

REPUBLIC OF RWANDA



MINISTRY OF EDUCATION



ORDINARY LEVEL BIOLOGY SYLLABUS (S1-S3)

Kigali, 2015

ORDINARY LEVEL BIOLOGY SYLLABUS (S1-3)

Kigali 2015

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FOREWORD

The Rwanda Education Board is honoured to make available syllabuses which will serve as both official documents and guides to competence based teaching and learning. This will ensure consistency and coherence in the delivery of quality education across all levels of general education in Rwandan schools.

The Rwandan education philosophy is to ensure that young people, at every level of education, achieve their full potential in terms of relevant knowledge, skills and appropriate attitudes. This will prepare them to be well integrated in society and maximise employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasises the importance of aligning the syllabus, teaching and learning and assessment approaches in order to ensure that the system is producing the kind of citizens the country needs. Many factors influence what children are taught, how well they learn and the competences they acquire, particularly the relevance of the syllabus, the quality of teachers' pedagogical approaches, the assessment strategies and the instructional materials available. The ambition to develop a knowledge based society and the growth of regional and global competition in the jobs market has necessitated the shift to a competence based syllabus. With the help of the teachers, whose role is central to the success of the syllabus, learners will gain appropriate skills and be able to apply what they have learned in real life situations. Hence they will make a difference not only to their own lives, but also to the success of the nation.

I wish to sincerely extend my appreciation to the people who contributed to the development of this document, particularly the REB and its staff who organised the whole process from its inception. Special appreciation goes to the development partners who supported the exercise throughout. Any comments and contributions would be welcome for improvement of this syllabus.

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Director General REB

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1. INTRODUCTION

1.1. Background to the curriculum review

Vision 2020 and other recent policies emphasise Rwanda's ambition to become a knowledge based and technology led economy. This stresses the need for the generation's dissemination and acquisition of scientific skills, technological innovations and the integration of these skills into the social and economic development of Rwanda.

According to the findings from the recent studies of the biology syllabus (2013), there are strengths and weaknesses in provisions, but the current focus is on how to rectify the weaknesses. The existing biology syllabus for general education does not emphasise sufficiently the skills needed by both society and the labour market. The existing syllabus dwells more on knowledge and very little on the skills and attitudes and values.

The underlying principle behind the biology syllabus review process was to ensure that the syllabus is responsive to the needs of the learner and to shift from objective and knowledge based learning to competence based learning. Emphasis in the review has been building more on skills and competences and streamlining the coherence within the existing content by benchmarking with syllabuses elsewhere with best practices.

The new biology syllabus guides the interaction between the teacher and the learner in the learning processes and highlights the essential practical skills and competences a learner should acquire during and at the end of each unit of learning.

1.2. Rationale of teaching and learning biology

Biology is the study of life and it plays a crucial role in our everyday existence. Biology has many applications, both in the natural environment and in health and education. Studying biology develops understanding of living systems and how to apply learning in direct ways to maintain the health of humans, animals and plants. Biology enables us to understand relationships between living

organisms and what is beneficial and what is harmful. Technological advances in new areas, such as DNA and genetics, have made this varied discipline more exciting than ever.

1.2.1. Biology and society

Biology, one of the natural science subjects, is an important discipline that has contributed significantly to the global environment and health transformation through discoveries on the part of biologists. This has led to new technologies in the production of small scale and industrial products that are beneficial to man and his environment. Application of the knowledge of biology is evident in medicine, pharmaceutical agriculture, fisheries and food processing industries. Biology has played a role in the harmonisation of man's needs with the conservation of nature and environment in particular.

Biology plays a role in the Rwandan ambition to:

- develop a competence based society
- promote science and technology competitiveness in the regional and global job market
- address the issue of lack of appropriate skills in the Rwandan education system.

1.2.2. Biology and learners

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 phenomena and manage man and the environment. It helps provide answers for the problems faced by our modern society which empowers students to be creative, innovative and use independent approaches to solve problems in unfamiliar situations.

1.2.3. Competences

Competence is the ability to perform a particular task successfully which results from having gained an appropriate combination of knowledge, skills and attitudes. The national policy documents, based on national aspirations, identify basic competences alongside the generic competences which will develop higher order thinking skills. Basic competences are addressed in the stated

broad subject competences, objectives highlighted on a yearly basis and in each of the units of learning. The selection of types of learning activities must focus on the learner's abilities to demonstrate such competences throughout the learning process. A generic competence is a competence that is not specific to a particular subject or situation. Generic competences are transferrable and applicable to a range of subjects and situations including employment. The core competences that must be emphasized and reflected in the learning process are briefly described below and teachers will ensure that learners are exposed to tasks that help the learners acquire such skills.

Critical thinking and problem solving skills: The acquisition of such skills will help learners think imaginatively and broadly to evaluate and find solutions to problems encountered in all situations.

Creativity and innovation: The acquisition of such skills will help learners take the initiative and use imagination beyond the knowledge provided to generate new ideas and construct new concepts.

Research: This will help learners find answers to questions based on existing information and concepts and to explain phenomena based on findings from information gathered.

Communication in official languages: Teachers, irrespective of not being teachers of language, will ensure the proper use of the language of instruction by learners, which will help them to communicate clearly and confidently. They will convey ideas effectively through speaking, writing and using the correct language structure and relevant vocabulary.

Cooperation, interpersonal management and life skills: This will help the learner to cooperate with others as a team in whatever tasks are assigned and to practice positive ethical moral values and respect for the rights, feelings and views of others. They will perform practical activities related to environmental conservation and protection. They will advocate for personal, family and community health, hygiene and nutrition as well as responding creatively to the variety of challenges encountered in life.

Lifelong learning: The acquisition of such skills will help learners to update knowledge and skills with minimum external support and to cope with the evolution of advances in knowledge for personal fulfilment in areas that need improvement and development.

Broad biology syllabus competences

The syllabus competences listed below describe the educational purposes of a course based on this syllabus. It outlines the educational context in which the syllabus content should be viewed. These competences are the same for all learners and are not listed in order of priority. Some of these competences may be delivered by the use of suitable local, international or historical examples and applications, or through collaborative experimental work.

Learners should be able to:

- Experience an enjoyable and worthwhile educational experience, whether or not they go on to study science beyond this level.
- Acquire sufficient knowledge and understanding to:
 - use ICT skills effectively to enhance learning and communication to become confident citizens in a technological world and develop an informed interest in scientific matters, and
 - be suitably prepared for studies beyond an ordinary level of secondary education.
- Recognise that science is evidence based and understand the usefulness and limitations of a scientific method.
- Analyse and explain scientific phenomena relating to real life experiences.
- Experiment using a range of scientific and technological tools and equipment and draw appropriate conclusions.
- Develop skills that:
 - are relevant to the study and practice of biology,
 - are useful in everyday life,
 - encourage a systematic approach to problem solving,

- encourage efficient and safe practice,
- encourage effective communication through the language of science,
- protect themselves against common illnesses and fatal diseases including HIV / AIDS and malaria, and
- develop motor skills to perform a variety of physical activities for leisure.
- Develop attitudes and basic values relevant to biology such as:
 - concern for accuracy and precision, objectivity, integrity, inquiry, initiative, inventiveness, curiosity, research skills and creativity, and
 - peace and tolerance, justice, respect for others and for human rights, solidarity and democracy, patriotism, hard work, commitment, resilience and dignity.
- Enable learners to appreciate that:
 - science is subject to social, economic, technological, ethical and cultural influences and limitations,
 - the applications of science may be both beneficial and detrimental to the individual, the community and the environment,
 - respect life and the natural equilibrium,
 - demonstrate awareness and concern for the environment, conservation and sustainability and act accordingly, and
 - advocate for personal, family and community health, hygiene and nutrition.

Biology and developing competences

These basic competences, alongside the generic competences, are stated in such a way that will develop higher order thinking skills and application of what has been learned in real life situations. Through experimentation, observations and presentation of information during the learning process, the learner develops not only deductive and inductive skills, but also communication, critical thinking and problem solving skills in trying to make inferences and conclusions.

The manipulation of numerical and other data, doing practical experiments and undertaking project assignments involves not only analytical and problem solving skills, but also innovation, creativity and research. Group work and cooperative learning of biology promote interpersonal relations and teamwork.

2. PEDAGOGICAL APPROACHES

Learners learn best when they are actively involved in the learning process through a high degree of participation, contribution and production. At the same time, each learner is an individual with their own needs, pace of learning, experiences and abilities. Teaching strategies must therefore be varied, but flexible within well structured sequences of lessons. Learner centered education does not mean that the teacher no longer has responsibility for seeing that learning takes place, but facilitates the process of learning by designing and introducing the tasks to the class to perform or for immediate discussion and guide the learners in constructing their own knowledge.

2.1. Role of the learner

The activities of the learner are indicated in each learning unit and reflect appropriate engagement in the learning process.

The teaching and learning processes will be tailored toward creating a learner friendly environment based on learners' capabilities, needs, experience and interests.

The learning activities will be organised in a way that encourages learners to construct their knowledge, either individually or in groups, in an active and engaging way.

Learners work on key competences in the form of concrete units with specific learning outcomes broken down into knowledge, skills and attitude.

In practical lessons, learners will work in groups where the availability of the apparatus will not permit working individually, but they will be encouraged to do simple project work individually.

2.2. Role of the teacher

The change to a competence based syllabus is about transforming learning, ensuring that learning is deep, enjoyable and habit-forming.

The teachers should shift from the traditional method of instruction to playing the role of a facilitator in order to value learners' individual needs and expectations.

The teacher must identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly.

The teacher's role is to organise the learners in the classroom or outside and engage them through participatory and interactive methods as individuals, in pairs or in groups. This ensures that the learning is personalised, active, participative and cooperative.

The teacher will design and introduce the tasks to perform or discuss. The role of the teacher will be to guide the learners in constructing their own knowledge.

Learners are taught how to use the textbooks and other resource materials in different ways to search for and make use of information in writing their own notes and providing explanations for observations, phenomena and processes in the living world.

The teacher must select and develop appropriate materials like teaching models and charts for the learners to use in their work. In practical lessons, the teacher first demonstrates the handling of the apparatus and the way the experiment should be carried out before exposing to the learners any task that might be dangerous. For example, the teacher should demonstrate how to mix reagents in the correct proportions before leaving the learners to do it on their own.

The teacher must devise remedial strategies in and outside of the classroom to address the issue of low achievers.

Those with learning difficulties can keep pace with the rest of the class in acquiring the required competences.

2.3. Special needs education and inclusive approach

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 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

These learners 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 for them. The teacher 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. Detailed guidance for each category of learners with special education needs is provided for in the guidance for teachers.

3. ASSESSMENT APPROACH

Assessment is the process of evaluating the teaching and learning methods through collecting and interpreting evidence of individual learner's progress in learning and to make a judgment about a learner's achievements measured against defined standards.

Assessment is an integral part of the teaching learning processes. In the new competence based curriculum, assessment must also be competence based. The 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.

Assessment will be organised at the following levels: school based assessment, district examinations, national assessment (LARS) and national examinations.

3.1. Types of assessment

3.1.1. Formative and continuous assessment (assessment for learning)

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a teacher is planning his/her lesson, he/she should establish criteria for performance and behavioural changes at the beginning of a unit. At the end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competences based on the criteria stated before going to the next unit. The teacher will assess how well each learner masters both the subject content and the generic competences described in the syllabus. 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: (a) observation (b) pen and paper (c) oral questioning and tests during or at the end of one or more learning units.

3.1.2. Summative assessment (assessment of learning)

When assessment is used to record a judgment of the 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 an internal school based assessment or external assessment in the form of national examinations. School based summative assessments should take place once at the end of each term and once at the end of the year. The school summative assessment average scores for each subject will be weighted and included in the final national examinations grade. The school based assessment average grade will contribute a certain percentage as teachers gain more experience and confidence in assessment techniques. In the third year of the implementation of the new curriculum, it will contribute 10% of the final grade, but will be progressively increased. Districts will

be supported to continue their initiative to organize 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.

3.2. Record keeping

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

This portfolio is a folder (or binder or even a digital collection) containing the learner's work as well as the learner's evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but it is a record of the activities undertaken over time as part of student learning. The portfolio output (formative assessment) will be considered enough for three years of the advanced level. 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.

3.3. Item writing in summative assessment

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

Before developing a question paper, the writer must ensure that the test or examination questions are tailored toward 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 memorization or recall answers only, but testing broad competences as stated in the syllabus.

Structure and format of the examination:

There will be two papers for biology subject at ordinary level. Paper 1 consists closed, semi-structured and open/ extended questions and paper 2 is practical. Time will depend on the paper’s items and weight. Extra time will be given to learners with special education needs if found necessary.

Paper	Component	Weight
Paper 1	This paper will measure both knowledge and understanding of the subject matter and acquisition of competences. The question items will be balanced as follows: <ul style="list-style-type: none"> • Assessment of Knowledge and understanding (questions from low levels of Bloom’s taxonomy) 30 % • Assessment of Skills and competences (questions from higher levels of Bloom’s taxonomy :application, analysis, evaluation and synthesis) 40% 	70%
Paper 2	Practical skills: This paper measures practical/experimental skills and investigations see assessment objectives (AO3) below (Observation, Measurement, Planning & designing, Recording & Manipulation, report writing,) The experiments should be drawn from different topic areas of the syllabus.	30%

Assessment of biology objectives (AO)

AO1: Knowledge with understanding

Candidates should be able to demonstrate knowledge and understanding of:

- scientific phenomena, facts, laws, definitions, concepts and theories
- scientific vocabulary, terminology and conventions (including symbols, quantities and units)
- scientific instruments and apparatus, including techniques of operation and aspects of safety
- scientific and technological applications with their social, economic and environmental implications.

Syllabus content defines the factual material that candidates may be required to recall and explain. Candidates will also be asked questions which require them to apply this material to unfamiliar contexts and to apply knowledge from one area of the syllabus to another. Questions testing this objective will often begin with one of the following words: define, state, describe, explain (using your knowledge and understanding) or outline.

AO2: Handling information and problem solving

Candidates should, in words or using other written forms of presentation (i.e. symbolic, graphical and numerical) be able to:

- locate, select, organise and present information from a variety of sources
- translate information from one form to another
- manipulate numerical and other data
- use information to identify patterns, report trends and draw inferences
- present reasonable explanations for phenomena, patterns and relationships
- make predictions and hypotheses
- solve problems, including some of a quantitative nature

Questions testing these skills may be based on information that is unfamiliar to candidates requiring them to apply the principles and concepts from the syllabus to a new situation, in a logical and deductive way.

Questions testing these skills will often begin with one of the following words: predict, suggest, calculate or determine.

AO3: Experimental skills and investigations

Candidates should be able to:

- demonstrate knowledge of how to safely use techniques, apparatus and materials (including following a sequence of instructions where appropriate)
- plan experiments and investigations
- make and record observations, measurements and estimates
- interpret and evaluate experimental observations and data
- evaluate methods and suggest possible improvements

3.4. Reporting to parents

The wide 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.

4. RESOURCES

4.1. Material resources

Teaching and learning of biology necessitates practical activities and experiments for better understanding of facts. The successful implementation of this curriculum requires a biology laboratory, textbooks, charts and ICT tools like computers and projectors.

However, there are some biology concepts that cannot be easily explained and some experiments that cannot be done in our school laboratories due to their nature or safety reasons. Thus the syllabus provides the opportunities to use ICT while studying to overcome such concepts that cannot be well understood. The learners need to be confident and effective users of ICT. These ICT opportunities may include:

- gathering information from the internet, DVDs and CD-ROMs,
- gathering data using sensors linked to data –loggers or directly from the computers,
- using spreadsheets and other software to process data,
- using animations and simulations to visualise scientific data,
- using software to present ideas and information on paper and on screen

The list of basic materials and apparatus that a well equipped biology laboratory would contain is found in the appendix (7a). This list is not exhaustive other items may be required to allow for variety in the questions set.

