INTEGRATED SCIENCE

TUTOR'S GUIDE

TTC Year 2

Options: Languages Education **(LE)**

&

Social Studies Education **(SSE)**

FOREWORD

Dear Tutor,

Rwanda Basic Education Board is honored to present tutor's guide for Integrated Science in Languages Education (**LE)** & Social Studies Education **(SSE)** Options, Year Two of TTC which serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of Integrated Science subject. The Rwandan educational philosophy is to ensure that student-teachers achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate their learning process. Many factors influence what they learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of tutor' pedagogical approaches, the assessment strategies and the instructional materials available. We paid special attention to the activities that facilitate the learning process in which student-teachers can develop ideas and make new discoveries during concrete activities carried out individually or with peers. With the help of the tutor student-teachers will gain appropriate skills and be able to apply what they have learnt in real life situations. Hence, they will be able to develop certain values and attitudes allowing them to make a difference not only to their own life but also to the nation.

This is in contrast to traditional learning theories which view learning mainly as a process of acquiring knowledge from the more knowledgeable who is mostly the teacher. In competence-based curriculum, learning is considered as a process of active building and developing of knowledge and understanding, skills and values and attitude by the student-teacher where concepts are mainly introduced by an activity, situation or scenario that helps the student-teacher to construct knowledge, develop skills and acquire positive attitudes and values.

In addition, such active learning engages student-teachers in doing things and thinking about the things they are doing and they are encouraged to bring their own real experiences and knowledge into the learning processes. In view of this, your role is to:

- Plan your lessons and prepare appropriate teaching and learning materials.
- Organize group discussions for student-teachers considering the importance of social constructivism suggesting that learning occurs more effectively when the student-teacher works collaboratively with more

knowledgeable and experienced people.

- Engage student-teachers through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.
- Provide supervised opportunities for student-teachers to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.
- Support and facilitate the learning process by valuing student-teachers' contributions in the class activities.
- Guide student-teachers towards the harmonization of their findings.
- Encourage individual, peer and group evaluation of the work done in the classroom and use appropriate competence-based assessment approaches and methods.

To facilitate you in your teaching activities, the content of this tutor's guide is self-explanatory so that you can easily use it. It is divided in 3 parts:

The part 1: Explains the structure of this tutor's guide and gives you the methodological guidance;

The part 2: Gives the sample lesson plans as reference for your lesson planning process;

The part 3: Provides the teaching guidance for each concept given in the student book.

Even though this tutor's guide contains the Answers to all activities given in the student-teacher's book, you are requested to work through each question and activity before judging student-teacher's findings.

I wish to sincerely appreciate all people who contributed towards the development of this tutor's guide, particularly REB staff who organized the whole process from its inception. Special gratitude goes to University lecturers, school teachers, illustrators and designers who diligently worked to successful completion of this tutor's guide. Any comment or contribution would be welcome for the improvement of this tutor's guide for the next edition.

Dr. MBARUSHIMANA Nelson

Director General of Rwanda Basic Education Board

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Finally, my word of gratitude goes to the Rwanda Basic Education Board staff particularly those from the Curriculum, Teaching and Learning Resources Department who were involved in the whole process of in-house textbook writing.

Joan MURUNGI,

Head of Curriculum, Teaching and Learning Resources Department

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PART I. GENERAL INTRODUCTION

1.0. About the tutor's guide

This book is a tutor's guide for Integrated Science subject, Year two in TTC. It is designed to accompany student teacher's book and intends to help tutors in the implementation of competence- based curriculum specifically Integrated science syllabus.

As the name says, it is a guide that tutors can refer to when preparing their lessons. Tutors may prefer to adopt the guidance provided but they are also expected to be more creative and consider their specific classes' contexts and prepare accordingly.

1.1. The structure of the guide

This section presents the overall structure, the unit and sub-heading structure to help tutors to understand the different sections of this guide and what they will find in each section.

Overall structure

The whole guide has three main parts as follows:

- **Part I: General Introduction.**

  This part provides general guidance on how to develop the generic competences, how to integrate cross cutting issues, how to cater for student-teachers with special educational needs, active methods and techniques of teaching integrated science and guidance on assessment.

- **Part II: Sample lesson plan**

  This part provides a sample lesson plan, developed and designed to help the tutor develop their own lesson plans.

- **Part III: Unit development**

  This is the core part of the guide which itself ends with references. Each unit is developed following the structure below:

  - **Unit title**
  - **Key unit competence**
  - **Prerequisites (knowledge, skills, attitudes and values)**

This section indicates knowledge, skills and attitudes required for successfully achieve the key unit competence. The competence-based approach calls for connections between units/topics within a subject and interconnections between different subjects. The tutor will find an indication of those prerequisites and guidance on how to establish connections.

- **Cross-cutting issues to be addressed**

This section suggests cross cutting issues that can be integrated depending on the unit content. It provides guidance on how to come up with the integration of the issue. Note that the issue indicated is a suggestion; tutors are free to take another cross-cutting issue taking into consideration the learning environment.

- **Guidance on the introductory activity**

Each unit starts with an introductory activity in the student-teacher's book. This section of the tutor's guide provides guidance on how to conduct this activity and related answers. Note that student-teachers may not be able to find the right solution, but they are invited to predict possible solutions or answers. Solutions are provided by student-teachers gradually through discovery activities organized at the beginning of lessons or during the lesson.

- **List of lessons/sub-heading**

This section presents in a table the suggested list of lessons, lesson objectives copied or adapted from the syllabus and duration for each lesson. Each lesson /subheading is then developed.

- **End of each unit**

At the end of each unit the tutor's guide provides the following sections:

- Summary of the unit which provides the key points of content developed in the student-teacher's book.
- Additional information which provides additional content compared to the student-teacher's book for the tutor to have a deeper understanding of the topic.
- End unit assessment which provides answers to questions of the end unit assessment in the student-teacher's book and suggests additional questions and related answers to assess the key unit competence.
- Additional activities (remedial, consolidation and extended activities)**.** The purpose of these activities is to accommodate each student-teacher (slow, average and gifted) based on end unit assessment results.

Structure of each subheading

Each lesson/sub-heading is made of the following sections:

Lesson /Sub heading title 1: ……..

- **Prerequisites/Revision/Introduction:**

This section gives a clear instruction to tutor on how to start the lesson.

- **Teaching resources**

This section suggests the teaching aids or other resources needed in line with the activities to achieve the learning objectives. Tutors are encouraged to replace the suggested teaching aids by the available ones in their respective schools and based on learning environment.

- **Learning activities**

This section provides a short description of the methodology and any important aspect to consider. It provides also answers to learning activities with cross reference to student-teacher's book.

- **Exercises/application activities**

This provides questions and answers for exercises/ application activities.

1.2. Methodological guidance

1.2.1. Developing competences

Since 2015 Rwanda shifted from a knowledge based to a competence-based curriculum for pre-primary, primary and general secondary education. For TTCs, it is in 2019 that the competence-based curriculum was embraced. This called for changing the way of learning by shifting from teacher centered to a learner centered approach. Tutors are not only responsible for knowledge transfer but also for fostering student-teacher's learning achievement and creating safe and supportive learning environment. It implies also that a student-teacher has to demonstrate what he/she is able to do using the knowledge, skills, values and attitude acquired in a new or different or given situation.

The competence-based curriculum employs an approach of teaching and learning based on discrete skills rather than dwelling on only knowledge or the cognitive domain of learning. It focuses on what learner can do rather than what learners know. Student-teachers develop basic competences through specific subject unit competences with specific learning objectives broken down into knowledge, skills and attitudes. These competences are developed through learning activities disseminated in learner-centered rather than the traditional didactic approach. The student-teachers is evaluated against set standards to achieve before moving on.

In addition to specific subject competences, student-teachers also develop generic competences which are transferable throughout a range of learning areas and situations in life. Below are examples of how generic competences can be developed in Integrated Science:

Generic competence	Examples of activities that develop generic competences
Critical thinking	- Describe the relationship and interdependence of sciences - Observe, record, interpret data recorded during experiments - Identify and use the applications of integrated science concepts to solve problems of life and society
Research and Problem solving	- Research using internet or books from the library - Design a project for making bioplastics - Design a questionnaire for data collection during field visit
Innovation and creativity	- Create an experiment procedure to prove a point - Develop a graph to illustrate information - Design a data collection survey/questionnaire - Conduct experiments with objectives, methodology, observations, results, conclusions - Identify local problems and ways to resolve them
Cooperation, Personal and Interpersonal management and life skills	- Work in Pairs - Small group work - Large group work
Communication	- Organise and present in writing and verbally a complete and clear report of an experiment - Observe, record, interpret the results of a measurement accurately. - Select and use appropriate formats and presentations, such as tables, graphs and diagrams.
Lifelong learning	- Exploit all opportunities available to improve on knowledge and skills. Reading scientific journals to keep updated.

1.2.2. Addressing cross cutting issues

Among the changes in the competence-based curriculum is the integration of cross cutting issues as an integral part of the teaching learning process-as they relate to and must be considered within all subjects to be appropriately addressed. The eight cross cutting issues identified in the national curriculum framework are: genocide studies, environment and sustainability, gender, Comprehensive Sexuality Education (CSE), Peace and Values Education, Financial Education, standardization Culture and Inclusive Education.

Some cross-cutting issues may seem specific to particular learning areas or subjects, but the tutor needs to address all of them whenever an opportunity arises. In addition, student-teacher should always be given an opportunity during the learning process to address these cross-cutting issues both within and out of the classroom so as to progressively develop related attitudes and values.

Below are examples on how crosscutting issues can be addressed in integrated science:

Cross-cutting issues	**Examples on how to integrate the cross-cutting issues**
Inclusive education	Involve all student-teachers in all activities without any bias. Eg: Allow a student-teacher with physical disability (using wheelchair) to take notes or lead the team during an experiment.
Gender	Involve both girls and boys in all activities: No activity is reserved only to girls or boys. Tutor should ensure equal participation of both girls and boys during experiments as well as during cleaning and tidying up related activities after experiments.
Peace and Values Education	During group activities, debates and presentations, the tutor will encourage student-teachers to help each other and to respect opinions of colleagues. He /she will remind them to be also conscientious when they use some materials during hand on activities / practical experiment.

Standardization culture	- Some lessons involve carrying out experiments. Instruction should be clear for student-teachers to always check if they are not using expired chemicals or defective apparatus. - In addition, when performing experiments student-teachers have to record data accurately. - For tasks involving calculations, they have to always present accurate results.
Environment and sustainability	- In order to avoid the environment pollution, before, during or after experiments student-teachers avoid throwing away chemicals anywhere; special places or appropriate containers should be used. - Student-teachers also have to be aware of the impacts of the use of hydrocarbons as fuels, halogenoalkanes, and plastics on the environment.
Financial Education	When performing experiments, student-teachers are encouraged to avoid wasting chemicals by using the quantities that are just required. They are required to also avoid spoiling equipment and other materials.

1.2.3. Attention to special educational needs specific to each subject

In the classroom, student-teachers learn in different way depending to their learning pace, needs or any other special problem they might have. However, the tutor has the responsibility to know how to adopt his/her methodologies and approaches in order to meet the learning need of each student-teacher in the classroom. Also, tutor must understand that student-teachers with special needs need to be taught differently or need some accommodations to enhance the learning environment. This will be done depending on the subject and the nature of the lesson.

In order to create a well-rounded learning atmosphere, tutor needs to:

- Remember that student-teachers learn in different ways, so they have to offer a variety of activities (e.g. role-play, music and singing, word games and quizzes, and outdoor activities).
- Maintain an organized classroom and limits distraction. This will help student-teachers with special needs to stay on track during lesson and follow instruction easily.

- Vary the pace of teaching to meet the needs of each student-teacher. Some student-teachers process information and learn more slowly than others.
- Break down instructions into smaller, manageable tasks. Student-teachers with special needs often have difficulty understanding long-winded or several instructions at once. It is better to use simple, concrete sentences in order to facilitate them understand what you are asking.
- Use clear consistent language to explain the meaning (and demonstrate or show pictures) if you introduce new words or concepts.
- Make full use of facial expressions, gestures and body language.
- Pair a student-teacher who has a disability with a friend. Let them do things together and learn from each other. Make sure the friend is not overprotective and does not do everything for the student-teacher. Both student-teachers will benefit from this strategy
- Use multi-sensory strategies. As all student-teachers learn in different ways, it is important to make every lesson as multi-sensory as possible. Student-teachers with learning disabilities might have difficulty in one area, while they might excel in another. For example, use both visual and auditory cues.

Below are general strategies related to each main category of disabilities and how to deal with every situation that may arise in the classroom. However, the list is not exhaustive because each student-teacher is unique with different needs and that should be handled differently.

Strategy to help student-teachers with developmental impairment:

- Use simple words and sentences when giving instructions.
- Use real objects that the student-teacher can feel and handle, rather than just working abstractly with pen and paper.
- Break a task down into small steps or learning objectives. The student-teacher should start with an activity that s/he can do already before moving on to something that is more difficult.
- Gradually give the student less help.
- Let the student-teacher work in the same group with those without disability.

Strategy to help student-teachers with visual impairment:

- Help student-teachers to use their other senses (hearing, touch, smell and taste) to play and carry out activities that will promote their learning and development.

- Use simple, clear and consistent language.
- Use tactile objects to help explain a concept.
- If the student-teachers has some sight, ask them what they can see. Get information from parents/caregivers on how the student-teacher manages their remaining sight at home.
- Make sure the student-teacher has a group of friends who are helpful and who allow the student-teachers to be as independent as possible.
- Plan activities so that student-teachers work in pairs or groups whenever possible.

Strategy to help student-teachers with hearing impairment:

- Strategies to help student-teachers with hearing disabilities or communication difficulties
- Always get the student-teacher's attention before you begin to speak.
- Encourage the student-teacher to look at your face.
- Use gestures, body language and facial expressions.
- Use pictures and objects as much as possible.
- Ask the parents/caregivers to show you the signs they use at home for communication use the same signs yourself and encourage other student-teachers to also use them.
- Keep background noise to a minimum.

Strategies to help children with physical disabilities or mobility difficulties:

- Adapt activities so that student-teacher who use wheelchairs or other mobility aids, or other student-teachers who have difficulty moving, can participate.
- Ask parents/caregivers to assist with adapting furniture e.g. The height of a table may need to be changed to make it easier for a student-teacher to reach it or fit their legs or wheelchair under.
- Encourage peer support friends can help friends.
- Get advice from parents or a health professional about assistive devices.

1.2.4. Guidance on assessment

Each unit in the tutor's guide provides additional activities to help student-teachers achieve the key unit competence. Results from assessment inform the tutor which student-teacher needs remedial, consolidation or extension activities. These activities are designed to cater for the needs of all categories of learners; slow, average and gifted learners respectively.

Assessment is an integral part of teaching and learning process. The main purpose of assessment is for improvement. Assessment for learning/ **Continuous/ formative assessment** intends to improve student-teachers' learning and tutor's teaching whereas assessment of learning/summative assessment intends to improve the entire school's performance and education system in general.

Continuous/ formative assessment

It is an ongoing process that arises out of interaction during teaching and learning process. It includes lesson evaluation and end of subunit assessment. This formative assessment plays a big role in teaching and learning process. The tutor should encourage individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

In Year one textbook, formative assessment principle is applied through application activities that are planned in each lesson to ensure that lesson objectives are achieved before moving on. At the end of each unit, the end unit assessment is formative when it is done to give information on the progress of students and from there decide what adjustments need to be done. Assessment standards are taken into consideration when setting tasks.

Summative assessment

The assessment done at the end of the term, end of year, is considered as summative. The tutor, school and parents are informed on the achievement of educational objectives and think of improvement strategies. There is also end of level/ cycle assessment in form of national examinations.

1.2.5. Student teachers' learning styles and strategies to conduct teaching and learning process

There are different teaching styles and techniques that should be catered for. The selection of teaching method should be done with the greatest care and some of the factors to be considered are: the uniqueness of subjects, the type of lessons, the particular learning objectives to be achieved, the allocated time to achieve the objective, instructional available materials, the physical/sitting arrangement of the classroom, individual student teachers' needs, abilities and learning styles.

There are mainly four different learning styles as explained below:

a) Active and reflective learners

Active learners tend to retain and understand information best by doing something active with it, discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.

b) Sensing and intuitive learners

Sensing learners tend to like learning facts while intuitive learners often prefer discovering possibilities and relationships. Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitive learners like innovation and dislike repetition.

c) Visual and verbal learners

Visual learners remember best what they see (pictures, diagrams, flow charts, timelines, films, demonstrations, etc); verbal learners get more out of words (written and spoken explanations).

d) Sequential and global learners

Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."

1.2.6. Teaching methods and techniques that promote the active learning

The different student-teacher learning styles mentioned above can be catered for, if the tutor uses active learning whereby student-teachers are really engaged in the learning process.

What is Active learning?

Active learning is a pedagogical approach that engages student-teachers in doing things and thinking about the things they are doing. In active learning, learners are encouraged to bring their own experience and knowledge into the learning process.

