.3 (Refer to Student's Book.)

- Organise the learners into groups and provide them with reference materials.
- At this point, you may go through the questions in Activity 19.3.
- Let the learners present their discussion briefly to the rest of the class.
- Summarise the lesson by highlighting the different ways of preventing unwanted pregnancies and HIV. You can also make this more interactive by inviting gifted learners to do the lesson summary as you guide them.

Synthesis

This lesson introduces learners to ways of preventing unintended pregnancies and HIV: Emphasise the guide questions of activity 19.3 to the learners to ensure that they appreciate the different ways of preventing unintended pregnancies and contraction of HIV.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is the disadvantage of using oral contraceptives like the everyday pill to prevent unintended pregnancies?

   Ans: *Does not prevent contraction of STIs including HIV.*

2. Describe at least three ways of preventing unintended pregnancies and HIV.

   Ans: *Refer to Student's Book.*

Lesson 4: Communication skills in consensual and safer sex *(To be covered in one period)*

Refer to Students's Book.

Specific objectives

By the end of the lesson, learners should be able to carry out dialogue skills in pairs for negotiation skills for safer sex.

Preparation for the lesson

1. This lesson will be a discussion and presentation lesson.
2. Provide reference materials in advance.

Teaching Aids

- Web link link https://www.youtube.com/watch?v=j96vja110MU&t=14s
- The notes in Student's Book.

IMPROVISATION: You may provide Youtube videos on a partner turning down sexual advances through proper communication and project to the whole class prior to group discussions.

Teaching/Learning activities

- What is the difference between communication and effective communication? ***Ans:*** *(Communication refers to sharing of information, ideas or thoughts effective communication on the other hand means that the transmitted information is received and understood the way it is intended.)*

Activity 19.5 (Refer to Student's Book.)

1. Let the learners discuss how to carry out effective communication with the intention to practise safer sex and avoid sexual harassment: then present their work to the rest of the class.
2. Provide learners with reference material.
3. Summarise the lesson by highlighting the need for effective communication with the intention of preventing unintended pregnancies and STIs including HIV. Let the learners take summary notes. Refer to the notes in Student's Book.

Synthesis

This lesson intends to create awareness to the learners of some of the challenges and discrimination that PLHIV face and ways of promoting non-discrimination in the community. They should be able to come up with some of their own ways of promoting non-discrimination and inclusion for PLHIV.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. What is the effect of misleading information about sex to teenagers? (***Ans:*** *Results to unhealthy and hostile relationships, increases likelihood of transmitting STIs including HIV)*
2. Explain the advantage of one expressing their opinions about sex freely. (***Ans:*** *Enables one to avoid engaging in sexual activity that they are uncomfortable with hence prevents unwanted pregnancies and transmission of STIs including HIV)*

Answers to self-evaluation test 19.1

1. It plays a role in your future. For example, unplanned pregnancy can

change your plans or your current path. It gives you more control over your own body

2. No. Young people should not practise sex before marriage.

Answer to self-evaluation test 19.2 Refer to students book

1. B

2. People may find it difficult to abstain for long periods of time.

3. The Safe Week. The safe period is the best way to prevent pregnancy without a condom. This means you can have coitus between the 8th day to the 20th day of a woman's menstrual cycle. Here the first day of the period signifies day one of the menstrual cycles. Consider surgery, such as: female sterilization or vasectomy.

Answers to self-evaluation test 19.3

1. B

2. It improves communication in the relationship and also ensures that neither of the partners engages in sexual activity they are uncomfortable with.

3. Seeking guidance and counselling from a sex therapist.

Summary of the unit

Human sexual behaviour is categorised according to sex of persons involved and number of participants involved. Sexual activity should be solitary, involving a male and a female or two people of same sex. Abstinence is the safest way to avoid unintended pregnancies and prevent transmission of STIs including HIV. Other means include condoms and contraceptives. Effective communication between partners is important in maintaining positive relationship and ensuring that people do not engage in sexual activity they might be uncomfortable with.

Additional information for the teacher

The human sexual response cycle is a four-stage model of physiological responses to sexual stimulation, which, in order of their occurrence, are the excitement phase, plateau phase, orgasmic phase and resolution phase.

Excitement phase

The excitement phase (also known as the arousal phase or initial excitement phase) is the first stage of the human sexual response cycle. It occurs as the result of physical or mental erotic stimuli such as kissing, petting or viewing erotic images that leads to sexual arousal. During the excitement stage, the body prepares for

sexual intercourse, initially leading to the plateau phase. There is wide socio-cultural variation regarding preferences for the length of foreplay and the stimulation methods used. Physical and emotional interaction and stimulation of the erogenous zones during foreplay usually establishes at least some initial arousal.

Plateau phase

The plateau phase is the period of sexual excitement prior to orgasm. The phase is characterised by an increased circulation and heart rate in both sexes, increased sexual pleasure with increased stimulation and further increased muscle tension. Also respiration continues at an elevated level. Both men and women may also begin to vocalize involuntarily at this stage. Prolonged time in the plateau phase without progression to the orgasmic phase may result in frustration if continued for too long.

Orgasmic phase

Orgasm is the conclusion of the plateau phase of the sexual response cycle and is experienced by both males and females. It is accompanied by quick cycles of muscle contraction in the lower pelvic muscles, which surround both the anus and the primary sexual organs. Women also experience uterine and vaginal contractions. Orgasms are often associated with other involuntary actions, including vocalizations and muscular spasms in other areas of the body and a generally euphoric sensation. Heart rate is increased even further.

Resolution phase

The resolution phase occurs after orgasm and allows the muscles to relax, blood pressure to drop and the body to slow down from its excited state. The refractory period, which is part of the resolution phase, is the time frame in which usually a man is unable to orgasm again though women can also experience a refractory period.

Answers to end unit assessment 19

Refer to Student's Book.

1. C 2. C

3. B 4. B

5. a) A persistent pattern of sexual attraction either to persons of opposite sex, same sex or both sexes

   b) Award based on explanation

   c) Award based on explanation

6. a) Not safe at all

   b) Award based on explanation

7. a) **Men**- there was lower HIV prevalence between the age of

15-19 but started rising between 20-24 years and was highest at 30-34; then drops but rises again at 40-45 before dropping till age 55-59. For women, HIV prevalence starts rising steadily from 15-19 and is highest at 35-39 then drops.

b) **Females** mature faster than males and become sexually active earlier than males. Males between ages 30-35 seem to have settled down in marriages resulting in a decreased HIV prevalence. Most men between the age of 40-44 are financially stable and seem to spending money and having sexual relationships with younger females between the age of 30-34.

c) Use of condoms for umarried person engaging in sex and also married people to remain faithful

- Testing the HIV/AIDs status
- No sharing of drug injection equipment
- Taking ART drugs for PLHIV
- Education on HIV and AIDS

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Write the common sexual behaviour. Use Manila paper provided by the teacher. Hang on the class wall.	1. Do further research in textbooks or the Internet about sexual behaviour and sexual response. Write short notes then share with other class members. 2. Write a poem on sexual behaviour and recite it to the class.
Remedial qiuetion for slow learners 1. What is sexual behaviour? 2. Who is responsible in preventing unwanted pregnancies?	***Extended questions for gifted learners*** 1. Using a diagram, show various aspects of sexual behaviour.
Answers to remedial questions for slow learners 1. Any activity that induces sexual arousal. 2. Both sexual partners	***Answers questions for slow learners*** 1. Refer to Fig 19.1 on Student's Book.

UNIT 20 Genetics

Key Unit Competence

By the end of the unit, the learner should be able to tell how genes determine structure and function of individuals.

Pre-requisites of this unit

This is divided into two sections: learning objectives and links to other subjects.

Learning objectives

Competence based curriculum embraces three categories of learning objectives, that is, knowledge and understanding, skills acquisition and attitude and values. At the end of the unit, learners should have knowledge and understanding of how traits are transmitted from parent to offspring following the Mendelian fashion.

Table 20.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Define inheritance. ▪ Define key genetic terms. ▪ Explain meaning of the term pure breeding. ▪ Describe the inheritance of sex in humans with reference to XX and XY chromosomes.	By the end of this unit, learners should be able to: ▪ Interpret pedigree diagrams for the inheritance of a given characteristic.	By the end of this unit, learners should be able to: ▪ Defend that inheritance of sex in humans is determined by males with reference to XX and XY chromosomes.

Table 20.1 Knowledge, skills and values to be attained continued

Knowledge and understanding	Skills	Attitudes and values
▪ Explain co-dominance by reference to the blood groups ABO ▪ Inheritance of ABO blood groups ▪ Describe sex linkage with reference to colour blindness and haemophilia	▪ Use Punnet squares in crosses which result in more than one genotype to work out and show the possible different genotypes ▪ Use genetic diagrams to predict the results of monohybrid crosses involving co-dominance or sex linkage and calculate the phenotypic and genotypic ratios.	

Pre-requisites of this unit

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to transmission of genetic information from parents to offspring. Let them understand that at this level, they may only need the basic information otherwise, more details of genetics will be learnt at higher level in molecular biology.

Background information

Human beings, like all other organisms, are produced through sexual reproduction; hence the characteristics of the organism are derived from both parents. The gametes have 23 chromosomes and are said to be haploid. The genes responsible for these characteristics are located in specific positions of the DNA of the chromosomes found in the nucleus.

Cross-cutting issues to be addressed

1. Standardisation culture

Bring to the learners' attention the need to appreciate inheritance of sex-linked traits. Also emphasise the need to seek medical healthcare in standard and quality hospitals whenever they have signs and symptoms of haemophilia to avoid being given fake or substandard drugs.

2. Financial education

Emphasise the need for going through genetic counselling before partners proceed to getting married to avoid transmitting genetic disorders whose treatment could have financial implications.

3. *Gender education*

Emphasise to learners that inheritance of sex in human beings follows the Mendelian fashion and that couples have a 50% chance of getting either boy or girl who are equally important.

4. *Inclusive education*

All learners should be encouraged to participate during lessons and practicals. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. *Cooperation and interpersonal management and life skills*

Developed as learners interact in pairs and as they engage in group work carrying out survey to determine traits that are exhibited by members of their class.

2. *Research skills*

Students will be expected to do research on sex determination in humans and inheritance of sex-linked traits in humans.

3. *Communication in English*

Developed as learners participate in group work and as they carry out presentation tasks to the rest of the class.

4. *Critical thinking*

Guide learners to discover for themselves the various traits exhibited in the human population through research and discussion activities, probing questions and the videos that they will be watching during the lessons. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. *Lifelong skills*

Advise learners to appreciate diversity of traits in the human population but not to discriminate or be mean to people with genetic disorders. Also make learners aware that they can become scientists and particularly molecular biologists if they take this topic seriously.