4.2. Human resources

The effective implementation of this curriculum requires a joint collaboration of educators at all levels. Given the material requirements, teachers are expected to accomplish their noble role as stated above.

The following are detailed skills required for secondary school biology teachers:

- Animated and engaging personality, patient and tolerant attitude, passion for sharing knowledge, excellent verbal and written communication abilities, creativity and diverse methodologies for imparting ideas and knowledge.
- Educational software, programs for recording, grading, and evaluating learners' work and progress.
- Teaching tools, like overhead projectors and other media-sharing devices, proficiency with biology and lab experiment equipment like microscopes and slides.
- Proficient in biology, motivate students and keep classroom on task, passion for life sciences and working with students, proficient in the use and implementation of the latest technologies and tools.

5. SYLLABUS UNITS

5.1. Presentation of the syllabus units

The subject of biology is taught and learned in lower secondary education as a core subject, i.e. in S1, S2 and S3 respectively. At every grade where it is taught, the syllabus of biology for lower secondary is structured in the following eight Topic Areas: biodiversity and classification, ecology and conservation, organisation and maintenance of life, reproduction, health and disease, reproduction, genetics and its applications, selection and evolution. Topic Areas are themselves broken down into Sub-topic Areas while Sub-topic Areas are in turn made up of 52 Units; 14 in S1, 16 in S2 and 22 in S3. The Units have the following elements:

- Unit is aligned with the Number of Lessons.
- Each Unit has a Key Unit Competence whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners. Each Key Unit Competence is broken into three types of Learning Objectives as follows:

Type I: Learning Objectives relating to knowledge and understanding (***Type I*** Learning Objectives are also known as Lower Order Thinking Skills or LOTS).

Type II and Type III: These Learning Objectives relate to acquisition of skills, attitudes and values (***Type II*** and ***Type III*** learning objectives are also known as Higher Order Thinking Skills or HOTS). These Learning Objectives are actually considered to be the ones targeted by the presently reviewed syllabus.

- Each unit has a content which indicates the scope of coverage of what a teacher should teach and learner should learn and should be in line with stated learning objectives.
- Each unit suggests learning activities that are expected to engage learners in an interactive learning process as much as possible (learner-centred and participatory approach).
- Each unit is linked to other subjects, its assessment criteria and the materials (or resources) that are expected to be used in the teaching and learning process.

5.2. Biology programme for S1

5.2.1. Key competences at the end of S1

- Explain the meaning of biology and its application, recall the characteristics common to all organisms and be able to apply safety and first aid in daily life.
- Explain classification and its significance.
- Describe the external structure of a typical flowering plant.
- Identify components and the proper use and care of a hand lens and light microscope.
- Differentiate between animal and plant cells using a light microscope.
- Explain specialisation of cells and the link between levels of organisation in multicellular organisms.
- Identify the different food nutrients and their significance to the human body.
- Describe the structure and functions of the human gas exchange system.
- Describe response to light and gravity by plants and explain the importance of trophic responses in plants.
- Analyse the different types of skeletons and identify the main parts of human skeleton.
- Classify diseases and explain ways of preventing the spread of infectious diseases.
- Analyse the structure, functions and processes of the human sexual and reproductive system and relate to the understanding of sex and gender.
- Analyse the physical, emotional and social changes related to puberty.
- Explain the process of reproduction, pregnancy and childbirth.

5.2.2. Biology units table for S1

Topic Area: BIODIVERSITY AND CLASSIFICATION			Sub-topic Area: Biodiversity	
S.1 BIOLOGY	Unit 1: Introduction to biology.		No. of lessons: 4	
Key Unit Competence: To be able to explain the meaning of biology and its application, recall the characteristics common to all organisms and be able to apply safety and first aid in daily life.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define biology and state its main branches. List the importance of studying biology. Identify different forms of life from a wide range of organisms. List the characteristics of living things. Explain the principles of first aid and how and when the first aid kit is used. 	<ul style="list-style-type: none"> Compare characteristics of life throughout different groups of organisms. Focus on their nutrition, respiration, excretion, reproduction, growth, sensitivity and movement. Compare living things and deduce their differences. Practice rules and regulations governing the laboratory and know how to avoid accidents in the laboratory. Use first aid kit. 	<ul style="list-style-type: none"> Appreciate the importance of biology in society. Acknowledge the diversity and uniqueness of different organisms. 	<ul style="list-style-type: none"> Introduction to biology and different branches of biology. Importance of studying biology. Characteristics of living things: <ul style="list-style-type: none"> nutrition respiration excretion reproduction growth sensitivity movement. Safety rules and regulations in the laboratory First aid and the first aid kit 	<ul style="list-style-type: none"> Using handouts and other visual and printed resources, discuss in groups the importance of biology to mankind. In pairs, observe collected specimens and come up with common characteristics. Learners compare characteristics of life for different groups of organisms focusing on their nutrition, respiration, excretion, reproduction, growth, sensitivity and movement. Learners visit the laboratory and discuss safety rules and regulations. They carry out a simple practical task, such as boiling water in a large test tube, presenting how this was done safely. Discuss in groups the first aid and

				components of the first aid kit and their implications.
Links to other subjects: <i>Laboratory rules in other science subjects.</i>				
Assessment criteria: <i>Learners can explain well the meaning of biology and its applications; recall the characteristics common to all organisms and are able to safely apply first aid in daily life.</i>				
Materials: <i>Reading materials, worksheets and visual materials, specimens such as leaves and insects, hand lens, preserved specimens.</i>				

Topic Area: BIODIVERSITY AND CLASSIFICATION			Sub-topic Area: Classification of living things	
S.1 BIOLOGY	Unit 2: Introduction to classification.		No. of lessons: 6	
Key Unit Competence: To be able to explain the need for, apply classification and use identification keys to name unknown specimens.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall the naming of the five kingdom system of classification. List the characteristics of the five kingdoms of organisms. 	<ul style="list-style-type: none"> Apply the binomial system of naming species. Compare living and non-living things and deduce their differences. Group collected specimens into different taxonomic categories. Use simple identification keys to identify given organisms. 	<ul style="list-style-type: none"> Appreciate the need for classification of organisms 	<ul style="list-style-type: none"> Importance of classification. The concept of hierarchical classification. The binomial system for genus and species. The five kingdom system of classification and the main features of each kingdom. Use of simple identification keys. 	<ul style="list-style-type: none"> Discuss in groups why classification is needed. Identify and justify from examples if something is alive or has ever lived. In pairs, observe collected specimens and come up with distinguishing external features. Classify unnamed provided specimen. Use identification keys provided to identify collected specimens or diagrams of organisms.
Links to other subjects: <i>Classification of weeds in agriculture.</i>				
Assessment criteria: <i>Students can explain the need for, apply classification and use identification keys to name unknown specimens.</i>				
Materials: <i>Different collections of specimens, live or dead, keys ...</i>				

Topic Area: Biodiversity and classification		Sub-topic Area: Classification of living things		
S.1 BIOLOGY	Unit 3: External structure and importance of flowering plant.	No. of lessons: 10		
Key Unit Competence: To be able to describe the external structure of a typical flowering plant.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Label different parts of a typical flowering plant. Recall that plant organs are organised into systems. Explain the role of roots, stem and leaves in plants. Identify different root, stem and leaf modifications. Describe the 	<ul style="list-style-type: none"> Differentiate flowering plants from other plants. Observe the external structure of leaves and root modifications and relate them to their functions. Differentiate between fibrous and tap root systems. Carry out 	<ul style="list-style-type: none"> Appreciate the importance of food storage organs in plants and the value of roots and leaves to man. 	<ul style="list-style-type: none"> External structure of a flowering plant limited to the shoot system: stems, leaves and flowers. External structure of root systems and functions. Functions of modified stems, leaves and roots. Importance of flowering plants. 	<ul style="list-style-type: none"> Label a diagram of a flowering plant. Observe different leaves to find out about their characteristics. In groups, discuss general functions of leaves Observe collected roots and identify the different types of root systems and note how each root system is adapted to its function. Observe collected leaves and stems and identify their differences and their modifications. Carry out home observation on the importance of flowering plants and report back to the class

<p>external structural modifications shown by roots, stem and leaves.</p> <ul style="list-style-type: none"> List the importance of flowering plants. 	<p>home observation on the importance of flowering plants and reporting.</p>			<ul style="list-style-type: none"> Individual learners carry out home observation on the importance of flowering plants and report their write up for marking.
<p>Links to other subjects: <i>Crop husbandry in agriculture.</i></p>				
<p>Assessment criteria: <i>Students can describe clearly the external structure of the flowering plant and be able to identify the different root and leaf modifications.</i></p>				
<p>Materials: <i>Charts and diagrams, collected specimens of flowering plants, roots, stems, and typical and modified leaves</i></p>				

Topic Area: Organisation and maintenance of life			Sub-topic Area: Cell structure	
S.1 BIOLOGY	Unit 4: Magnifying instruments and biological drawings.		No. of lessons: 6	
Key Unit Competence: To be able to identify the components and proper use and care of a hand lens and light microscope.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall that a hand lens is a simple magnifying glass for observing relatively small objects. Identify the components of a light microscope and state their functions. Recall that microscopes are delicate instruments that need great care. Recall that the light microscope has varying magnifying powers. State the features of a good biological 	<ul style="list-style-type: none"> Manipulate a hand lens to observe relatively small specimens. Manipulate a light microscope to observe specimens from prepared slides. Observe and draw the biological specimens under a light microscope. Draw well labelled biological diagrams of specimens. Compare the relationship between actual size of the specimen and its image. Measure and 	<ul style="list-style-type: none"> Appreciate the need for using a light microscope and hand lens in observation of specimens. Show perseverance when making scientific observations. Show care and proper use of instruments. 	<ul style="list-style-type: none"> Need for magnifying instruments in biology. Features of hand lens. Parts of a light microscope. Functions of the light microscope. Biological drawings. Calculation of magnification. 	<ul style="list-style-type: none"> Observe and draw relatively small specimens using a hand lens. In groups, discuss the proper handling of magnifying instruments. Learners locate different lenses and the reflecting mirror on a microscope. Observe microscopic organisms on prepared slides, draw and label the parts visible with a light microscope. Identify a given unknown specimen using a light microscope and determine the magnification. Individually draw and label common plant and animal parts. Measure the length of a

<p>drawing. State that magnification is the number of times larger an image is than the object (specimen).</p>	<p>calculate the magnification of a given biological specimen.</p>			<p>specimen.</p> <ul style="list-style-type: none"> • Draw and calculate the magnification of different specimens provided. • Determine the actual size of a specimen from a given image.
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Links to other subjects: *Enlargement in maths and optics in physics*

Assessment criteria: *Students can identify the parts of magnifying instruments and be able to compare actual size and the image size.*

Materials: *Hand lens, prepared slides, light microscope, collected specimens (leaves, seeds, flower etc.)*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Cell structure	
S.1 BIOLOGY	Unit 5: Plant and animal cells.		No. of lessons: 4	
Key Unit Competence: To be able to differentiate between animal and plant cells using a light microscope.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> State the role of a cell in a living organism. Describe the structure of plant and animal cells. Identify the different parts of the cell. State the uses of the structures seen under the light microscope in the plant and animal cell. State that cells with high rates of metabolism possess large numbers of mitochondria for sufficient energy. 	<ul style="list-style-type: none"> Organize a science practical setup according to given instructions. Prepare slides of human cheek cells and epidermal cells of plant. Compare the structure of a plant and animal cell seen under a light microscope. Demonstrate that plant and animal cells differ in shape. 	<ul style="list-style-type: none"> Appreciate the importance of cells in organisms Show perseverance when observing slides of plant and animal cells. Pay attention while handling delicate slides and sharp instruments to avoid injury. 	<ul style="list-style-type: none"> The cell as basic unit of life. The structure of a plant to (cellulose) cell wall, nucleus, cytoplasm, chloroplasts, vacuoles and location of the cell membrane. The structure of animal cells limited to cell membrane, nucleus, cytoplasm and vacuoles. Uses of the structures seen under the light microscope in the plant and animal cell. Role of mitochondrion. 	<ul style="list-style-type: none"> Individually or in groups observe human cheek cells and epidermal cells in an onion on a prepared slide. Find out the parts of the plant and animal cells that are not visible under light microscope using different resources. Match parts of the cell with their functions in a table form.
Links to other subjects:				
Assessment criteria: Students can apply the knowledge of cell structure to differentiate between plant and animal cells.				
Materials: Prepared slides, light microscope.				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Cell structure	
S.1 BIOLOGY	Unit 6: Levels of organisation in multicellular organisms.		No. of lessons: 4	
Key Unit Competence: To be able to explain specialisation of cells, and the link between levels of organisation in multicellular organisms.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall that a cell is a basic structure of an organism. State the different types of cells limited to examples in content and outline their functions. Describe cell structure and relate to their function. Identify different levels of organisation in organisms. 	<ul style="list-style-type: none"> Observe and draw different types of cells and tissues under light microscope or micrographs. Categorise plant and animal tissue using observation of micrographs or slides. Draw well labelled structures of xylem and phloem tissue from slides or micrographs of sections of vascular plants. Sequence the levels of organisation of organisms from simplest to the complex. Differentiate the relationship between structure and function of specialised cells. 	<ul style="list-style-type: none"> Appreciate the complexity of life from cell through tissue, organ, system and organism levels of organisation. Be aware that an organism is a complex organisation of cells, a unit of life. 	<ul style="list-style-type: none"> Structure and function of ciliated cells, root hair cells, xylem vessels, palisade and mesophyll cells, nerve cells, red blood cells, sperm and egg cells. Advantages of specialisation of cells. Levels of organisation in multi-cellular organisms. 	<ul style="list-style-type: none"> Observe micrographs of cells; separate the specialised cell from non-specialised cells. For each of them, outline their features and functions. Complete the table of levels of organisation by writing in boxes both the functions and location of cells in the given tissues of organisms. Using wall charts, discuss in groups how the different organs and systems are interrelated in structure and function. Research and discuss reasons for specialisation of cells in organisms.
Links to other subjects:				
Assessment criteria: Students can explain clearly the importance of cell specialisation in multicellular organisms.				
Materials: Drawings and diagrams of tissues and specialised cells, prepared slides, wall charts showing body organs and systems in plants and animals.				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Nutrition	
S.1 BIOLOGY	Unit 7: Food nutrients and diet.		No. of lessons: 8	
Key Unit Competence: To be able to identify the different food nutrients and their significance to the human body.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • List the chemical elements that make up carbohydrates, fats and proteins. • List the principle sources of food nutrients. • State that large molecules are made from small molecules • State the importance of the classes of foods listed in the content. • State that balanced diet is eating the correct amount and proportions of food containing nutrient groups. • Explain how age, gender and activity affect the dietary needs of humans, including pregnant and breastfeeding 	<ul style="list-style-type: none"> • Apply knowledge of deficiency symptoms to identify different deficiency diseases among individuals. • Test for carbohydrate, protein and lipid content in different food samples. • Demonstrate the different functions of water, mineral salts and 	<ul style="list-style-type: none"> • Acknowledge the importance of having a balanced diet and its relation to age and gender. • Appreciate the need for a specific diet for individuals who carry out strenuous activities like sports and manual labour. • Take care when using reagents to test for food types. • Appreciate the myths and values communities attach to certain foods. • Adopt and disseminate the 	<ul style="list-style-type: none"> • Food nutrients and principal sources in food stuffs of food nutrients. • Importance of nutrients in human body and of having a balanced diet. • Composition of biological molecules limited to carbohydrates, lipids and proteins. • Formation of large biological molecules (starch, glycogen, cellulose, proteins and lipids) from small molecules such as glucose, amino acids and fatty acids/glycerol. • Deficiency symptoms limited to vitamins C and D, and calcium, and iron only). 	<ul style="list-style-type: none"> • Record in a journal the list of components of the diet taken at home for a given period and discuss why their lists change from time to time. • Discuss the common deficiency diseases in communities they come from. • In pairs, discuss the causes and prevention of obesity. • Investigate the carbohydrates, proteins and lipids content in different food samples using food tests and present results in a table form.