- The role of the tutor in active learning the tutor engages student-teachers through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.
- He/she encourages individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

- He provides supervised opportunities for student-teachers to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.
- Tutor supports and facilitates the learning process by valuing student-teachers' contributions in the class activities.

The role of learners in active learning

Learners are key in the active learning process. They are not empty vessels to fill but people with ideas, capacity and skills to build on for effective learning. A learner engaged in active learning:

- Communicates and shares relevant information with other learners through presentations, discussions, group work and other learner-centred activities (role play, case studies, project work, research and investigation)
- Actively participates and takes responsibility for their own learning
- Develops knowledge and skills in active ways
- Carries out research/investigation by consulting print/online documents and resourceful people, and presents their findings
- Ensures the effective contribution of each group member in assigned tasks through clear explanation and arguments, critical thinking, responsibility and confidence in public speaking
- Draws conclusions based on the findings from the learning activities.

Some active techniques that can be used in Integrated sciences

The teaching methods strongly emphasised in the competence Based Curriculum (CBC) are active methods. Below are some active techniques that apply in sciences:

A. Practical work/ experiments:

Many of the activities suggested in the Integrated science curriculum as well as in the student-teacher's book are practical work or experiments.

Practical work is vital in learning Integrated science; this method gives the student-teacher the opportunity to implement a series of activities and leads to the development of both cognitive and hands-on skills. The experiments and questions given should target the development of the following skills in student-teachers: observation, recording and report writing, manipulation, measuring, planning and designing.

A practical lesson / Experiment is done in three main stages:

- **Preparation of experiment:** Checking materials to ensure they are available and at good state; try the experiment before the lesson; think of safety rules and give instructions to lab technician if you have any.
- **Performance of experiment:** Sitting or standing arrangement of student-teachers; introduction of the experiment aims and objectives; setting up the apparatus; performing the experiment; write and record the data.
- **Discussion:** Observations and interpreting data; make generalisations and assignment: writing out the experiment report and further practice and research.

In some cases, demonstration by the tutor is recommended when for example the experiment requires the use of sophisticated materials or very expensive materials or when safety is a major factor like dangerous experiments, and it needs specific skills to be learnt first.

In case your school does not have enough laboratory materials and chemicals, experiments can be done in groups but make sure every student-teacher participates. You can also make arrangements with the neighbouring science school and take your student-teachers there for a number of experiments.

B. Research work

Each student-teacher or group of student-teachers is given a research topic. They have to gather information from internet, available books in the library or ask experienced people and then the results are presented in verbal or written form and discussed in class.

C. Project work

Integrated science tutors are encouraged to sample and prepare project works and engage their student-teachers in, as many as possible. Student-teachers in groups or individually, are engaged in a self-directed work for an extended period of time to investigate and respond to a complex question, problem, or challenge. The work can be presented to classmates or other people beyond the school. Projects are based on real-world problems that capture learners' interest. This technique develops higher order thinking as the student-teachers acquire and apply new knowledge in a problem-solving context.

D. Field trip

One of the main aims of teaching Integrated science in Rwanda is to apply its knowledge for development. To achieve this aim, we need to show to students the relationship between classroom science lessons and applied sciences. This helps them see the link between science principles and technological applications.

To be successful, the field visit should be well prepared and well exploited after the visit:

Before the visit, the tutor and student-teachers:

- Agree on aims and objectives
- Gather relevant information prior to visit
- Brainstorm on key questions and share responsibilities
- Discuss materials needed and other logistical and administrative issues
- Discuss and agree on accepted behaviours during the visit
- Visit the area before the trip if possible, to familiarise yourself with the place

After the visit

When student-teachers come back from trip, the tutor should plan for follow-up. The follow-up should allow student-teachers to share experiences and relate them to the prior science knowledge. This can be done in several ways; either: Student-teachers write a report individually or in groups and give to the tutor for marking. The tutor then arranges for discussion to explain possible misconceptions and fill gaps. Or student-teachers write reports in groups and display them on the class notice board for everyone to read.

Main steps for a lesson in active learning approach

All the principles and characteristics of the active learning process highlighted above are reflected in steps of a lesson as displayed below. Generally, the lesson is divided into three main parts whereby each one is divided into smaller steps to make sure that student-teachers are involved in the learning process. Below are those main parts and their small steps:

1) Introduction

Introduction is a part where the tutor makes connection between the current and previous lesson through appropriate technique. The tutor opens short discussions to encourage student-teachers to think about the previous learning experience and connect it with the current instructional objective. The tutor reviews the prior knowledge, skills and attitudes which have a link with the new concepts to create good foundation and logical sequencings.

2) Development of the new lesson

The development of a lesson that introduces a new concept will go through the following small steps: discovery activities, presentation of student-teacher's findings, exploitation, synthesis/summary and exercises/application activities, explained below:

- **Discovery activity**

Step 1

- The tutor discusses convincingly with student-teachers to take responsibility of their learning
- He/she distributes the task/activity and gives instructions related to the tasks (working in groups, pairs, or individual to instigate collaborative learning, to discover knowledge to be learned)

Step 2

- The tutor let the student-teachers work collaboratively on the task.
- During this period the tutor refrains to intervene directly on the knowledge
- He/she then monitors how the student-teachers are progressing towards the knowledge to be learned and boost those who are still behind (but without communicating to them the knowledge).

- **Presentation of student-teacher's productions**
  - In this episode, the tutor invites representatives of groups to present the student-teacher's productions/findings.
  - After three/four or an acceptable number of presentations, the tutor decides to engage the class into exploitation of the student-teacher's productions.
- **Exploitation of student-teachers's productions**
  - The tutor asks the student-teachers to evaluate the productions: which ones are correct, incomplete or false
  - Then the tutor judges the logic of the student-teacher's products, corrects those which are false, completes those which are incomplete, and confirms those which correct.
- **Institutionalization (summary/conclusion/ and examples)**
  - The tutzApplication activities
  - Exercises of applying processes and products/objects related to learned unit/sub-unit
  - Exercises in real life contexts

- Tutor guides student-teachers to make the connection of what they learnt to real life situations. At this level, the role of tutor is to monitor the fixation of process and product/object being learned.

3) Assessment

In this step the teacher asks some questions to assess achievement of instructional objective. During assessment activity, student-teachers work individually on the task/activity. The tutor avoids intervening directly. In fact, results from this assessment inform the tutor on next steps for the whole class and individuals. In some cases, the tutor can end with a homework assignment.

PART II: SAMPLE LESSON PLAN

School Name: _____ Teacher's name: _____

Term	**Date**	**Subject**	**Class**	**Unit N°**	**Lesson N°**	**Duration**	**Class size**
		Integrated science	Year 2	6	2 of 2	80 min	40

Type of Special Educational Needs to be catered for in this lesson and number of learners in each category	Only one learner with vision impairment
Unit title	Analog and Digital signal
Key Unit Competence	To compare analogue and digital signal and system in communication
Title of the lesson	Signal and system in communication
Instructional Objective	With the help of real-life examples, learners will be able to differentiate analog and digital systems Clearly.
Plan for this Class (location: in / outside)	In class, care must be taken so those learners with different impairments.
Learning Materials	Flip charts, audio-visual materials of signal and system in communication
References	Syllabus of TTC, LE & SSE; various websites of signal & system in communication, sheet of discovery questions

Timing for each step	Description of teaching and learning activity		Generic competences and Cross cutting issues to be addressed + a short explanation
	Tutor displays videos of signal and system in communication. Learners watch video and according to the tutor's instructions, learners complete question sheet about signal and system in communication. Finally tutor consolidates learners' findings.		
	Tutor's activities	Learner activities	

Introduction 10min	Tutor asks questions that engage learners in thinking of the meaning of the term "system" in communication, such as: 1. What is communication as a system?	Students teachers provide possible answers for questions: 1. A collection of communication equipment that is integrated into a coherent system. Communication is a process of passing information and understanding from one person to another. 2. Main types of communication: - Face- to –face communication - Broadcast media (microwave, satellite, radio and infrared)	**Communication** Through brainstorming of question-response exercise the learners gain various vocabulary and express their communication skill

	2. What are main types of communication channels?	- Mobile channel - Electronic communication (twisted –pair wire, cable and fiber optic cable) - Written communication	.
Development of the lesson 50 min	The teacher asks student-teachers to form group discussion of 4 student teachers and displays the documentaries Videos about signals & systems in communication and lets students-teacher watch, analyze and interpret. Tutor facilitates presentation and consolidates findings from respective group discussion The teacher provides questions related to signals such as: 1. What are two main types of signals? 2. What are advantages of each type of signal?	- Teacher-Students form groups with respect of gender balance as possible. They watch the documentaries videos displayed. - Students-Teacher share ideas and suggest possible answers then prepare for presentation. - Students-Teacher make presentation about the findings from their discussion on displayed analog and binary digital signals. - Possible answers: 1. Analog and binary digital signals -	**Critical thinking** Through watching Videos, learners develop their critical thinking **Co-operation** and

		1. Advantages of analog signal are: • Density is much higher • Easy possessing • Infinite amount of data Advantages of binary digital signal are: • Noise immunity • Inherently less susceptible to interference	**communication skills** are developed through sharing ideas and presentation **Gender** Is addressed group making and presentation.
Conclusion 20 min	Tutor asks learners to compare the advantages of analog and digital signals Tutor summarizes the key points and gives a take away to be in his / her notebook	Learners provide com Write down the summary and comments about the answers being provided.	**Critical thinking** through recognition of responses of the challenges in the lesson **Problem solving and critical thinking** when drawing on a graph paper and analyzing the experimental results.
Teacher self-evaluation			

PART III: UNITS DEVELOPMENT

UNIT 1

CELL DIVISION

1.1. Key Unit competence

Describe the stages of the cell cycle and explain the significance of cell and nuclear division in organisms.

1.2. Prerequisite

Student-teachers learn better this unit if they know the following:

- List the main component of cell and their respective function.
- State the importance of nucleus and chromosomes in the cell.
- Manipulate microscope to observe prepared slide.

As tutor, you start this unit by asking questions related to the above topics studied in ordinary level to ensure that student-teachers have good foundations to this new unit.

1.3. Cross cutting issues to be addressed

In this unit, the following cross cutting issues will be addressed:

a) Gender education

In all lessons of this unit, design the activities that give equal opportunity to both girls and boys. For examples: mixing boys and girls in group work, while setting tasks and when presenting the work done. Gender can be integrated by emphasising on the role of everyone in environmental protection.

b) Inclusive education

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

c) Peace and Values Education

The role of a tutor is to create and promote good conducive learning environment. Guide student -teacher to ensure that all living organisms coexist in harmony and help each other during learning process. This cross cutting issue can be integrated at any time in classroom, outside classroom, in school environment and anywhere in life. Tutor should be a role model for student-teachers. Student-teachers need to appreciate peace and values and advocate for positive behaviour among them.

d) Financial education

Tutor talk about the contribution of living organisms and their protection to the national income. For example: When guiding students on how to manipulate the microscope, you should give a caution of handling them carefully as they are very expensive, and that the country spends a lot of money to buy them.

1.4. Guidance on introductory activity

- Bring the printed diagram of house and link how its construction is related to the growth of organisms or ask student-teachers to watch the prepared movies on growth of organisms. Let student-teachers observe (charts, nature facts) and answer questions of introductory activity 1 as designed in Student's Book, page 1.
- It is impossible to build a house by using only one brick. The house grows up and increases in size as a result of building bricks over others. As the house grows up and increases in size as a result of building bricks over others, the human body will also increase in size as a result of cell division which increases the number of cells of the body. An adult human body size cannot be made by only one cell. Cells which are used to build the body come from cell division. The cells may divide mitotically, where one cell sprits into two daughter cells.

This unit deals with the cell and nuclear division and its importance in living organisms. During the lessons, try your best to bring real life situation or examples that develop the awareness of student-teachers on the significance mitosis and meiosis in nature.

1.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
1	Cell cycle and Mitosis	- Describe the main stages of the cell cycle - Describe the process of mitosis - Outline the significance of mitosis in cell replacement and tissue repair by stem cells.	2
2	Meiosis	- Describe the process of meiosis. - Compare mitosis and meiosis - Explain and interpret haploid and diploid conditions of the cell cycle - Explain the role of meiosis in gametogenesis in humans and in the formation of pollen grain and embryo sacs in flowering plants - Show concern to individuals with physical disabilities like Down's syndrome	2
3	End unit assessment		1

Lesson 1. Cell cycle and Mitosis

a) Learning objectives

- Describe the main stages of the cell cycle
- Describe the process of mitosis
- Outline the significance of mitosis in cell replacement and tissue repair by stem cells.

b) Teaching resources

Manila paper or rice sacs with diagrams for improvisation, student books and internet, computer animations, projector, microscope, Micrographs, compound microscopes, prepared slides on root tips and cheek cells etc.

c) Prerequisites/Revision/Introduction

Student-teachers have learnt better this unit if they know the following:

- List the main component of cell and their respective function.
- State the importance of nucleus and chromosomes in the cell.
- Manipulate microscope to observe prepared slide.

This will help them to learn well this lesson.

d) Learning activities

Activities 1.1&1.2

Guidance

- Organize student-teachers in groups and ask them to follow the instruction.
- Bring the teaching material you need to use and give them the task to do.
- Guide student- teachers to use text books or watch movies or use diagram and work on the learning activity 1.1 to describe the phases of cell cycle, and learning activity 1.2 to interpret mitosis phases

Activity 1.3

- Organize student-teachers into small groups to carry out **activity 1.3 in unit 1 of Student's Book**.
- Ask student-teachers to join the group formed as located by the tutor.
- Provide a diagram showing the role of mitosis (can be also printed) for each group to observe and attempt the related questions.
- Encourage student-teachers to work as a team as they share duties, ideas and openly share their views.

Notes: If tutor uses computer animations, prepare them in advance and make sure the materials are working properly.

- Take student-teachers in smart classroom to observe interactive video on mitosis and meiosis. Let them make observations and answer guiding questions.
- Provide student-teachers with reference materials for research. If computers with internet are available they can do their research and watch animated interactions and videos.
- Help student-teachers to get conclusion of the work.

Answer to learning activity 1.1

The cell cycle is a series of events of cellular growth and division that has five phases such as:

- The first growth phase (G_1),
- The synthesis phase (S),
- The second growth phase (G_2),
- Mitosis (M),
- Cytokinesis.

The cell cycle is a cycle because of its function in life cycle of organism

Answer to learning activity 1.2

The answer is discussed in **unit 1** of learner's Book, page 4- 11

Answers to learning activity 1.3

Answer to learning activity1.3 is discussed in **unit 1 of learner's Book on page 13-17**

e) Application activity 1.1

Guidance

Ask student-teachers to work individually or in pair to answer the questions of application activity 1.1.

Answer to application activity 1.1

- The G1 phase is the most variable in length.
- The cycle of some types of cells is faster than in others due to its location. The speed at which cells regenerate to rebuild tissue through mitosis is very high due to several factors. The function and environment of the cells must be taken into account first. Take skin cells, for example. The cells must be constantly regenerated to replenish the cells that are sloughed of every day. It is the function of the skin to maintain the barrier between our innards and the dry environment outside, so this barrier must be quickly regenerated. Under somewhat the same pretense, stomach cells are regenerated quickly because of the harsh environment that they endure to serve their purpose.

Lesson 2: Meiosis

a) Learning objectives

- Describe the process of meiosis.
- Compare mitosis and meiosis
- Explain and interpret haploid and diploid conditions of the cell cycle
- Explain the role of meiosis in gametogenesis in humans and in the formation of pollen grain and embryo sacs in flowering plants
- Show concern to individuals with physical disabilities like Down's syndrome

b) Teaching resources

Manila paper or rice sacs with diagrams for improvisation, computer animations, projector, microscope, student books, internet etc.

c) Prerequisites / Revision / Introduction

Student-teachers have learnt better this unit if they know the following:

- List the main component of cell and their respective function.
- State the importance of nucleus and chromosomes in the cell.
- Manipulate microscope to observe prepared slide.
- Description of cell cycle
- Description of mitosis process.

This will help them to learn well this lesson.

d) Learning activity 1.2 ,remember that this activity has already been discussed with lesson 1.

d) Application activities 1.2 & 1.3

Ask student-teachers to work individually or in pair and answer the questions of **application activity 1.3 on page 17**

Answers to application activity 1.2

a) A: Interphase, B: Prophase; Interphase due to the duplication of chromosomes. Prophase due to paired homologous chromosomes
b) The events were discussed in unit 1 of student book page 8-10
c) Six chromosomes
d) Reproductive cell

Answers to application activity 1.3

a) Sperm cell is formed from meiosis, thus has 23 chromosomes; red blood cell is formed under the process of mitosis and has 46 chromosomes.

b) The problem begins when a single cell in a tissue undergoes transformation, the process that converts a normal cell to a cancer cell. The body's immune system normally recognizes a transformed cell as an abnormal and destroys it. However, if the cell escapes immune system, it may proliferate to form a tumor (a mass of abnormal cells within an otherwise normal tissue). There are three types of tumors: benign tumors, malignant tumors and metastasis.