Key words in this unit and their meaning

Genetics- The study of heredity and the variation of inherited characteristics

Genome- Refers to the total genetic constitution of any cell in an organism

Gene- Refers to the portion of DNA that is responsible for synthesis of a protein.

Trait- The characteristics shown by an organism.

Chromosomes- Threadlike structures of nucleic acids and proteins found in the nucleus of most living cells

Genotype- The genetic constitution or genetic makeup of an organisms

Phenotype- The outward or physical appearance of an organism

Haploid- Half number of chromosomes in the body of cell

Diploid- The nucleus of a cell that has its chromosomes in the homologous pair

First generation-The offspring that are produced after crossing the parental genotypes

Second generation- The offspring produced by crossing the first generation

Guidance on the problem statement

As earlier mentioned, this topic is about transmission of genetic information. As a way of introducing the concept of inheritance, refer learners to Activity 20 on page 337 of their book on inheritance of traits. **IMPORTANT:** Help learners identify traits exhibited in humans and to distinguish tongue rollers from non-rollers in the class.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Gifted learners to be given heavy tasks that require more critical thinking while slow learners are given tasks which they can manage such as collecting materials for use during practicals. • When watching videos, you may repeat or pause for the benefit of slow learners. • Both gifted and slow learners to be given equal opportunity to lead in group discussions and do presentations.	• Allocate gifted learners to help fellow learners with special needs. • Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Definition of terms used in genetics	1
2.	Monohybrid inheritance	1
3.	Genetic crosses to determine monohybrid ratios	1
4.	Co-dominance	2
5.	Inheritance of the ABO blood groups	1
6.	Inheritance of sex in humans	2
7.	Sex linkage-haemophilia	1
8.	Inheritance of colour blindness	1

20.1 Inheritance and key terms used in genetics

Lesson 1: Inheritance and key terms used in genetics *(to be covered in one lesson)*

Refer to Student's Book.

Specific objectives

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

- Define terms used in genetics.

Preparation for the lesson

1. This lesson will involve discussion activities in pairs. You will therefore organize the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Obtain pedigree diagrams for study of human traits.

Teaching Aids

- Introduction link: https://www.youtube.com/watch?v=J1wuttlsJTY
- Activity in Student's Book.

Teaching/Learning activities

1. Introduce the unit as explained under **guidance on the problem statement** then narrow down to the lesson.
2. Ask probing questions to introduce the lesson. Such questions may include: What are the observable traits seen in members of the same species called? *(**Ans:** Variations)* Why is polypeptide called a protein? *(**Ans:** Because it is made up of many amino acid units linked by peptide bonds)* What are homologous chromosomes?

(***Ans:*** *A pair of chromosomes that are similar in shape and size.)*

Activity 20.1 (Refer to Student's Book.)

3. This is a discussion activity. Use the YouTube link provided to introduce family tree and inheritance.

4. Let learners have a brief discussion session on their findings then write summary notes. Correct them as is appropriate. Refer to notes.

5. Summarise the lesson by highlighting the key points, which should include the different genotypes and the associated phenotypes depending on traits possessed by organisms.

   End the lesson by instructing learners to attempt Self – evaluation test 20.1 in their books.

Synthesis

The lesson introduces learners to basic concepts and definition of terms used in genetics. The groups' investigation of the possible number of students exhibiting various variations.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is inheritance?

   Ans*:The transmission of characteristics from parents to offspring*

2. What is the relationship between a gene and allele?

   Ans*: An allele is an alternative form of a gene responsible for a certain trait.*

3. Define the term heterozygous using an example.

   Ans*: Genetic constitution of an organism where the alleles are dissimilar*

4. Describe discontinuous variation using an example?

   Ans: *These are observable differences in a species that have no intermediates for example sex in humans; a person is either male or female.*

Lesson 2: Monohybrid inheritance

(To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Explain the meaning of monohybrid inheritance.
- Use genetic diagrams to predict results of monohybrid crosses.

Preparation for the lesson

1. This lesson will involve group work. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.

2. Learners will carry out activity to enable them calculate ratios in monohybrid crosses.
3. Obtain materials to be used in the group Activity 20.3 in advance.

Teaching Aids

- Black and red beads
- Plasticine
- Transparent jars
- Notes on Student's Book
- Use https://www.youtube.com/watch?v=Lsj-Ij53CkA

IMPROVISATION: You may come up with audio or video presentations on to further emphasise the concept of monohybrid inheritance.

Teaching/Learning activities

1. Ask probing questions to introduce the lesson. Such questions may include: Explain how offspring inherit traits from both parents *(**Ans:** one of each pair of alleles from both parents fuse during fertilization resulting to offspring genotypes.)* Offspring from pure breeding parents are referred to as-*(**Ans.** First filial generation/ progeny)*
2. If a pea plant had a genotype of Tt, why would it not be phenotypically short? ***Ans:*** *The allele for tallness (T), is dominant over that for shortness (t); hence allele T is expressed in the phenotype.*

Activity 20.3 (Refer to Student's Book.)

- Put learners into groups considering their abilities. Let them carry out this activity.
- Provide learners with the required materials for the activity.
- At this point, you can introduce the lesson by playing the YouTube video.
- Let learners write notes on Mendelian monohybrid cross.
- Summarise the lesson by highlighting the monohybrid ratio of 3:1 from the selfing of F1. Refer to the notes in Student's Book.
- Finalise by working out with learners results of a cross between a homozygous dominant and a heterozygous parent.

Synthesis

This lesson introduces learners to Mendelian monohybrid cross. Use genetic diagrams to illustrate the monohybrid 1:2:1 and 3:1 ratios. Give learners more work on monohybrid crosses.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. A cross between a white flowered plant and a purple flowered plant produced all purple flowered plants

in the F1 generation. If 560 plants were produced in the F2 generation, determine the number of purple flowered plants?

Ans:

F1 parental phenotypes; Purple Purple

F1 genotypes Pp X Pp

	P	*p*
P	*PP*	*Pp*
p	*Pp*	*pp*

F2 offspring: PP, Pp , Pp, pp

Phenotypes: 3 purple , 1 white

Total purple plants; ¾ x 560 = 420

2. In a pea plant, the allele for tallness (T) is dominant over that for shortness (t). Describe how one would determine whether a tall pea plant is heterozygous (Tt) or homozygous (TT).

   Ans: *.By cross pollinating with a short plant i.e. a homozygous recessive (tt); If all the plants produced from this cross are tall, then the unknown genotype is TT. However, if the plants produced from this cross are a mixture of Tall and short; then the unknown genotype is Tt.*

Lesson 3: Genetic crosses to determine monohybrid ratios *(To be covered in one periods)*

Refer to Student's Book.

Specific objectives

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

- Carry out genetic crosses using cross diagrams or Punnet squares to determine 1:2:1 and 3:1 monohybrid ratios.

Preparation for the lesson

1. This lesson will be an individual lesson.
2. Provide worksheets for learners to work out ratios in monohybrid crosses.

Teaching Aids

- Worksheets
- The notes in Student's Book
- YouTube tutorials

IMPROVISATION: You may provide charts of already worked out genetic crosses of more challenging questions.

Teaching/Learning activities

1. Introduce the lesson by asking learners probing questions like: A tall pea plant and a short pea plant were crossed and they produced 111 tall and 109 short plants. Determine:

   i) The parental genotypes.

   ii) Phenotypes of the offspring from this cross.

Ans: i) Tt, tt

Male / Female	T	t
t	Tt	tt
t	Tt	tt

Offspring phenotypes: Tt , tt

- Provide learners with work on this. Give them worksheets.
- Let the learners work in pairs to work out one genetic cross. Then identify at least two questions for the learners to work individually as you go round to mark and help students with difficulty.
- Summarise the lesson by highlighting common mistakes you have identified from the genetic crosses. You may also identify a challenging question to be worked out by a gifted learner on the board.

Synthesis

This lesson aims to ensure that all the learners can attempt and work out genetic crosses to determine phenotypic and genotypic ratios.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Given that the allele for smooth seed coats in pea plants is dominant over that for wrinkled seed coats:
   i) State the phenotype of offspring from crossing pure breeding plant with smooth coated seeds and pure breeding plant with wrinkled seeds.
   ii) Account for answer in (i).

   Ans: *i) All would produce smooth coated seeds.*

   *ii) The allele for smooth seed coats is dominant over that for wrinkled seed coats hence in the genotype **Ss** of F1 offspring, allele for wrinkled seed coats **s**, would be completely suppressed by allele **S** for smooth seed coats.*
2. With reference to question 1 above, work out the phenotypic and genotypic ratios of F2 offspring from selfing smooth coated F1 offspring.

Ans:

	S	s
S	SS	Ss
s	Ss	ss

Phenotypic ratio: 3 smooth: 1 wrinkled

Genotypic ratio: 1 SS: 2 Ss: 1ss

Lesson 4: Co-dominance

Refer to Student's Book.

Specific objectives

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

- Use genetic diagrams to predict results of monohybrid inheritance involving co-dominance.

- Determine phenotypic and genotypic ratios from the genetic crosses on co-dominance.

Preparation for the lesson

1. This lesson will involve working in pairs and group discussion. You will therefore organize the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Obtain worksheets and other materials in advance.

Teaching Aids

- Worksheets
- Marker pens
- Student's Book
- YouTube tutorials https://www.youtube.com/watch?v=2LhwbM7FupQ
- **IMPROVISATION:** You may come up with audio or video presentations to further emphasise the concept of incomplete dominance and co- dominance.

Teaching/Learning activities

- Introduce the unit as explained under **guidance on the problem statement** above then narrow down to the lesson.
- Ask probing questions to introduce the lesson. Such questions may include: In a certain species of plants, the gene for red colour of flowers and the gene for white colour of flowers are both dominant. State the genotypes of pure breeding: (i) White flowered plant. ii) Red flowered plant. *(**Ans:** i) WW ii) RR*

  Why would the phenotypes of dominant alleles be represented in the offspring? *(**Ans**: Since both alleles are dominant and are expressed equally in the phenotype)*
- This is a discussion activity on identifying traits controlled by co-dominant alleles.
- Provide learners with worksheets.
- At this point play the YouTube video to help the learners discuss.
- Let the learners write notes on co-dominance in their books
- Summarise the lesson by highlighting the difference between co-dominance and incomplete dominance.

Synthesis

The lesson introduces learners to the concept of co-dominance and incomplete dominance.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What did you learn in this lesson?

   Ans: *That in some cases, the alleles responsible for a pair of contrasting traits may be both dominant and would therefore be expressed equally in the offspring.*

2. If the alleles for white and black coat in some breeds of cows are dominant; work out the genotype of offspring of a cross between a purebred black bull and a purebred white cow.