<p>mothers.</p> <ul style="list-style-type: none"> • Explain the effects of malnutrition. • State obesity as the accumulation of excess fat into the body due to excess intake of calories. 	<p>vitamins in the body.</p>	<p>habits of having a good balanced diet.</p>	<ul style="list-style-type: none"> • Functions of vitamins, water and mineral salts. • Malnutrition limited to starvation, obesity, constipation and scurvy. 	
<p>Links to other subjects: <i>Elements and compounds in chemistry, animal nutrition in agriculture.</i></p>				
<p>Assessment criteria: <i>Students can identify the different food nutrients and list their significance to the human body.</i></p>				
<p>Materials: <i>Common food stuffs including fruits, fish, meat, cereals, milk, carrots, protein and glucose test strips, fat testing strips, permanent markers, snack dips, clock timer, and paper towel and iodine to test for starch.</i></p>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE

Sub-topic Area: Gaseous exchange and smoking

S.1 BIOLOGY

Unit 8: Structure and functions of human gas exchange system.

No. of lessons: 2

Key Unit Competence: To be able to describe the structure and functions of human gas exchange system.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries. State the functions of the parts of the human gas exchange system. 	<ul style="list-style-type: none"> Observe the structure of gas exchange system and relate it to its functions. Demonstrate the structure of human gas exchange system using models. 	<ul style="list-style-type: none"> Appreciate the similarity between the human gas exchange system and that of other mammals. 	<ul style="list-style-type: none"> Structure of the human gas exchange system. Functions of the parts of the human gas exchange system. 	<ul style="list-style-type: none"> Using animations or dissected mammal, learners observe and identify structures of the gas exchange system. Individually, observe prepared microscopic slides and micrographs for the structures of the different parts of the gas exchange system and relate them to their functions. In pairs, learners model structure of the human gas exchange system (using plastic bottles).

Links to other subjects: *Atmospheric pressure in physics.*

Assessment criteria: *Learners can identify the parts of human respiratory system.*

Materials: *Wall chart, model of human respiratory system, small mammal (rat, rabbit or guinea pig) dissecting set, computer aided teaching materials, transparent plastic bottles, straws, balloons, plasticine, rubber band.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE Sub-topic Area: Coordination in plants and animals

S.1 BIOLOGY

Unit 9: Tropic responses.

No. of lessons: 5

Key Unit Competence: To be able to describe response to light and gravity by plants and explain the importance of tropic responses in plants.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall that plants have root system. Identify the parts of the shoot that respond to light. State that gravitropism is 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. Describe the change in shape of the shoot and root tips when exposed to light and ground level. State the importance of phototropism and gravitropism in plants. 	<ul style="list-style-type: none"> Carry out an investigation on the response of plant shoot toward light and gravity. Observe and draw plant shoots growing toward stimuli of light and gravity. Show that plants respond quite differently compared to animals. 	<ul style="list-style-type: none"> Appreciate the importance of tropisms in plants. Show perseverance when carrying out experiments that take a rather long time to get results. 	<ul style="list-style-type: none"> The need for tropisms in plants (phototropism gravitropism). 	<ul style="list-style-type: none"> In groups, learners investigate phototropism and gravitropism in shoots and roots and present their findings to the class. Research about other forms of plant responses (such as hydrotropism, chemotropism and thigmotropism) and present before the class. Observe and draw the tendrils to show their response to touch in plants with weak stems (thigmotropism).

Links to other subjects:

Assessment criteria: Students can correctly describe responses to light and gravity by plants and understand the importance of tropic responses in plants.

Materials: Potted plant seedlings, cotton wool, pea and bean seeds, transparent plastic beakers, clinostats.

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Support and locomotion	
S.1 BIOLOGY	Unit 10: Skeletal systems of organisms.		No. of lessons: 6	
Key Unit Competence: To be able to analyse the different types of skeletons and identify the main parts of human skeleton.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall the different types of skeletons in organisms. Explain the role of the different types of skeletons. State the functions of the human/mammalian skeleton. Describe the general structure of the human skeleton and identify some of the bones of the central and peripheral parts. 	<ul style="list-style-type: none"> Recognise the different parts of the human skeleton from models. Practice drawing and labelling the major bones. Research on the skeleton and presentation of the findings. 	<ul style="list-style-type: none"> Justify practices that favour good health of the skeletal system. 	<ul style="list-style-type: none"> Types of skeletons (hydrostatic, exoskeleton, endoskeleton). Parts of human skeleton: central skeleton consisting of the skull, vertebral column and thoracic cage. The peripheral skeleton consisting of the upper and lower limbs, the shoulder and pelvic girdles. Functions of human skeletons. Practices that favour good health of the skeletal system. 	<ul style="list-style-type: none"> Learners observe illustrations and/or specimens of earthworm, insects to identify types of skeletons. Individually use model of human skeleton to identify and name the parts of human skeletons, draw and label major bones from central and peripheral skeleton. In groups, learners research from textbooks about the functions of human skeleton and present their findings in class. In groups, learners discuss practices that favour good health of the skeletal system.
Links to other subjects:				
Assessment criteria: Learners can analyse types of skeleton and identify the main parts of human skeleton.				
Materials: Illustrations and computer aided study materials, prepared slides, microscopes, small animals (rat/rabbit/guinea pig, toad/frog, and cockroach/locust).				

Topic Area: HEALTH AND DISEASE		Sub-topic Area: Infectious and non-infectious diseases		
S.1 BIOLOGY	Unit 11: Classification of diseases.		No. of lessons: 5	
Key Unit Competence: To be able to classify diseases and explain ways of preventing the spread of infectious diseases.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Define good health as a state of mental, social and physical wellbeing. • Define disease as any physical or mental disorder or malfunction with characteristic set of signs and symptoms. • Describe ways by which infectious diseases (cholera, tuberculosis, malaria, Ebola, HIV/AIDS) spread. • State ways by which infectious and non-infectious diseases can be prevented. 	<ul style="list-style-type: none"> • Classify diseases into infectious, non-infectious, inherited, degenerative, social, mental, eating disorder and deficiency diseases. 	<ul style="list-style-type: none"> • Adopt and advocate for practices that enhance good health. • Be aware that clearing bushes and grasses in the habitat of anopheles mosquitoes and treatments of standing water for anopheles larvae are necessary of eradicating malaria. 	<ul style="list-style-type: none"> • Health and disease. • Classification of diseases. • The spread and prevention of infections. • Non-infectious diseases: sickle cell, allergies, ageing, osteoporosis, cancer, cardiovascular diseases, eating disorders, deficiency diseases. 	<ul style="list-style-type: none"> • Learners discuss their perceptions of what makes a healthy and a sick person until they come out with an agreed meaning for good health and disease. • In groups, learners make a list of diseases according to their categories. • Individually research on the mode of transmission and suggest modes of preventing spread of cholera, tuberculosis, malaria, Ebola, HIV/AIDS.
Links to other subjects:				
Assessment criteria: Learners can classify diseases and explain ways of preventing the spread of infectious diseases.				
Materials: Charts/illustrations and computer aided materials.				

Topic Area: HEALTH AND DISEASES			Sub-topic Area: Reproductive health	
S.1 BIOLOGY	Unit 12: Human reproductive system.		No. of lessons: 10	
Key Unit Competence: To be able to Analyse the structure, functions and processes of the human sexual and reproductive system and relate to the understanding of sex and gender.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Describe the structure and function of the human sexual and reproductive system. • Define sex and gender stating that: <ul style="list-style-type: none"> ○ Sperm are produced in the testes by actively dividing cells and become motile in semen. ○ Ovum is produced in the ovary by actively dividing cells and is non- motile. ○ Sex is determined by sperm chromosomes during fertilisation. ○ Hormones play a major role in growth, development and the regulation of reproductive organs and sexual functions. 	<ul style="list-style-type: none"> • Analyse the social and biological aspects of sex and gender. • Compare the size and shape of ovum and sperm. 	<ul style="list-style-type: none"> • Appreciate that gender stereotypes are not biologically determined and can be challenged. 	<ul style="list-style-type: none"> • External and internal reproductive organs. • The process of sperm and ovum production. • Determination of sex. • Role of hormones in growth, development and the regulation of reproductive organs and sexual functions. • Influence of culture, tradition and religious practices on one's thinking about sex, gender and reproduction. 	<ul style="list-style-type: none"> • Use illustrations to identify the human sexual and reproductive organs. • Discuss biological and social aspects of sex and gender. • Carry out drama role play to enact how sex is determined. • In groups, learners provide examples of characteristics or behaviours that are seen as "male" and "female" and discuss whether this is biological or social. • Individually write out an assignment on how cultural, traditional and religious practices influence their thinking about sex, gender and reproduction and present it for evaluation.

Links to other subjects:				
<i>Assessment criteria: Can explain the structure, functions and processes of the human sexual and reproductive system and relate to understanding of sex and gender.</i>				
<i>Materials: Illustrations and computer aided materials.</i>				

Topic Area: HEALTH AND DISEASES			Sub-topic Area: Reproductive health	
S.1 BIOLOGY	Unit 13: Puberty and sexual maturation.		No. of lessons: 8	
Key Unit Competence: To be able to Analyse the physical, emotional and social changes related to puberty.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define puberty as a time of sexual maturation during which men and women become capable of sexual reproduction. State the key emotional and physical changes in puberty that occur as a result of hormonal changes. Recall the events of the menstrual cycle. Describe briefly the different phases of the menstrual cycle. 	<ul style="list-style-type: none"> Analyse the physical, emotional and social changes associated with puberty between girls and boys. 	<ul style="list-style-type: none"> Show respect for diversity in when and how peers develop and change during puberty. 	<ul style="list-style-type: none"> Puberty is a time of sexual maturation which leads to major physical and emotional changes and can be stressful. Puberty occurs at different times for different people and has different effect on boys and girls. Male and female hormones differ and have a major influence on the emotional and physical changes that occur over one's lifetime. 	<ul style="list-style-type: none"> In groups, learners discuss social changes that girls and boys experience in adolescence and how gender roles change in this period (how they are being treated by others, opportunities, freedom, responsibilities, expectations). Through mini-plays and drama, the learners perform short scenarios

(Details of the interaction of hormones not needed.)			<ul style="list-style-type: none"> • Hormones can affect body shape and size, body hair growth, development and other changes. • The menstrual cycle. 	related to physical, emotional and social changes of boys and girls at puberty.
Links to other subjects: <i>Music and drama.</i>				
Assessment criteria: <i>Students can Analyse the physical, emotional and social changes related to puberty.</i>				
Materials: <i>Illustrations and computer aided materials.</i>				

Topic Area: HEALTH AND DISEASES			Sub-topic Area: Reproductive health	
S.1 BIOLOGY	Unit 14: Reproduction, pregnancy and childbirth.		No. of lessons: 8	
Key Unit Competence: To be able to Analyse the process of reproduction, pregnancy and childbirth				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Describe male and female reproductive systems. State that fertilisation takes place when sperm from a man fuses with an ovum from a woman. Explain how a pregnancy occurs. Define maternal mortality and list major causes of maternal mortality. Describe the main ways that poverty and gender inequality lead to death (and serious health problems) among pregnant women and how these outcomes can be prevented. Describe the signs of pregnancy, and the stages of foetal development and childbirth. List health risks associated with early pregnancy and birth. 	<ul style="list-style-type: none"> Analyse using simulation s of stages of pregnancy and come up with signs and behavioural symptoms of pregnancy. 	<ul style="list-style-type: none"> Appreciate the importance of steps that can be taken to promote safe pregnancy and childbirth (avoiding early pregnancy, ante-natal care (ANC), and healthy lifestyle in pregnancy, safe delivery, post-partum care, etc.). Show concern about maternal mortality as an issue in the region. 	<ul style="list-style-type: none"> Reproduction: male and female reproductive systems. Intercourse and fertilisation. Pregnancy and its signs. Foetal development, ante-natal care, childbirth and health risks associated with teenage pregnancy and early childbirth. Steps to promote safe pregnancies and childbirth 	<ul style="list-style-type: none"> In groups, learners discuss the events and circumstances that bring about unintended pregnancy. Learners observe computer simulations of the development of the stages of pregnancy and identify the signs and outline behavioural symptoms of pregnancy. A guest medical official makes an interactive session about health risks associated with early pregnancy and birth.
<p>Links to other subjects: <i>Early and unintended pregnancies are causes of early death and poverty as studied in geography and economics.</i></p>				
<p>Assessment criteria: <i>Can analyse the process of reproduction, pregnancy and childbirth.</i></p>				

Materials: *Illustrations and computer aided materials.*

5.3. Biology programme for S 2

5.3.1. Key competences at the end of S2

- Classify animals into their main groups based on external features.
- Explain the concepts applied in environmental biology.
- Demonstrate and explain different processes of movement of water and ions in and out of a cell.
- Analyse and interpret the process of active transport and its significance to living organisms.
- Carry out chemical tests on a variety of foods to identify the nature of food substances.
- Explain the role of enzymes in living organisms and how they are affected by temperature and pH.
- Explain the process of photosynthesis and how various environmental factors affect the rate at which photosynthesis occurs.
- Explain the process of uptake and transport of xylem sap, transpiration and translocation and their roles in plants.
- Demonstrate and explain gaseous exchange in humans and plants.
- Describe the structure and function of excretory organs and suggest good practices for healthy kidneys.
- Describe types of joints and relate their structure to their functions.
- Identify symptoms of common infectious diseases namely cholera, malaria, Ebola and HIV/AIDS.
- Describe natural and artificial methods that fight against the infection.
- Explain safe sex and sexual behaviours.
- Apply knowledge of pregnancy prevention in sexual and reproductive decisions.
- Apply knowledge of sexually transmitted diseases and HIV transmission, prevention and treatment in sexual decision making.