1.6. Summary of the unit

This unit **"Nuclear and cell division"** deals with cell cycle, and different phases which are involved in it like: interphase, mitotic, cytokinesis and meiotic division and their significance to living organisms. The cell cycle consists of a series of events of cellular growth and division that has five phases such as: the first growth phase (G_1), the synthesis phase (S), the second growth phase (G_2), mitosis (M), and cytokinesis.

The mitotic division consists of four phases including: prophase, metaphase, anaphase and telophase. It is a type of nuclear division where a mother nucleus sprint into two daughter nuclei identical between them and their mother cells, with the same number of chromosomes. Cytokinesis is a division of cytoplasm which leads to formation of two daughter cells identical to their mother cell. Meiosis is a type of cell division which is concerned with reproductive cells (gametes). From a diploid cell, meiosis leads to formation of haploid gametes.

1.7. Additional information for tutors

Even if many cells divide, they are other cells which do not divide. These are like red blood cells which lack nuclei. They are produced in bone marrow. The white blood cells: many of them do not divide, neurons: most do not divide, cardiac and skeletal muscle cells do not divide. So they have to be protected from being damaged.

Guidance on skills Lab 1

Tutor organizes student-teachers in groups and guides them on how they grow avocado species using mitosis process. Tutor guides them using the following procedure:

Plant the avocado seed and let them germinate, grow and attain 40 to 50 cm of height. Then make grafting using the below steps.

Step 1: Vertical Incisions

Make four 3-inch vertical incisions through the rootstock's bark, starting at the top. Slip a small rubber band on the rootstock, stopping just below these vertical cuts. With the point of a knife, separate the bark from the wood at the tip of the rootstock. Peel the bark down in four 3-inch-long flaps. Cut off an equal-sized piece of rootstock with shears after peeling back the bark.

Step 2: Prepare the Scion

Prepare the scion by trimming 1/2 inch off the bottom to show fresh, green wood. Slice a shallow, 2-inch cut into the wood at the bottom end of the scion. This cut exposes cambium tissue, which carries sap through the tree. Repeat this in order to create four evenly-spaced cuts.

Step 3: Connect Scion and Rootstock

Place the cut end of the scion inside the four flaps, lining up each cut surface with a flap

Step 4: Secure the Graft

Now is the time to use the rubber band to hold the flaps in place. Make sure the cambium tissue of the scion is seated against the cambium tissue of the rootstock.

Step 5: Protect the Graft

Protect the graft by wrapping it with a piece of heavy-duty aluminum foil, then a piece of plastic.

Step 6: Secure the Plastic

Tape the plastic lightly around the graft using masking tape. New buds should appear in 15 to 30 days. You may want to write the date and tree variety on the tape to keep track of multiple trees.

Ask student-teachers to make observation and follow the guidance of tutor.

Ask student-teachers to repeat the same procedure and make their own grafting.

Tutor monitor and provide guidance where necessary. Make a follow up to check the spoiled and the living scion and record the data in evaluation sheet. Provide the reasons for the spoiled scion and interpret the recorded observation.

1.8. Answers to end unit assessment

I. 1) True
2) False
3) True
4) False

5) False

6) True

7) True

8) True

9) False

II. Multiple choice questions

1) b

2) c

3) a

4) a

5) d

III. Long answer type questions

1) The main stages of cell cycle I are:

- The first growth phase (G_1),
- The synthesis phase (S),
- The second growth phase (G_2),
- Mitosis (M),
- Cytokinesis.

2) Homologous chromosomes are those which are identical and form pairs. These homologous chromosomes line up gene-for-gene down their entire length, allowing the crossing-over to occur. This process permits the exchange of genetic material between maternal and paternal chromosomes. Thus, crossing-over results in genetic recombination by producing a new mixture of genetic material.

3) See the answers in the content summary of the lesson 1.2.

4) See the answers in the content summary of the lesson 1.3

5) To maintain the number of chromosomes in species after fertilization of gametes to form a zygote.

6) and 7) see answers in the content summary of the lesson 1.3

8) Answers are:

a) Anaphase I

b) 1= centriole, 2= centrosome, 3= spindle.

c) Reproductive cells

d) No movement of chromosomes to poles can occur.

1.9. Additional activities

1.9.1 Remedial activities

1. Meiosis starts with diploid cell but ends with ..... haploid cells.

   (a) One (b) two (c) three (d) four

2. What do you mean by the terms haploid cell and diploid cell?

3. By using a tabular form, discuss 10 differences between mitosis and meiosis.

Answers:

1) Four
2) A diploid cell abbreviated as 2n contains two sets of chromosomes in their nuclei, while the haploid cells have only one set of chromosomes, abbreviated as n.
3) See the content summary of the lesson 1.3

1.9.2. Consolidation activities

1) Meiosis is done into two divisions: meiosis I and Meiosis II. In which division haploid cells are produced from a diploid cell.
2) Differentiate the haploid cell from a diploid cell.
3) A horse cell contains 64 chromosomes. How many chromosomes are there in: (a) a horse liver cell. (b) a horse sperm cell.
4) What do you understand by: spindle formation, synapsis, bivalents and chiasma?

Answers

1) In meiosis I
2) See answers in the content summary of the lesson 10.2.

2) a) 64 chromosomes, b) 32 chromosomes.

3) Spindle fibers: are microtubules that move chromosomes during cell division. They are found in eukaryotic cells. Spindle fibers move chromosomes during mitosis and meiosis to ensure that each daughter cell gets the correct number of chromosomes.

Bivalents: These are the two homologous chromosomes attached at chiasmata. The homologous chromosomes consist of two sister chromatids each.

Synapsis: In prophase I, homologous chromosomes become closely associated in **synapsis**. At prophase I of meiosis, after the homologous pair of chromosomes pair up in the process called synapsis, the non-sister chromatids overlap, forming an X-shape. They then exchange their alleles at the point of crossing over.

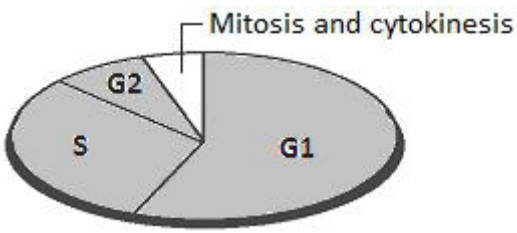
Chiasmata: is the region of crossing over between two homologous chromosomes during prophase I of meiosis.

1.9.3. Extended activities

1) Suggest why most plant cells (except meristem cells) are not capable of undergoing mitosis and cytokinesis.

2) Some cells have several nuclei within the cytoplasm of a single cell. Considering the events in a typical cell cycle, which phase of the cell cycle is not operating when such cells form?

3) The diagram represents the cell cycle. During which phase does the following take place:



a) DNA replication
b) Energy production
c) Organelle replication?
d) Name the main stages in mitosis.

Answers:

1) The formation of a cell wall in plant cells stops cells being able to divide effectively. Meristematic cells have very thin wall.

2) The presence of many nuclei indicates that mitosis has occurred repeatedly without cytokinesis having occurred, because there is still only one cell.

3) a) S phase. b) G2 phase. c) G2 phase. d) Prophase, metaphase, anaphase and telophase.

UNIT 2

KIRCHHOFF'S LAW IN ELECTRICAL CIRCUIT

2.1. Key Unit competence

Apply Kirchhoff's law in electrical circuit analysis

2.2. Prerequisite

- Charges concepts and forces between static charges
- Measurements of electrical current from unit 1 year one
- Sources of errors during measurements learned in O level
- Curiosity, honesty, and respect for evidence, perseverance and tolerance of uncertainty through the study of electric charges

2.3. Cross cutting issues to be addressed

- **Standardization culture**: Emphasize the need to use appropriate electrical components.
- **Financial education:** Emphasize the need to compare price against electric components while buying based on its functionality.
- **Environment and sustainability:** Recognize the safety measures taken for the sake of environmental protection
- **Peace and values education:** Cooperation and teamwork spirit should be encouraged in learning process

2.4. Guidance on introductory activity

- Ask student-teachers to look at the illustration of the unit 2 and let them discuss what they see.
- Let them brain in few minutes to discover what is observed in the illustration of the unit.
- Let sample student-teacher expose their ideas in five minutes to discover more details in the illustration of the unit.
- Ask them to suggest what topics do they think this unit will focus on based on the illustration?
- Give time for some brainstorming and try to introduce the unit based on the discussion done.

2.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
1	Simple electric circuit	- Describe the components of simple electric circuit - Outline the measuring instruments for voltage and electrical current - Differentiate resistance and resistor.	**2**
2	Arrangement of resistors either in series or parallel or mix-up	- Identify arrangement of parallel and series connections in circuit. - Explain the advantages and disadvantages of parallel, series and arrangement/ connections in circuit - Enjoy connecting resistors in series and parallel and determining the effective resistance	**2**
3	Kirchhoff's laws and its applications in solving problems in complex electric circuits	- Apply Kirchhoff's laws to problems in electric circuits - Appreciate the application of Kirchhoff's laws in designing complex circuits	**2**
4	End unit assessment		**1**

Lesson 1: Simple electric circuit

a) Learning objectives

- Describe the components of simple electric circuit
- Outline the measuring instruments for voltage and electrical current
- Differentiate resistance and resistor.

b) Teaching resources

- Wires, electric current sources such as dry cells, batteries, receptors such as bulbs, water heaters, resistors, switches, circuits breakers, ammeters, voltmeters.

c) Prerequisites/Revision/Introduction

Measurements of physical quantities

d) Learning activity 2.1

Guidance

- This activity introduces the student-teacher to gain more manipulative skills of electrical components and electric circuit construction.
- Divide your class into small groups of not more than five student-teachers, and let them read and interpret the activity based on their understanding and corresponding concepts about simple electric circuit and their construction.
- Let the student-teachers perform the activity using their prior knowledge about the provided electrical components and write the observation in the notebook.
- Monitor the discussions for the student-teachers' comments to support them in order to continue the discussion with a brief brainstorming of the concepts using student-teachers' observation and problems involved in the process of performing the experiment.
- Comment on student-teachers' discussion and give them the summary of expected deep understanding of expected observations.
- Remember that responses from the discussions may differ but you can refer to the key concepts in electric circuit construction in the student-teacher book and use the information in giving the expected feedback.
- Remember that responses from the discussions may differ but you can refer to the key concepts in measurement of physical quantities in the student-teacher book and use the information while reviewing the questions together.

Expected answers to activity 2.1

a) X generates electric current, Y transforms electricity to other form of energy and Z connects X to Y.

b) Example X is dry cell and Example of Y is bulb.

c) No. Ammeters and voltmeters are incorporated for the purpose of measuring the current through the conductors and the potential difference across two points.

d) Three devices that we need are only sources, conductors and receptors. Therefore, no more components are needed.

a) Answers for application activity 2.1

1. **Resistance is** the opposition that a substance offers to the flow of an electric current when an electric current of one ampere passes through a component across which a potential difference(voltage) of one volt exists,

   the resistance of that component is one Ohm. By ohm's law $R = \frac{V}{I}$ where R: resistance, V: voltage and I: current
2. Instrument used to measure current electricity is an **Ammeter**
3. volt is p.d between two points in a circuit in which one joule of electrical energy is transformed when one coulomb passes from one point to the other.

4. $p.d = \frac{w}{q} = \frac{5\ joules}{2\ coulombs} = 2.5\ J/C = 2.5\ V$

4. Instrument used to measure the potential difference is a v**oltmeter**

Lesson 2: Arrangement of resistors

a) Learning objectives

- Identify arrangement of parallel and series connections in circuit.
- Explain the advantages and disadvantages of parallel, series and arrangement/ connections in circuit
- Enjoy connecting resistors in series and parallel and determining the effective resistance

b) Teaching resources

Electric sources, conductors / wires, receptors/ resistors, ammeters and voltmeters

c) Prerequisites/Revision/Introduction

Ohms law and Pouillet law, measurement of physical quantities

d) Learning activity 2.2

Guidance

- This activity introduces the student-teacher to gain more skills about manipulation of electrical components and electric circuit construction.

- Divide your class into small groups of student-teachers, and let them read and interpret the activity based on their understanding and corresponding concepts about simple electric circuit and their construction.
- Let the student-teachers perform the activity using their prior knowledge about the provided electrical components and write the observation in the notebook.
- Schedule the discussion through presentation and let the student-teacher brainstorm on the tasks in order to gain more.
- Monitor the discussions for the student-teachers' comments to support them in order to continue the discussion with a brief brainstorming of the concepts using student-teachers' observation and problems involved in the process of performing the experiment.
- Comment on student-teachers' discussion and give them the summary of expected deep understanding of expected observations.
- Remember that the responses from the discussions may differ but you can refer to the key concepts in electric circuit construction in the student-teacher book and use the information in giving the expected feedback.
- Remember that the responses from the discussions may differ but you can refer to the key concepts

Expected answers to activity 2.2

Guide and facilitate the activity based on procedures shown by activity 2.2. See student teachers book.

Task 1

1. When bulbs are connected in series and one is removed from the circuit others stop to shine.
2. And (3) Two bulbs brightness is less than that of one bulb.

Task 2

1. When bulbs are connected in parallel and one is removed from the circuit other continues to shine.
2. And (3) Two bulbs brightness is the same that of one bulb.

e) Answers for application activity 2.2

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3} \Leftrightarrow \frac{1}{R}=\frac{1}{12}+\frac{1}{16}+\frac{1}{20}$$

$$\frac{1}{R} = \frac{20}{240} + \frac{15}{240} + \frac{12}{240} = \frac{47}{240}$$

$$R = 5.11\,\Omega$$

$$R_x + R = 25$$

$$R_x = 25 - 5.11 = 19.89\,\Omega$$

Lesson 3: Kirchhoff's laws and its applications

a) Learning objectives

- Apply Kirchhoff's laws to problems in electric circuits
- Appreciate the application of Kirchhoff 's laws in designing complex circuits

b) Teaching resources

Ammeter, voltmeter, ohmmeter, Rheostat, conductors and resistors, batteries, connecting wires.

c) Prerequisites/Revision/Introduction

Ohm's law. Solving system of linear question by substitution or other methods.

d) Learning activity 2.3

- **Guidance**
  - Instruct learners to carry out activity 2.3
  - After the activity, let learners submit their work to you. The purpose of this activity is to remind learners about combinations of resistances.
  - Review their knowledge of the general formulae of resistances in series and in parallel.
  - In order to introduce this lesson, the teacher can show two circuits represented by diagrams.
  - Show that activity it's possible and easy to calculate the current owing in the circuit using general method and but also it's more challenging to calculate the currents without knowing methods; so we use other new rules called Kirchhoff's rules which will be studied in the next lesson.

- **Answers to activity 2.3**

a) $I = \frac{12-6}{8+10} A = \frac{6}{18} A = \frac{1}{3} A, \quad P = RI^2$

$(b)\ P_1 = \left(\frac{1}{3}\right)^2 \times 8w = 0.89\ W, P_2 = \left(\frac{1}{3}\right)^2 \times 10w = 1.11\,W$

$(c)\ P_{12V} = 12 \times \frac{1}{3} = 4\,W$

e) Answer for application activities

Based on direction shown here below and starting from junctions A and C we write the rule as follow:

a) Use Kirchhoff's first law to write down an expression for the current in BE, in terms of I_1 and I_2

$$I_3 = I_1 + I_2$$

b) (i) LOOP 1 (ABEFA) :

$$3V - (10\Omega) I_1 - (10\Omega) I_3 - (10\Omega) I_1 = 0$$
$$3V - (20\Omega) I_1 - (10\Omega) I_3 = 0$$

(ii) Loop 2 (CBED):

$$1.5V - (10\Omega) I_3 = 0$$

2.6. Summary of the unit

- A cell is a kind of a 'pump' which provides electrical energy needed to drive charges along a complete path formed by the wire through the bulb switch and back again to the cell.
- Potential difference is the work done in moving one coulomb of charge from one point to the other in an electrical circuit.
- An electric generator is a device which is used to produce electric energy, which can be stored in batteries or can be directly supplied to the homes, shops, offices.
- Circuits consisting of just one battery and one load resistance are very simple to analyze, but they are not often found in practical applications.

- For any *n* resistors connected in series combination, the effective resistance is

$R_{eq} = R_1 + R_2 + R_3 + ... + R_n$For *n* resistors connected in parallel combination, the effective resistance is

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_n}$$

- A junction in a circuit is a point where three or more conductors meet. Junctions are also called nodes of branch points. A loop is any closed conducting path.
- Kirchhoff's junction rule: the algebraic sum of the currents into any junction is zero. That is, $\sum I = 0$

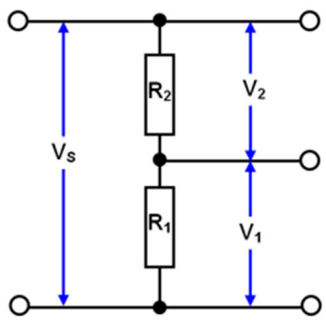
i.e The sum of the currents entering the junction must equal the sum of the currents leaving the junction.