Ans:

Female/ Male	W	W
B	BW	BW
B	BW	BW

Lesson 5: Inheritance of ABO blood groups *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Explain how blood groups are determined in humans.
- State the possible genotypes of blood groups A, B, AB and O.
- Carry out genetic crosses to determine offspring genotypes.

Preparation for the lesson

1. This lesson will involve group work and individualised study. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Learners will discuss on the blood groups they are familiar with and the blood group they have.
3. Ensure that there is internet and obtain reference materials in time.

Teaching Aids

- Notes in Student's Book.

IMPROVISATION: You may come up with a YouTube video that explain. https://www.youtube.com/watch?v=KXTF7WehgM8

Teaching/Learning activities

1. Ask probing questions to introduce the lesson. Such questions may include: State another blood type other than the ABO blood groups? (***Ans:*** *Rhesus*) Name the proteins on the surface of red blood cells that determine blood groups in humans. (***Ans:*** *Antigens)*
2. Why is it important to know one's blood type? *(**Ans:** Enables a person to be given the correct blood type during*

blood transfusion to avoid antigen-antibody reactions that could result to death)

- Put learners into groups considering their abilities. Let them watch the YouTube you will provide them with.
- Provide learners with access to Internet in case they need to research for more information.
- At this point, you can introduce the lesson by writing on the board the possible genotypes associated with the different blood groups and by highlighting concept of antigen-antibody reactions and running the YouTube video. Use a genetic diagram to explain how offspring inherit blood types from their parents.
- Engage learners in a question-answer session to ascertain level of understanding.
- Guide learners to write notes in students' book.
- Give learners worksheets and select questions for them to attempt individually.
- Summarise the lesson by highlighting co-dominance in the inheritance of the ABO blood groups.
- Finalise by giving a talented learner a challenging question to work out to the rest of the class.
- End the lesson by instructing learners to attempt Self – evaluation test 20.3.

Synthesis

This lesson introduces learners to inheritance of blood groups in humans and the concept of blood transfusion in relation to blood types.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is multiple alleles?

   *(**Ans:** A case where more than two alternative allelic forms of a gene determine the inheritance of a certain trait)*

2. Why are alleles A and B said to be co-dominant?

   *(**Ans**:They are both expressed equally in the phenotype; such that a person with antigen A and B on their red blood cells would be blood group AB.)*

3. A woman is married for the second time. Her first husband was blood type B, her child by that marriage was type O. Her second husband is type A and their child is type AB. What is the woman's: i) Genotype? ii) Blood type?

   *(**Ans**: i) BO ii) Blood group B*

Lesson 6: Inheritance of sex in humans *(To be covered in two period)*

Refer to Student's Book.

Specific objectives

- By the end of the lesson, learners should be able to describe the inheritance of sex in humans with reference to XX and XY chromosomes.

Preparation for the lesson

1. This lesson will be a discussion and presentation lesson.
2. Guide learners to carry out their research in activity 20.4 in advance.

Teaching Aids

- YouTube link: https://www.youtube.com/watch?v=o_nG9lbJ2iE
- The notes in Student's Book.

IMPROVISATION: You may provide YouTube video to illustrate how sex is determined in human beings.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include; which chromosomes determine sex in humans? *(**Ans**: X and Y chromosome)* State the genotype that represents male and female; male-*XY* female-*XX*

Activity 20.4(Refer to Student's Book).

- Let the learners present their research work of Activity 20.4 to the rest of the class.
- At this point, run the You Tube video of sex determination in humans.
- Explain to the learners using a genetic cross how sex is determined in humans and indicate the chance of getting either a boy or girl.
- Summarise the lesson by highlighting the fact that a man determines sex of a child since they can either pass X or Y unlike females who can only pass X; let the learners take summary notes. Refer to the notes in Student's Book.

Synthesis

This lesson intends to create awareness to the learners of how sex of a baby is determined at conception and that the man is the determinant of whether the child will be male or female.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. State the terms that are used to describe the following: i) XX ii) XY *(**Ans**: i) Homogametic ii) Heterogametic)*
2. What is the probability that a couple would get a boy as a fourth born?

(***Ans***: *½ x ½ x ½ x ½ = 1/16*

Lesson 7: Sex linkage-haemophilia

(To be covered in one period)

Refer to Student's Book.

Specific objectives

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

- Define the term sex- linkage.
- Use genetic diagrams to explain the inheritance of haemophilia.

Preparation for the lesson.

1. This lesson will involve working in pairs and individualised study. **REMEMBER:** When grouping learners, you should consider the different abilities and the special needs for various individuals.
2. Learners will discuss in pairs the possible genotypes regarding the trait in males and females.
3. Ensure that there is Internet if learners need to research for more content and obtain reference materials in time.

Teaching Aids

- Notes in Student's Book.
- Tutorials on You Tube.

IMPROVISATION: You may prepare a pedigree to show inheritance of haemophilia in royal families in England and link to how the defective allele is passed down from parents to offspring.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is haemophilia? (***Ans***: *Also called the bleeder's disease is a genetic condition where the blood takes abnormally long to clot due to absence of certain clotting factors*)
- Why is haemophilia more common in males than females? (***Ans***: *The recessive allele for haemophilia is located on the X chromosome; males have only one X chromosome, hence there cannot be carriers.They can either be hemophiliac or normal. Females on the other hand have two X chromosomes hence they have higher chance of being carriers or normal.)*
- Put learners into groups considering their abilities. Let them discuss content they researched in activity 20.4.
- Allow the learners in their groups to present their findings to the rest of the class.
- At this point, you can introduce the lesson writing on the board the possible genotypes associated with haemophilia and by highlighting how the trait is transmitted from their parents.

- Carry out a genetic cross to illustrate inheritance of haemophilia.
- Engage learners in question-answer session to ascertain level of understanding.
- Guide learners to write notes on page 349 of the on Student's Book.
- Give learners worksheets and select questions for them to attempt individually.
- Summarise the lesson by highlighting the effects of haemophilia to an individual.
- Finalise by giving a talented learner a challenging question to work out to the rest of the class.

Synthesis

This lesson introduces learners to inheritance of haemophilia as a sex-linked trait in humans.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Why would a female having genotype XH Xh be said to be a carrier and not hemophiliac?

   (***Ans***: *The defective allele responsible for haemophilia is suppressed by the dominant allele.)*

2. Determine the genotypic ratios of offspring from a cross between a carrier female and a haemophiliac male.

   Ans:

Parental phenotypes

carrier female *haemophiliac male*

Parental genotypes *XH Xh* × *Xh Y*

	Xh	*Y*
XH	XH Xh	XH Y
Xh	Xh Xh	XhY

Genotypic ratio: XH Xh: Xh Xh : XH Y: Xh Y

Lesson 8: Inheritance of colour blindness *(To be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Explain the inheritance of colour blindness.
- Use genetic diagrams to explain the inheritance of colour blindness.

Preparation for the lesson

a) This lesson will involve working in pairs and individualised study.

REMEMBER: When grouping learners, you should consider the different abilities and the special needs for various individuals.

b) Learners will discuss in pairs the possible genotypes regarding the trait in males and females.

c) Ensure that there is Internet if learners need to research for more content and obtain reference materials in time.

Teaching Aids

- Notes in Student's Book.

IMPROVISATION: You may prepare a pedigree to show inheritance of colourblindness from parents to offspring.

Teaching/Learning activities

- Ask probing questions to introduce the lesson. Such questions may include: Which is the most common form of colourblindness in humans? *(**Ans**. Red-green colourblindness)* Is it possible to treat colour blindness? *(**Ans**: Yes, by using a colour correction system that changes the wavelength of each colour entering the eye)*
- Put learners into groups considering their abilities. Let them discuss content they researched in activity 20.4.
- Allow the learners in their groups to present their findings to the rest of the class.
- At this point, you can introduce the lesson by writing on the board the possible genotypes associated with the trait and how the trait is transmitted from their parents.
- Carry out a genetic cross to illustrate inheritance of colour blindness.
- Engage learners in a question-answer to ascertain level of understanding.
- Guide learners to write notes in Student's Book.
- Give learners worksheets and select questions for them to attempt individually.
- Summarise the lesson by highlighting the challenge associated with an individual who is colour blind.
- Finalise by giving a talented learner a challenging question to work out to the rest of the class. Give the learners time to do self-evaluation test 20.5.

Synthesis

This lesson introduces learners to inheritance of colour blindness as a sex-linked trait in humans.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions

such as:

1. Other than colour blindness and haemophilia, state two other types of sex linked traits in humans.

   *(**Ans**: Baldness, growing tufts of hair from nose and pinna in males)*

2. What is the probability of a colour blind female married to a normal male getting a male child with normal colour vision? *(**Ans**: 0)*

Answers to Self-evaluation Test 20.1

1. Inheritance
2. Nucleus
3. Pedigree
4. 23
5. First generation refers to the offsprings that are produced after crossing the parental genotypes while second generation is produced from the crossing of the first generation offspring.
6. C

Answers to Self-evaluation Test 20.2

1. Mendel's law of independent assortment states that the alleles of two (or more) different genes get sorted into gametes independently of one another.
2. homozygous, heterozygous
3. A
4. A
5.

Male/ female	T	t
t	Tt	tt
t	Tt	tt

The phenotypic and genotypic ratio is 1:1

Answer to Self-evaluation Test 20.3

1. Phenotype group A x group B

   Genotype I^A x I^B

   Gametes $I^A I^O$ x $I^B I^O$

   $I^A I^B$ $I^O I^B$ $I^A I^O$ $I^O I^O$

2. Use number one above
3. D
4. A and B
5. Dominance, incomplete dominance
6. Phenotype group A x group B

   Genotype I^A x I^B

   Gametes $I^A I^O$ x $I^B I^O$

   $I^A I^B$ $I^O I^B$ $I^A I^O$ $I^O I^O$

Answers to Self-evaluation Test 20.4

1. Describes the way in which two genes that are located close to each other on a chromosome are often inherited together.
2. *Refer to the table.*

3. Chromosomes

Answers to Self-evaluation Test 20.5 1. Is a sex-linked trait where the normal allele for blood clotting is replaced by a defective recessive allele.

2. X

3. C

4. 1:3

5. The probability is high

6. X^HX^H, X^HX^h

Summary of the unit

The unit covers genetics. Genetics is the study of hereditary, inheritance is the transmission of genetic information from one generation to another. You therefore should effectively use the practical activities and suggested teaching approaches in the Teacher's Book to guide the learners to acquire knowledge and skills in this area. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well.

Additional information to the teacher

Origin of genetics

The **history of genetics** started with the work of the Augustinian friar George Johann Mendel. His work on pea plants, published in 1866, described what came to be known as Mendelian inheritance. Many theories of heredity proliferated in the centuries before and for several decades after Mendel's work.