5.3.2. Biology units table for S2

Topic Area: BIODIVERSITY AND CLASSIFICATION			Sub-topic Area: Classification of living things	
S.2 BIOLOGY	Unit 1: Classification of kingdom Animalia.		No. of lessons: 14	
<ul style="list-style-type: none"> • Key Unit Competence: To be able to classify animals into their main groups based on external features. 				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • State the characteristics of all animals. • Identify the common features of chordates (fish, amphibians, reptiles, birds and mammals). • Explain adaptations of chordates, limited to fish and birds, to their environments. • State the classes of the phylum arthropod and outline their main characteristics. • Explain the economic importance of arthropods to humans. • State other phyla of 	<ul style="list-style-type: none"> • Distinguish different groups of animals using observable features. 	<ul style="list-style-type: none"> • Appreciate the existence of animal diversity and increasing complexity from lower organisms to higher animal groups. • Appreciate the need for classification of animals. 	<ul style="list-style-type: none"> • General characteristics of animals. • Phylum Chordata (fish, amphibians, reptiles, birds and mammals). • Key classes of phylum arthropods (insects, crustaceans, diplopods, Chilopoda, arachnids) and other phyla in the kingdom Animalia (Platyhelminthes; nematodes, annelids, molluscs, oelenterates, cnidarians, porifera, sponges, echinoderms). 	<ul style="list-style-type: none"> • In groups, learners observe different animals from their surrounding/field and record observable characteristics among them. • In groups, observe external features of a fish, an amphibian, a reptile, a bird and a mammal and present what they observed. • Engage the learners to discuss the adaptations of fish and birds to their environments. • Learners collect or observe the provided specimens of arthropods to draw out differences among them. • In groups, learners discuss the

<p>kingdom Animalia and give examples of each. (Platyhelminthes; nematodes, annelids, molluscs, coelenterates / cnidarians, porifera/ sponges, echinoderms.)</p>				<p>economic importance of arthropods to humans.</p> <ul style="list-style-type: none"> • Learners make research from the library or internet about different phyla in the kingdom Animalia and come up with examples in each group.
<p>Links to other subjects:</p>				
<p>Assessment criteria: <i>Students can classify animals into their specific phyla based on external features.</i></p>				
<p>Materials: <i>Live/preserved specimens, audio-visual resources, photographs of animals.</i></p>				

Topic Area: ECOLOGY AND CONSERVATION			Sub-topic Area: Environmental biology	
S.2 BIOLOGY	Unit 2: Introduction to environmental biology.		No. of lessons: 8	
Key Unit Competence: To be able to explain the concepts applied in environmental biology including the interaction and interdependence of organisms.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define the following items: Ecology: a study of organisms in relation to the surroundings in which they live. Population: a group of individuals of the same species living in the same habitat at the same time. Community: the combination of populations of all the species in an area. Habitat: a place where an organism lives. Ecosystems: all the living organisms in a place and the interactions between them and their physical environment. Niche: the role of an organism in its habitat and how it makes it's living. Biotic factors: as influences of other organisms on each other 	<ul style="list-style-type: none"> Construct and interpret simple food chains and food webs. Construct pyramids of biomass and numbers. Carry out analysis of the diagram showing a food chain. 	<ul style="list-style-type: none"> Appreciate the role of green plants in terms of conversion and supply of energy to all living organisms. Appreciate the interdependence of living organisms. 	<ul style="list-style-type: none"> Biosphere and biome, ecosystem population, community, habitat, ecological niche, biotic and abiotic factors. Food chains and food webs. Trophic levels in food chains and webs (producers, consumers and decomposers) Energy flow in ecosystems. 	<ul style="list-style-type: none"> Learners read in groups about ecological vocabulary. Learners answer simple questions and make notes. In groups, learners discover which non-living (abiotic) factors they interact with in their environment and ways that non-living things are essential to living organisms. Learners, at different occasions, observe feeding relationships among wild and domestic animals. Learners draw or model simple food chains and food webs. Learners carry out analysis of the diagram showing a food chain and then find out the trophic level of each organism in the chain. Construct pyramids of numbers

<p>Abiotic factors: effects of non-biological surroundings of an organism such as temperature, light intensity and rainfall</p> <p>Food chain: showing the transfer of energy from one organism to the next beginning with the producers.</p> <p>Food web: the network of interconnected food chains.</p> <ul style="list-style-type: none"> Describe how energy is lost between trophic levels. 				<p>and biomass on graph paper from given data. Argue why a pyramid of biomass is needed.</p> <ul style="list-style-type: none"> Learners watch an audio-visual of wildlife and appreciate the interdependence of different organisms.
<p>Link to other subjects: <i>A biotic factors of an ecosystem are related to the climate in geography.</i></p>				
<p>Assessment criteria: <i>Can explain the interaction and interdependence of organisms with one another and their environment.</i></p>				
<p>Materials: <i>Wall charts, audio visuals.</i></p>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE		Sub-topic Area: Movement in and out of cell		
S.2 BIOLOGY	Unit 3: Passive movement of substances across the cell membrane.		No. of lessons: 8	
Key Unit Competence: To be able to explain and demonstrates the different processes of movement of water ions in and out of a cell.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define diffusion as the movement of particles from the region of their higher concentration to the region of their lower concentration. State that substances move in and out of cells by diffusion through the cell membrane. Recall that energy in diffusion comes from the kinetic energy. Describe the importance of diffusion of gases and solutes and water as a solvent. Define osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of low water potential (concentrated solution) through a partially permeable membrane. 	<ul style="list-style-type: none"> Carry out an experiment to show that diffusion occurs in gases and liquids. Investigate the factors that influence diffusion; limited to surface area, temperature, concentration gradients and distance. Design an experiment to show that osmosis occurs in living tissues. Design an experiment to show how turgor pressure occurs. 	<ul style="list-style-type: none"> Appreciate the importance of turgidity in the supporting systems in plants. 	<ul style="list-style-type: none"> Importance of diffusion of gases and solutes. Factors that influence rates of diffusion. Osmosis, turgidity, turgor pressure, plasmolysis, flaccidity and importance of water potential and osmosis. Role of turgor pressure within cells. 	<ul style="list-style-type: none"> Discuss the need for transport of substances in and out of the cell. Carry out an experiment to demonstrate diffusion in gas (e.g. spray perfume) and in liquids (e.g. KMnO₄ crystals in water). Design and carry out investigations of factors likely to affect diffusion rates. Investigate that osmosis occurs only in living tissue using raw and boiled plant tissues. In groups, learners

<ul style="list-style-type: none"> • Describe the importance of osmosis in the uptake of water by plants and its effects on plant and animal tissues. • Explain how plants are supported by pressure of water inside the cells (turgor pressure) pressing on their cell walls. 				<p>carry out an experiment to show turgor pressure in plants using solutions of different concentrations (e.g. sugar).</p>
<p>Links to other subjects: <i>Concentration of solutions in chemistry.</i></p>				
<p>Assessment criteria: <i>Learners can explain and demonstrate the processes of diffusion and osmosis.</i></p>				
<p>Materials: <i>Solutions of different concentrations, cotton wool, open ended test tube, Visking tube, raw and boiled Irish potatoes, potassium permanganate, calibrated beakers.</i></p>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Movement in and out of the cell	
S.2 BIOLOGY		Unit 4: Active transport.		No. of lessons: 6
Key Unit Competence: To be able to analyse and interpret the process of active transport and its significance to living organisms.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define active transport as the movement of particles through the cell membrane from a region of lower concentration to a region of high concentration using energy. State locations in plant and animal tissues where active transport occurs. State the factors affecting active transport. Explain the importance of active transport as the process of movement across membranes limited to ion uptake by root hairs and uptake of glucose by epithelial cells of villi and kidney tubules. Describe how carrier proteins move particles across membranes during active 	<ul style="list-style-type: none"> Compare passive and active transport. Demonstrate active transport using charts and animations. Use IT skills to carry out simulations of the process of endocytosis and exocytosis. 	<ul style="list-style-type: none"> Appreciate the importance of active transport in plants and animals. Acknowledge and support the role of energy in absorption of mineral salts in soils that support germinating and growing plants. 	<ul style="list-style-type: none"> Active transport and its importance. Factors affecting active transport. Role of proteins in active transport across the membrane. Endocytosis Exocytosis. 	<ul style="list-style-type: none"> Make a group presentation to compare passive and active transport. Observe and interpret charts and animations of the active transport and list the sequence of stages in which ions are moved across the cell membrane. Research and present findings on the need energy in kidney tubules and intestinal epithelial cells in relation to their functions. Use animations, computer simulations or charts, and diagrams to illustrate the process of endocytosis and exocytosis.

transport.				
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Links to other subjects: ICT.

Assessment criteria: *Students can analyse and interpret clearly the process of active transport and its significance to living organisms.*

Materials: *Computer animations, charts and illustrations of active transport.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Biological molecules	
S.2 BIOLOGY	Unit 5: Identification of food components.			No. of lessons: 8
Key Unit Competence: To be able to carry out chemical tests on a variety of foods to identify the nature of food substances.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> State the chemical reagents used in the identification of each the classes of foods. List the suitable apparatus required for the chemical test of a given food sample. 	<ul style="list-style-type: none"> Practice designing a table including the procedure, observation and deductions for the tests made about the food samples. Carry out tests to identify food substances in a given sample. Carry out an investigation to determine the composition of an unknown food substance. Observe changes in colour during food tests and relate them to the chemical reactions. 	<ul style="list-style-type: none"> Appreciate the importance of different classes of food in one food substance. Show perseverance when making observations for changes in colour during practical lessons. Acknowledge the need to carry out practical activities with less supervision to develop independent mind and dealing with apparatus. Show concern when carrying out practical work in groups. Take care while carrying out an experiment involving heating to avoid burns. 	<ul style="list-style-type: none"> Chemical tests for starch, reducing sugars, proteins, fats and vitamin C. 	<ul style="list-style-type: none"> With guided instructions, carry out a chemical test on starch using Iodine solution, on glucose solution using benedict's solution, on egg albumen using biuret reagent, cooking vegetable oil using ethanol and lemon juice using the DCPIP (Dichlorophenol- indol-phenol). Record in table form the observations. Devise an experiment to determine the composition of given food stuffs from the presence of reducing sugars, protein, lipid and vitamin C. Record your procedure, observation and deductions in a table form.

Links to other subjects: *Qualitative analysis in chemistry.*

Assessment criteria: *Students can carry out chemical tests on a variety of foods to identify the nature of food substances.*

Materials: *Test tubes, Iodine solution, Benedict's solution, Biuret reagent, ethanol, Millons' reagent, translucent paper, DCPIP, Source of heat, Lemon/ Orange/Tomato juice, Maize flour, egg albumen, cooking oil, glucose.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE		Sub-topic Area: Biological molecules		
S.2 BIOLOGY	Unit 6: Enzymes.		No. of lessons: 8	
Key Unit Competence: To be able to explain the role of enzymes in living organisms and how they are affected by temperature and pH.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define the term catalyst and enzyme. Describe why enzymes are important in all living organisms in terms of reaction speed necessary to sustain life. Explain the factors affecting enzyme activity limited to temperature and pH. 	<ul style="list-style-type: none"> Apply knowledge of food tests to observe the changes and determine the effect of enzyme activity on substrates. Conduct an experiment on the effect of temperature and pH on enzyme activity. Draw and interpret graphs for the rate of enzyme activity on temperature and pH. Illustrate enzyme action with reference to the complementary shape of an enzyme and its substrate and the formation of a product. 	<ul style="list-style-type: none"> Appreciate the importance of enzymes in speeding up reactions to sustain life. Appreciate the specificity of enzyme activity to substrates and with respect of the effect of temperature and pH 	<ul style="list-style-type: none"> Catalyst Enzymes Characteristics of enzymes. Factors affecting enzyme activity. Importance of enzymes in all living organisms in terms of reaction speed necessary to sustain life. Mode of action of enzymes in terms of shapes and interactions with substrate and products. 	<ul style="list-style-type: none"> In groups, learners carry out an experiment to show the effect of amylase on starch. Independently, learners investigate the effect of temperature on enzyme activity using amylase on starch solution and carry out the test for presence or absence of the product of enzyme activity and present results in tabular form. In pairs, devise an experiment to find out the effect of pH on enzyme activity using amylase starch solution and carry out the test for presence or absence of the product of enzyme activity and present results in tabular form.
Links to other subjects: <i>Inorganic catalysts and rates of reactions in chemistry and interpretation of graphs in mathematics.</i>				

Assessment criteria: *Students can explain the role of enzymes in living organisms and how they are affected by environmental factors.*

Materials: *starch solution, Benedict's solution, amylase, thermometers and pH indicators, Bunsen burner and test tubes. Beakers for water baths.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Nutrition	
S.2 BIOLOGY	Unit 7: Photosynthesis.		No. of lessons: 14	
Key Unit Competence: To be able to explain the process of photosynthesis and how various environmental factors affect the rate at which photosynthesis occurs.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall the location of plastids and chloroplasts in plants cells. Define photosynthesis and state the word equation for photosynthesis. Identify the products of photosynthesis. Identify and explain the limiting factors of photosynthesis in different environmental conditions. Explain how the internal and external structures of a leaf are adapted for photosynthesis. Describe the 	<ul style="list-style-type: none"> Carry out an experiment to test for starch in green leaves. Interpret graphs about the variations in amount of carbon dioxide and light intensity on the rate of photosynthesis. Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis. Conduct an experiment to show that oxygen is produced by 	<ul style="list-style-type: none"> Appreciate the process of photosynthesis in the production of oxygen and reduction of carbon dioxide from the atmosphere. Realise safety in handling flammable liquids (ethanol). Express how plants have inhabited different geographical regions. 	<ul style="list-style-type: none"> The necessity for chlorophyll, light energy and carbon dioxide for photosynthesis. Limiting factors of photosynthesis. Adaptations of the leaf for photosynthesis. Importance of photosynthesis. Mineral requirements (nitrate ions for protein synthesis and magnesium ions for chlorophyll synthesis). Use and dangers of nitrogen and other 	<ul style="list-style-type: none"> In pairs, carry out an experiment to test for the presence of starch in a leaf using iodine and ethanol and present the results. Interpret graphs provided on variation in the amount of carbon dioxide and light intensity affecting the rate of photosynthesis. Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis. In groups, perform an experiment to show that oxygen is produced by plants during photosynthesis. Make research from the library or internet of internal and external adaptations of leaves for photosynthesis. Investigate the effects of

<p>importance of nitrate and magnesium in chlorophyll synthesis.</p> <ul style="list-style-type: none"> • Describe the uses, and dangers of nitrogen and other fertilisers. 	<p>plant leaves during photosynthesis.</p> <ul style="list-style-type: none"> • Conduct experiment to find out the effects of nitrate and magnesium ions deficiency on plant growth. 		<p>fertilisers.</p>	<p>varying light intensity, carbon dioxide concentration, temperature and light intensity on the rate of photosynthesis, e.g. in submerged aquatic plants.</p> <ul style="list-style-type: none"> • In groups learners isolate chlorophyll and discuss the importance of photosynthesis. • Discuss case studies of examples of eutrophication from nitrogen and other fertilizers • In groups, devise an experiment to find out the effects of nitrate and magnesium deficiency on plant growth and record the changes in leaves in tabular form.
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Links to other subjects: *Chemical equations in chemistry, green houses, fertilisers in modern agriculture.*

Assessment criteria: *Students are able to explain the process of photosynthesis and how various environmental factors affect the rate of photosynthesis.*

Materials: *Pond weed, potted plants, beakers, bicarbonates, ethanol, iodine solution Light bulbs, illustrations, charts for graphs of limiting factors, computer animations of the process of photosynthesis.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Transport in plants	
S.2 BIOLOGY	Unit 8: Transport of water, mineral and organic foods in plants.		No. of lessons: 10	
Key Unit Competence: To be able to explain the process of uptake and transport of mineral and organic saps, transpiration and translocation and their roles in plants.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • State the functions of xylem and phloem. • Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves. • Explain the mechanism by which water moves upwards in the xylem. • Explain the adaptations of plant leaves to controlling water loss. • State that water is transported from the roots to leaves through the xylem vessels. • Define transpiration as 	<ul style="list-style-type: none"> • Demonstrate how translocation takes place in plants. • Create a table to compare transpiration and translocation. • Use a potometer to measure the rate of water uptake of a given plant. • Demonstrate by practical evidence the process of translocation. 	<ul style="list-style-type: none"> • Appreciate the importance of absorption and transport of water in plants. • Understand other perspectives related to transport like the absorption and transport of pesticides. • Show concern for the control of aphid populations among plants since their feeding process on phloem content permits spread of viruses among plants. 	<ul style="list-style-type: none"> • Transport system in plants. • Water and minerals uptake. • Source and sink of food products. • Transpiration. • Adaptations of plants to different environment conditions. • Translocation of organic foods. 	<ul style="list-style-type: none"> • Find out about the parts of the shoot system that carry out transpiration using branches with leaves. • In pairs, set up a potometer to measure the rate of water uptake at various conditions of temperature and humidity. • Discuss how some parts of a plant may act as a source and a sink at different times during the life of the plant. • In pairs, discuss reasons for the different modifications shown on plant shoot and root systems in desert and

<p>loss of water vapour from plant leaves by evaporation of water at the surfaces of the mesophyll.</p> <ul style="list-style-type: none"> • Describe the effects of variation of temperature and humidity on transpiration rate. • Explain how and why wilting occurs. • List ways in which desert plants are able to reduce water loss and conserve water. • Define translocation in terms of the movement of sucrose and amino acids in phloem. • Explain how some parts of a plant may act as a source and a sink for food stores at different times during the life of a plant. 	<ul style="list-style-type: none"> • Compare the role of transpiration and translocation in transport of materials from sources to sinks, within a plant at different seasons. 			<p>aquatic environments.</p> <ul style="list-style-type: none"> • Research from library or internet how systemic pesticides work to kill pests.
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Links to other subjects: *Vaporisation, heat capacity and pressure in fluids in physics.*

Assessment criteria: *Students can explain the process of uptake and transport of xylem sap, transpiration and translocation and their roles in plants.*

Materials: *Branches with leaves, potometer, cut shoot light bulb, fun, plant shoot and root from aquatic and dry environments.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE

Sub-topic Area: Gaseous exchange and smoking

S.2 BIOLOGY

Unit 9: Gaseous exchange in humans and plants.