- Kirchhoff's loop rule: the algebraic sum of the potential differences in any loop, including those associated with emfs and those of resistive elements, must equal zero. That is, $\sum V = 0$

2.7. Additional Information for teachers

Potential Dividers

Potential dividers are resistors connected in series across a voltage source used to obtain a desired fraction of the voltage. An example is shown below:



Potential divider formula

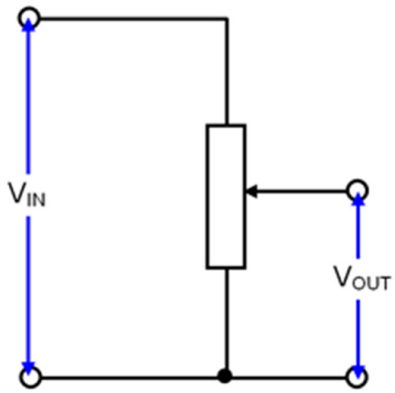
For an unloaded potential divider the current through each resistor is the same so the voltage is proportional to the resistance. This means that the pd across the pair of resistors is divided in the same ratio as the resistors themselves:

i.e. $V_1 / V_2 = I R_1 / I R_2$ or $V_1 / V_2 = R_1 / R_2$

If $R_1 >> R_2$ then V1 is more or less the supply voltage and if $R_1 << R_2$ then V1 is close to 0 V.

V_s is an input to the potential divider and V1 is an output. The circuit itself provides a way to tap off a voltage between 0 V and V_S.

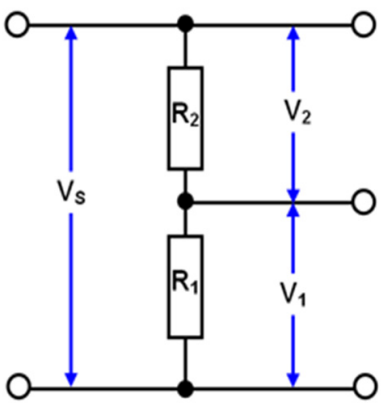
This can, of course be done continuously using a rheostat or potentiometer shown below:



Rotary potentiometers are used as volume controls in hi-fi systems.

The potential divider equation can be derived by rearranging the ratios above to give:

$V_1 = V_S \times (R_1 / (R_1+R_2))$



Lets do it now:

Use KVL: $Vs = I(R_1+R_2)$ so $I = Vs/(R_1+R_2)$

Now: $V_1/V_2 = IR_1/IR_2 = R_1/R_2$

And $V_1 = I \times R_1$

So, $V_1 = (Vs/(R_1+R_2)) \times R_1$

Therefore: $V_1 = V_S \times (R_1 / (R_1+R_2))$

Effect of the load on output

Connecting a load across R_1 reduces the output voltage.

This is because the effective resistance in the lower arm of the potential divider is now a parallel combination of R_1 and R load (less than R_1) so a smaller fraction of the voltage is 'tapped off'.

If $R_{load} >> R_1$ then there is no significant effect on the output voltage.

Consider what happens when a lit bulb goes out when "shorted out" by a piece of wire. It is because the low resistance of the wire in parallel reduced the combination's total resistance, compared to the rest of the circuit**.**

Skills Lab

At the end of this unit, the Tutor give an activity of skills lab in which Students teachers

Demonstrating Kirchhoff's laws and complex electric circuit.

- The Tutor will give them instructions as indicated in learner's book.
- The activity will be done in two periods and Student Teachers will present their findings
- The assistance and advices of the Tutor are needed here and this will help him to mark any progress of his/her Students.

2.8. Answers to end unit assessment

1. Kirchhoff's current law states that the sum of the currents entering the junction must equal the sum of the currents leaving the junction. Kirchhoff's voltage law states that the algebraic sum of the potential differences in any loop, including those associated with emfs and those of resistive elements, must equal zero.
2. Electric source of current transforms any form of energy into electrical energy while receptors are those devices that transform electrical energy into any form of energy like heat, light, sound as well as mechanics.
3. $\frac{1}{R} = \sum \frac{1}{Ri} \Rightarrow \frac{1}{R} = \frac{1}{50} + \frac{2}{100} \Rightarrow R = 25\Omega$

   $I = \frac{10V}{25\Omega} = 0.4A$
4. In parallel connection the energy transformed is the same but in series potential difference depends on resistance property. Therefore **(B**) is the best answer.
5. The circuit has two nodes (at A and B). We have the choice of choosing only two of the three loops shown. This is because only two of the loops are independent.

Node A: $I_1 + I_2 = I_3$ Node B: $I_3 = I_1 + I_2$ Loop1: $10 - I_1R_1 - I_3R_3 = 0$

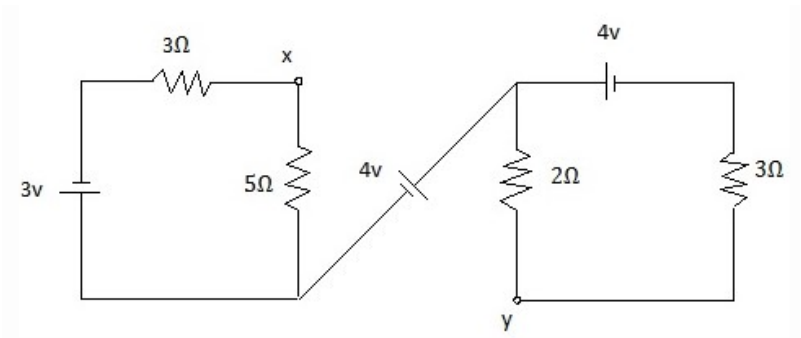
Loop2: $20 - I_2R_2 - I_3R_3 = 0$

By substitution, the answer can be shown to be I_1=-0.143A, and I_2=0.429A.

2.9. Additional activities

2.9.1. Remedial activities

1. Choose the correct answer; KCL is based on the fact that
   a) There is a possibility for node to store energy
   b) There cannot be an accumulation of charge at the node
   c) Charge accumulation may be or may not be possible.
2. Choose the correct answer; The algebraic sum of voltages around any closed path in a network is equal to
   a) Infinity
   b) 1
   c) 0
   d) Negative polarity
3. Choose the correct answer; Potential difference between X and Y is

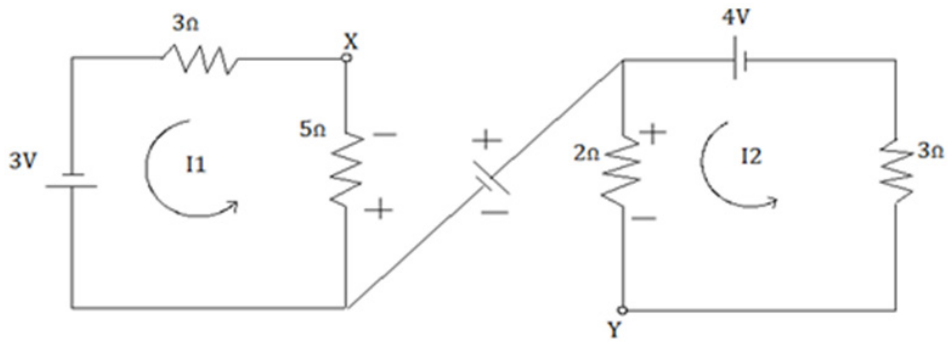


   a) 4.275V
   b) -4.275 V
   c) 4.527V
   d) -4.527V

Answers:

1. b)
2. c)
3. b)

Explanation:



4. $I_1 = \frac{3V}{3\Omega + 5\Omega} = \frac{3V}{8\Omega} = 0.375A$

$I_2 = \frac{4V}{5\Omega} = 0.8A$

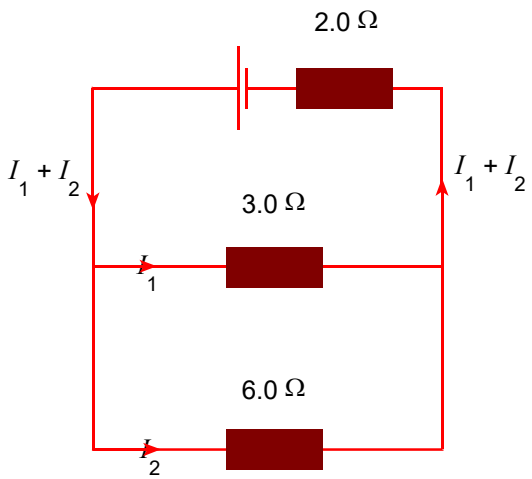
$V_{xy} = V_x - V_y$

$V_x + 5I_1 + 4 - 2I_2 - V_y = 0$

$V_x - V_y = 2I_2 - 4 - 5I_1 = -4.275V$

2.9.2. Consolidation activities

A circuit consists of a cell of emf 1.6 Ω in series with a resistance 2.0 Ω connected to a resistor of resistance 3.0 Ω in parallel with a resistor of resistance 6.0 Ω Determine the total current drawn from the cell and the potential difference across the 3.0 Ω resistor.



Solution

Consider the circuit loop consisting of the cell and the 3.0 Ω resistor:

$$1.6V = 3I_1 + 2(I_1 + I_2) = 5I_1 + 2I_2$$

Consider the circuit loop consisting of the cell and the 6.0 Ω resistor:

$$1.6V = 6I_1 + 2(I_1 + I_2) = 5I_1 + 8I_2$$

Subtracting the second equation from the first gives:

$$0V = 3I_1 + 6I_2 \rightarrow I_1 = 2I_2$$

Substituting $I_1 = 2I_2$ into the second equation gives:

$$1.6V = 12I_2 \rightarrow I_2 = 0.13A \text{ and } I_1 = 0.27A$$
$$\text{Current through cell} = I_1 + I_2 = 0.40A$$

pd across 3.0 Ω resistor

$$V = I_1 \times 3.0\Omega = I_2 \times 6.0\Omega = 0.8V$$

2.9.3. Extended activities

1. Ten lamps are connected in series across a power supply. The voltage across each lamp is 6.0 V. What is the voltage of the supply?
2. Ten lamps are connected in parallel across a 12 V supply. What is the voltage across each lamp?

Answers:

1. 60 V

2. 12 V

UNIT 3

CLASSIFICATION AND PATTERNS OF DISEASE

3.1. Key Unit competence

Explain symptoms of diseases, their treatment and prevention.

3.2. Prerequisite

Student-teachers have learnt better this unit if they know the following:

- Classification of microorganisms.
- Give examples of micro-orgasms and their importance.
- Classification of diseases, infectious diseases and non-infectious diseases learnt in ordinary level.
- They should also be able to do observation of prepared slides on microscope, analysis, interpretation of the pictures and then capable to present and or communicate the results.

As tutor, you start this unit by asking questions related to the above topics studied in ordinary level to ensure that student-teachers have good foundations to this new unit.

3.3. Cross cutting issues to be addressed

The cross-cutting issues to be addressed by this unit include: inclusive education, gender education, standardized culture and comprehensive sexuality education.

a) Inclusive education

For addressing inclusive education, while student-teachers will be conducting learning activities and experiments, instructional information should be given clearly and student-teachers with visual or physical impairment will be involved in learning activities and experiments. They can sometimes use their sense organs for identifying the results and observe the symptoms in order to draw conclusion.

Provide procedure earlier before the experiment so that student-teachers get familiar with them. They can be written on the chalkboard or printed depending on available resources. If you have children with low vision remember to print in appropriate fonts.

b) Gender education

In all lessons of this unit, design the activities that give equal opportunity to both girls and boys. For example: mixing boys and girls in group work, while setting tasks and when presenting. Gender can be integrated by emphasising on the role of everyone in health protection.

Tutors should ensure equal participation of both girls and boys during experiments as well as during cleaning and tidying up related activities after experiments.

c) Standardization culture

The standardization culture will be addressed when students will appreciate the conception of food and beverages in relation to positive or good results of the activities. Emphasis should be made so that student-teachers should always check the date of manufactured and expiration of chemicals/substances, beverages and even the food material to prevent the diseases related to poor hygiene and food storage.

Some lessons involve observing human being about diseases. Student-teachers will identify the causes of diseases and also the drugs used to treat them. Through questions they can develop awareness of the standardized culture whereby the misuse use of some drugs as well as their state could not treat diseases. Thus, student- teachers have to always check if they are not using expired chemicals or defective apparatus.

d) Comprehensive sexuality education

Comprehensive sexuality education, which is age-appropriate, gender-sensitive and life skills-based can provide young people with the knowledge and skills to make informed decisions about their sexuality and life style. Preparing young people for the transition to adulthood has been one of humanity's greatest challenges with human sexuality and relationships at its core. Few young people receive adequate preparations for their sexual lives. This leaves them potentially vulnerable to coercion, abuse and exploitation unintended pregnancy and sexually transmitted infections (STIs) including HIV/AIDS. Many young people approach adulthood faced with conflicting and confusing messages about sexuality and gender. This is often exacerbated by embarrassment, silence, disapproval and open discussion of sexual matters by adults (parents, tutors) at the very time when it is most needed.

Comprehensive sexuality education supports a rights - based approach in which values such as respect, acceptance tolerance, equality, empathy and reciprocity are inextricably linked to universally agreed human rights. A clear message concerning these dangers and how they can be avoided, from right across the

curriculum, is the best way to ensure that young people understand the risks and know how to stay healthy.

3.4. Guidance on introductory activity

- Bring the diagrams of different abnormal organs and physical appearance of human body and ask student-teachers to observe them. Print or write the guiding questions on chalkboard. Ask student-teachers to answer questions of **introductory activity 3** as designed in Student's Book on observed diagram.
- Ask student-teachers to observe the figures, read and discuss the given questions.

Notes: This activity is very essential since it captures the attention of student-teachers. As a tutor, you are required to give such activity because it has the following benefits:

- It creates curiosity among student-teachers and enhances active learning through practice.
- It promotes critical thinking and allows student-teachers to predict the next lesson.
- The tutor is encouraged to set clear introductory activity which can give a general picture of the whole unit if possible.

3.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
1	**Common diseases** (Infectious diseases, STDs, and worm diseases)	- Explain the symptoms, mode of prevention of infectious diseases. - Describe the types of infectious and worm diseases. - Describe the challenges encountered to eradicate some common infectious diseases.	2
2	Deficiency diseases	Describe the types of deficiency diseases	1
3	Importance and Hygiene practices	- Outline the importance of hygiene and related issues. - Analyze the importance of hygiene and related issues. - Create a health and hygiene community of practice in the society to apply the hygiene practices to avoid diseases.	1

4	Human immune system: Immunity, structure and role of antibodies	- Describe the human immune system and ways to keep it healthy. - Explain the Immunity, structure and role of antibodies in human immune system.	1
5	Common addictive substances and their effects	- Discuss the most common addictive substances and their effects on the society. - Describe the common addictive substances and prevent their effects	1
	End unit assessment		1

Lesson 1. Common diseases

a) Learning objectives

- Explain the symptoms, mode of prevention of infectious diseases.
- Describe the types of infectious and worm diseases
- Describe the challenges encountered to eradicate some common infectious diseases

b) Teaching resources

Illustration of different diseases, simulations, computer animations, projector, Manila paper, rice sacs with diagrams for improvisation.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Definition of microbiology and microorganisms.
- Classifying microorganisms.
- Give examples of diseases caused by microorganisms

Remind student-teachers what they have learnt about infectious diseases in ordinary level, and ask them to list some infectious diseases and their causal agents. This will help student-teachers to pay attention during this lesson.

d) Learning activity 3.1

Guidance

- Organize student-teachers in groups and ask them to read passage of activity 3.1 in Student' Book**.** Give the work in advance in order to help student-teachers to make research.

- Provide the necessary materials and ask student-teacher to answer the questions of activity 3.1.
- Move around in silence to monitor if they are having some problems.
- Remember to assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Ask other student-teachers to follow carefully and comment the representations.
- Note on chalk board / Manila paper the student's ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and conclude the presentations.

Answers to learning activity 3.1

a) The infectious diseases are: Cholera, typhoid, tetanus, tuberculosis, polio, measles, Ebola, malaria, sleeping sickness, trichomoniasis, candidiasis, athlete's foot, ring worms, elephantiasis, bilharzias, syphilis, gonorrhea.

b) Tuberculosis. The cause, mode of transmission and signs and symptoms are discussed in **Unit 3 of Student's Book on page 48-50**

c) Malaria. Their cause, mode of transmission and signs and symptoms are discussed in **Unit 3 of Student's Book on page 50-53**

d) Application activity 3.1

Guidance

Ask student-teachers to work individually or in pair or in groups to answer the questions of application activity 3.1. If you used group work, let the student-teachers hung on the wall their work and make gallery walk to read, observe and assess other's work.

Answer to application activity 3.1

a) Cholera, typhoid, malaria etc

b) The preventive measures to the suspected diseases are discussed in **Unit 3 of Student's Book on page 45-52**

Lesson 2: Deficiency diseases

a) Learning objective

Describe the types of deficiency diseases

b) Teaching resources

Illustration of deficiency diseases, simulations, computer animations, projector, Manila paper, rice sacs with diagrams for improvisation.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Food groups and their sources.
- Functions food nutrients in human body

Remind student-teachers what they have learnt about food groups in ordinary level, and ask them to list sources of food nutrients and their respective functions in human body. This will help student-teachers to pay attention during this lesson.

d) Learning activity 3.2

Guidance

- Organize student-teachers in groups and ask them to observe the figures of activity 3.2 in Student' Book on **page 64.**
- Provide the necessary materials and ask student-teacher to answer the questions of activity 3.2.
- Remember to assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Ask other student-teachers to follow carefully and comment the representations.
- Note on chalk board / Manila paper the student's ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and conclude the presentations.