The year 1900 marked the "rediscovery of Mendel" by Hugo de Vries, Carl Correns and Erich von Tschermak, and by 1915 the basic principles of Mendelian genetics had been applied to a wide variety of organisms—most notably the fruit fly *Drosophila melanogaster.* Led by Thomas Hunt Morgan and his fellow "drosophilists", geneticists developed the Mendelian model, which was widely accepted by 1925. Alongside experimental work, mathematicians developed the statistical framework of population genetics, bringing genetic explanations into the study of evolution.

Gene, DNA and cell

Every cell in the body with a nucleus (a compartment in most cells) has the same complete set of genes. A gene is made of DNA (deoxyribonucleic acid) and is basically a type of genetic instruction. Those instructions can be used for making molecules and controlling the chemical reaction of life. Genes can also be passed from parent to offspring; this is inheritance.

Some genes are active ('on') in some tissues and organs but not in others. This is what makes the difference between a liver cell and a lung cell. Genes are turned on and off during development and in

response to environmental changes, such as metabolism and infection.

Gene stability

Genes can change or mutate, although this happens only rarely. A mutation is a permanent change in DNA.

Given our trillions of cells, some mutation is occurring all the time. While certain mutations are harmful, in many cases there is no effect on traits. Some mutations are even beneficial. Only mutations in sperm or egg can be passed from parent to child.

Our bodies can sometimes recognize and destroy cells with harmful mutations, but not always. This is how cancer starts. In general, the genome (all the DNA in your body) is quite stable, and the genetic makeup we are born with remains throughout our lives. It is this stability that makes genetic testing a little different from other medical testing. For example, your cholesterol level or your blood count may change with time, but your genes do not change.

Answers to end unit assessment 20

Refer to Student's Book

1. (a) Continuous and discontinuous variations.

2. Colour blindness, haemophilia, baldness.

3. D

4. (a) Dominant

   (b) Recessive

5. (a) TT

   (b) Tt

   (c) tt

6. (a) Tt, tt

   (b) Genotypic ratio- 1 Tt : 1 tt
   Phenotypic ratio- 1 tall : 1 dwarf

7. (a) tt

   (b)

Parental phenotypes Black × Black

Parental genotypes Bb × Bb

	B	B
B	BB	Bb
b	Bb	bb

- Genotypic ratio: 1 BB: 2 Bb : 1 bb

Phenotypic ratio: 3 Black: 1 brown

8. a)

Parental phenotypes

colour blind female X normal man

Parental genotypes $X^c X^c$ × $X^C Y$

	X^C	Y
X^c	$X^C X^c$	$X^c Y$
X^c	$X^C X^c$	$X^c Y$

3 boys would be normal, 3 would be colourblind.

The two girls would be carriers.

9. (a)

- Genotypic ratio; 1RR: 2RW: 1WW
  Phenotypic-1 Red: 2 pink : 1 pink
- Incomplete dominance
- ¼ x 7324= 1831

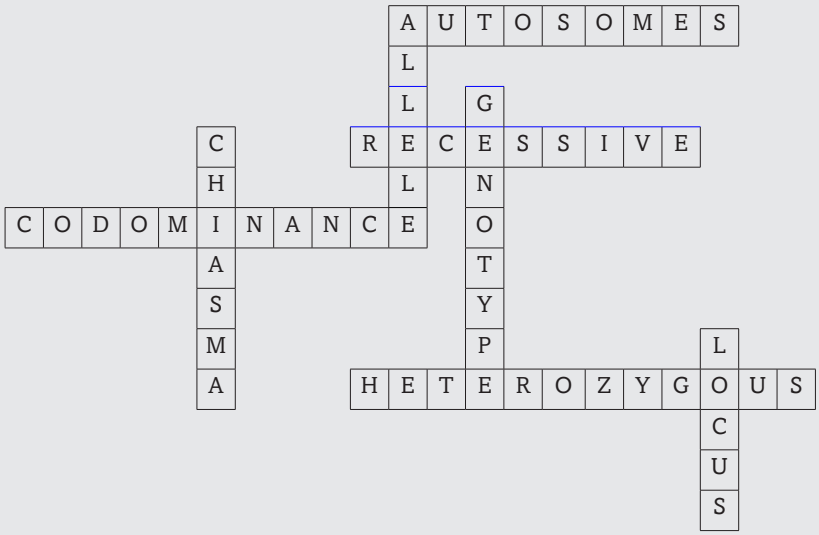
(b) Yes ; both male and female could have haemophilia.

(c) He would mate the insects with broad abdomen with that for narrow abdomen then if all offspring develop broad abdomen, then the allele for broad abdomen is dominant over the other and vise further.

10. True – if both are heterozygous for the state of blood groups (with genotype AO, then one of them could possibly be the parent.

11. False- if both of them are homozygous then they could both be wrong to claim that they are mothers of the child.

12



13. (b) Phenotype group A *group B

Genotype I^A x I^B

Gametes $I^A I^O$ × $I^B I^O$

$I^A I^B$ $I^O I^B$ $I^A I^O$ $I^O I^O$

14. a) A

b) Dominant

c) F

d) Discontinuous

15. B

16. C

17. D

18. A

19. C

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Using Manila paper, write examples of continuous and non-continuous and pin on the class wall. 2. Come up with an acronym for the key words used in genetics.	1. Do further research in textbooks or the Internet genetics. Write short notes then share with other class members. 2. Using examples, suggest ways in which genetics helps in solving family conflict. Share your findings with the rest of the class. 3. Come up with more calculations involving sex linkage. Do and give your teacher for marking.
Remedial questions for slow learners 1. What is genetics? 2. List four key terms used in genetics. 3. Using a table, show the genotypes of ABO blood groups.	**Extended questions for gifted learners** 1. What is the name of the 23rd chromosome in human beings? 2. How is haemophilia treated?
Answers to remedial questions	**Answers to Extended activities for gifted and talented learners**
1. Genetics is a branch of science that deals with the study of inheritance. 2. Genes, inheritance, genotype, heterozygous and many others 3. Refer to table 20.7 in the Student's Book	**Answers to high order thinking questions** 1. Sex chromosomes. 2. In order to help blood to clot, haemophilia is treated by giving the person some of the factor they are missing. This is given by injection. People suffer from different levels of haemophilia, and bleeding can occur both on the surface of the skin and under the skin.

UNIT 21 Gene theurapy

Key Unit Competence

After studying this unit, learners should be able to explain the role of genetic engineering in industrial production of insulin and genetically modified crops.

Pre-requisites of this unit

This is divided into two sections: learning objectives and links to other subjects.

Learning objective

Competence-based curriculum embraces three categories of learning objectives, that is, knowledge and understanding, skills acquisition and attitude and values. At the end of the period, the learner should have knowledge and understanding of the various concept areas, acquire the necessary skills, change their attitude towards various life aspects and subscribe to certain values that are acceptable in the society where they live. Therefore, emphasise attainment of these three objective areas during the learning process.

Table 21.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Define genetic engineering. ▪ Explain industrial production of insulin. ▪ Explain the advantages and disadvantages of genetically modifying crops. ▪ Describe colour blindness as an example of sex linkage.	By the end of this unit, learners should be able to: ▪ Make research on plants that require fewer fertilisers, resist drought, diseases and pests. ▪ Compare the advantages of the natural crops and genetically modified crops.	By the end of this unit, learners should be able to: ▪ Appreciate that modified crops increase the world's food production to increasing human population. ▪ Appreciate that animal insulin is available and safe for use by people with diabetes mellitus.

Pre-requisites of this unit

During the lessons, strive to bring to the awareness of learners the fact that this topic is related biology and molecular biology to be specific. Let the learners understand that at this level, they may only need the basic information. The content in this unit will help the learner to gain knowledge on improvement of crop varieties and animal breeds in Agriculture.

Background information

Gene technology is the term given to a range of activities concerned with understanding gene expression, taking advantage of natural genetic variation, modifying genes and transferring genes to new hosts. Genes are found in all living organisms and are passed on from one generation to the next.

Genetic engineering is also called genetic modification. It involves the direct manipulation of an organism's genome using biotechnology. It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms.

Cross-cutting issues to be addressed

1. Inclusive education

All learners should participate actively in their study groups, whether disabled or normal. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities.

2. 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.

3. Gender education

Both boys and girls should participate equally in the activities. Also emphasise that anybody irrespective of gender can pursue a career in genetic engineering.

4. Financial education

Emphasise the need to buy quality equipment and devices made of magnets. This saves money in the long run as the equipment stay long and costs on repair are reduced.

Generic competences covered

1. Critical thinking

This is achieved as learners find out the answers to the questions you give to them. Guide the learners to discover

for themselves various applications of gene technology. This competence will also come out as the learners think about their findings in the activities and as they give out suggestions on why this is the case.

2. ***Cooperation and Interpersonal management and life skills***

Learners learn to work with each other in their groups. They also learn how to solve problems that may arise in their groups. During group presentation you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentations as slow learners contribute.

3. ***Communication skills***

This is achieved as the learners express their ideas to the teacher and class members during the discussion. Encourage all learners irrespective of their abilities to participate in group discussions, during presentations by asking questions and during question-and-answer sessions.

4. ***Listening and note taking skills:***

This is achieved as the learners listen to you and during the note taking process.

Key words in this unit and their meanings

Genetic engineering-It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms.

GMO-A genetically modified organism, or GMO, is an organism that has had its DNA altered or modified in some way through genetic engineering.

Biotechnology – The exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones.

Transgenic plants – These are plants that have been genetically engineered; a breeding approach that uses recombinant DNA techniques to create plants with new characteristics.

Herbicides – These are chemicals that are meant to kill weeds.

Insulin- This is a hormone produced by the pancreas and responsible for regulation of blood sugar.

Guidance on the problem statement

In this topic, you will teach about gene technology which is part of biotechnology. Biotechnology being a branch of biology involving the manipulation of organisms DNA is an interesting and important scientific application.

You will need to introduce this chapter by explaining what biotechnology

means. This will easily be achieved by using common examples which include genetically modified crops like avocados and oranges. You will need to state clearly the reasons as to why man has taken this route of science. Explain the problems that man has solved by using biotechnology.

You will need to use videos to familiarise learners with procedures taken while manufacturing insulin. Let them understand that this is one of the greatest achievements science has ever made towards the field of medicine.

Lastly you will need to employ the research and discussion method to stimulate students to find out what dangers are associated with the use of GMOs.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
• Slow learners can point at the various parts on the charts as gifted learners name the parts and explain their effect on the environment. • When watching videos, you may repeat or pause for the benefit of slow learners. • Gifted learners to lead in group discussions and do presentations. • Ensure all learners respect others, views irrespective of their shortcomings or talents.	• Provide braille for blind learners and large print text to learners with visual difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. • Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Introduction and genetic engineering	2
2.	Industrial manufacture of insulin	3
3.	Advantages and disadvantages of GMOs	3

21.1 Genetic engineering

Lesson 1: Introduction to genetic engineering *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Define genetic engineering.
- Give examples of products manufactured through genetic engineering.