No. of lessons: 12

Key Unit Competence: To be able to explain gaseous exchange in humans and plants.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • State the characteristic features of respiratory surfaces. • Define gaseous exchange and state why it is an important process. • Explain the features or adaptations of gaseous exchange surfaces. • Describe the process by which air is moved into and out of the lungs during breathing. • Describe the process of gaseous exchange at the alveolus. • Identify common respiratory diseases and suggest their 	<ul style="list-style-type: none"> • Demonstrate the processes of inspiration and expiration through deep breathing movements. • Dissect a mammalian lung and arrive at its characteristic features related to gaseous exchange surfaces. • Construct a bell-jar model apparatus from locally available materials. • Design an experiment to show that expired air contains more carbon dioxide than inspired air. • Observe stomata from epidermal leaf and use it to explain how 	<ul style="list-style-type: none"> • Appreciate that learning can be enhanced by using readily available simple materials. 	<ul style="list-style-type: none"> • Characteristic features of respiratory surfaces. • Mechanism of breathing in humans. • Gaseous exchange at the alveoli. • Respiratory diseases, their causes, spreads and preventive measures. • Structure of a leaf. • Gaseous exchange in plants. 	<ul style="list-style-type: none"> • Learners discuss the importance of gaseous exchange by answering the teacher’s probing questions. • Learners observe the lungs of a dissected mammal and arrive at characteristic features of gaseous exchange surfaces. • Learners make and use a model thorax to understand the mechanism of breathing. • Set up experimentation to show that expired air contains more carbon dioxide than inspired air. • Learners in groups use illustrations to explain gaseous exchange at the alveolus. • Learners research common respiratory diseases, their prevention and treatment. • Learners observe stomata from epidermal leaf and use it to explain how gaseous exchange

<p>prevention and treatment.</p> <ul style="list-style-type: none"> • Explain the process of gaseous exchange in plants. 	<p>gaseous exchange takes place.</p> <ul style="list-style-type: none"> • Compare the composition of inspired and expired air. 			<p>takes place.</p>
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Links to other subjects: *Diffusion of gases is linked to physics and chemistry.*

Assessment criteria: *Learners can explain gaseous exchange in humans and plants.*

Materials: *Model of human respiratory system, small mammal, dissecting set, computer aided teaching materials bottle, delivery tubes, balloons microscope.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Homeostasis	
S.2 BIOLOGY	Unit 10: Excretion in humans.		No. of lessons: 4	
Key Unit Competence: To be able to describe the structure and function of excretory organs and suggest good practices for healthy kidneys.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define excretion as the removal from organism of toxic materials, the waste products of metabolism and substances in excess of requirements. Explain the need for excretion, limited to toxicity of urea and carbon dioxide. Name the excretory organs and excretory products of humans. State that urea is formed in the liver from excess amino acids through the process of deamination. Identify on drawings, diagrams and images, the kidneys, ureters, bladder and urethra. 	<ul style="list-style-type: none"> Using a dissected mammal to identify parts of the urinary system. Illustrate using diagrams the internal structure of a mammalian kidney limited to cortex, medulla and ureter. Demonstrate that an individual may pass much dilute urine or little but concentrated urine. Draw a well labelled 	<ul style="list-style-type: none"> Develop good habits to maintain a healthy urinary system. 	<ul style="list-style-type: none"> Need for excretion and the human excretory organs and their products. Role of the liver in excretion. Structure of the human urinary system. Structure of human kidney. Process of urine formation. Factors affecting concentration of urine. Practices that maintain healthy urinary system. 	<ul style="list-style-type: none"> Learners brainstorm why an individual would develop health problems if he/she does not urinate for a long period. Learners carry out research on different excretory organs and the respective secretions and present to the class. Learners observe the urinary system of a dissected mammal such as a rabbit or a photograph and identify the kidneys, ureters, bladder and urethra. Learners observe the internal structure of mammalian kidney and identify cortex, medulla and pelvis. Learners are provided with two unlabelled diagrams of the urinary system and human kidney and are requested to label them. Learners make research from

<ul style="list-style-type: none"> • Outline the structure of the kidney, limited to the cortex, medulla and ureter. • Describe a nephron as made of Bowman’s capsule, proximal convoluted tubule, Loop of Henle, distal convoluted tubule, and collecting duct (no further details are required). • Describe the process of urine formation limited to ultra-filtration and selective re-absorption. • Explain that the volume and concentration of urine produced is affected by water intake, temperature and exercise. 	<p>structure of nephron.</p>			<p>textbook to identify parts of a nephron/kidney tubule and locate on it stages in urine formation.</p> <ul style="list-style-type: none"> • Learners make a research project on why an individual may pass much diluted urine or little but concentrated urine. • Learners discuss in groups good habits that enhance healthy urinary system.
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Links to other subjects:

Assessment criteria: Learners will describe clearly the structure and function of excretory organs and identify precisely the common urinary diseases.

Materials: Small mammals, dissection kit, prepared slides or models of urinary system, kidney, nephron, computer aided teaching materials.

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE		Sub-topic Area: Support and locomotion		
S.2 BIOLOGY	Unit 11: Joints and movement.		No. of lessons: 6	
Key Unit Competence: To be able to describe types of joints and relate their structures to their functions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Differentiate between hinge joint and ball and socket joint. • Outline the function of bones, ligaments, tendons, cartilage, nerves and synovial fluid in the joint. 	<ul style="list-style-type: none"> • Analyse the structure of immovable and movable joints. • Use acquired knowledge to classify joints in the human body as immovable or movable. • Draw and label a typical synovial joint. • Demonstrate by using a diagram how antagonistic muscles bring about movement at a hinge joint. 	<ul style="list-style-type: none"> • Appreciate the importance of link between skeletal muscles and bones in movement. • Develop good habits that maintain safety of the body joints. 	<ul style="list-style-type: none"> • Types of joints: <ul style="list-style-type: none"> ○ Immovable joints (e.g. sutures between the bones of the skull) ○ Movable joints: joints between the vertebrae, synovial joints (hinge joints, ball-and-socket joints, pivot). • Structure of a synovial joint. • Action of antagonistic muscles in movement of a hinge joint. • Practices that promote healthy bones and joints. 	<ul style="list-style-type: none"> • Individually identify and locate immovable and movable joints. • Investigate the location of immovable and movable joints in the body and the antagonistic actions of biceps and triceps (e.g. by using an arm model with elastic bands). • Research about the effect of diet on healthy joints and bones • In groups, discuss practices that maintain healthy bones and joints.
Links to other subjects:				
Assessment criteria: Learners can describe types of joints and relate their structures to their functions.				
Materials: Illustrations and computer aided study materials, model of human skeleton.				

Topic Area: HEALTH AND DISEASE		Sub-topic Area: Infectious and non-infectious diseases		
S.2 BIOLOGY	Unit 12: Infectious diseases.		No. of lessons: 8	
Key Unit Competence: To be able to identify symptoms of common infectious diseases and their prevention and treatment.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define pathogen, transmissible disease and host. State that the pathogen for a transmissible disease may be transmitted either through direct contact (e.g. through blood or other bodily fluids) or indirectly (e.g. from contaminated surfaces or food, from animals, or from the air). State that the body has defences: mechanical barriers limited to skin and hairs in the nose; chemical barriers limited to mucus and stomach acid; cells, limited to phagocytosis and antibody production by white blood cells. Explain that somebody defences can be enhanced by vaccinations. 	<ul style="list-style-type: none"> Apply practices of hygienic food preparation, good personal hygiene, waste disposal and sewage treatment in controlling the spread of disease. Illustrate the danger of infectious diseases using a chart. Organise community campaigns on prevention and treatment of infectious diseases. Recognise individuals displaying symptoms of cholera, malaria, 	<ul style="list-style-type: none"> Campaign against the existence and spread of cholera, malaria, Ebola and, HIV/AIDS. Value the science of infectious diseases to avoid prejudice and discrimination 	<ul style="list-style-type: none"> Pathogens. Transmission of infectious diseases. Defence against infection (first line of defence, second line of defence, immunity). Symptoms, prevention and control, treatment of common diseases (cholera, TB, malaria, salmonellosis, typhoid, Ebola and HIV/AIDS) 	<ul style="list-style-type: none"> Learners carry out group research from the library or the internet to find out the definition and the role of pathogens. With reference to the spread of cholera, learners discuss ways by which infectious diseases are transmitted from one host to another and from one area to another. Learners are provided with worksheets containing a list of infectious diseases and blank columns for symptoms and prevention/control. Learners then work in groups to complete the table and present to the class. Research about ways by which the body defends itself from infections and then present their findings to class.

<ul style="list-style-type: none"> Explain the symptoms, prevention and control of the following common diseases: malaria, Ebola and HIV/AIDS. 	Ebola or HIV/AIDS.			
Links to other subjects: <i>Health sciences</i>				
Assessment criteria: <i>Can identify symptoms of common infectious diseases namely cholera, malaria, Ebola and HIV/AIDS and their treatments.</i>				
Materials: <i>Charts/illustrations and computer aided materials.</i>				

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Immunity	
S.2 BIOLOGY	Unit 13: Immunity and vaccination.		No. of lessons: 8	
Key Unit Competence: To be able to describe natural and artificial methods that fight against infection.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Explain how each pathogen has its own antigens, which have specific shapes and specific antibodies which fit these are needed. • State that antibodies lock on to antigens leading to direct destruction of pathogens, or marking of pathogens, for destruction by phagocytes. • Define active immunity, pathogen and antibody production in the body. • State that memory cells are not produced in passive immunity. • Explain the importance of passive immunity for breast fed infants. • State that some diseases 	<ul style="list-style-type: none"> • Use a diagram of mode of action of antibody – antigen to identify the antigen, the antibody and the binding site. • Observe and differentiate the immune responses of an organism using computer aided simulation. • Demonstrate the good practice for mothers in their families to breast feed the newborn baby for 1000 days. 	<ul style="list-style-type: none"> • Advocate for vaccination and breast feeding as sustainable disease prevention. • Aware of vaccination programs in their communities. 	<ul style="list-style-type: none"> • Antigens and antibodies. • Immune response. • Types of immune system. • Vaccination/immunisation. • Autoimmune response and Type 1 diabetes. 	<ul style="list-style-type: none"> • Learners are given a text paragraph about the discovery and chemical nature of both antibodies and antigens and how they react with each other. Thereafter, learners discuss the specificity and mode of action of an antibody and antigen. • Using the diagram to comprehend the mode of action of antibody or antigen, learners identify the antigen, the antibody and the binding site. • Learners use computer aided simulation to observe and differentiate the immune responses of an organism. • Learners discuss how one's own immune system can bring about Type 1 diabetes. • Learners research and present their findings on the background of the vaccination and its application

<p>are caused by the immune system targeting and destroying body cells, limited to Type 1 diabetes.</p> <ul style="list-style-type: none"> • Explain the process of vaccination. • Explain the role of vaccination in controlling the spread of diseases. 				<p>as a means of preventing later/ present infections.</p> <ul style="list-style-type: none"> • Learners are engaged in the discussion that supports the practice of breastfeeding newborns and attending the vaccination campaign.
<p>Links to other subjects:</p>				
<p>Assessment criteria: <i>Learners can describe natural and artificial methods that fight against infection.</i></p>				
<p>Materials: <i>Charts, illustrations and computer aided materials.</i></p>				

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.2 BIOLOGY	Unit 14: Sexual behaviour and sexual response.		No. of lessons: 4	
Key Unit Competence: To be able to explain safe sex, sexuality and sexual behaviours and argue for control of sex violations.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Discuss the concepts of physical and emotional maturity and what this implicates for forming sexual relationships. • Describe male and female responses to sexual stimulation. • Explain different ways couples can show love and affection. • Outline responses to sexual attraction and stimulation at puberty by boys and girls. 	<ul style="list-style-type: none"> • Share experience on the physical and emotional attraction to sexuality. 	<ul style="list-style-type: none"> • Recognise that sexual relationships require emotional and physical maturity. • Be sensitive that people have different feelings, beliefs and attitudes concerning sex. • Develop self-confidence and control towards sexual thoughts and feelings. 	<ul style="list-style-type: none"> • Male and female sexual responses. • Sexual stimulation (physical or mental) for physical response. • Puberty (boys and girls), sexual thought and feelings, love and care. • People and sexual relationships • Sexual problems and disappointment. • Sexuality, age and culture. • Violation of human rights (sex harassment, coercion and human trafficking) 	<ul style="list-style-type: none"> • Learners discuss different ways of showing love and affection without engaging in sexual activity. • Share experience on physical and emotional attraction to sexuality through role plays, games, drama and audio-visual material. • Learners interact and reflect on sex harassment and coercion using information from internet and video animation, come up with a report to present to class their ideas for control.
<p>Links to other subjects: <i>Early and unintended pregnancies can be causes of early death and poverty as studied in geography and economics.</i></p>				
<p>Assessment criteria: <i>Can explain male and female sexual response and apply critical thinking skills in discussing forming relationships and control of sex violations.</i></p>				

Materials: *Illustrations and computer aided materials.*

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.2 BIOLOGY	Unit 15: Pregnancy prevention.		No. of lessons: 6	
Key Unit Competence: To be able to apply knowledge of pregnancy prevention in sexual and reproductive decisions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify effective ways of preventing unintended pregnancy. Outline forms of contraceptive methods and their working mechanisms in the body, associated efficacy, benefits and side effects. Describe benefits and possible side effects of available methods of contraception. 	<ul style="list-style-type: none"> Demonstrate confidence in discussing different contraceptive methods. Design and illustrate a model that shows efficient use of male and female condoms. 	<ul style="list-style-type: none"> Appreciate the importance of making informed choices about reproduction and family size. Recognise the benefits of child spacing. 	<ul style="list-style-type: none"> Abstinence. Common myths about contraceptives. Importance of the use of contraceptive methods. Natural contraceptive methods; calendar (cycle beads), billings, lactation amenorrhea. Artificial contraceptive methods Barrier methods, male and female condoms, spermicides. Hormonal based contraception methods (oral contraceptive pills, injectables and implants). Non-hormonal based contraception methods (intrauterine device (IUD) permanent contraceptive methods (tubal ligation, vasectomy), Abortion and menopause. 	<ul style="list-style-type: none"> Learners carry out research from the library or internet about contraceptive methods. In groups, learners discuss the advantage and disadvantages of using each contraceptive method. Learners research, in groups about the effective ways of preventing unintended pregnancy and present to class. In groups, learners discuss different forms of contraception and their working mechanism in the body, associated efficacy, benefits and side effects. Brainstorm on menopause and abortion related to the pregnancy conception Learners' observe models and discuss how they are used in relation to the real life situation.