Answer to learning activity 3.2

a) **Deficiency diseases** are diseases that are caused by a dietary deficiency of specific nutrients, especially a vitamin or mineral, possibly stemming from insufficient intake, digestion, absorption, or utilization of a nutrient.

b) A: marasmus, B: Kwashiorkor, C: goiter

The cause, the signs and symptoms, and preventive measures of the mentioned diseases are discussed **in Unit 3 of Student' Book on page 65-79**

e) Application activity 3.2

Guidance

Ask student-teachers to work individually to answer the questions of application activity 3.2. Assess the work and provide feedback.

Answer to application activity 3.2

a) (i) Fatality rate for Haiti in 2010 = **3 990/179 379*100 = 2.22%**

(ii) Case fatality rates are not constant; they can vary between populations and over time, depending on the interplay between the causative agent of disease, the host, and the environment as well as available treatments, quality of patient care and malnutrition problems.

(iii) It is important that the WHO collects data on marasmus to check the standards of living for each country and to be aware of food availability. Malnutrition problems weaken the metabolism creating a vicious cycle of infection and undernourishment, leading to vulnerability to illness.

(iv) Nutrient deficiency is the main cause of marasmus. It occurs in children that do not eat enough protein, calories, carbohydrates, and other important nutrients. This is usually due to poverty and a scarcity of food

b) The developed countries do not have the problem of undernourished children that may weaken the immune systems and lead to more susceptible to infections and illnesses. They have good standards of living.

Lesson 3. Hygiene practices and their importance

a) Learning objective

- Explain what is meant by hygiene.
- Identify the importance of promoting hygiene in community.
- Describe the practices of hygiene.
- Discuss how poor hygiene and sanitation leads to different health problems.

b) Teaching resources

Illustration promoting hygiene, simulations, computer animations, projector, Manila paper, rice sacs with diagrams for improvisation, Student's Books.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Sources of waste materials that can bring out health problems
- Some diseases caused by poor hygiene

Remind student-teachers what they have learnt about hygiene in ordinary level, and ask questions related to poor hygiene and its consequence.

d) Learning activity 3.3

Guidance

- Organize student-teachers in groups and ask them to read the scenario of activity 3.3 as designed in Student' Book.
- Ask student-teachers to discuss the question indicated in activity and find out the answer.
- Provide the necessary materials such as scenario, markers, Manila paper or rice sacs.
- Guide them and monitor the activity.
- Invite groups to present their findings to the rest of student-teachers.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and conclude on the learned knowledge and engage student-teachers in making conclusion.

Answers to learning activity 3.3

To answer the asked question, student-teachers will use different ideas depending on life status in their families. The answer is discussed in **Unit 3 of Student' Book on page 80-82**

e) Application activities 3.3

Guidance

Ask student-teachers to work in groups to answer the questions of application activity 3.3. Avail all material needed to demonstrate the practice of how to make hygiene of eyes, nose, feet, hands and teeth. Monitor the activity and assess other's work.

Answer to application activities 3.3

1. The general human hygiene may be described by:

- Washing the body regularly with clean water and soap.
- Wearing clean clothes.
- Living in clean environment with adequate fresh air.
- Eating adequate balanced diet. Young children should be fed between 5 to 6 times per day. Their diet should be rich in proteins.
- Having regular exercises.

2. General importance of human hygiene are:

- It insures proper growth and development of children.
- It helps to prevent diseases especially hygiene related diseases.
- It prevents bad smell it helps to keep the environment clean, tidy and beautiful.
- It makes the environment appealing and attractive.

The hygiene of eyes, nose, feet, hands and teeth is discussed in **Unit 3 of Student' Book on page 80-82.**

Lesson 4. Human immune system

a) Learning objective

- Describe the human immune system and ways to keep it healthy
- Explain the Immunity, structure and role of antibodies in human immune system.

b) Teaching resources

Manila paper or rice sacs with diagrams for improvisation, simulations, computer animations, projector, student's books, and graph charts, etc.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Distinguish antibody and antigens
- Types of immunity

Remind student-teachers what they have learnt about hygiene in ordinary level, and ask questions related to immunity, antibody and antigen.

d) Learning activity 3.4

Guidance

- Organize student-teachers in groups and ask them to do the activity 3.4 indicated in Unit 3 of Student' Book on page 83.
- Provide the necessary materials. Let student-teachers discuss.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Note on chalk board / Manila paper the student's ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion.

Answers to learning activity 3.4

a) Vaccination process

b) Vaccination process helps the body to resist on vaccinated diseases.

c) Yes, it is possible that the human body can resist an infection from environment full of pathogens due to its lines of defense such as:

(i) Body's first line of defense is the line of defense that prevents harmful micro-organisms from entering the body. It is the external defense system of the body. Examples of the body defense mechanism are discussed in **unit 3 of Student's Book on page 84.**

(ii) Body's second line of defense: This is the body defense mechanism that fights the pathogens already entered the body. It uses white blood cells to destroy pathogens.

e) Application activity 3.4

Guidance

Ask student-teachers to work in pairs to answer the questions of application activity 3.4. Avail all Monitor the activity, assess other's work and provide feedback.

Answer to application activity 3.4

a) Vaccination process helps the body to resist on vaccinated diseases.

b) Tuberculosis, measles, poliomyelitis, tetanus, etc.

c) The body of someone who did not get vaccination is very weak and can be affected by infectious diseases easily.

d) If vaccines are not well prepared.

Lesson 5. Common addictive substances and their effects

a) Learning objectives

- Discuss the most common addictive substances and their effects on the society.
- Describe the common addictive substances and prevent their effects

b) Teaching resources

Different types of drugs, graph charts, simulations and computer animations, projector, Manila paper or rice sacs with diagrams for improvisation, student's book, chemical,.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Examples of drugs

Remind student-teachers what they have learnt about drugs in ordinary level, and ask questions related to drugs and why are known as drugs. From what they know, they can prepare themselves for the lesson.

d) Learning activity 3.5

Guidance

- Organize student-teachers in groups and ask them to do the activity 3.5 indicated in **Unit 3 of Student' Book on page 90**.
- Provide the necessary materials. Let student-teachers discuss.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Note on chalk board / Manila paper the student's ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion

Answers to learning activity 3.5

1. Student-teachers will answer according to what they use. But in human life most of people use substances like tobacco, beer, water. Other ones are used in illegal ways. Even if tobacco and bier are used they also have serious negative effects.
2. All except water

3. The answer is discussed in unit 3 of Student's Book on page 91-99

a) Application activity 3.5

Guidance

Ask student-teachers to work individually to answer the questions of application activity 3.5. Avail all Monitor the activity, assess other's work and provide feedback.

Answer to application activity 3.5

This is to stop passive smoking. Public smoking bans appear to significantly reduce the risk of heart attacks, particularly among younger individuals and nonsmokers, according to a new study. Researchers find that smoking bans can reduce the number of heart attacks by as much as 26 percent per year.

Guidance on skills Lab 3

Tutor in collaboration with school administration officers make regular provision of clean water, liquid soap, clean tissue and boiled water.

Tutor organizes student-teachers in groups which are acting as clubs. Tutor demonstrates how to use clean water and liquid soap to wash hand, plate, spoon and cup. After, the tutor uses clean tissue to dry the washed hand and materials. Tutor recommends student-teachers to do the activity regularly. Tutor monitors the activity and fulfills the evaluation sheet. Tutor provides regular feedback and asks student-teachers to make improvement where necessary.

3.6. Summary of the unit

- **Infectious diseases** are caused by microorganisms known as pathogens which may include viruses, bacteria, fungi and protozoa.
- ***Vibrio cholerae*** are pathogens of cholera which multiply in the intestine, releasing a powerful toxin which results in violent inflammation of the intestine and production of the watery diarrhea.
- **Human malaria** is caused by infections from four species of plasmodium: *Plasmodium falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*, each responsible for a different form of the disease.
- AIDS (**Acquired Immune Deficiency Syndrome)** is a disorder which damages the human body's immune system. It is caused by the HIV virus (Human Immunodeficiency Virus).
- Sexually transmitted diseases (STDs) are transmitted by infected persons to healthy persons during sexual intercourse. Examples of these diseases are **chlamdia, gonorrhoea, syphillis and, HIV and AIDS.**

- The examples of common deficiency diseases are Kwashiorkor, Marasmus, Vitamin deficiencies.
- Worms causing infection in people are parasites that live and breed mostly in the intestine. Infection is caused by worms such as roundworms, hookworms and tapeworms.
- **Immunity** is a process by which the body of a living organism defends itself against pathogens.
- **The immune system** is a protective system that is made of a series of defenses that fight against diseases by: recognizing, attacking, destroying and remembering each type of pathogen that enters the body. It does this by producing specialized cells which inactivate pathogens.
- An **antibody** is shaped like the letter **Y**, and has two identical **antigen-binding sites**. The shape of the binding site allows the antibody to recognize a specific antigen with a complementary shape.
- Immune system has the capacity to kill cells, it is very important for it to make a distinction between self and non-self.
- Whenever there is a failure in distinguishing self from non-self, auto-immune diseases develop such as multiple sclerosis, rheumatoid arthritis.
- Mounting of a successful immune response depends on a number of cells and chemical mediators, defect in any component can lead to immunodeficiency state such as absence of mature T lymphocytes in Di George syndrome.
- Immune system has two main parts, innate and adaptive.
- Two branches of the immune system collaborate with each other to make a highly effective immune response.
- Innate system is present at birth, comes into operation immediately upon infection, relies on barriers such as skin and mucous membranes, phagocytes and NK cells, and lacks memory.
- Tobacco, Alcohol and drugs are **common addictive substances**
- The signs and symptoms of drug addiction drug vary according to the individual and the substances he or she uses.
- The main food nutrients are carbohydrates (sugars and starches), proteins, lipids (fats and oils), vitamins, mineral salts and water.
- A balanced diet contains all the food nutrients that a person needs in the right quantities. Different people need different diets depending on their age, gender, level of activity and whether or not they are ill.

- A nutritional disorder occurs when a person does not have enough food or when their diet is lacking certain vitamins or minerals.
- Scurvy, rickets, anaemia, starvation and obesity are examples of nutritional disorders.

3.7. Additional information for tutors

Measles is a contagious acute viral disease with symptoms that include a bright red rash of small spots that spread to cover the whole body. Small white spots, known as Koplik's spots, appear in the mouth on the inside of the cheeks a few days before the rash appears and can be used in diagnosis.

Typhoid caused by ***Salmonella typhus***, a Gram negative bacterium. Typhoid is waterborne disease. The bacteria are derived from the feces of a patient. It has high infectivity as low dosage of organisms is only needed for typhoid to spread. Common sources of typhoid infection are contaminated water, milk and food.

Smallpox caused by ***Variola virus (DNA virus),*** **a pox virus**. It was a highly infectious disease transmitted by direct contact and it affects the respiratory passage.

Tinea is a skin infection due to a fungus. Often, there are several patches of ringworm on the skin at once. Tinea is also known as Ringworm and it is caused by a tiny fungus known as dermatophyte.

3.8. Answer to end unit assessment

I. Choose whether the given statements are True (T) or False (F):

1. **True**; innate immunity is present at birth.
2. **False**; as breast milk contains IgA type of antibodies.
3. **True**; as antibodies can tag the microbial agents and bind to phagocytes.
4. **False**; as antibiotics cure the disease by either killing or slowing the growth of bacteria.
5. **True**; as initially this disease was curable, but gradually the bacterium acquired resistance to a number of antibiotics.
6. **False**; as hay fever is a localized allergic reaction involving upper respiratory tract.
7. **True**; as memory cells are already primed and upon second exposure to the same antigen grow bigger in size and start secreting antibody.
8. **True**; as preformed antibodies are administered to neutralize the toxin with no stimulation of immune system.
9. **False**; Immune system has two main parts, innate and adaptive.

10. **True**; as intact cell wall is important for survival of bacteria.

II. Long answers

1. Antibodies are immunoglobulins, designated as Ig. Different types of antibodies, secreted by B-lymphocytes are written as IgM, IgG, IgA, IgE and IgD. These antibodies are capable of recognising over a million different antigens and confer protection in a number of ways. Functions performed by antibodies are:

(i) Antibodies bind to toxins produced by bacteria that cause infection like diphtheria or tetanus, effectively nullifying them.

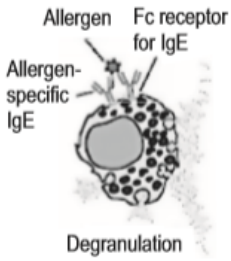
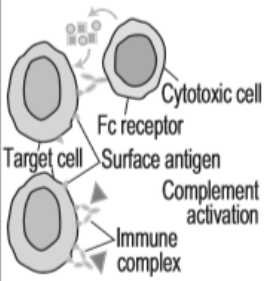
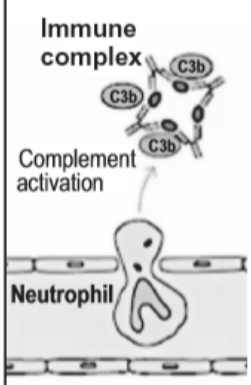
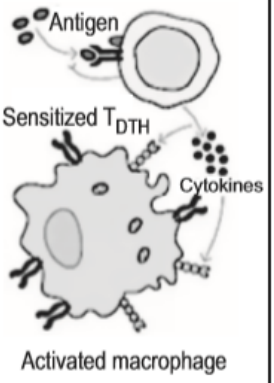
(ii) By attaching to microbial pathogens, antibodies promote their clearance by phagocytes manifold.

(iii) Antibodies form a covering on bacteria and viruses, not allowing them to gain entry into tissues. Bacteria and viruses, thus having being coated, are eliminated by beating of cilia present on the epithelial cells in the respiratory tract or by peristalsis of the gastrointestinal tract.

(iv) Antibody, esp. of the IgG type, is highly mobile, capable of leaving circulation and reaching skin where it can neutralize surface bacteria. This antibody can also pass through the placenta reaching the developing foetus, providing it some protection against infections.

(v) Antibody, esp. of the IgA type, is found in large amounts in mother's milk, and helps protect the newborn against infections during the first months of life when infant's immune system is not fully functional.

(vi) Antibody of the IgE type, plays an important role against parasitic infections, though it is also responsible for the allergic reactions to various allergens in the environment and will be described later in detail.

			
Type I	**Type II**	**Type III**	**Type IV**
IgE mediated Hypersensitivity	IgG mediated Cytotoxic Hypersensitivity	Immune Complex Mediated Hypersensitivity	Cell Mediated Hypersensitivity
Ag induces crosslinking of IgE bound to mass cells and basophils with release of vasoactive mediators	Ab directed against cell surface antigens meditates cell destruction via complement activation or ADCC	Ag-Ab complexes deposited in various tissues induce complement activation and an ensuing inflammatory response mediated by massive infilatration of neutrophils	Sensitized T_H1 cells release cytokines that activate macrophages or TC cells which mediate direct cellular damage
Typical manifestations include systemic anaphylaxis and localized anaphylaxis such as hay fever, asthma, hives, food allergies, and eczema	Typical manifestations include blood transfusion reactions, erythroblastosis fetalis, and autoimmune hemolytic anaemia	Typical manifestations include localized Arthus reaction and generalized reactions such as serum sickness, necrotizing vasculitis, glomerulnephritis, rheumatold arthritis, and systemic lumpus erthyematosus	Typical manifestations include contact dermatitis, tubercular lesions and graft rejection

Types of Hypersensitive responses

2. (a) Phagocytes, which include both neutrophils and macrophages, play an important role in innate immunity. They can identify foreign invading pathogens, discriminate them from cells of the body, and internalize them by throwing pseudopodia around them. Once within the phagocytes, pathogens are digested by a number of hydrolytic enzymes, thus freeing the body of disease-causing germs. Phagocytes also help in removing old, dead cells as well as cancerous cells.

(b) Lymphocytes, with a very large, darkly staining nucleus occupying the entire volume of the cell, with very little cytoplasm. Generation of memory cells upon first exposure to infectious agent is seen in primary response. Primary response leads to the generation of activated lymphocytes of the B- or T- type as well as memory cells. This response is not only weak in intensity but also takes a long time to initiate.

(c) Response produced by the body upon invasion of a foreign substance, especially infectious microbes and toxins produced by them and is protective in nature.

3. Differences between active and passive immunity

Active Immunity

(i) It is produced due to contact with pathogen or its antigen.

(ii) Immunity is not immediate. A time lapse occurs for its development.

(iii) It lasts for sufficiently long period, may be lifelong.

(iv) Antibodies are produced by the body in response to pathogen or antigen.

(v) Side effects are very few.

Passive Immunity

(i) It is produced due to antibodies obtained from outside

(ii) Immunity develops immediately

(iii) It lasts for a few days

(iv)Antibodies are obtained from outside

(v) At times the body reacts to the introduction of antisera. It is called serum sickness.