Preparation for the lesson

- This is a group activity that will involve a class discussion, reading a story and field work. You will guide the learners during the discussion and organize for a field study to a nearby research Centre.
- Ensure the Internet is working properly before the lesson for the learners to use when researching.

Teaching aids

- Student book
- Pictures and videos showing processes of genetic engineering
- Computers connected to the internet
- Library source

Introduction to the lesson

Introduce the unit as explained under the guidance on the problem statement above then narrow down to this lesson.

Teaching /learning activities

- Introduce the topic by asking learners to read the story in the Student's Book. The story will enable them understand how gene technology is applied in various fields.
- Let learners discuss the story they have read using the study questions.
- Using their findings explain what is gene technology. Organize for a visit to a research facility around the school. Assist learners prepare a questionnaire for Activity 21.1 in the Student's Book.
- Instruct learners to write a report and present it to the rest of the class.
- Organise learners into groups then provide them with computers having Internet connectivity or reference materials to do research on genetic engineering.
- Thereafter have a class discussion on genetic engineering as they take notes.

Synthesis

This lesson is meant to introduce biotechnology and its principles to

students. In today's society, man is faced with numerous problems of which he has to find solutions. These problems include poverty, hunger and disease. Biotechnology is one of the solutions that man has applied to such problems. Students are supposed to be equipped with knowledge on such solutions that man has created through biotechnology.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is gene technology used for?

   Ans: *Gene technology is used to produce new breeds of animals with better production output and new varieties of crops with higher output and which are more resistant to drought and diseases.*

2. What is biotechnology?

   Ans: *Refers to productive application of Biology in research and industry to maximize output*

3. Give three examples where genetic engineering is applicable.

   Ans: *in vitamin A production, in pest resistant crops and in herbicide resistant crops*

21.2 Industrial manufacture of insulin

Lesson2: ***Industrial manufacture of insulin*** *(To be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Explain industrial production of insulin.
- Reasons why insulin is synthetically manufactured.
- Appreciate that animal insulin is available and safe for use by people with diabetes mellitus.

Preparation for the lesson

- This is a group activity that will involve a class discussion and observation of the processes involved in insulin production.
- You will guide the learners during the discussion and observations.

Teaching aids

- Resource person
- Student book
- Pictures and videos showing processes of genetic engineering
- Computers connected to the Internet
- Library source

Introduction to the lesson

You may begin the lesson by asking learners questions on what they learnt in lesson 1 above. Ask probing questions such as: What is genetic engineering? Is manufacturing insulin an example of genetic engineering?

Teaching/ learning activities

- In Activity 21.3, organize learners into groups of four and provide them with study materials to observe industrial manufacture of insulin.
- Let them carry out the activity then compare their findings with the rest of the class.
- Build on their findings to explain the process of insulin manufacture and other examples of gene technology application.
- End the lesson by instructing learners to take notes about insulin production in their notebooks. They can also attempt some numbers in self-assessment test 21.1 .

Synthesis

One of the present day problems facing man is diabetes. This is a condition of having too much blood sugar than the required normal standards. This condition can be as a result of less insulin production in the body or the pancreas being totally unable to produce insulin.

Students are to be introduced to the knowledge behind insulin production using biotechnology. Through this lesson therefore, learners will be introduced to the biotechnological procedures that are followed during the manufacture of insulin. Insulin is used to control **Diabetes mellitus.**

Lesson assessment

1. Outline the process involved in the manufacture of insulin.

   Ans: *isolation of DNA of insulin from human being, a plasmid made of DNA is removed from the bacterial cell, restriction enzyme cuts the plasmid from the bacterial cell open, leaving sticky ends, the insulin gene from human cell is added to the plasmid, the plasmid which is now genetically modified is inserted back into the bacterium, the bacterium host cell divides and produces copies of the plasmid. The bacterium manufactures human insulin using genes in the plasmid, the insulin is extracted from the bacterium culture and purified.*

21.3 Advantages and disadvantages of GMOs

Lesson 3: Advantages and disadvantages of GMOs *(To be covered in three periods)*

Refer to Student's Book.

Specific objective

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

- Explain the advantages and disadvantages of genetically modified crops.

Preparation for the lesson

- This is a group activity that will involve a class discussion and observation of the processes involved in insulin production.
- You will guide the learners during the discussion and observations.

Teaching aids

- Resource person
- Student book
- Pictures and videos showing processes of genetic engineering
- Computers connected to the Internet
- Library source

Introduction to the lesson

You may begin the lesson by asking learners questions on what they learnt in lesson 2 above. Ask probing questions such as: What are people's reactions to gene technology in your area?

Suggested teaching/learning activities/approach

1. Introduce the lesson with a discussion on advantages and disadvantages of GMOs.
2. Organize learners into groups of four. Let them discuss the advantage and disadvantages of GMO. 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. Let learners contribute to the discussion. Correct these learners where they go wrong.
3. Build on their findings to explain the advantages and disadvantages of GMOs as you cite examples.
4. End the lesson by asking learners to attempt the self-evaluation test 21.3 and Test your Competence 21.

Synthesis

This lesson is meant to introduce to learners the dangers and advantages that come with genetically modified organisms. They should therefore appreciate that these organisms whose gene structure have been altered are both useful and harmful to some point.

Lesson assessment

Assess whether the learning objective of the lesson was met by asking questions such as:

1. Give three advantages of GMO.

   Ans: *Crops are more resistant and have a larger yield, offer more nutrition and flavour, they eliminate allergy-causing properties*

2. Most Christians are against GMO, explain.

   ***Ans**: One of the biggest arguments that Christians (and many other people) use against genetically modified organisms is that modifying the genetics of plants is "playing God," and that changing something God created isn't right, because it is saying we don't believe that God's creation is "good enough.*

Answers to self-evaluation test 21.1

1. D
2. C
3. false
4. A

Answers to self-evaluation test 21.2

1. Genetic engineering is good because of the following reasons:
   - It has helped to create crops which are resistant to pests.
   - Created a way of manufacturing biologically important proteins like insulin
   - Has created crops that are highly nutritious
   - More income-With genetic engineering, farmers will have more income, which they could spend on important things.
2. Yes, because of the following reasons:

   There is a shortage of these crops because of pests, drought, weeds and pests. GMOs can be modified in a way to improve on their resistance towards all these problems. Hence the harvest can increase greatly.

Summary of the unit

- Biotechnology is technology based on biology - biotechnology harnesses cellular and bimolecular processes to develop technologies and products that help improve our lives.
- Modern biotechnology provides important products and technologies to combat rare diseases, reduce degradation, use less and cleaner energy, and have safer, cleaner and more efficient industrial manufacturing processes and harvest much more from our agricultural crops.
- Recent advances in biotechnology are helping us prepare for and meet the society's most pressing challenges.
- Gene Technology is one of the branches of modern Biotechnology concerned with understanding the expression of genes, modifying and/or transferring genes to new hosts to create products with desired traits.
- Genetic engineering is the changing of the genetic material of an organism by removing or inserting individual genes.

- Man's body is capable of producing insulin by the use of the pancreas.
- The pancreas however might not function properly because of disease and age. The body therefore will face a shortage of insulin which results into an increase in blood sugar level.
- When this increase is not checked, it will develop into a condition known as diabetes mellitus.
- Human insulin is made by genetically engineered microbes. They produce human insulin in a pure form that is less likely to cause body reactions.

Additional information to the teacher

- ***Gene Transfer***

  Relevant to the previous disadvantage, a constant risk of genetically modified foods is that an organism's modified genes may escape into the wild. Experts warn that genes from commercial crops that are resistant to herbicides may cross into the wild weed population, thus creating super-weeds that have become impossible to kill.

- **New Diseases**

  As previously mentioned, genetically modified foods can create new diseases. Considering that they are modified using viruses and bacteria, there is a fear that this will certainly happen. This threat to human health is a worrisome aspect that has received a great deal of debate.

- **Economic Concerns**

  Bringing a genetically modified food to market can be a costly and lengthy process, and of course, agricultural bio-technology companies want to ensure profits. Consumer advocates are worried that this will raise seed prices to very high levels that third-world countries and small farmers cannot afford them, thus widening the gap between the rich and the poor.

Answers to end unit assessment 21

Refer to Student's Book

1. D
2. This is because it has become a solution to most of the complicated problems man has had before.
3. False
4. C
5. D
6. Protein, pancreas, diabetics, injection, cow,pig,genetic engineering
7. Award based on the explanation
8. a) DNA

   b) PLASMID

c) BACTERIA

d) ENZYME

e) GENE

9. D

10. D

11. Advantages

- Pest resistance
- Highly nutritious
- Large quantities of harvest
- Crops can survive drought

Disadvantages

- Poor taste of such crops
- Gene pollution can take place
- Foreign genes can escape to weeds creating super weeds.

12. a) Pancreas

b) The levels of glucose in blood would rise beyond normal and with time, this person would become diabetic.

c) *E.coli*

13. Award based on students expalnation.

14. Genetic engineering is applied in manufacturing of herbicides which kiil weeds. Once the weeds become resistant to specific herbicide, through engineering another herbicide can be produced.

15. How quickly does the seed emerges?

How tall is the resulting plant

How does the resulting plant stand throughout the year?

How strong are the resulting plants roots, stalk/stem?

How is the resulting plant affected by various insects and diseases?

How is the resulting plant is affected by it being planted on various soil types?

How well does the resulting plant perform under stress from excess water or drought?

How well does the resulting plant yield stack up to others?

How long will it take the resulting plant to mature for harvest? How does the resulting plant react to various populations and row spacings? What weed pressures do the farmers fields have?

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Use manila paper provided by the teacher to write the process involved in the manufacturing of insulin. Hang it on the class wall and discuss it with other students. 2. Watch the video that is played by your teacher showing different ways in which genetic engineering is applied. Take short notes and share your notes with the rest of the class.	1. Do further research in textbooks or the Internet about gene technology. Write short notes then share with other class members. 2. Using the computer, draw a flow chart showing the process involved in industrial manufacture of insulin. Share your results with the class. 3. Visit the nearby farm where the farmers still practise traditional farming methods. Persuade the farmer to practise the modern method, list down the points you will use to persuade the farmers.
Remedial questions for slow learners 1. What is gene technology used for? 2 List three advantages of GMO. 3. List three types of pollution. 4. What is a habitat?	**Extended questions for gifted learners** 1. How do scientists incorporate herbicide tolerance into crop plant species? 2. Explain how human activities can lead to species extinction. 3. How can human beings best protect biodiversity? 4. Explain monoculture and diversity.