Links to other subjects:

Assessment criteria: *Can apply knowledge of pregnancy prevention in sexual and reproductive decisions.*

Materials: *Illustrations and computer aided materials, condoms.*

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.2 BIOLOGY	Unit 16: Reducing risk of STIs and HIV.		No. of lessons: 8	
Key Unit Competence: To be able to apply knowledge of STI and HIV transmission, prevention and treatment in sexual decision making.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Explain how STIs and HIV are transmitted, treated and prevented. • Identify specific ways of reducing the risk of acquiring or transmitting HIV and other STIs, including the correct use of condoms. • State that abstinence is the most effective protection against HIV and other STIs. • State that age disparate/intergenerational relationship can increase the risk of acquiring HIV. • State that post- 	<ul style="list-style-type: none"> • Recognise symptoms and complications of STIs and HIV. • Demonstrate communication skills in negotiating safer sex and refusing unsafe sexual practices. • Explain how culture and gender affect personal decision making regarding sexual relationships. • Explain how STIs such as chlamydia, gonorrhoea, syphilis, HIV and HPV (genital human papilloma virus) can be 	<ul style="list-style-type: none"> • Appreciate behaviours that reduce the risk of STIs and HIV transmission. • Recognise the importance of getting tested and treated for STIs including HIV. 	<ul style="list-style-type: none"> • Transmission of STIs (chlamydia, gonorrhoea and syphilis). • Transmission of HIV infection. • Ways of reducing STIs and HIV infection avoiding penetrative sex, mutual faithfulness, reducing the number of sexual partners). • Role of artificial contraceptive methods (barrier methods, male and female condoms,). • Treatments of STIs and HIV infection. • STIs and HIV routes of 	<ul style="list-style-type: none"> • Making posters presenting different topics related to STIs and HIV. • Dramatise negotiation and refusal skills regarding sex. • Demonstration and practice of correct use of condom. • Watch movies relating risky behaviour and ways of reducing risk of STIs and HIV. • Through drama and sketch, • Learners reflect on the harmful effects on sexual behaviour of consuming drugs and alcohol.

<p>exposure prophylaxis (PEP), or short-term anti-retroviral therapy (ART), can reduce the likelihood of HIV infection after a potential exposure.</p> <ul style="list-style-type: none"> • Explain that sexual health services, including voluntary counselling and testing (VCT) centres offering pre- and post-test counselling can help people to assess personal risk and perceived vulnerability and explore their attitudes about safer sexual practices. • State that culture, gender and peer norms can influence decision making about sexual behaviour. • Explain that alcohol and drug use can impair rational decision making and contribute to high-risk behaviours. 	<p>prevented.</p>		<p>transmission, ways of treatment and prevention.</p>	
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Links to other subjects:

Assessment criteria: *Can apply knowledge of STI and HIV transmission, prevention and treatment in sexual decision making.*

Materials: *Illustrations and computer aided materials, movies related to STI/HIV prevention.*

5.4. Biology programme for S 3

5.4.1. Key competences at the end of S3

- Classify examples of species interactions.
- Sketch and interpret population growth curves.
- Describe the water, carbon and nitrogen cycles.
- Assess the consequences of uncontrolled human activities on ecosystems.
- Describe the process of cell division and its importance in living organisms.
- Compare forms of heterotrophic nutrition and explain the process of digestion in humans.
- Relate the structure of circulatory system to their functions.
- Compare energy yield in aerobic and anaerobic respiration.
- Explain homeostatic mechanisms and the role of skin in temperature control.
- Relate structures of nervous and endocrine systems to their functions.
- Explain response to light and gravity by plants and understand the importance of tropisms in plants.
- Differentiate between asexual and sexual reproduction, giving advantages and disadvantages of each.
- Explain how sexual reproduction occurs in flowering plants.
- Describe process of sexual reproduction in humans.
- Describe the social factors that affect good health and apply knowledge gained in familiar and unfamiliar contexts.
- Identify potential legal, social and health consequences of sexual decision-making.
- Explain the importance and key elements of living positively with HIV.
- Describe common sexual behaviours and how to make responsible decisions.
- Explain how genes determine structure and function of individuals.

- Explain the role of genetic engineering in industrial production of insulin and genetically modified crops.
- Explain that variation is caused by both genetic and environmental factors and adaptive features shown different organisms.
- Explain natural and artificial selection in relation to evolution of species and breeding.

5.4.2. Biology units table for S3

Topic Area: ECOLOGY AND CONSERVATION			Sub-topic Area: Environmental biology	
S.3 BIOLOGY	Unit 1: Interdependence among organisms in an ecosystem.		No. of lessons: 6	
Key Unit Competence: To be able to classify examples of species interactions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Observe features that allow a predator to kill and feed on its prey. Differentiate between intraspecific and interspecific relationships using examples. Interpret graphs and data for predator- prey relationships in an environment. Illustrate commensalism and amensalism. 	<ul style="list-style-type: none"> Appreciate the interdependence of living organisms in an environment. 	<ul style="list-style-type: none"> Interdependence (intraspecific and interspecific relationships). Parasitism. Predation (hunting animal (prey), animal (predator). Grazing Competition Mutualism Neutralism Commensalism Amensalism, Allelopathy. 	<ul style="list-style-type: none"> Learners investigate using the internet, books and the natural environment different interactions between living organisms according to the mode of interaction. Learners discuss the different interactions observed and report in tabular form. In pairs, learners interpret data about numbers of predators and prey in the same environment. Watch video on wildlife to assess effects of predation, competition and grazing.
Links to other subjects: <i>Harmfulness of parasites in agriculture.</i>				
Assessment criteria: <i>Learners can clearly explain the various interactions of organisms in nature and state their significance.</i>				
Materials: <i>Photographs, wild life videos, ICT materials, illustrations.</i>				

Topic Area: ECOLOGY AND CONSERVATION			Sub-topic Area: Environmental biology	
S.3 BIOLOGY	Unit 2: Population size.		No. of lessons: 8	
Key Unit Competence: To be able to analyse and interpret population curves.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define population. State the factors affecting the rate of population growth of an organism (limited to food supply, predation and disease, and describe their importance). Identify phases in the sigmoid population growth curve. Explain the factors that lead to the lag phase, exponential (log) phase and stationary phase in the sigmoid curve of population growth making reference to the role of limiting factors. Describe the increase in human population size over the past 250 years and its social and environmental implications. 	<ul style="list-style-type: none"> Interpret population growth curves. Sketch population growth curves on basis of size (figures) against time. Interpret graphs and diagrams of the human population growth. 	<ul style="list-style-type: none"> 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). 	<ul style="list-style-type: none"> Population. Environmental factors that limit population size. Population growth curve (carrying capacity, lag and log phase). Human population growth and effects. 	<ul style="list-style-type: none"> Reading textbooks and journals about population growth to get current global population status. Learners culture fruit flies (<i>drosophila</i>) in small bottles to demonstrate population growth pattern. Learners use ICT to draw population curves from given data and discuss the shapes of different curves.
Links to other subjects: <i>Drawing curves in mathematics and IT.</i>				
Assessment criteria: <i>Can clearly analyse and interpret population curves.</i>				
Materials: <i>Audio-visuals, photographs, charts, IT materials to draw growth curve.</i>				

Topic Area: ECOLOGY AND CONSERVATION			Sub-topic Area: Environmental biology	
S.3 BIOLOGY	Unit 3: Nutrient cycles.		No. of lessons: 6	
Key Unit Competence: To be able to describe the water, carbon and nitrogen cycles.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Interpret charts of nitrogen, carbon and water cycles. Justify the use of leguminous plants in crop rotation. 	<ul style="list-style-type: none"> Acknowledge the role of microorganisms in nutrient recycling. Support tree planting programs at home and school. 	<ul style="list-style-type: none"> Water cycle Carbon cycle Nitrogen cycle Phosphorous cycle Deforestation, combustion of fossil fuel, oxygen and carbon dioxide in the atmosphere and acid rain. 	<ul style="list-style-type: none"> Learners research about water cycle and present their findings to the class. Learners discuss carbon and nitrogen nutrient cycles. Observe root nodules from collected leguminous plants and discuss their importance.
Links to other subjects: <i>Water, carbon and nitrogen cycles linked to chemistry and geography.</i>				
Assessment criteria: <i>Students can describe the water, carbon and nitrogen cycles.</i>				
Materials: <i>Illustrations of the nutrient cycles, audio-visuals.</i>				

Topic Area: ECOLOGY AND CONSERVATION

Sub-topic Area: Applied ecology

S.3 BIOLOGY	Unit 4: Effects of human activities on ecosystems 1.	No. of lessons: 8
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Key Unit Competence: To be able to assess the consequences of uncontrolled human activities on ecosystems.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • State how modern technology has resulted in increased food production. • Describe the negative impacts to an ecosystem of large-scale monocultures of crop plants and intensive livestock production. • Describe the reasons for habitat destruction, limited to agriculture, housing and extraction of natural resources. • State that through altering food webs and food chains, humans can have a negative 	<ul style="list-style-type: none"> • Assess the disadvantages of environmental degradation. • Demonstrate ways of reducing pollution and protecting the environment. • Assess the effectiveness of management of parks and forests. • Demonstrate recycling products from papers, plastics, steel and solid waste. 	<ul style="list-style-type: none"> • Appreciate measures taken by the Rwandan government to protect the environment. • Appreciate the balance between society, environment and economy. • Recognise that extinction is a natural part of the evolution of life on earth, but has taken place at an unprecedented rate mainly as a result of human activities. • Support the Rwandan government policy of protecting the 	<ul style="list-style-type: none"> • Food supply (chemical fertilisers, insecticides, herbicides and selective breeding). • Negative impacts to an ecosystem of large scale monocultures of crop plants and intensive livestock production. • Habitat destruction (increased area for food crop growth, livestock production, housing, extraction of natural resources, road construction). 	<ul style="list-style-type: none"> • Discuss the social, environmental and economic implications of providing sufficient food for an increasing human global population. • In pairs, learners analyse photographs related to environmental degradation and discuss consequences and protective measures. • Field study field trip to protected areas such as national parks and forests to find out and, report back any effects of human activity and how these are mitigated. • Discuss the causes and effects on the environment of acid rain and measures

<p>impact on habitats.</p> <ul style="list-style-type: none"> • Explain the undesirable effects of deforestation on the environment. • State the sources and effects of pollution of land and water (rivers, lakes and the sea) by insecticides, herbicides and by nuclear fall-out. • State the sources and effects of pollution of the air by methane and carbon dioxide, limited to the enhanced greenhouse effect and climate change. 		<p>environment.</p> <ul style="list-style-type: none"> • Respect norms set for the natural environment. 	<ul style="list-style-type: none"> • Pollution (chemical waste, sewage, fertilisers, Greenhouse effect, climate change, pesticides, insecticides, herbicide and nuclear fallout. 	<p>to reduce its incidence.</p> <ul style="list-style-type: none"> • Discuss the problems which contribute to famine including unequal distribution of food, drought and flooding, increasing population and poverty. • Learners design a project for recycling paper and plastic bottles.
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Links to other subjects: *Acidic gases in chemistry, agriculture.*

Assessment criteria: *Students can clearly assess the consequences of uncontrolled human activities on ecosystems.*

Materials: *Audio-visuals, photographs and computer aided learning materials.*

Topic Area: ECOLOGY AND CONSERVATION			Sub-topic Area: Applied ecology	
S.3 BIOLOGY	Unit 5: Effects of human activities on ecosystems 2: conservation and sustainability		No. of lessons: 8	
Key Unit Competence: To be able to assess the outcomes of conservation measures.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • Define the terms sustainable resource, sustainable development. • Explain the need to conserve non-renewable resources, limited to fossil fuels. • State that some resources can be maintained, limited to forests and fish stocks. • State that products can be reused or recycled, limited to paper, glass, plastic and metal. • Outline how sewage is treated to make the water that it contains safe to return to the environment or for human use. 	<ul style="list-style-type: none"> • Organise clubs aiming at environmental education and wildlife protection. • Conduct shows and drama on wildlife conservation. • Make research on the endangered species in Africa as a result of human activities. • Design a project for recycling products from papers, plastics and steel solid 	<ul style="list-style-type: none"> • Appreciate measures taken by the Rwandan government to protect the environment. • Appreciate the balance between society, environment and economy. • Recognise that extinction is a natural part of the evolution of life on Earth, but has taken place at an unprecedented rate mainly as a result of human activities. • Support the Rwandan government policy of protecting the 	<ul style="list-style-type: none"> • Sustainable resource and sustainable development (social, economic and ecological) non-renewable resources (limited to fossil fuels). • Reuse or recycling (paper, glass, plastic and metal). Sewage treatment. • Reason for extinction and introduction of species. • Conservation of endangered species, limited to monitoring and protecting species and habitats, education, captive breeding programmes and seed banks. • Requirements of 	<ul style="list-style-type: none"> • In groups, design a poster for a wildlife club showing how it will be organised. • Conduct shows and drama on wildlife conservation to show human effects on protected and unprotected areas, • Research on the endangered species in Africa as a result of human activities. • Make research on the endangered species in Africa as a result of human activities. • Design a project for recycling papers, plastics and steel solid waste • Carry out a field study to

<ul style="list-style-type: none"> • Explain why organisms become endangered or extinct. • Describe how endangered species can be conserved. • Explain how forests and fish stocks can be sustained using education, legal quotas and re-stocking. • Explain the requirements of sustainable development. • Explain reasons for conservation programmes. 	<p>waste.</p> <ul style="list-style-type: none"> • Compare human effects on protected and unprotected areas. 	<p>environment.</p> <ul style="list-style-type: none"> • Respect norms set for the natural environment. 	<p>sustainable development limited to management of conflicting demands, planning and co-operation at local, national and international levels.</p> <ul style="list-style-type: none"> • Benefits of conservation programmes (reducing extinction, protecting vulnerable environments, maintaining ecosystem functions). 	<p>compare human effects on protected and unprotected areas and report back.</p>
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Links to other subjects: *Field study trips to protected areas are linked to tourism in geography.*

Assessment criteria: *Students can clearly assess the outcomes of conservation measures.*

Materials: *Audio-visuals, photographs and computer aided learning materials.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Cell division	
S.3 BIOLOGY	Unit 6: Mitosis and meiosis.		No. of lessons: 8	
Key Unit Competence: To be able to explain the different processes of cell division and their implications for living organisms.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Recall DNA, chromosome and cytokinesis. Explain the role of mitosis, meiosis and duplication of chromosomes. Outline the stages of mitosis and arrangement of chromosomes. State that meiosis is involved in gamete formation in sex organs. State the differences between mitosis and meiosis. State significance of meiosis division. 	<ul style="list-style-type: none"> Observe from charts and identify the diploid and haploid states of cells. Research about the disadvantages of producing large numbers of similar organisms by mitosis. Compare mitosis and meiosis. 	<ul style="list-style-type: none"> Appreciate the importance of mitosis in the production of large numbers of off spring by vegetative propagation. Be aware that the process of regrowth of body parts in organisms such as reptiles and healing of wounds involves mitosis. 	<ul style="list-style-type: none"> Chromosomes. Haploid and diploid conditions of the cell. Cell division. Mitosis. Stages of mitosis and cytokinesis (details of stages not required). Implication of mitosis in growth, repair of damaged tissues, replacement of worn out cells and in asexual reproduction in plant propagation. Meiosis. Stages of meiosis (details of stages not required). Implication of meiosis in gamete formation and genetic variation. 	<ul style="list-style-type: none"> Observe the features shown on charts, computer simulations or animations and micrographs of mitosis (using onion root tip) and meiosis. In groups, students discuss the differences between meiosis and mitosis and make presentations. Learners carry out project work about the disadvantages of producing large number of similar organisms by mitosis and present to the class.