4. Though smallpox has been successfully eradicated, eradication of other diseases such as measles, tuberculosis, cholera and malaria has not been so successful. Success of smallpox vaccine was due mainly to the fact that pox virus did not mutate and the same vaccine could be used everywhere and the vaccine was highly effective. On the other hand, though measles vaccination has decreased death rates drastically, its total eradication has not been achieved so far due to several reasons. The disease is highly infectious, and spreads very fast. As long as it is present in one area, unvaccinated children in any country are at risk. For measles, boosters are required, difficult to achieve in poor countries, parents' decision not to vaccinate their children due to fear or other misconceived notions has also made the vaccination program less effective.

Effective vaccine against cholera has not been available for two major reasons:

(a) Immunity conferred by the vaccine is not long lasting;

(b) Cholera is a toxin mediated disease while protective immune mechanism is antibacterial rather than antitoxic.

Oral cholera vaccines have become available recently. Tuberculosis is a major killer, causing 2 to 3 million deaths annually. According to WHO reports, nearly one-third of the world's population is currently infected with TB.

Today, the only approved tuberculosis vaccine is bacilli Calmette Guerin (BCG) which was started in 1921.

Though it is quite effective in infants and young children, in adults, its efficacy is variable. Many boosters are also being developed, MVA85A, being the most advanced boost available. BCG vaccine has not been modified since 1921 and that may also be one reason why it is not so effective. That bacteria may have changed through evolution is suggested by their evolution of resistance to a number of known antibiotics.

A lot of effort is being devoted, but proving difficult as the bacterium lives within the cells and lack of suitable animal model for developing and testing human tuberculosis vaccine is posing a big challenge. In Africa, co infections of human immunodeficiency virus and TB have led to increases in the incidence rate of TB.

5. B cells produce and secrete antibodies, activating the immune system to destroy the pathogens. The main difference between T cells and B cells is that T cells can only recognize viral antigens outside the infected cells whereas B cells can recognize the surface antigens of bacteria and viruses.

6.

	Name
Cause malaria	Plasmodium
Transmits malaria	Female anopheles mosquito
Cause influenza	Influenza virus
Causes Ancylostomiasis	Ancylostoma duodenale
Provide penicillin	Penicilium notatum
Elephantiasis	Wuchereria bancrofti
Transmits venereal disease	HIV, *Chlamydia trachomatis, Treponema paridum,……..*
Scurvy	lack of vitamin C
Causes body's bad smell	Poor hygiene and sanitation
Creates feeling of pleasure and satisfaction	Cocaine abuse

3.9. Additional activities

3.9.1 Remedial activities

1) Diseases are broadly divided into two categories. What are they?
2) What do you think is a causal agent of cholera?
3) State the functions of having a balanced diet

Answers to remedial activities

1) Two categories of diseases are infectious diseases and non-infectious diseases
2) Vibrio cholerae.
3) A balanced diet helps to:

- Make you strong
- Provide better health
- Make you more productive
- Ensure strong immune system

3.9.2. Consolidation activities

1. Differentiate Antibody from Antigen.
2. State any two diseases caused by: a. Bacteria b. Protozoa c. Microscopic fungi
3. Explain what is meant by ring vaccination.

Answer to Consolidation activities:

1. Antibody: is a protein produced by the body's immune system when it detects harmful substances called antigen while Antigen is any substance that causes your immune system to produce antibodies against it.
2. Any two diseases caused by:
   a) Bacteria: Cholera, typhoid, tetanus, tuberculosis, etc.
   b) Protozoa: Malaria, sleeping sickness, trichomoniasis, etc.
   c) Microscopic fungi: Candidiasis, athlete's foot, ring worms, etc.
3. Ring vaccination is a vaccination of everyone within a certain place of the outbreak of the disease.

3.9.3. Extended activities

1. Observe the figure and answer to the question below.

a) What is this figure presenting?

b) Give the effect of living organism in figure to human body life?

2. What do you think are factors that cause the failure to eradicate tuberculosis?
3. (i) ..... leads to production of long lived memory cells.

   ii) Cholera is a ..... mediated disease.

   iii) ..... decreases blood pressure and contraction of muscles of bronchioles.

   iv)..... occurs upon inhaling certain allergens in the air leading to sneezing and coughing. (v) Penicillin is produced by .....

Answers to extended activities

1. a) The figure is presenting Salmonella typhus

   b) The effect of Salmonella typhus to human body life is that it causes the disease Typhoid
2. Factors that cause the failure to eradicate tuberculosis?

- Patients can carry pathogen and infection without showing symptoms. Therefore, they are difficult to identify due to a long period of incubation
- Germs of tuberculosis can survive longer in the house dust
- The disease is related to poverty where many people share the same room and have malnutrition.
- The disease is associated with AIDS that reduced the body immunity
- Long period of treatment (6-8 moths), hence patients give up when not yet fully healed. The pathogens then form endospores that resists to medicines.
- The disease is also spread through milk from infected animals. Tuberculosis is an airborne disease i.e. spread in air

3. (i) Vaccination (ii) Toxin (iii) Generalized allergic reaction (iv) High fever
   (v) Penicillium notatum

UNIT 4

EFFECTS OF HUMAN ACTIVITIES ON ECOSYSTEMS

4.1. Key unit competence

Evaluate the effects of human activities on the environment

4.2. Prerequisite

In order to learn better this unit, student-teachers should possess knowledge and understanding, skills and attitudes that are related to ecosystem. They should also be able to do observation, interpretation of the event and then capable to present and or communicate the results.

4.3. Cross cutting issues to be addressed

The following cross cutting issues will be addressed in this unit: environment and sustainability, financial education, inclusiveness education.

a) Environment and sustainability

Environment and sustainability will be addressed when student-teachers will be involved in activities related to visiting areas that have been polluted by human actions on the Earth and then take or suggest measures or ways and do practices aimed at reducing and stopping the destruction of the natural resources.

b) Financial Education

Financial education will be addressed when student-teachers will be discussing how modern agricultural technologies lead to high production from economies of scale since the misuse of them leads to economic depletion as well to other human's effects that will need more money to overcome them in terms of the money that is invested in the process and that will be used to deal with consequences.

Additional questions may be asked at the end of each lesson after student-teacher's presentation of the findings as well as the conclusion for emphasizing on finance as well as environment and sustainability.

c) inclusiveness education

All student-teachers should be encouraged to participate during lessons and group activities. Special arrangements should be done to take care of student-teachers with special needs. For example, provide large printed text or chart for those with sight problems and allocate physically challenged student-teachers to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during the practical sessions. For the clarity and visibility of teaching materials, make sure that students can see the pictures. As you will be taking students in a field study trip, care about all student-teachers particularly those with disabilities.

4.4. Guidance on introductory activity

Use picture provided in Student' Book or create your own contextualized scenario / learning situation and then do the following:

- Ask them what they can do for sustainably conserving ecosystems.
- Ask them to briefly suggest what can be done for sustainably conserve natural ecosystems.
- Give student-teachers time to think about the question and then give them time to brainstorm their ideas. Student-teachers will be to know the impact of human being on ecosystem.

4.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
	Negative impact of human activities on ecosystems	- Explain negative impact of human activities on an ecosystem. - Assess the negative impacts of intensive livestock production on ecosystem.	1
	Pollution: Air, water and land pollution	- Explain the sources and effects of air, water and land pollution - Assess the negative impacts of intensive livestock production on ecosystem.	2

	Bioindicators of pollution	- Discuss the indicators of ecosystem pollution	1
	Biological conservation and conservation method	- Explain the main methods of the conservation of environment resources. - Carry out research on the African species endangered by human activity - Assess the reasons of conserving wildlife	1
	End assessment unit		1

Lesson 1: Negative impact of human activities on ecosystems

a) Learning objectives

- Explain negative impact of human activities on an ecosystem.
- Assess the negative impacts of intensive livestock production on ecosystem.

b) Teaching resources

Pictures or illustrations, physical environment, farming using machines, Student's books, internet, simulation, computer, animation, etc.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Introduction to ecology and ecological terms.

Tutor introduces the lesson by asking questions that help student-teachers to remember ecological terms. This will be a good foundation to learn this unit.

d) Learning activities 4.1

Guidance

- Organize student-teachers in groups and ask them to do the **activity 4.1 indicated in Unit 3 of Student' Book on page 104.** Print the activity if you do not want to give student-teachers.
- Provide the necessary materials. Let student-teachers discuss.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.

- Note on chalk board / Manila paper the student-teachers' ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion.

Note: The activity should be given in advance in order to help student-teachers to make research.

Answer to learning activity 4.1

1. Undesirable effects of habitat destruction include extinction/ decrease of biodiversity, soil deterioration, greenhouse effects and climate change/ global warming, water contamination by minerals, acid rain, and ozone depletion etc.
2. The deforestation may cause flooding since trees absorb too much of heavy rain water and allow water to be retained or be given chance to penetrate into the soil. The absorbed water is used by a plant as well as lost during plant transpiration. Without trees, useful land becomes desert as the useful one is washed off by erosion.
3. Overfishing impacts water ecosystem due to lack or diminution of one species which favour the increase of another or one species lack food. Deforestation causes soils containing nutrients and chemicals to be washed into water.
4. Mining and industrialization impact ecosystem by: Compaction of soil, emissions of gases, industrial water sewage, and loss of habitat of biodiversity.

e) Application activity 4.1

Guidance

Ask student-teachers to work in pair to answer the questions of application activity 4.1. Avail all material, monitor the activity, assess other's work and provide feedback.

Answer to application activity 4.1

The answer is discussed in **unit 4 of Student' Book on page 104-109**

Lesson 2: Pollution: Air, water and land pollution

a) Learning objective

- Explain the sources and effects of air, water and land pollution
- Assess the negative impacts of intensive livestock production on ecosystem.

b) Teaching resources

Pictures or illustrations, photographs, physical environment, farming using machines, Student' books, internet, simulation, computer, animation, etc.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Ecosystem component

Tutor introduces the lesson by asking questions that help student-teachers to remember ecological functions. This will be a good foundation to learn this lesson.

d) Learning activity 4.2

Guidance

- Organize student-teachers in groups.
- Take them to a nearby your school site polluted (water pond or land) that is suffering from degradation. Provide guiding questions.
- Invite them to conduct a survey about how the site is polluted.
- Ask them to predict the causes of pollutant.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Note on chalk board / Manila paper the student-teachers' ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion.

Note: If there is no polluted site nearby the school, use computer or print a diagram that show it.

Answer to learning activity 4.2.

a) The sources of water and land pollution are: Domestic and municipal wastes; industrial and mining wastes; radioactive wastes; biological agents; fertilizers and pesticides.

b) Main sources of pollution are: Main cause of environmental pollution include: industrial emissions, poor disposal of wastes, mining, deforestation, use of fossil fuels and agricultural activities.

c) Causes of acid rain are:

i) The emissions of Sulphur oxides by industries and other equipment. Acid rain affects living organisms particularly plants and animals.

ii) Eutrophication is caused by excess of too much nitrogen, phosphorus and potassium that ends by being released in water. Eutrophication causes death to organisms living in water due to algae bloom followed by suffocation.

iii) Poor disposal of plastic bottles is the cause of non-biodegradable plastics. They prevent water from getting into the soil. They cause death to soil living organisms.

a) Ways of reducing pollution: proper disposal of the wastes, planting trees, not releasing domestic or industrial wastes into surface water, not using carbon dioxide releasing equipment, etc.

e) Application activities 4.2

Guidance

Ask student-teachers to work in pair to answer the questions of application activity 4.1. Avail all materials, monitor the activity, assess the work and provide feedback.

Answer to application activities 4.2

1. Industrial sewage and fertilizer application pollute water and land. This lead to the change of water and land composition; thus destroying the organisms
2. The increase of carbon dioxide in atmosphere stops the infra-red reflected by the earth and cause the constant increase of earth temperature. The effect of global warming on ecosystem is discussed in unit 4 of Student's Book on page 112.
3. Non-biodegradable plastics are very dangerous to farmers and other soil dwelling organisms since they prevent water from getting into the soil. They cause death to soil living organisms
4. Ways of mitigating pollution include proper disposal of wastes, not using equipment that release more carbon dioxide, planting plants.

Lesson 3: Bio-indicators of pollution

a) Learning objective

Discuss the indicators of ecosystem pollution

b) Teaching resources

Pictures or illustrations, photographs, physical environment, farming using machines, Student' books, internet, simulation, computer, animation, etc.

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

Ecosystem components

Tutor introduces the lesson by asking questions that help student-teachers to remember ecological functions. This will be a good foundation to learn this lesson.

d) Learning activities 4.3

Guidance

- Organize student-teachers in groups.
- Take them to a nearby your school site polluted (water pond or land) that is suffering from degradation. Provide guiding questions.
- Invite them to conduct a survey about how the site is polluted.
- Ask them to predict the causes of pollutant.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Note on chalk board / Manila paper the student-teachers' ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion.

Answer to learning activities 4.3

The answer is discussed in Unit 4 of Student's Book o**n page 117-118**.

e) Application activities 4.3

Guidance

Ask student-teachers to work individually to answer the questions of application activity 4.3. Avail all materials, monitor the activity, assess the work and provide feedback.

Answer to application activities 4.3

a) The present bioindicators are algae. Algae indicate the change in chemical composition of water and air.

b) The answer is discussed in Unit 4 of Student's Book **on page 117.**

Lesson 4: Biological conservation and conservation method

a) Learning objective

- Explain the main methods of the conservation of environment resources.
- Carry out research on the African species endangered by human activity
- Assess the reasons of conserving wildlife

b) Teaching resources

Internet, physical environment like a park, students' textbooks, illustrations or photographs

c) Prerequisites/Revision/Introduction

Student-teachers learn better this lesson if they know the following:

- Ecosystem components
- pollution

Tutor introduces the lesson by asking questions that help student-teachers to remember ecological functions and pollution. This will be a good foundation to learn this lesson.

d) Learning activity 4.4

Guidance

- Organize student-teachers in groups.
- Ask them to carry out research on the endangered species in Africa as a result of human activity and the methods of conservation of resources.
- Provide guiding questions.
- Monitor the activity and assist slow student-teachers with learning difficulties.
- Invite groups to present their findings to the rest of student-teachers.
- Note on chalk board / Manila paper the student-teachers' ideas.
- Tick the correct findings and correct those ones which are incorrect and try again to complete those which are incomplete.
- Harmonize and engage student-teachers in making that conclusion.

Answer to learning activity 4.4

1. We should care the loss of biodiversity in order to maintain the ecological equilibrium.
2. The most endangered species in Africa include elephants for their tusks, impala, and others.
3. Main methods of the conservation of resources include: Bioremediation, Biological augmentation, mowing, grazing or burning to halt success, coppicing, creating protected areas or zones, Restricting urban and industrial development, Reclaiming derelict sites or other areas, legally protecting endangered species, Prohibiting the release or introduction of non-native/ invasive animals and plants into an area, Controlling pollution, especially in sensitive environments in which species are at risk of extinction, Recycling materials such as paper, glass bottles and clothes.
4. Examples of conservation in action are discussed in **Unit 4 of Student's Book on page 121.**

e) Application activities 4.4

Guidance

Ask student-teachers to work individually to answer the questions of application activity 4.4. Avail all materials, monitor the activity, assess the work and provide feedback.

Answer to application activities 4.4

1. The measures to implement environmental protection are discussed in **unit 4 of Student's Book on page 122-123.**
2. Nyungwe national park and other protected areas would be destroyed and lead to the loss of biodiversity.
3. The aquatic livings will end up by not having their habitat if soils eroded from hillsides keep on being reaching and taken by Nyabarongo River which is ecosystem of a number of aquatic wildlife. The way of restoring Nyabarongo River is by removing the soils and preventing other soils to get into that river.

4.6. Summary of the unit

This unit consists of modern agricultural technologies for food production, impacts of human activities on ecosystem, pollution and biological conservation and restoration.

Modern agricultural technologies increase for food production. It is followed by the impact of human activities on ecosystem whereby within this lesson, the negative consequences of large scale monoculture and livestock farming are presented.

In the third lesson which is about pollution, types, causes and effects of pollution are provided. Regarding to the lesson of biological conservation and restoration, different practices of conservation and restoration are discussed.

4.7. Additional Information for tutor

Modern agriculture uses pesticides which are organic compounds or substances. They include; insecticides, herbicides and fungicides, used with the purpose of killing unwanted plants, insects or fungi which might harm the plants. Utilization of pesticides escalates food production in case of their effective use. However, some of the pesticides present negative effects on the environment.

Examples include the 3, 5, 6-Trichloro-2-pyridinyloxyacetic acid which inhibits soil bacteria that transform ammonia into nitrite, Glyphosate ($C_3H_8NO_5P$) which reduces the growth and activity of free-living nitrogen-fixing bacteria in soil, and oryzalin and trifluralin which inhibits the growth of certain species of mycorrhizal fungi. Insecticides can contaminate non-targeted organisms including; insects, fish, or plants through the spray onto eroding soil or when heavy rain falls right after an application.