Answers to remedial questions for slow learners	Answers to extended questions for gifted learners
1. Gene technology is used to produce new breeds of animals with better production output and new variety of crops of higher output. 2. Crops are more productive and have a larger yield. 3. Offer more nutrition and flavour. 4. They eliminate allergy causing properties in some foods.	1. Finding a closely related species that has herbicide tolerance or resistance and then incorporate that tolerance into the desired plants. 2. Use of a cell or tissue culture to test many different lines of plants for tolerance to a specific herbicide. 3. Determining the specific gene or genes within a plant or microbe that allow tolerance or resistance to a specific herbicide.

UNIT 22 Variation and adaptive features

Key unit competence

After studying this unit, learners should be able to explain that variation is caused by both genetic and environmental factors and adaptive features shown on different organisms.

Learning objective

Table 22.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Define variation as differences between individuals of the same species. ▪ Distinguish between phenotypic variation and genetic variation.	By the end of this unit, learners should be able to: ▪ Record and present the results of investigations into continuous and discontinuous variation. ▪ Observe the differences in phenotypes between two extremes, e.g. height in humans.	By the end of this unit, learners should be able to: ▪ Appreciate variation in human beings e.g. tongue rolling and height.

Knowledge and understanding	Skills	Attitudes and values
▪ State that continuous variation results in a range of phenotypes between two extremes e.g. height in humans. ▪ State that discontinuous variation results in a limited number of phenotypes with no intermediates e.g. tongue rolling. ▪ Define mutation as genetic change. ▪ State that mutation is the way in which new alleles are formed. ▪ Define adaptive feature as an inherited feature that helps an organism to survive and reproduce in its environment. ▪ Explain that ionizing radiation and some chemicals increase the rate of mutation. ▪ Explain the adaptive features of hydrophytes and xerophytes to their environments.	▪ Interpret images or other information about a species to describe its adaptive features.	

Pre-requisites of this unit

Learners learnt about variation and adaptive features in senior 1 and senior 2. Review the topic by reminding the learner of what they learnt such as the definition and types of variation. Also mention some of the keywords learnt and their meanings.

During the lessons, strive to bring to the awareness of learners the fact that this topic is linked to genetics. Let them understand that at this level, they may only need the basic information otherwise details of the topic's content would be learnt at higher levels.

Background information

This topic deals with variation. Emphasise on the type of variation, characteristics

and importance of variation. Variation is any difference between cells, individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic variation) or by the effect of environmental factors on the expression of the genetic potentials (phenotypic variation). Variation may be shown in physical appearance, metabolism, fertility, mode of reproduction, behaviour, learning and mental ability and other obvious or measurable characters.

Cross-cutting issues

1. 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.

2. Genocide issues

Learners should be reminded that it is wrong to segregate against people especially using their phenotypic characteristics. We should appreciate that we are all human beings and learn how to live together happily.

3. Standardisation culture

Bring to the attention of learners the importance of buying from certified qualified agronomist in case they want to plant. This will aid in improving the production.

4. Gender education

Emphasise to learners that anybody, irrespective of their gender, can pursue a career in genetics. Give examples of role models who are successful doctors in the area where the learners come from.

5. Inclusive education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions.

Generic competences covered

1. Cooperation and interpersonal management and life skills

Developed as learners interact in pairs as they engage discussion on processes involved in variation. During presentations, you can allow rotational presentations within the group members. Gifted learners should help in coming up with presentations as slow learners contribute.

2. Research skills

Guide the learners on how to find information regarding various. Guide

the learners on how to come up with summarised notes from a large body of text.

3. Communication in English

Developed as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in the discussions, presentations and during question-and-answer sessions.

4. Critical thinking

This will be developed by learners as they answer the probing questions. This competence will also come about as learners think about their findings in the activities and as they give out their suggestions.

5. Lifelong skills

Advise learners that content learnt in these lessons would be applicable in their future. Also, make learners aware that they can become doctors and farmers.

Key words in this unit and their meanings

Variation refers to the differences within the observable and non-observable characteristics in a given species of organisms

Phenotypes are traits or characteristics of an organism that we can observe such as size, colour, shape, capabilities, and behaviors.

Continuous variation is where the differences range from one extreme end to another with many intermediate forms in between.

Discontinuous variation is where characteristics in a given species show definite or distinct differences; there are no intermediates.

Mutations are alterations to a DNA sequence resulting into the formation of new alleles.

Gene mutation occurs as a result of altering the chemical structure of genes.

Chromosomal mutations involve changes in structure of a chromosome or a change in the number of chromosomes in a given individual.

Adaptive features are inherited characteristics that allows an organism to both survive and reproduce in its environment.

Xerophytes are plants that survive in very dry regions.

Guidance on the problem statement

You will introduce this unit by asking learners to identify the different characteristics which make them similar as human beings. Go ahead and ask them how they are different as human beings. Those differences will help you explain

to them that they are the variations that exists between groups of living organisms.

Tell them that variations can be grouped into genetic and phenotypic variations. Give them common examples to allow them grasp the difference between the two types of variations. Without examples it will be hard for students to classify variations on this basis.

You will use classroom activities in the student's book to familiarize learners with the concepts of continuous and discontinuous variations. They will include rolling tongues and also taking measurements of their heights.

You will explain mutations of genes well by using examples of tests which have been written in order and the same sentences whose words have been misplaced. Tell them that when a word is misplaced in a sentence, then the message conveyed is totally different from the one intended.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ Both gifted and slow learners to be given equal opportunity to lead in group discussions and to do presentations of group findings to the rest of the class. ▪ Ensure all learners respect others view irrespective of their shortcomings or talents. ▪ Gifted learners to be given heavy tasks requiring more critical thinking while slow learners be given tasks which they can manage such as collecting materials for use during practicals.	▪ All learners whether disabled or not should participate actively in the class activity. ▪ Physically challenged learners should be given priority in the learning process. In the group work, disabled learners should be given lighter duties like recording observations; while the rest go to the field to collect specimen. ▪ Learners with visual problems should be placed at the front of the class. ▪ **Remember** disability is not inability!

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Variation	1
2.	Continuous and discontinuous variation	2
3.	Mutations	1
4.	Adaptive features	2

22.1 Variation

Lesson 1:Variation *(to be covered in one period)*

Refer to Student's Book.

Specific objectives

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

- Define variation.
- Appreciate the causes of variation in organisms.
- State the different types of variation.

Lesson preparation

1. This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching aid

- Computers connected to Internet
- Student's Book
- YouTube link

Prerequisite to the lesson

Introduce the unit as explained under guidance on problem statement and narrow down to this lesson.

Teaching/learning activities

- Ask probing questions to introduce the lesson. Such questions may include:
- What is variation?
- ***Ans*:** Variation is differences within the observable and non-observable characteristics in a given species of organisms. What causes variation? ***Ans***: Mutation, separation of chromosomes during gamete formation and crossing over during meiosis.

Activity 22.1 (Refer to Student's Book.)

- Organise learners to form groups of four. Learners should discuss

the different characteristics they have. Ask them to note these characteristics in their notebooks.

- Ask them to identify the causes of such differences. Let them research on such variations that are caused by the environment and those caused by genes.
- Use the contributions done by learners to point out more variations including blood groups, sex, gum colour etc. Explain to learners that these differences are known as variations. They can be caused by genes or the environment. Refer to Student's Book.
- End the lesson by instructing learners to attempt Self-evaluation Test 22.1.

Synthesis

This lesson is meant to introduce the concept of variation to students. Genes are the basic factors that control the phenotypic characteristics of organisms. The environment can also cause differences to exist between different organisms of the same species. Through this lesson therefore learners will be given knowledge on the different types of variations and the reasons behind them.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What is genetic variation?

   Ans: *It refers to differences amongst organisms of the same species caused by difference in genes they inherit from their parents.*

2. What are the external environments that can bring about phenotypic variation?

   Ans: *Climate, physical accidents, diet, culture, lifestyle*

22.2 Continuous and discontinuous variation

Lesson 2: Continuous and discontinuous variation *(to be covered in two units)*

Refer to Student's Book.

Specific objectives

By the end of the lesson, learners should be able to differentiate between continuous and discontinuous variation.

Lesson preparation

1. This lesson will involve individual work and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the

special needs for various individuals.

2. Organise to have the charts in place before the lesson.

3. Provide reference materials.

Teaching aids

- Computer connected to the Internet
- Rulers
- Reference book

Prerequisite to the lesson

Introduce the unit as explained under guidance on problem statement above and narrow down to this lesson.

Teaching/learning activities

- Ask probing questions to introduce the lesson. Such questions may include:
- What is continuous variation? **Ans**: Variation that has no limit on the value that can occur within a population.
- Is height and weight characteristics of discontinous variation? **Ans:** No
- *Activity 22.2 , 22.3 and 22.4 (Refer to Student's Book.)*
- Organise them into groups of five. Let learners measure the heights of fellow class members and record in a table format.
- Show them how to present the information collected into frequency and range table. Assist them to answer the study questions and the calculations involved.
- Thereafter have a class discussion on characteristics that show continuous variation and discontinuous variation.
- Have a class discussion on characteristics of discontinuous variations as they take notes.
- Learners should discuss about the difference between continuous and discontinuous variation. Refer to Student's Book. Ask them to note these characteristics in their notebooks.
- End the lesson by instructing learners to attempt the Self-evaluation Test 22.2.

Synthesis

This lesson is meant to impart skills to learners about identifying different forms of variations among individuals. It will also help learners to appreciate the differences between them and know why living organisms are created different. This can create a society where we do not segregate one another because of our phenotypic differences.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Choose the odd one out. *Height, weight, skin colour, male*

   Ans: *Male*

2. Name two examples of discontinuous variation that show more than two variations.

   Ans: *Blood groups, fingerprints*

22.3 Mutations

Lesson 3: Mutations *(to be covered in two periods)*

Refer to Student's Book.

Specific objectives:

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

- Define a mutation.
- State the causes of mutations.
- Explain how mutations can result into variations.

Lesson preparation

1. This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.

2. Organise to have the charts in place before the lesson.

3. Provide reference materials.

Teaching aid

- Reference materials
- Computer connected to Internet
- Mobile phone

Prerequisite to the lesson

Introduce the unit as explained under guidance on problem statement above and narrow down to this unit.

Teaching/learning activities

- Learners are already conversant with using a mobile phone especially texting.
- Ask them their experience and if they have ever sent a text to a wrong recipient or a wrong text. What was their experience?

Activity 22.5 (Refer to Student's Book.)