Links to other subjects: *Vegetative propagation in agriculture.*

Assessment criteria: *Students can accurately describe the differences between mitosis and meiosis and their implications for living organisms.*

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 blade, 1M HCl, Pasteur pipette, dissection tray with a wooden back, water bath, distilled water, microscope, microscope slide, cover slip and meiosis.*

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Nutrition	
S.3 BIOLOGY	Unit 7: Heterotrophic nutrition.		No. of lessons: 12	
Key Unit Competence: To be able to compare forms of heterotrophic nutrition and explain the process of digestion in humans.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify the different forms of heterotrophic nutrition. Describe the proper care of teeth in terms of diet and regular brushing. Identify the types and functions of human teeth. State the causes and preventive measures of dental decay. Describe the process of digestion in various parts of the alimentary canal. Define ingestion, mechanical digestion, egestion and food molecules. Explain absorption and assimilation. Explain how food not digested or absorbed, become faeces. State that constipation and 	<ul style="list-style-type: none"> Research the difference in alimentary canal of a human and cattle based on the type of food they eat. Demonstrate the stages in preparing oral rehydration therapy. Suggest the healthy practices for the proper care of teeth. 	<ul style="list-style-type: none"> Appreciate the forms of feeding shown by different organisms. Developing regular brushing of teeth. Show concern for immediate attention of contaminated foods. 	<ul style="list-style-type: none"> Forms of heterotrophic nutrition. Structure and functions of human teeth. Care of teeth. Alimentary canal. Stages of digestion (ingestion, mechanical and chemical ingestion). The structure and function of a villus. Absorption and assimilation Egestion. Digestive disorders and good health practices. 	<ul style="list-style-type: none"> In pairs, investigate the mechanism of feeding by bread mould and make a group presentation. In pairs, devise an experiment to investigate the effect of Hydrochloric acid and lemon juice and fizzy drinks on egg shells (to model the enamel of the teeth). Carry out an experiment showing the action of enzyme amylase on the starch. Solve a problem of matching the parts of the alimentary canal on a chart with the list of roles they play. Research on digestive disorders and suggest the healthy practices for the

diarrhoea arise as digestive disorders.				digestive system.
Links to other subjects: <i>Acid based reactions in chemistry.</i>				
Assessment criteria: <i>Students can compare forms of heterotrophic nutrition and explain the process of digestion in humans.</i>				
Materials: <i>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).</i>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Transport in animals	
S.3 BIOLOGY	Unit 8: Circulatory system in humans.		No. of lessons: 12	
Key Unit Competence: To be able to relate the structure of the circulatory system to its functions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood. Describe the single circulation of a fish and the double circulation of a mammal. Explain the advantages of double circulation. Identify the structures of the mammalian heart. Explain how blood is pumped away from the heart and returns through the veins. State that the activity of the heart may be monitored by ECG, pulse rate, and listening to sounds of valves closing. 	<ul style="list-style-type: none"> Apply knowledge of pressure differences to explain how valves open and close during blood flow. Compare relative thickness of the muscle walls of the four chambers of the heart. Demonstrate the effect of physical activity on the pulse rate. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Types of circulation. Human circulatory system. Structure and functioning of the human heart. Effect of physical activity on heart rate. Roles of diet and exercise in the prevention of coronary heart disease. Blood and lymphatic vessels. Lymphatic system and its functions. Components of blood. Blood transfusion and safe handling of blood. Blood clotting. Role of capillaries in transfer of materials between capillaries and tissue fluid (details of the roles of water potential and 	<ul style="list-style-type: none"> Using charts, illustrations and computer animations outline, in sequence, the phases of human heart beat and types of circulation and trace the path taken by red blood cell in a complete circuit. In pairs, investigate the effect of physical activity on the pulse rate using a sphygmomanometer to measure changes in blood pressure before and after physical activity. Observe red and white blood cells in blood smear, as seen

<ul style="list-style-type: none"> • Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors. • Explain how the structures of arteries, veins and capillaries are adapted for their functions. List and state the functions of the components of blood. • Describe the transfer of materials between capillaries and tissue fluid. • State the roles of blood clotting as preventing blood loss and preventing the entry of pathogens. • Outline the components of the lymphatic system. • Explain the functions of the lymphatic system. • State precautions taken in carrying out blood transfusion. 	<ul style="list-style-type: none"> • Compare the components of blood smears as seen under the light microscope, micrographs and charts. • Relate structure of blood vessels to their functions. 		<p>hydrostatic pressure are not required).</p>	<p>under the light microscope, diagrams and photomicrograph.</p> <ul style="list-style-type: none"> • In groups, discuss the possible risk factors associated with heart and circulatory diseases. • Students plan out a personal fitness program that will help them have a healthy heart and present it to the class. • In groups, investigate the mechanism of blood clotting using simulations and other visual materials.
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Links to other subjects:

Assessment criteria: Students can describe the structures and components of the human circulatory system and explain their roles in the body.

Materials: 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.

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Energy and respiration	
S.3 BIOLOGY	Unit 9: Cellular respiration.		No. of lessons: 8	
Key Unit Competence: To be able to compare energy yield in aerobic and anaerobic respiration.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> • 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. • Write simple chemical equations for aerobic and anaerobic reaction using glucose as substrate. • Describe the effect of lactic acid in muscles during exercise. • Describe the role of anaerobic respiration in yeast during brewing and baking. 	<ul style="list-style-type: none"> • Design simple experiments on respiration. • Carry out controlled experiments. • Compare aerobic and anaerobic respiration. • Draw and interpret graphs of accumulation of lactic acid. 	<ul style="list-style-type: none"> • Recognise that the accumulation of lactic acid in active muscles during vigorous exercises leads to itching and nausea. • Appreciate the need and benefit of physical exercises. 	<ul style="list-style-type: none"> • Role of ATP in metabolism. • Aerobic respiration. • Anaerobic respiration. • Oxygen debt. 	<ul style="list-style-type: none"> • In groups, learners discuss the relationship between body activity and amount and type of food eaten in different people. • Investigate heat production by germinating seeds. • Learners design and carry out simple experiments to show that organisms require oxygen for respiration. • Learners carry out alcoholic fermentation of banana juice/sugar. • Learners discuss the role of yeast in baking and brewing. • Learners watch a video and compare the post-race ventilation behaviours of sprinters and marathon runners to show how oxygen debt is paid off.

Links to other subjects: <i>Alcoholic fermentation and test for CO₂ in chemistry.</i>				
Assessment criteria: <i>Learners can differentiate between aerobic and anaerobic respiration and the yield of energy from each method.</i>				
Materials: <i>Sugar, ripe bananas, yeast, conical flasks, viable seeds, vacuum flasks, thermometers, cotton wool, stands and clamps.</i>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE			Sub-topic Area: Homeostasis	
S.3 BIOLOGY	Unit 10: Skin and homeostatic mechanisms.		No. of lessons: 10	
Key Unit Competence: To be able to explain homeostatic mechanisms and the role of skin in temperature control.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> 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. 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, 	<ul style="list-style-type: none"> Draw and label parts of the human skin. Interpret graphs for glucose tolerance in a person with normal glucose metabolism and a diabetic. 	<ul style="list-style-type: none"> Appreciate the importance of maintaining a constant internal environment. Develop good nutrition habits that reduce the risk of diabetes. 	<ul style="list-style-type: none"> The skin and temperature control. Controlling the internal environment. Negative feedback. Control of blood glucose level. 	<ul style="list-style-type: none"> Research from the library or internet to define and homeostasis and give examples and present their findings in class. Learners comment on how a model shows the mechanism of negative feedback. Using a glucometer, learners record the blood glucose level (glycaemia) of a volunteer before, and after taking glucose solution and thereafter at one hour intervals and then discuss their findings. Discuss in groups the mechanism by which blood glucose is controlled. Learners observe a diagram or a model of the skin to name its parts. Learners discuss in groups the difference and shivers in cold

<p>vasodilatation and vasoconstriction of arterioles supplying skin surface capillaries and the coordinating role of the brain.</p>				<p>period. Learners then observe the structures of the mammalian skin during cold and another in hot condition and discuss any differences.</p> <ul style="list-style-type: none"> • In pairs, students investigate how some lizards control their body temperature under different conditions.
<p>Links to other subjects:</p>				
<p>Assessment criteria: <i>Students can explain homeostatic mechanisms and the role of skin in temperature control.</i></p>				
<p>Materials: <i>Electric oven/electric iron, charts, model of the skin, computer aided learning materials.</i></p>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE Sub-topic Area: Response and Coordination in Organisms

S.3 BIOLOGY

Unit 11: Response and co-ordination in plants.

No. of lessons: 8

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

Knowledge and understanding	Skills	Attitudes and values	Content	Learning Activities
<ul style="list-style-type: none"> • 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. • 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 	<ul style="list-style-type: none"> • 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. • 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. 	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Role of auxin in controlling shoot growth, limited to: auxin made in shoot tip. • Use of auxins as weed killers e.g. the synthetic plant hormone 2,4-D. • Other forms of responses shown by plants that relate to pollination, insectivorous plants in plant life cycles. 	<ul style="list-style-type: none"> • Investigate gravitropism and phototropism. • Interpret a graph of the effect of auxin concentration on plant and shoot growth. • Research about other forms of plant responses and their importance to plants. • Make research on the role of auxin in controlling shoot growth.

stimulating cell elongation. • Identify other forms of plant responses.				
Links to other subjects:				
<i>Assessment criteria: Students can correctly explain response to light and gravity by plants and the importance of tropisms in plants.</i>				
<i>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.</i>				

Topic Area: ORGANISATION AND MAINTENANCE OF LIFE

Sub-topic Area: Response and coordination in organisms

S.3 BIOLOGY

Unit 12: Response and coordination in animals.

No. of lessons: 16

Key Unit Competence: To be able to relate structures of nervous and endocrine systems to their functions.

Learning Objectives

Knowledge and understanding	Skills	Attitudes and values	Content	Learning Activities
<ul style="list-style-type: none"> • State the components of coordinated behaviour in an organism. • Identify the components of the human nervous system. • Define a nerve impulse as an electrical signal that passes along nerve cells called neurones. • Identify motor (effector), relay (connector) and sensory neurones from diagrams. • Define a synapse as a junction between two neurons. • State that in a reflex arc the synapses ensure that impulses travel in one direction only. • Describe a simple reflex arc in terms of receptor, sensory neurone, relay neurone, motor neurones and effector. 	<ul style="list-style-type: none"> • Analyse the structures of different neurones. • Carry out an investigation to determine the time to react to a stimulus. • Demonstrate the role of antagonistic muscles as effectors in rapid responses. • Distinguish between rods and cones in terms of function and distribution. 	<ul style="list-style-type: none"> • Appreciate the importance of a 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. 	<ul style="list-style-type: none"> • The need for coordination and response in animals. • Nervous control in humans. • Neurons. • Reflex arcs and reflex actions. • Sense organs. • Hormonal control. • Application of hormones in food production. 	<ul style="list-style-type: none"> • Investigate the time to react to a stimulus. • Individually match parts of the eye in one list and their correct functions on another list. • In pairs, observe and interpret the pupil reflex. • Investigate the location of the rods in the retina of the eye by individually tracing objects at night. • Map out the regions of the tongue concerns with sweet, sour, salt and bitter). • Carry out the experiments on frequency range and source of sound and hearing.

<ul style="list-style-type: none"> • Explain how reflex actions are important to the body. • Explain the difference between voluntary and involuntary actions. • Recall the five human senses. • Define a sense organ as groups of cells responding to a particular stimulus. • Outline the structure and function of the five mammalian sensations and their respective sense organs. • Explain the importance of hormonal communication. • Define the term hormone. • Identify the location of the endocrine glands and state the functions of their secretions in the human body. 	<ul style="list-style-type: none"> • Compare endocrine and nervous systems. • Compare endocrine and exocrine glands. • Design a model showing a reflex arc. • Locate human endocrine glands on a provided diagram. 			<ul style="list-style-type: none"> • Research about the use of hormones in food production. • In groups, discuss the use of BST to increase milk production pointing out its advantages and its possible disadvantages.
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Links to other subjects: *Optics and sound in physics.*

Assessment criteria: *Learners can describe the components of the human nervous and endocrine systems and explain their roles to the body.*

Materials: *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.*

Topic Area: REPRODUCTION		Sub-topic Area: Reproduction in plants		
S.3 BIOLOGY	Unit 13: Asexual and sexual reproduction.		No. of lessons: 8	
Key Unit Competence: To be able to differentiate between asexual and sexual reproduction, giving advantages and disadvantages of each.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define asexual reproduction as a process resulting in the production of genetically identical offspring from one parent. Define sexual reproduction as a process involving the fusion of the nuclei of two gametes (sex cells) to form a zygote and the production of offspring that are genetically different from each other. Define fertilisation as the fusion of gamete nuclei. State that the nuclei of gametes are haploid and that the nucleus of a zygote is diploid. Discuss the advantages and disadvantages of sexual reproduction to a population of a species in the wild and to crop production. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Appreciate the importance of asexual reproduction in crop plants such as potatoes and cassava. 	<ul style="list-style-type: none"> Asexual reproduction: binary fission, budding, spore formation, stem tubers stem cuttings rhizomes. Advantages and disadvantages of asexual reproduction in plants. Sexual reproduction: Fertilisation: advantages and disadvantages. 	<ul style="list-style-type: none"> Learners observe different forms of asexual reproduction and use to arrive at definition of asexual reproduction. In groups, learners compare with sexual reproduction. Learners use internet or library resources to research about advantages and disadvantages of asexual reproduction and present their findings in class. Learners use computer simulations or illustration to discover what fertilisation is, and that a zygote is diploid.
Links to other subjects: <i>Artificial propagation of crop plants is linked to crop production in agriculture.</i>				
Assessment criteria: <i>Learners can differentiate between asexual and sexual reproduction, giving advantages and disadvantages of each.</i>				

Materials: *Illustrations and computer aided materials, perenating organs such as rhizomes, stem tubers, corms and Bryophyllum leaf.*

Topic Area: REPRODUCTION		Sub-topic Area: Reproduction in plants		
S.3 BIOLOGY	Unit 14: Sexual reproduction in flowering plants.		No. of lessons: 10	
Key Unit Competence: To be able to explain how sexual reproduction occurs in flowering plants.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, filaments and anthers, carpals, 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. Define pollination, self-pollination and cross-pollination. Explain the implications to a species of self-pollination and cross-pollination in terms of variation, capacity to respond to changes in the environment and reliance on pollinators. State that fertilisation occurs when a pollen nucleus fuses with 	<ul style="list-style-type: none"> Analyse the structural adaptations of insect-pollinated and wind-pollinated flowers. Compare insect pollinated and wind pollinated flowers. 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 	<ul style="list-style-type: none"> Appreciate the dependence of flowering plants on insects and wind for pollination. 	<ul style="list-style-type: none"> Structure of a flower. Pollination. Fertilisation and seed formation. Fruits, seeds and seed germination. 	<ul style="list-style-type: none"> Learners dissect a flower such as Hibiscus or bean, to identify floral and reproductive structures, draw and state functions of the different parts. Use a hand lens to identify and describe structure and arrangement of the anthers and stigmas of a wind-and insect pollinated flower. In groups, learners collect different fruits and discuss how the fruits and seeds are dispersed. Learners discuss the implications to a species of self-pollination and cross-pollination in terms of variation, capacity to respond to changes in the environment and reliance on pollinators Learners design and carry out

<p>a nucleus in an ovule.</p> <ul style="list-style-type: none"> • 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. 	<p>dispersed.</p> <ul style="list-style-type: none"> • Distinguish between the pollen grains of insect-pollinated and wind-pollinated flowers. 			<p>experiments to investigate factors that affect germination of seeds.</p> <ul style="list-style-type: none"> • Learners carry out research on fruit and seed dispersal and present to class.
<p>Links to other subjects: <i>Fruits, seeds in agriculture.</i></p>				
<p>Assessment criteria: <i>Can describe how sexual reproduction occurs in flowering plants.</i></p>				
<p>Materials: <i>Flowers, hand lenses, illustrations, fruits and seeds, computer aided materials and suitable containers for germination investigations.</i></p>				

Topic Area: REPRODUCTION		Sub-topic Area: Reproduction in animals		
S.3 BIOLOGY	Unit 15: Reproduction in humans.		No. of lessons: 12	
Key Unit Competence: To be able to describe the process of sexual reproduction in humans.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify and name on diagrams 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. State the adaptive features of sperm, limited to flagellum and the presence of enzymes. State the adaptive features of egg cells, limited to energy stores and a jelly coating that changes after fertilisation. Define fertilisation as the fusion of the nuclei from a male gamete (sperm) and a female gamete (egg cell/ovum). 	<ul style="list-style-type: none"> Describe the ante-natal care of pregnant women, limited to special dietary needs and the harm from smoking and alcohol consumption. Interpret charts for the hormonal control of the menstrual cycle. 	<ul style="list-style-type: none"> Advocate for good ante-natal care of pregnant women. 	<ul style="list-style-type: none"> The male and female reproductive system. The menstrual cycle. Sex hormones. Fertilisation and implantation. Pregnancy, ante-natal care and birth. 	<ul style="list-style-type: none"> Learners observe and identify internal structures of the human reproductive system from charts and animations. Learners sequence the stages in the development of the pregnancy using charts. Learners discuss the ante-natal care of pregnant woman in relation to dietary needs and the harm from smoking and alcohol consumption. Using a chart diagram of the menstrual cycle, discuss the interaction of hormones that control the menstrual cycle in females.