Guidance on skills Lab 4

The tutor helps student-teachers to identify the area that need to be protected in school compound. Tutor and student-teachers identify the new species of plants to be added that fit with the climate. Tutor guides student-teachers to prepare the land for planting new species and avail the appropriate fertilizers and manure. Tutor makes a follow up and completes the evaluation sheet.

Tutor provides regular feedback and asks student-teachers to make improvement where necessary.

4.8. Answers to end unit assessment

1. Humans impact the ecosystem by:

- Deforestation (cutting trees);
- Agricultural activities that use agricultural machines, pesticides, fertilizers; intensive farming and monoculture;
- Overfishing;
- Doing mining;
- Industrial activities;
- Releasing domestic and or industrial wastes in the open environment

2. The major and single cause of the deforestation in tropical area is the conversion of forest to cropland (agricultural land) and pasture (livestock farming).

3. Advantages and disadvantages of agricultural practices (deforestation, applying nitrogenous fertilizers to crops, burning agricultural waste such as straw, growing crop plants with genetically engineered resistance to herbicide e.g. glyphosate)

a) Deforestation

Advantages: wood used as fuel; land cleared for agriculture to grow more food; profit made from selling timber for export;

Disadvantages: burning of timber releases additional carbon dioxide which contribute to greenhouse effect as there is fewer producers to absorb carbon dioxide; soil may be eroded; eventually desertification; silting up of rivers etc.; heavy rain no longer absorbed by forests leads to increased risk of flooding; loss of biodiversity/ habitats/ species/

b) Applying nitrogenous fertilizers to crops

Advantages: increased productivity/ total yield of farmland; increased growth rate of crops; poor land can be used for agriculture;

Disadvantages: eutrophication/ soluble excess fertilisers increase algal growth in rivers/lakes, decomposer organisms thrive when this decays, reducing oxygen content and killing aerobic organisms/ population in water; excess fertiliser wastes money/ reduces profits; too little fertiliser may not enough increase in yield to pay for cost of fertilizer.

c) Burning agricultural waste such as straw

Advantages: quick/easy clearance of waste; destroy fungal spores/parasitic eggs

Disadvantages: increased amounts of carbon dioxide, adding to greenhouse effect; less humus/organic material to return to, and improve the quality of soil

d) Growing crop plants with genetically engineered resistance to herbicide e.g. glyphosate

e) Advantages: weeds controlled more easily/less labour/ cost involved in overcoming weeds; increased crop yield as less completion for resources; increasing profits

f) Disadvantages: herbicide resistance may theoretically spread to weeds; consumers may dislike the idea of genetically engineered foods; maybe more expensive than normal crop plants.

g) Increased in minerals cause algal bloom / algae/ small water plants to multiply rapidly/ eutrophication so much growth occurs that light prevented from reaching plants / algae below surface which then die; massive increase in aerobic, decomposer bacteria decreases concentration of oxygen. Thus, as the decrease in amount of oxygen threaten fish population.

4. The following are the key points of the answer:

- Zoologists and conservationists fear that many if not all species of amphibians (frogs, toads, and salamanders) would distinct since they are in deep trouble due to global pollution and climate change.
- Industrial Combustion of fossil fuels/ oil/ coal: release of nitrogen oxides/ Sulphur dioxide which will form dilute nitric acid/ sulphuric acid when dissolved in rain. Acid rain may be carried by wind from one country or industry to another
- Agricultural pesticides are also pollutants of the amphibians
- Those pollutants affect directly amphibians' eggs; harm indirectly tadpoles (irritate their gills, heavy metals may increase in concentration, and poisoning the tadpoles as well as food chain); some herbicides kill all vegetation, so could destroy adult's habitat/ food source for tadpole in herbivorous stage; if young affected, overall population of amphibians may decline
- Adult amphibians live on land, apart from breeding season, so are less likely to be vulnerable to pollutants in water; eggs/ tadpoles are aquatic for all of their lives, so have greater exposure to pollutants than adults; soluble material may enter soft/ unshelled eggs by diffusion; water passing over tadpole gills come into close contact with circulatory system, so harmful material, dissolved in water could diffuse into tadpole's blood; amphibians have thin skins, allowing pollutants to diffuse easily across tadpole skin.

5. Adding nutrients cause population explosion of algae and the organisms that feed on them increased respiration by algae and consumers', including detritivores, depletes the lake's oxygen which the fish use to survive. Thus, fish may die due to the lack of oxygen.

6. At lower trophic level, because biological magnification increases the concentration of toxins up the food chain.

7. The newly introduced species damage natural environment/ecosystem by the substances that they produce and secrete into the soil. Those substances are not suitable to the native organisms. In addition, they are sometimes good competitors with the native species so that they have high adaptation to the new environment.

8. Modern agriculture is a solution to humans as the increase food production. However, they are also an issue as they destroy the environment in different ways through pollution, destruction of natural environment, and so on.

4.9. Additional activities

4.9.1. Remedial activities 4

1. Referring to modern agriculture and extraction of natural resources, explain the reasons for habitat destruction.
2. Describe how you can identify the area polluted by excess of fertilizers by Bio-indicators

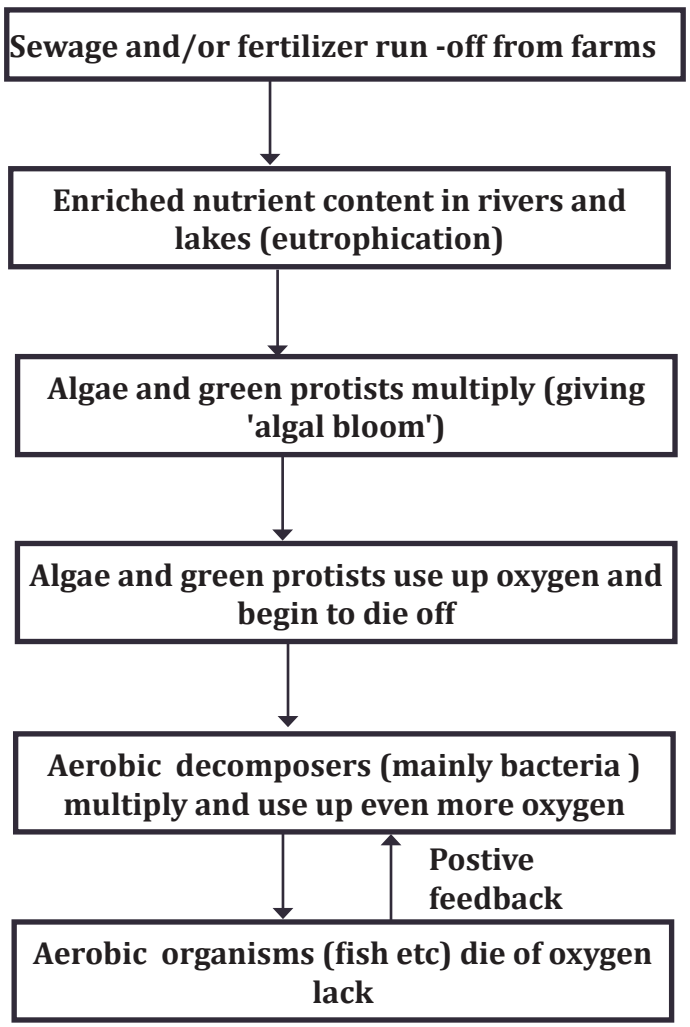
Answer to remedial activities 4

1. Reasons for habitat destruction are mainly about searching land for agricultural services, intensification of livestock, economic services by searching timber/ charcoal, mining and overfishing.
2. This can be done by observing whether there is algal bloom which will cause eutrophication.

4.9.2. Consolidation activities 4

1. Create a flowchart showing the sequential events that lead to eutrophication.

Answer to consolidation activities 4



4.9.3. Extended activities 4

1. Make a research on the bio-indicators and their indications vis-à-vis the pollution.
2. Describe how it is very dangerous to introduced new species in natural ecosystem.
3. Why do Rwandans need to conserve elephant? Suggest how its conservation can be ensured?

4. Using resources wisely is one of the recommendations of REMA. How the misuse of them has great impact to entire ecosystem?

Answer to extended activities 4

1. The commonly used bio indicators and their indications include: lichens, liverworts that indicate the area contaminated by sulphur dioxide; diatoms/ unicellular marks an area with rapid eutrophication; bacteria which change their colour or the light they emit due to change in their proteins as a result of the minerals exposed that are exposed to.
2. Invasive species damage natural environment/ ecosystem by destroying or harming the native species.
3. A keystone species for example an elephant is an animal that plays a unique and crucial role in the way an ecosystem functions. If the attention is not paid to them, the ecosystem would be dramatically different or cease to exist altogether or species being animals or plants would diminish to extinction.
4. By being released in different ecosystems being water, land, and air. Once released, they contribute to harming or threatening natural ecosystem.

UNIT 5

WORK, ENERGY AND POWER

5.1. Key unit competence

Differentiate work, energy and power and criticize the management of energy and natural resources.

5.2. Prerequisite

The success of this unit relies partly on the mastery of knowledge, skills acquired in Physics and other subjects in previous grades or unit as indicated below.

Work, energy and Power (I) (unit 6, Senior 1)

Simple harmonic motion (Unit 2, senior two). This will help them to understand work, energy and power and the management of energy and natural resources

5.3. Cross cutting issues to be addressed

Gender: Let the student teacher carry out activities in student teacher's book (if it is a mixed school, the number of boys and girls in each group should be balanced).

Inclusive education: - All differentiation should be taken into consideration in solving different activities in this unit.

- Help them in selecting their group leaders. Identify student teacher with special needs in group making. -Encourage them to actively participate in their respective groups.

Peace and value: - When student teachers are working activities, tell them that they can respect each other's opinion (don't blame someone, respect his/her ideas).

Put learners in groups (select any number of learners depending on the size of the class) make sure that they work in harmony.

5.4. Guidance on introductory activity

The Tutor asks Student Teachers to open Learner's Book and read carefully the questions given on introductory activity of unit 5. The Tutor will guide Student Teachers in their discussions. The activity should be done in groups, in pairs or individually depending on the size of the class. Learners should share their findings in groups or pairs before presentation in front of the whole class. The Student Teachers should not answer all questions. If this happen, the Tutor will help them to get the answers as the lesson is ongoing

5.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
1	Concept of work, energy and power	- Distinguish the concepts of work, energy and power - Classify energy sources as renewable and non-renewable. - Explain energy degradation - Solve problems related to work, power and energy.	2
2	Energy production and related issues	- Identify major issues associated with energy management. - Show concern about shortage of energy sources in Rwanda.	3
3	End unit Assessment		1

Lesson 1: Concepts of work, energy and power

a) Learning objectives

- Distinguish the concepts of work, energy and power
- Classify energy sources as renewable and non-renewable.
- Explain energy degradation
- Solve problems related to work, power and energy.

b) Teaching resources

Simulations, typical scientific reports.

c) Prerequisites/Revision/Introduction

Linking this lesson to the previous one, ask learners to state the effects of green gases in the atmosphere.

Use concepts from: **Environmental phenomena and related physics concepts (S.3 unit 15)**

d) Learning activity 5.1

Guidance to activity 5.1

This activity introduces learners to the concepts of work, energy and power

- Tell student-teacher to observe clearly picture in the activity 5.1 in the learner's book.
- Decide the methodology to use in this lesson. (You can use individual or groups)
- Tell them to read the questions in the activity 5.1
- Leave the students to copy the questions and attempt them by themselves.
- While students are doing this work, you can move around marking and guiding learners where there might be a problem.
- When students are done and you are also done with marking, invite some students to discuss their answers and observations to the whole class.
- Together with students summarize what you have discussed and note down important points on the board and let them put them in their findings.
- Link what you have discussed to the lesson and give them the summary of expected feedback based on their findings.

Note in case there is a student that requires special attention, please make sure assistance is provided.

Expected answers to activity 5.1

a) Doing work

b) When a mass (weight) is moved through a distance

c) From the question, its shows that the machine has less power since it took a lot of time to accomplish the work that would be done in 5 minutes.

From $Power = \frac{Work\ done}{time}$ .Thus since time is much then it implies that the power of machine is less, hence inefficient.

d) It's not as described in c) above. Power of machine can be derived from

$$Power = \frac{Work\ done}{time}$$

e) Answers for application activity 5.1

1) $mass(m) = 500\ kg$, $height(h) = 20\ m$, $time(t) = 60\ s$

$Power(\mathrm{P}) = ?$

$$P = \frac{mgh}{t}$$

$$P = \frac{500\ kg \times 20\ \ m/s \times 9.8}{60\ s}$$

$$P = 1.63\ kW$$

2) $Velocity(v) = 100\ km/h$, $mass\ of\ the\ car(m) = 950\ kg$

$kinetic\ energy(KE) = ?$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(950\ kg)(\frac{10^5\ \ m}{3600\ s})$$
$$= 3.67 \times 10^5\ J = 0.367\ MJ$$

3) $mass(m) = 1200\ kg$, $initial\ velocity(v_i) = 20\ m/s$, $dis\tan ce(d) = 130\ m$

$$W_F = -Fs = \Delta K$$

$$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = \frac{1}{2}(1200\ kg)(225\ m^2/s^2 - 400\ m^2/s^2)$$

$\Delta K = -105\ kJ$. Thus $Fs = 105\ kJ$ and $F = \frac{\Delta K}{s} = \frac{105}{130}\ N$

$$F = 0.81\ kN$$

4) $mass\ of\ a\ car(m) = 1300\ kg$, $Initial(v_i) = 0\ m/s$, $Finalvelocity(v_f) = 20\ m/s$
$distaance(d) = 80\ m$

$Force(F) = ?$

$$W = \Delta K = \frac{1}{2}mv^2 - 0 = \frac{1}{2}(1300\ kg)(20\ m/s^2)$$

$W = 260\ kN$ **. But** $W = Fs \Leftrightarrow F = \frac{W}{S}$

$$F = \frac{260}{80}\ N = 3.25\ kN$$

Lesson 2: Energy production and related issues

a) Learning objective

- Identify major issues associated with energy management.
- Show concern about shortage of energy sources in Rwanda.

b) Teaching resources

Simulations, typical scientific report and Text books (all reference books in student's book) and internet.

c) Prerequisites/Revision/Introduction

Student Teachers have skills on Work, energy and power (I) learnt in S1 Unit 6 and S2 unit 8, they have learnt Work, Power and Energy. This will help them to understand energy production and related issues.

d) Learning activities

Guidance about activity 5.2

This activity is aimed at making students explore energy production and its usage through research. It is also aimed at improving research skills amongst students.

- Tell the students to start/do on their research. Guide them to get areas where to do the research.
- In case there is a student that needs special care, please guide them accordingly.
- Please try to correct their research work and advise those who had difficulties in getting relevant information.
- When all students are done with the research, make sure they present their findings to the whole class. Remember findings may be different. Try to harmonize in case there are contradictions. In presentations, students may use PowerPoint.

- Let learners summarize the key concepts in their notebooks.

Expected answers to activity 5.2.

These questions need not to be answered. (Have no exact answers) It a research-based question where findings are to be got from people.

e) Answers for application activity 5.2

1. (a) 2. (b) 3. (a) 4. (c) 5. (a)

5.6. Summary of the unit

The work –kinetic energy theorem states that the net work done on an object equals the change in kinetic of the object $W_{net} = KE_f - KE_i = \Delta KE$

Power is the ratio of energy transfer to the time interval during which the transfer occurs. $P = \frac{W}{t}$ The SI unit of power is the **watt (or J/s).**

Relation between work, energy and power $P = \frac{W}{t} = \frac{F \times d}{t}$

$$= F \times \frac{d}{t} = F \times V$$

Power $= \frac{\text{work}}{\text{time}} = \frac{\text{energy}}{\text{time}}$

5.7. Additional Information for teachers

- **Elastic potential energy**

Restoring force

A block on a horizontal, frictionless surface is connected to a spring. If the spring is either stretched or compressed a small distance from its unscratched (equilibrium) configuration, it exerts on the block a force that can be expressed as

$$F = -kx$$

where :

- x is the position of the block relative to its equilibrium (x = 0) position

- *k* is a positive constant called the force constant or the spring constant of the spring. It is a measure of the **stiffness of the spring**. Stiff springs have large *k* values, and soft springs have small *k* values. The units of *k* are N/m.
- The negative sign in Equation signifies that the force exerted by the spring is always directed *opposite* to the displacement from equilibrium.

Because the spring force always acts toward the equilibrium position (x = 0), it is sometimes called a **restoring force.** The force required to stretch or compress a spring is proportional to the amount of stretch or compression *x*. This force law for springs is known as **Hooke's law.**

Elastic Potential Energy

The elastic potential energy of the system can be thought of as the energy stored in the deformed spring (one that is either compressed or stretched from its equilibrium position).

When a block is pushed against the spring and the spring is compressed a distance *x*, the elastic potential energy stored in the spring is $U = \frac{1}{2}kx^2$

When the block is released from rest, the spring exerts a force on the block and returns to its original length. The stored elastic potential energy is transformed into kinetic energy of the block

The elastic potential energy stored in a spring is zero whenever the spring is undeformed. Energy is stored in the spring only when the spring is either stretched or compressed. Furthermore, the elastic potential energy is a maximum when the spring has reached its maximum compression or extension (that is, when $x = x_m$ is a maximum).