- Relate the activity to mutation of genes in the DNA and explain to learners how mutations occur and its causes. Refer to Student's Book.
- End the lesson by instructing learners to attempt Self-evaluation Test 22.3.

Synthesis

This lesson is meant to introduce the concept of mutations to learners. Mutations are mistakes that occur as genes try to relay information during cell division. Mutations are the reason why

most variations occur within organisms of the same species.They also explain the sudden existence of characteristics that were not existent before.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What are the two types of mutation?

   Ans: *Chromosomal and gene*

2. What are the causes of chromosomal mutation?

   Ans: *The DNA failing to copy accurately, external influences such as exposure to specific chemicals or radiation*

22.4 Adaptive features

Lesson 4: Adaptive features *(to be covered in two periods)*

Refer to Student's Book.

Specific objective:

By the end of the lesson, learners should be able to explain adaptive features of xerophytes and hydrophytes.

Lesson preparation

1. This lesson will involve individual working and group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Organise to have the charts in place before the lesson.
3. Provide reference materials.

Teaching Aids

- Student's Book
- Computer connected to Internet
- Microscope

Prerequisite to the lesson

Introduce the unit as explained under guidance on problem statement and narrow down to this lesson.

Teaching/learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What are adaptive features? ***Ans***: They are inherited characteristics that allow an organism to both survive and reproduce in an environment.
- Activity 22.6 (Refer to Student's Book.)
- Organise learners to carry out Activity 22.6. Provide each group with at least two hydrophytes and xerophytes. Ask the learners to identify them carefully. Ask the learners to note down the characteristics of each. Ask them reasons to why they think these plants have such characteristics.

- You will build from the contributions made by learners to explain why xerophytes and hydrophytes have such characteristics. Refer to student's Book.
- End the lesson by instructing learners to attempt Self-evaluation Test 22.4 and Test your competence 22.

Synthesis

The lesson is meant to instill skills of identification of xerophytes and mesophytes to students. It is also meant to make learners understand why such plants have these specific adaptations. They will understand the effect of the environment on organisms.

Answers to Self-evaluation Test 22.1

(Refer to Student's Book)

1. A
2. B
3. Genetic variation is the variation in alleles and genes, both within and among populations while phenotypic variation is a type of variation that can be due to inheritance, and also due to environmental factors such as climate and diet.
4. Climate, diet and diseases

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. What are xerophytes?

   Ans: They *are plants that survive in very dry regions*.

2. Give two adaptive features of hydrophytes.

   Ans: *The epidermal has little cuticle, vascular bundles are greatly reduced, root system is very much reduced.*

Answers to self-evaluation Test 22.2

(Refer to Student's Book.)

1

Continuous variations	Discontinuous variations
Weight, length of fore arm, height	Gender, blood groups

2. C
3. A
4.

Continuous variations	Discontinuous variations
This is a type of variation where there is a range of values.	This is the type of variation that has distinct groups for organisms to fall into.

Answers to Self-evaluation Test 22.3

(Refer to Student's Book.)

1. D
2. A
3. True

Answers to Self-evaluation Test 22.4

(Refer to Student's Book.)

1. Deserts
2. A
3. Xerophytes
4. Adaptive features are inherited characteristics that allow an organism to both survive and reproduce in its environment

Summary of this unit

This unit deals with variation. You should therefore use the practical activities and many examples as possible to guide learners to acquire the requisite knowledge and desired competences in this area. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones as well. Emphasise the fact that taking this unit seriously may lead to careers such genetic engineering.

Additional information to the teacher

Biological diversity – biodiversity – is reflected in the vast number of species of organisms, in the variation of individual characteristics within a single species and in the variation of cell types within a single multicellular organism.

Differences between species reflect genetic differences. Differences between individuals within a species could be the result of genetic factors, of environmental factors, or a combination of both.

A gene is a section of DNA located at a particular site on a DNA molecule, called its locus. The base sequence of each gene carries the coded genetic information that determines the sequence of amino acids during protein synthesis. The genetic code used is the same in all organisms, providing indirect evidence for evolution.

Genetic diversity within a species can be caused by gene mutation, chromosome mutation or random factors associated with meiosis and fertilization. This genetic diversity is acted upon by natural selection, resulting in species becoming better adapted to their environment.

Variation within a species can be measured using differences in the base sequence of DNA or in the amino acid sequence of proteins.

Biodiversity within a community can be measured using species richness and an index of diversity.

Answers to end unit assessment 22

(Refer to Student's Book)

1. B
2. C
3. Bar graph
4. False
5. C
6. B
7. B
8. D
9. Refer to Student's Book.

10. a)

Continuous variations	Discontinuous variations
This is a type of variation where there is a range of values e.g. height,weight and length of forearm.	This is the type of variation that has distinct groups for organisms to fall into e.g. blood groups and sex

b) Refer to table 22.1 in Student's Book.

11. Albinism, haemophilia, dwarfism, kilinifelter's syndrome

Additional activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Present the findings on activities to the class. 2. Help in collecting practical materials needed for the lesson.	1. Do further research in textbooks or the Internet about variation and adaptive features.Write short notes then share with other class members. 2. Apart from what was done in class, comeup with other ways in which variation is important.
Remedial questions for slow learners 1. Name factors that bring about phynotypic variation. 2. What is variation?	***Extended questions for gifted learners*** 1. Use a simple experiment to demonstrate continuous variation.
Answers to remedial questions for slow learners 1. Climate, diet, physical accidents, lifestyle, culture 2. Any difference between cells, individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic **variation**) or by the effect of environmental factors on the expression of the genetic potentials	***Answers to extended questions for gifted learners*** 1. Refer to Student's Book.

UNIT 23 Natural and artificial selection

Key Unit Competence

After studying this unit, the learner should be able to explain natural and artificial selection in relation to evolution and breeding.

Learning objectives

Table 23.1 Knowledge, skills and values to be attained

Knowledge and understanding	Skills	Attitudes and values
By the end of this unit, learners should be able to: ▪ Describe natural selection with reference to: variation, reproduction, competition, adaptation and inheritance of favourable characteristics. ▪ Describe selective breeding with reference to: selection by humans of individuals with desirable features, crossing these individuals to produce the next generation, selection of offspring showing the desirable features. ▪ State the differences between natural and artificial selection. ▪ Describe the role of artificial selection in producing varieties of animals and plants with increased economic importance. ▪ Describe evolution as the change in adaptive features of a population over time as the result of natural selection.	By the end of this unit, learners should be able to: ▪ Master selective breeding by artificial means and how selection is carried out to improve crop plants and domestic animals breeds. ▪ Interpret images of extinct animals and related present species to determine the course of evolution.	By the end of this unit, learners should be able to: ▪ Appreciate the role of artificial selection in producing varieties of breeds with increased economic importance.

Pre-requisites of this unit

Learners have learnt about natural and artificial selection in senior 1 and senior 2. Review the topic by reminding the learners what natural selection and artificial selection is. Differentiate further natural selection from artificial selection by giving examples in each case.

During the lessons, strive to bring to the awareness of learners the fact that this topic is related to Agriculture. Let them understand that at this level, they may only need the basic information otherwise; details of development of natural and artificial selection will be learnt at higher level in breeding and animal husbandry in agriculture.

Background information

The term evolution is formed from the word 'evolve' which means 'gradual change over a long period of time' Evolution is a theory. The evolution theory tries to explain how the great diversity of animals and plants that exist on earth today has come to be. It suggests that life on earth began from simple forms which then slowly evolved into the present day organisms.

This was because the original simple forms of organisms underwent small changes that accumulated over millions of years thus selection. This led to the great variations of the complex plants and animals we have today. Therefore selection is evolution's engine. Selection acting on random variation makes adaptive evolution possible.

Cross-cutting issues to be addressed

1. ***Financial education:***

Make learners aware that scientists have taken advantage of artificial selection to develop plant and animal breeds for sale. This has generated man a lot of income.

2. ***Standardisation culture***

Bring to the attention of learners the need to embrace natural and artificial selection.

3. ***Gender education***

Emphasise to learners that anybody, irrespective of their gender can pursue a carreer in agriculture where breeding is involved. Give examples of role models who are successful in the area where the learners come from.

4. ***Inclusive education***

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with visual problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this

category should be given tasks that they can manage during the practical sessions.

Generic Competences

1. ***Cooperation and interpersonal management and life skills***

During group discussions and pair work, let learners engage one another by giving a chance for all to participate. This can also be achieved during presentations; you can allow rotational presentation within the group members.

2. ***Research skills***

Guide learners on how to find information regarding various topics such as natural selection. Guide the learners on how to come up with summarised notes from a large body of text.

3. ***Communication in English***

Developed as learners participate in pairs and group work in performing skits and as they perform to the rest of the class. Encourage learners, irrespective of their abilities, to participate in group discussion, during presentations and the question-and-answer session.

4. ***Critical thinking:***

This is achieved as learners find out the answers to the questions you give to them.

5. ***Listening and note taking skills:***

This is achieved as the learners listen to you and during the note taking process.

Key words in this unit and their meaning

Natural selection– is a process whereby organisms with favourable variations survive and produce more offspring than organisms with less favourable variations.

Non-beneficial variations– are variations that do not enable an organism to compete effectively.

Beneficial or favourable variations are variations that enable the organisms to compete effectively.

Speciation– the gradual process of formation of new species due to evolution.

Artificial breeding– also known as selective breeding is a process in the breeding of animals and in the cultivation of plants by which the breeder chooses to perpetuate only those individuals having certain desirable inheritable characteristics.

Guidance on the problem statement

In order to make learners give special attention into the general direction of the unit, the teacher should organise learners to do some discovery and guiding questions in groups. Remember they already know something about variations, guide them such that they head to where you want them to be.

- Divide the students into small groups of 3-4. Hand out a piece of paper to each group.
- Ask them to write down on the piece of paper about the origin of man.
- Ask them to explain what happens if a lion is aged and cannot hunt.

Use the questions above to explain very well the meaning of terms of survival for the fittest and evolution.

You have to use common variations that allow leopards to survive as hunters in the forest. How are they able to camouflage? This will help you to explain the beneficial variations. You will also refer learners to diagram on page 364 to help them understand how the process of natural selection can lead to evolution.

Attention to special educational needs

Support for Multi-ability learning	Support for special needs learning
▪ When watching videos, you may repeat or pause for the benefit of slow learners. ▪ Gifted learners to lead in group discussions and do presentations. ▪ Ensure that all learners respect others views irrespective of their shortcomings.	▪ Allocate roles like holding charts and dismantling models like the heart model to learners with physical disabilities. ▪ Provide braille for blind learners and large print text to learners with seeing difficulties. Provide sign language alphabet symbols for the deaf and sign language interpreters. ▪ Also, arrange learners such that shortsighted ones are at the front and long-sighted ones are at the back. Spectacles can as well be provided if available.