<ul style="list-style-type: none"> • 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. 				
Links to other subjects:				
<i>Assessment criteria: Learners can describe the process of sexual reproduction in humans.</i>				
<i>Materials: Computer animations; charts for reproductive parts, menstrual cycles and fertilisation and pregnancy; photomicrographs; semen with sperm and egg.</i>				

Topic Area: HEALTH AND DISEASE

Sub-topic Area: Infectious and non-infectious diseases

S.3 BIOLOGY

Unit 16: Social factors that affect good health.

No. of lessons: 6

Key Unit Competence: To be able to describe the social factors that affect good health and apply knowledge gained in familiar and unfamiliar contexts.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Describe factors that affect good health limited to: good housing, food inspection, clean water and hygiene. Define a drug as any substance taken into the body that modifies or affects chemical reactions in the body. Describe the use of antibiotics for the treatment of bacterial infection. State that some bacteria are resistant to an antibiotic which reduces the effectiveness of antibiotics. State that antibiotic kills bacteria, but do not affect viruses. Explain how development of resistant bacteria such as MRSA can be minimised, limited to using antibiotics only when 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Appreciate the organisation and functioning of public health services. Campaign against drug and substance abuse. 	<ul style="list-style-type: none"> Good housing, food inspection clean water and hygiene. Public health services, their organisation and functioning. Drugs: antibiotics, alcohol and marijuana. 	<ul style="list-style-type: none"> Learners research from the internet or library about factors that affect good health, with reference to good housing, food inspection, clean water and hygiene and present their findings to the class. An invited nurse or doctor gives a talk to the class about antibiotics. Learners take notes during the presentation and later summarise what they have learned about antibiotics. Learners research about common drugs (alcohol, marijuana and tobacco), limiting their research to definition of drug, effects

<p>essential and ensuring treatment is completed.</p> <ul style="list-style-type: none"> • Describe the effects of excessive alcohol and marijuana consumption. • State that the liver is the site of breakdown of alcohol and other toxins. • State that excessive alcohol consumption can cause liver damage. • State that tobacco smoking can cause chronic obstructive pulmonary disease (COPD), lung cancer and coronary heart disease. 				<p>on the body and ways of avoiding abuse.</p>
<p>Links to other subjects:</p>				
<p><i>Assessment criteria: Learners can describe the factors that affect good health in familiar and unfamiliar circumstances.</i></p>				
<p><i>Materials: Charts/illustrations and computer aided materials.</i></p>				

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.3 BIOLOGY	Unit 17: Decision-making regarding sexual relationships.		No. of lessons: 8	
Key Unit Competence: To be able to identify potential legal, social and health consequences of sexual decision-making.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify a range of risk reduction strategies for effectiveness and personal preference. State that some risk reduction strategies offer dual protection against both unplanned pregnancy and STIs, including HIV. Explain that the decisions about the most appropriate risk reduction strategies to adopt are often influenced by one's self-efficacy, perceived vulnerability, gender roles, culture and peer norms. 	<ul style="list-style-type: none"> Analyse factors that affect sexual decision making. Demonstrate communication and decision-making skills in relation to safer sex. 	<ul style="list-style-type: none"> 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 practice safer sex, including the correct and consistent use of condoms and contraceptives. 	<ul style="list-style-type: none"> Factors hindering practice of safer sex. Strategies for dual protection against both unplanned pregnancy and STIs, including HIV 	<ul style="list-style-type: none"> Discuss examples of difficult situations relating to sexual relationships. Suggest concrete strategies for how to reduce risk of STIs and HIV related to the various difficult situations. Make word webs with factors that affect decision making. Role plays focusing on effective communication in difficult situations.
Links to other subjects:				
Assessment criteria: Learners can identify potential legal, social and health consequences of sexual decision-making.				
Materials: Illustrations and computer aided materials.				

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.3 BIOLOGY	Unit 18: HIV and AIDS, stigma, treatment, care and support.		No. of lessons: 4	
Key Unit Competence: To be able to explain the importance and key elements of living positively with HIV.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> State rights of People living with HIV (PLHIV). Explain that PLHIV can live longer if they adopt a healthy life style. Explain the importance and key elements of living positively with HIV. 	<ul style="list-style-type: none"> Conduct research to identify human rights of People Living With HIV (PLHIV). Organise drama and clubs aiming at supporting people living with HIV. 	<ul style="list-style-type: none"> Recognize the importance of, and their own responsibility in, non – discrimination against PLHIV (People living with HIV). Everyone has a right to confidentiality about their health status, and should not be required to disclose their HIV status. 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. 	<ul style="list-style-type: none"> Right to confidentiality about personal health status, including HIV status. Sexuality education and programs promoting positive living of people with HIV. Support groups and mechanisms for people living with HIV. Non discrimination against people on the basis of their HIV status. 	<ul style="list-style-type: none"> Students conduct research to identify human rights related to living with HIV, and explore laws, social, and health policies that relate to living with HIV in Rwanda. Students choose an issue/dilemma related to living with HIV and how they think this issue can be addressed and write a short story or play about it. Students discuss 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.
Links to other subjects:				
<i>Assessment criteria: Learners can examine key elements of living with HIV and appreciate that people living with HIV can lead an active and normal life.</i>				

Materials: *Journals, access to government leaflets and other materials, newspaper articles, access to the internet.*

Topic Area: HEALTH AND DISEASE			Sub-topic Area: Reproductive health	
S.3 BIOLOGY	Unit 19: Sexual behaviour and sexual response.		No. of lessons: 4	
Key Unit Competence: To be able to describe common sexual behaviours and how to make responsible decisions.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Identify common sexual behaviours. Describe abstinence as choosing not to engage in sexual behaviours with others, and is the safest way to avoid pregnancy and STIs, including HIV. State that condom and other contraceptives enable people to engage in sexual behaviours that reduce the risk of unintended consequences. Explain transactional sexual activity as the exchange of money, goods or protection for sexual favours. 	<ul style="list-style-type: none"> Demonstrate effective communication of personal needs and sexual limits. Organise a dialogue for communication exercises in pairs for negotiation skills for safer sex. 	<ul style="list-style-type: none"> Recognize 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 practice safer sex. 	<ul style="list-style-type: none"> Abstinence Condoms and other contraceptives. Responsibility of both sexual partners in preventing unintended pregnancies and HIV. Non-penetrative sexual behaviours. Transactional sexual activity. Communication skills in consensual and safer sex. 	<ul style="list-style-type: none"> 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.

Links to other subjects:

Assessment criteria: *Learners can apply knowledge about consequences of sexual behaviour to make responsible decisions.*

Materials: *Illustrations and computer aided materials.*

Topic Area: GENETICS AND ITS APPLICATION			Sub-topic Area: Genetics	
S.3 BIOLOGY	Unit 20: Genetics.		No. of lessons: 10	
Key Unit Competence: To be able to explain how genes determine structure and function of individuals.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define inheritance as the transmission of genetic information from generation to generation. Define key genetic terms limited to the content. Describe the inheritance of sex in humans' with reference to XX and XY chromosomes. State that two identical homozygous individuals that breed together will be pure-breeding. State that a heterozygous individual will not be pure-breeding. Explain co-dominance by reference to the inheritance of ABO blood groups – phenotypes being A, B, AB and O blood groups and alleles being I^A, I^B and I^O. Describe colour blindness as an 	<ul style="list-style-type: none"> Interpret pedigree diagrams for the inheritance of a given characteristic. Use Punnett 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. 	<ul style="list-style-type: none"> Defend that inheritance of sex in humans is determined by males with reference to XX and XY chromosomes. 	<ul style="list-style-type: none"> Inheritance. Key genetic terms: chromosome, gene, allele, genotype, phenotype, homozygous, heterozygous, dominant and recessive alleles. Monohybrid inheritance. Co-dominance. Inheritance of sex in humans. Sex linkage limited to haemophilia and colour blindness. 	<ul style="list-style-type: none"> 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 co-dominance or sex linkage and calculate phenotypic ratios. Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypic

example of sex linkage.				ratios, limited to 1:1 and 3:1 ratios.
Links to other subjects: <i>Ratios and probability in mathematics.</i>				
Assessment criteria: <i>Clearly to explain how genes determine structure and function of individuals.</i>				
Materials: <i>Online resources, CDs, simulations, diagrams, charts.</i>				

Topic Area: GENETICS AND ITS APPLICATION			Sub-topic Area: Gene technology	
S.3 BIOLOGY	Unit 21: Gene therapy.		No. of lessons: 8	
Key Unit Competence: To be able to explain the role of genetic engineering in industrial production of insulin and genetically modified crops.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define genetic engineering as changing the genetic material of an organism by removing, changing or inserting individual genes. Explain the industrial production of insulin. State other examples of genetic engineering limited to: insertion of genes into crop plants to confer resistance to herbicides, confer resistance to insect pests, and to provide additional vitamins (details not required). Explain the advantages and disadvantages 	<ul style="list-style-type: none"> Make research on plants that require fewer fertilisers, resist drought, disease and pest. Compare the advantages of the natural crops and genetically modified crops. 	<ul style="list-style-type: none"> Appreciate that modified crops increase world's food production to the increasing human population. Appreciate that animal insulin is available and safe for use to people with diabetes mellitus. 	<ul style="list-style-type: none"> Genetic engineering. Industrial production of insulin. Other examples of genetic engineering. Advantages and disadvantages of genetically modified crops, such as soya, maize and rice. 	<ul style="list-style-type: none"> Students write a paragraph in which they suggest that plants could be genetically altered to improve world's food supply. In their paragraph, learner 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

of genetically modifying crops				the advantages and disadvantages of genetically modified crops such as soy, maize and rice.
Links to other subjects: <i>Improvement of crop varieties and animal breeds in agriculture.</i>				
Assessment criteria: <i>Learners can explain the role of genetic engineering in industrial production of insulin and genetically modified crops.</i>				
Materials: <i>Online resources, CDs, simulations, diagrams, charts, micrographs.</i>				

Topic Area: SELECTION AND EVOLUTION			Sub-topic Area: Variation	
S.3 BIOLOGY	Unit 22: Variation and adaptive features.		No. of lessons: 6	
Key Unit Competence: To be able to explain that variation is caused by both genetic and environmental factors and adaptive features shown different organisms.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> Define variation as differences between individuals of the same species. Distinguish between phenotypic variation and genetic variation. 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 ionising radiation 	<ul style="list-style-type: none"> 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. Interpret images or other information about a species to describe its adaptive features 	<ul style="list-style-type: none"> Appreciate variation in human beings, e.g. tongue rolling and height. 	<ul style="list-style-type: none"> Variation. Types of variation, phenotypic and genotypic variation. Continuous and discontinuous variation. Mutations; adaptive features. 	<ul style="list-style-type: none"> 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.

<p>and some chemicals increase the rate of mutation.</p> <ul style="list-style-type: none"> • Explain the adaptive features of hydrophytes and xerophytes to their environments. 				
<p>Links to other subjects:</p>				
<p>Assessment criteria: <i>Students can explain that variation is caused by both genetic and environmental factors and adaptive features shown by different organisms.</i></p>				
<p>Materials: <i>Collected specimens of plants, charts, illustrations, computer animations.</i></p>				

Topic Area: SELECTION AND EVOLUTION			Sub-topic Area: Selection	
S.3 BIOLOGY	Unit 23: Natural and artificial selection.		No. of lessons: 4	
Key Unit Competence: To be able to explain natural and artificial selection in relation to evolution and breeding.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Appreciate the role of artificial selection in producing varieties of breeds with increased economic importance. 	<ul style="list-style-type: none"> Selection: natural selection and selective breeding. 	<ul style="list-style-type: none"> 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

Links to other subjects: *Breeding in animal husbandry in agriculture.*

Assessment criteria: *Can explain natural and artificial selection in relation to evolution and breeding.*

Materials: *Online resources, CDs, simulations.*

6. REFERENCES

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7. APPENDIX

7.1 List of laboratory materials and equipment

The list below details the materials and apparatus expected to be generally available for both teaching and for examination. The list is not exhaustive. Confidential instructions, provided to centres prior to the examination, will give the detailed requirements for the examination.

- Bunsen burners and gas bottles
- tripods
- hot water baths
- rulers capable of measuring to 1 mm
- mounted needles or seekers or long pins with large heads
- means of cutting biological materials such as scalpels, solid edged razor blades or knives
- scissors
- forceps
- means of writing on glassware
- beakers, 100 cm³, 250 cm³
- test tubes, 125 mm × 15 mm and 150 mm × 25 mm, including some hard glass test tubes and a means of holding them (e.g. rack)
- means of measuring small and larger volumes of liquids such as syringes and measuring cylinders
- dropping pipette
- white tile
- spotting tile (having small depressions)

- hand lens, × 6 magnification
- a thermometer, -10 °C to +110 °C at 1 °C, graduations
- clock (or wall clock or wrist-watch), to measure to an accuracy of 1's
- funnels
- Petri dishes
- syringes
- glass rods
- chemicals (e.g. for food tests, e.g. limewater; Benedict's reagent)
- indicators (Litmus paper, Universal Indicator paper, hydrogen carbonate indicator)
- prepared bacterial cultures, stains, microscopes, microscope slides, cover slides, electro and photo micrographs, prepared and permanent slides, biological charts, online materials, flash light, spirogyra, flowers, fruits and seeds

Apparatus for field work:

- beating tray (homemade)
- pooter (homemade)
- sweeping net (muslin)
- plankton net and dip net (if aquatic environment is being sampled)
- pitfall trap/jam jar with suitable cover to prevent water entry
- trays for hand sorting
- frame quadrants, open or gridded
- tape measures.

7.2 Subjects and weekly time allocation for ordinary level

Core subjects	Weight (%)	Number of Periods (1 period = 40 min.)		
		S1	S2	S3
1. English	11	5	5	5
2. Kinyarwanda	7	3	3	3
3. Mathematics	13	6	6	6
4. Physics	9	4	4	4
5. Chemistry	9	4	4	4
6. Biology and Health Sciences	9	4	4	4
7. ICT	4	2	2	2
8. History and Citizenship	7	3	3	3
9. Geography and Environment	7	3	3	3
10. Entrepreneurship	4	2	2	2
11. French	4	2	2	2
12. Kiswahili	4	2	2	2
13. Literature in English	2	1	1	1
Sub Total		41 periods	41 periods	41 periods
II. Elective subjects: Schools can choose 1 subject				
Religion and Ethics	4	2	2	2
Music, Dance and Drama	4	2	2	2
Fine arts and Crafts	4	2	2	2

Home Sciences	4	2	2	2
Farming (Agriculture and Animal husbandry)	4	2	2	2
III. Co-curricular activities (Compulsory)				
Physical Education and Sports	2	1	1	1
Library and Clubs	2	1	1	1
Total number of periods per week	100	45	45	45
Total number of contact hours per week		30	30	30
Total number of hours per year (39 weeks)		1170	1170	1170