Finally, because the elastic potential energy is proportional to x^2, we see that *Us* is always positive in a deformed spring.

- **Gravitational potential energy (potential energy of position)**

An object raised to a height has energy due to the position it is at. An object raised to a higher level has more gravitational potential energy. If an object such as a hummer or a brick which was placed on a table top is let to fall it can break something which is placed in its way or it can hurt someone whose foot is in its way because the potential energy which was stored in it is changed into motion (kinetic) energy which is used to break something or hurt someone in its way. More work is done in raising a brick to higher level hence more gravitational potential energy is stored in the brick at a higher level.

The potential energy associated with a body's weight and its height above the ground is called gravitational potential energy. The gravitational potential energy of a mass m, at a height h, is:

$$U_g = mgh$$

Gravitational potential energy is the potential energy of the object–Earth system. This potential energy is transformed into kinetic energy of the system by the gravitational force.

Guidance about skills lab 5

In this activity, Learners are able to show the skills attained from this unit. According to the activity, they find power developed in moving a body from one place to another.

- Facilitate the student teachers' to get materials to use in performing the activity. These are: Meter rule, Masking tape, 100g object, spring balance (of 10N), a string, and a stop watch. Some of these materials may be found in the school laboratory.
- Assist them (if necessary) to arrange the materials as set in the procedures/ questions as set in the learner's book.
- You may always inspect their progress and advise where necessary. Inform them to note down their results in their books.
- Help those students with any problem (SEN) so that all of your students achieve the objectives of this activity.
- Try to check every group/individual whether they are getting expected results for different questions (i, ii, and iii). You can mark their work.
- You may allow them/some groups/individuals to share their results to the whole class.
- In case there some individuals that are not making it, ask others that have tried it, to help them**.**

Note: For these questions, answers vary depending on the amount of force (pull) applied to the mass. What is important is to make students analyze how power is calculated.

5.8. Answers to end unit assessment

Part1

1. A	2. B	3. A	4. D	5. C	6. B
7. B					
8. D	9. A	10. E	11. A	12. B	13. B
14. D					
15. A	16. D	17. E			

Part2

1. - The kinetic energy $W = \frac{1}{2}mv^2 = \frac{1}{2} \times 7 \times 3^2 = 31.5\ J$

   - The power $P = \frac{mgh}{t} = \frac{193 \times 10 \times 7.5}{5} = 2895\ W = 2.895\ kW$

2. The best motor is one with power of 3.5 kW

3. The change in kinetic energy must be equal to the net work done on the car,

   $W = Fd = 400 \times 5 = 2\,000\ J$

   The final velocity is obtained from

   $$W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \Leftrightarrow v_f = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2 \times 2000}{1000}} = 2\ m/s$$

4. a) Energy: is the ability to do work such as moving matter over a distance or causing a heat transfer between two objects at different temperature. Example, Heat, Light, Electricity, Chemical energy.

   b) The energy contained in moving body is called Kinetic Energy.

   c) Potential Energy is stored energy that is latent but available for use. Chemical energy stored in the food and gasoline are examples of Potential Energy.

   d) Power is the rate of doing work. Its SI unit is J (joule)

5. a) $P = \frac{W}{t} = \frac{Fs}{t} = Fvd$; $F = 900\ N$, Speed: $v = \frac{s}{t} = \frac{45000}{60 \times 60} = 12.5\ m/s$

   Work done is equal to force´distance $W = Fs$. But distance is equal to speed´time

$s = vt \Rightarrow v = \frac{s}{t}$ and hence $P = 900 \times 12.5 = 11.25\ kW$

b) $F = 1200\ N$ speed: $v = \frac{60000}{60 \times 60} = \frac{50}{3}\ m/s$, using $P = Fv = 1200 \times \frac{50}{3} = 20\ kW$

6. Difference $\Delta E = \frac{1}{2}(5.2)\left[(4.2)^2 - (3.1)^2\right] = 21\ J$

5.9. Additional activities

5.9.1. Remedial activities

1. Which the following is not a renewable source of energy?
   a) Solar energy
   b) Biomass energy
   c) Hydro-power
   d) Geothermal energy
2. Identify the non-renewable energy resource from the following:
   a) Coal
   b) Fuel cells
   c) Wind power
   d) Wave power
3. Photovoltaic energy is the conversion of sunlight into:
   a) chemical energy
   b) Biogas
   c) Electricity
   d) Geothermal energy
4. Which of the following energy resources accounts for most of the world's percent energy use?
   A. Uranium
   B. Fossil fuels
   C. Solar energy
   D. Wind energy
5. Which of the following is not the source of solar energy?

A. Photo-electric cell
B. Solar cell
C. Photo voltaic cell
D. Thermocouple

Answers: 1. (b); 2. (a); 3. (a); 4. (b); 5. (d)

5.9.2. Consolidation activities

1. Find the work done in lifting a mass of 2 kg vertically upwards through 10 m.

$(g = 10\ m/s^2)$

2. What power is expended by a boy who lifts a 300 N block through 10 m in 10 s?

3. Determine the work done by a horse exerting a force of 60kg on a vehicle when the vehicle travels a distance of 2 km.

Answers*:*

1. To lift the mass upwards against gravity, a force equal to its own weight is exerted.

Applied force $= weight = mg = 2\ kg \times 10\ N/kg = 20\ N$

Work done $W = F \times d = 20\ N \times 10\ m = 200\ Nm$

Work done $(W) = 200\ J$

2. Force $(F) = 300\ N$, Distance $(d) = 10\ m$, **Time** (t) $= 10$ s

Work done by the body (W) $= F \times d = 300 \times 10$

$$W = 3000\ J$$

$$Power(\mathrm{P}) = \frac{work}{time} = \frac{3000\ J}{10\ s}$$
$$= 300\ Watts$$

3. From work done

$W = Force \times displacement = F \times d$

$F = m \times g$

$F = 60 \times 9.8\ N = 588\ N$

Then $Work = F \times d = 588 \times 2000 = 1176000J$

5.9.3. Extended activities

1. A 145-g baseball is thrown with a speed of 25m/s
   a) What is its kinetic energy?
   b) How much work was done to reach this speed starting from rest?
2. A girl whose mass is 60 kg can run up a flight of 35 steps each of 10 cm high in 4 seconds. Find the power of the girl. (Take $g = 10\ m/s^2$)

Answers:

1. a) $Ke = \frac{1}{2}mv^2$

$$Ke = \frac{1}{2} \times 0.145 \times (25)^2 = 45.3\ J$$

b) Using kinetic energy theorem $W = \Delta Ke = \frac{1}{2}mv^2 - 0$

$$W = \frac{1}{2}mv^2 = 45.3\ J$$

2. Force overcome (weight) $= mg$

$$= 60 \times 10\ N = 600\ N$$

Total distance $d = 10 \times 35 = 350cm = 3.5\ cm$

Work done by the girl $W = F \times d = 600 \times 3.5$

$$W = 2100\ J$$

Power $P = \frac{Work}{time} = \frac{2100\ J}{4\ s}$

The power of the girl is 525 Watts

UNIT 6

ANALOG AND DIGITAL SIGNALS

6.1. Key unit competence

Compare analogue and digital signal systems

6.2. Prerequisite

The success of this unit relies partly on the mastery of knowledge, skills acquired in Physics and other subjects in previous grades or unit as indicated below.

Telecommunication channels (unit 13, senior three)

6.3. Cross cutting issues to be addressed

In this unit teacher need to focus on where and when and how she/he will integrate crosscutting issues, for examples:

- **Peace and value**: assigning work peacefully
- Inclusive education: all learners are included.
- Gender: recognize male and female in performing tasks.
- Should learn to work together

6.4. Guidance on introductory activity

This activity aims at bringing/capture students' attention about 6.1 analogue and digital signal systems

- Divide your students into groups (Grouping may depend on the nature of your class or number of learners you have). Always take care of learners with any kind of disability while making groups.
- Tell the learners to open the introductory activity 6 in the learner's book. Give them clear information about the activity.
- While learners are doing this activity, you move around, guide or answer to the questions of slow learners. You may mark the working of those who have finished.
- When everyone has finished the activity, invite some member(s) or group(s) to present their findings to the whole class. Guide the discussion

- Ask other members whether their answers correspond to the discussed points and if there is any point that is different from what have been raised to mention it.
- Note some misconceptions and misunderstanding so that they will be corrected and harmonised in the lesson. Together with students, harmonize the points and make a summary on the board. Give to the learners the opportunity to write the main points in their notebooks.
- Harmonize the lesson by linking what have been discussed and the summary of the lesson.
- Summarize your lesson by linking this concept to real life situations.

Note *that in case there is a student that requires special attention, please make sure assistance is provided*

6.5. List of lessons

#	Lesson title	Learning objectives	Number of Periods
1	Introduction to information	- Explain the types of information and Main terms used in communication	2
2	Signal systems	- Differentiate digital and analogue systems of communication - Evaluate advantages and disadvantages of digital and analogue systems - Describe the principles of signal system in information technology	2
3	End unit assessment		1

Lesson 1: Introduction to information

a) Learning objectivities

Explain the types of information and Main terms used in communication

b) Teaching resources

Computer, projector, oscilloscope, cell phones

c) Prerequisites/Revision/Introduction

Student Teachers have skills on Telecommunication learnt in S3 unit 13, this will help them to understand Main terms used in communication

d) Learning activity 6.1

Guidance

Discussion in pairs with hand out of activity 6.1

Expected answers to activity 6.1

1. Communicating via telephone
2. The question requires need for communication. To send and receive messages

e) Answer for application activity 6.1

The channel is a medium through which a message travels from the sender to the receiver.

Feedback describes the receiver's response or reaction to the sender's message.

Lesson 2: Signal systems

a) Learning objectives

- Differentiate digital and analogue systems of communication
- Evaluate advantages and disadvantages of digital and analogue systems
- Describe the principles of signal system in information technology

b) Teaching resources: Textbooks,

c) Prerequisites/Revision/Introduction

Through guided discovery, assist learners to describe signals systems. You can make a recap using Telecommunication channels learnt in o'level, Unit 13.

d) Learning activity 6.2

Guidance

This activity aims at capturing students' attention and minds towards this concept

- Divide your students into groups, tell the learners to open the activity 6.2 in the learner's book.
- Instruct learners to observe the picture in the activity 6.2 in the learner's book and discuss by answering in their notebooks.

- While students are doing this activity, you move around and mark their work.
- When everyone is done and you are done, invite some member(s) or group(s) to discuss their findings to the whole class.
- Inquire from other students or groups whether their answers correspond to the ones discussed
- Together with students harmonize the points and make a summary on the board. Allow learners to write the main points in their notebooks
- Linking to the summary and what have been discussed in class, take a step and explain intensively Signal systems
- Link this lesson to real life

Expected answers to activity 6.2

1. a) By wireless

   b) Mobile phone and radio communication.

2. a) Refer to students' book

   b) This would be not only bad but also expensive. Above all there would be congestion of wires in the space and other related problems on transmission of signals using cables/wires.

e) Answers for application activity 6.2

1. D 2. D 3. B 4. a

6.6. Summary of the unit

A message is information put in an appropriate form for transmission. Each message contains information. A message can be either **analog message (**a physical time-variable quantity usually in smooth and continuous form) or **a digital message (**an ordered sequence of symbols selected from finite set of elements

Analogue systems operate with values that vary continuously and have no abrupt transitions between levels. Analog signal is a continuous signal that contains time varying quantities. An analog signal is a continuous wave denoted by a sine wave and may vary in signal strength (amplitude) or frequency (time).

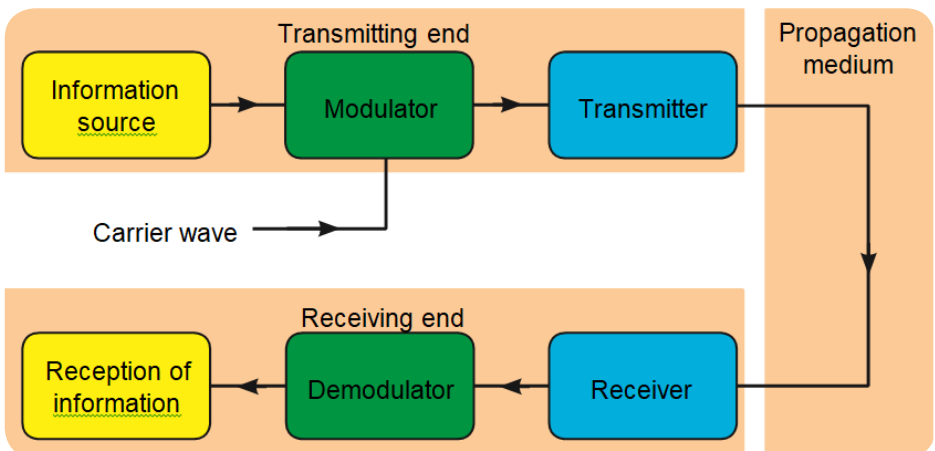
Unlike analog technology which uses continuous signals, digital technology encodes the information into discrete signal states. Numerous and very successful applications of digital technology include the continuously growing number of computers, the communication network as well as the increasing use of digital control stations (Direct Digital Control: DDC).

A transmitter is a device that converts the input signal to transmitted signal suited for the transmitting channel after **using a modulator** and **using an encoder** it. Here the signal can be affected by various phenomena which take place in the channel within which the signal will be fed for transmission.

6.7. Additional Information for teachers

- A communication system is made up of devices that employ one of two communication methods: (**wireless or wired**) different types of equipment: portable radios, mobile radios, base/fixed station radios and repeaters) accessories (examples include speaker microphones, battery eliminators and carrying cases) and/or enhancements (encryption, digital communications, security measures, and networking) to meet the user needs.
- The most common processing of a signal in a communication system consists of passing the signal through a linear time-invariant system. In this context, such a system is often spoken of as a "filter". These systems are usually applied to reduce some undesirable components in the signal, to compensate for some undesirable distortion of the signal, or to accentuate some characteristic of a signal. This unit discusses digital and analog signals and their use in modern communication

A communication system comprises of three sections or parts; transmitting end, propagation medium and receiving end.



The signals from information source are added to the carrier in the modulator. The modulated signal is sent along a channel in **the propagating medium** by a transmitter. The propagation medium is a channel through which information is transmitted. This may be a cable or free space.

At the receiving end, the receiver may have to select and perhaps amplify the modulated signal before the demodulator extracts from it the information signal for delivery to the receptor of information.

A propagation or transmission medium can be classified as;

Linear medium*:* if different waves at any particular point in medium can be superposed.

Bounded medium: if it is finite in extent, otherwise unbound.

Uniform medium or homogeneous medium: if it's physical properties are unchanged at different points.

Isotropic medium: if it's physical properties are the same in different directions.

Guidance on Lab skills 6

- At the end of this unit of Analogue and Digital in Communication, the Tutor assigns an activity of skills lab in which Students teachers will conduct a survey to identify different devices used in telecommunication in a chosen village near the school.
- Student teachers will carry out this activity in pairs if possible.
- The Tutor will give them instructions as indicated in learner's book. He/ She choose a suitable moment to carry out this activity.
- The following chart should be used to collect information.

Device	Number of family	Wireless devices	Non wireless devices	%

- The total number of family will be given by local authorities. They will be helping in this activity.
- The guidance of the Tutor is needed here and this will help him to work hand in hand with local authorities and students.
- After getting information, the students will present their findings and the Tutor will mark reports of his/her Students.

6.8. Answers to end unit assessment

1. Digital data refers to information that is

   A. Continuous
   B. Discrete
   C. Bits
   D. Bytes

2. In data communications, non- periodic signals

   A. Sine wave
   B. Digital Signals
   C. Analog Signals
   D. None of the above

3. Completion of one full pattern is called a

   A. period
   B. Cycle
   C. Frame
   D. Segment

4. Term that refers to infinite no of values in range is

   A. Peak
   B. Analog Signal
   C. Digital Signal
   D. None of the above

Answers: 1. B 2. D 3. B 4.B

6.9. Additional activities

6.9.1. Remedial activities

1. An analog signal continuous in both----------and----------

   A. frequency, power
   B. Time, amplitude
   C. Segments, Packets

2. Analog signals is a measured response to changes in a ----------

   A. Bus
   B. Base
   C. Physical phenomena
   D. Thick net

3. Modulation is defined as:
   A. Another method of conveying an analog signal
   B. The beginning and ending bits of an analog signal
   C. Away to convert analog in to a digital signal
   D. A method of marking an analog frequency higher

4. ----------is both discrete and quantized.
   A. Digital signal
   B. Analog signal
   C. Modulated signal
   D. Synchronized signal

5. Analog Circuit do not involve quantization of information into digital format
   A. True
   B. false

Answers: 1. B 2. C 3. A 4. A 5. A

6.9.2 Consolidation activities

1. Distinguish between modulator and demodulator
2. What do you understand by the following terms?
   A. Analog signal
   B. Digital signal

6.9.3 Extended activities

Recently, the government of Rwanda decided to replace analog system of communication by digital system of communication. Debate about this government policy

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