List of lessons

Lesson No.	Lesson title	No. of periods
1.	Natural selection	2
2.	Artificial selection	2

23.1 Natural selection

Lesson 1: Natural selection *(to be covered in two periods)*

Refer to Student's Book.

Specific objectives

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

- Explain natural selection.
- Explain the difference between natural selection and artificial selection.
- Give the advantages and disadvantages of natural selection.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Refer to Activity 23.1 in the Student's Book
- Creating experiments to demonstrate natural selection
- Group discussions
- Internet

Prerequisite for the lesson

Introduce the unit as explained under guidance on the problem statement above then narrow down to the lesson.

Teaching/learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is natural selection? (***Ans***: *The process where organisms better adapted to their environment tend to survive and produce more offspring.)*

Activity 23.1 in the Student's Book.

- Let learners watch a film or a documentary of evolution. After the activity organise learners into groups of four.
- Instruct each group to create their own experiments that demonstrate natural selection. Basically, they will need some items to represent the generations as well as a tool to weed out the "fittest".
- Encourage learners to be creative. They should be able to write directions for their experiment as well as demonstrate it if time allows. As they are demonstrating, they should be able to verbally explain how natural selection works.

- Assign a short writing exercise. Tell learners to write one to two pages on a species. They can fictionalize the species; describe the species' advantages, and how it may have changed over millions of years to adapt to the environment.
- Learners can be as creative as they wish. For instance, if they want to create a deer with extra-long legs, the situation could be that food became higher placed, or that they had to run faster to get away from predators. Instruct learners to do the following:
    - Describe the species in the beginning.
    - Explain how it changed from generation to generation. Describe in detail the variation inheritable characteristics; how some characteristics gave individuals an advantage over others, and how this affected reproduction and future populations.
    - Papers should show how the proportion of individuals that have advantageous characteristics would increase.
- Show learners different forms of cross bred plants and different types of crossbred dog puppies. Use pictures or computer to illustrate these.
- Thereafter have a class discussion on natural selection as they take notes.
- End the lesson by instructing learners to attempt Self-evaluation Test 23.1 in the Student's Book.

Synthesis

This lesson is meant to introduce natural selection and its principles to students. Natural selection is the process that led to speciation. It is the reason behind all different species of organisms seen in the environment.

Through this lesson learners are to be imparted with skills about natural breeding and also how man has interrupted with the process of natural breeding which is the mastermind of natural selection.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. Explain the meaning of natural selection.

   ***Ans**: The process whereby organisms better adapted to their environment tend to survive and produce more offspring.*

2. Give importance of natural selection.

   Ans: *Natural selection is the process by which species adapt to their environment. Natural selection leads to evolutionary change when individuals with certain characteristics have a greater survival or reproductive rate than other individuals in a population and pass on these inheritable genetic characteristics to their offspring. Simply put.*

Lesson 2: Artificial selection (to be covered in two periods)

Refer to Student's Book.

Specific objective

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

- Describe the role of artificial selection.
- Explain the difference between natural selection and artificial selection.
- Give the advantages and disadvantages of artificial selection.

Preparation for the lesson

1. This lesson will involve group activities. You will therefore organise the class as need arises during the lesson. **REMEMBER:** When grouping learners, you should consider the different abilities of learners and the special needs for various individuals.
2. Provide reference material and ensure the Internet is working or provide modems.

Teaching Aids

- Farm visit. You can refer to activity 23.2 in the Student's Book.
- Presentations
- Discussions
- Internet

Pre-requisite for the lesson

Introduce the unit as explained under guidance on the problem statement then narrow down to the lesson.

Teaching/learning activities

- Ask probing questions to introduce the lesson. Such questions may include: What is artificial selection? (***Ans****: It is the process in the breeding of animals and in the cultivation of plants by which the breeder chooses to use only individuals having certain desirable inheritable characteristics.)*

Activity 23.2 (Refer to Student's Book.)

- This is a farm visit activity. Let learners carry out the farm visit and present their work to the rest of the class.
- Organise for a field trip to a farm that practises artificial selection near the school.

- Ask learners prepare questionnaire and recording manuals. Instruct learners to ask questions and record their observation in the notebooks. Let them do a presentation of their findings and compare it with others. Have a class discussion after their presentations as they take notes.
- End the lesson by instructing learners to attempt Self-evaluation Test 23.2 and Test your Competence 23 in the Student's Book.

Synthesis

This lesson is meant to explain the procedures of artificial selection and its influence on the process of evolution. Students should understand why man has continuously carried out breeding activities for different crops and animals by choosing desirable traits.

The lesson is also meant to influence learners to appreciate the economic importance of artificial selection as carried out by man.

Lesson assessment

Assess whether the learning objectives of the lesson were met by asking questions such as:

1. State two advantages of artificial selection.

   Ans: *It creates desirable traits for plants and animals, animals can produce a lot of products, it rules our weakness and disability.*

2. What is the difference between natural selection and artificial selection.

   Ans: *The difference between the two is that natural selection happens naturally, but selective breeding only occurs when humans intervene.*

Answers to Self-evaluation Test 23.1

(Refer to Student's Book.)

1. B
2. a) • Shortage of water
   • Shortage of food
   • Shortage of mates
   • overcrowding

   b) It depends on the organism's ability to change with a changing environment.
3. Beneficial variations allow an organism to compete effectively while non-beneficial variations do not allow an organism to compete favourably.

Answers to Self-evaluation Test 23.2

(Refer to Student's Book.)

1. B
2. C
3. It's colour was a non-favourable variation which did not allow it to compete favourably.

Summary of the unit

This unit deals with natural selection and artificial selection. You should therefore use practical activities, discussion and other suggested teaching approaches in the Teacher's Book to guide the learners to acquire the knowledge. Plan remedial activities where necessary for slow learners and give extra activities for gifted ones.

Emphasise that taking this unit serious may lead to a career in research such as plant or animal breeders. Encourage the learners to have interest in the unit and also to practise what is learnt in this unit.

Additional information to the teacher

Embryo Rescue

Sometimes human technical intervention is required to complete an interspecies gene transfer. Some plants will cross-pollinate and the resulting fertilized hybrid embryo develops but is unable to mature and sprout. Modern plant breeders work around this problem by pollinating naturally and then removing the plant embryo before it stops growing, placing it in a tissue-culture environment where it can complete its development. Such embryo rescue is not considered genetic engineering, and it is not commonly used to derive new varieties directly, but it is used instead as an intermediary step in transferring genes from distant, sexually incompatible relatives through intermediate, partially compatible relatives of both the donor and recipient species.

Somatic Hybridisation

Recent advances in tissue-culture technologies have provided new opportunities for recombining genes from different plant sources. In *somatic hybridization,* a process also known as *cell fusion,* cells growing in a culture medium are stripped of their protective walls, usually using pectinase, cellulase and hemicellulase enzymes. These stripped cells, called *protoplasts*, are pooled from different sources and, through the use of varied techniques such as electrical shock, are fused with one another.

When two protoplasts fuse, the resulting somatic hybrid contains the genetic material from both plant sources. This method overcomes physical barriers to pollen-based hybridization, but not basic chromosomal incompatibilities. If the somatic hybrid is compatible and healthy, it may grow a new cell wall, begin mitotic divisions, and ultimately grow into a hybrid plant that carries genetic features of both parents. While protoplast fusions are easily accomplished, as almost all plants (and animals) have cells suitable for this process, relatively few are capable of regenerating a whole organism, and fewer still are capable of sexual reproduction.

This non-genetic engineering technique is not common in plant breeding as the resulting range of successful, fertile hybrids has not extended much beyond what is possible using other conventional technologies.

Cell Selection

Several commercial crop varieties have been developed using *cell selection,* including varieties of soybeans (Sebastian and Chaleff, 1987) canola (Swanson et al., 1988), and flax (Rowland et al., 1989). This process involves isolating a population of cells from a so-called "elite plant" with superior agricultural characteristics. The cells are then excised and grown in culture. Initially the population is genetically homogeneous, but changes can occur spontaneously (as in somaclonal variation) or be induced using mutagenic agents. Cells with a desired phenotypic variation may be selected and regenerated into a whole plant. For example, adding a suitable amount of the appropriate herbicide to the culture medium may identify cells expressing a novel variant phenotype of herbicide resistance. In theory, all of the normal, susceptible cells will succumb to the herbicide, but a newly resistant cell will survive and perhaps even continue to grow. A herbicide-resistant cell and its derived progeny cell line thus can be selected and regenerated into a whole plant, which is then tested to ensure that the phenotypic trait is stable and results from a heritable genetic alteration. In practice, many factors influence the success of the selection procedure, and the desired trait must have a biochemical basis that lends itself to selection in vitro and at a cellular level.

Answers end unit assessment 23

(Refer to Student's Book.)

1. B
2. C
3. D
4. B
5. This is due to the phenomenon known as survival for the fittest. Those that survived the pesticide gave birth to others with a similar trait. This went on until the whole new population had genes that allowed them survive the pesticide.
6. two
7. False
8

Natural selection	Artificial selection
Done by the environment	Done by man
Involves accumulation of many important traits	Majorly focuses on one characteristic

Happens because of chance	No chance is given to the process

9. This is a long term process by which new species of organisms come from the pre-existing ones.

10. • A variety of cattle may have a higher than average milk yield. Another variety may have a very high milk yield. If the two varieties are crossbred, a new breed could be artificially produced that has the benefits of both parental varieties (high milk production in females; high meat yield in males).

• Wild varieties of plants sometimes have increased resistance to fungal diseases, but have poor fruit yield. Crossbreeding wheat plants can result in the formation of varieties that have both high resistance to disease and high seed yield.

Additional Activities to cater for slow and gifted learners

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Participate fully during class and practical activities. You can do this by collecting materials needed for practicals or taking notes during class session. 2. Using Manila paper and a marker pen, draw a table giving the difference between artificial and natural selection.	1. Do further research in textbooks or the Internet about natural selection and artificial selection. Write short notes then share with other class members. 2. Using school computers, come up with slides explaining natural and artificial selection with the aid of Microsoft power point. Seek help from school computer technician. 3. Come up with a simple project applying the use of artificial selection. Use your notes for reference.
Remedial questions for slow learners 1. What is evolution? 2. Quote Darwin's theory.	***External questions for gifted learners*** 1. Explain the relationship between natural selection, evolution and Christianity.
Answers to remedial questions for slow learners 1. It is change in the heritable characteristics of biological populations over successive generations. 2. Members of a species compete with each other for resources and individuals that are better adapted to their lifestyle have a better chance of surviving to reproduce.	***Answers to extended questions for gifted learners*** Award marks according to explanation given by the learner.