GEOGRAPHY

TUTOR'S GUIDE

FOR TTCs

OPTION:

SOCIAL STUDIES EDUCATION (SSE)

FOREWORD

The Rwanda Basic Education Board is honoured to avail the Geography Tutor's Guide for Teacher Training Colleges (TTCs) in SSE Option, Year three, which serves as official guide to teaching and learning of Geography.

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

The ambition to develop a knowledge-based society and the growth of regional and global competition in the job market has necessitated the shift to a competence-based curriculum. After a successful shift from knowledge to a competence-based curriculum in general education, TTC curriculum also was revised to align it to the CBC in general education to prepare teachers who are competent and confident to implement CBC in pre-primary and primary education. The rationale of the changes is to ensure that TTC leavers are qualified for job opportunities and further studies in higher education in different programs under education career advancement.

I wish to sincerely express my appreciation to the people who contributed towards the development of this document, particularly, REB staff, lecturers, TTC Tutors, Teachers from general education and experts from Local and International Organizations for their technical support.

I take this opportunity to call upon all educational stakeholders to bring in their contribution for successful implementation of this textbook.

Dr. MBARUSHIMANA Nelson

Director General, REB

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I wish to sincerely express my special appreciation to the people who played a major role in development of Geography Tutor's guide for SSE Option, Year three. It would not have been successful without the support from different education stakeholders.

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PART I: GENERAL INTRODUCTION

1.0. Introduction

The purpose of this tutor's guide is to help you implement the Geography syllabus in the option of SSE. It is designed to stimulate you to create exciting and meaningful lessons by enabling you to choose relevant and purposeful activities and teaching strategies. It will encourage you to research and look for new and challenging ways of facilitating students' learning. The tutor's guide and the syllabus must be used side by side. The syllabus states the learning objectives for the subject and each unit, and outlines the content and skills that students will learn, and the assessment requirements.

The tutor's guide provides direction for you in using the outcomes approach in your classroom using a step by step approach. This tutor's guide provides examples of teaching and learning strategies for Geography in the option of SSE, elaboration of suggested activities and content, detailed information on how to make assessment tasks and the resources needed to teach Geography in the option of SSE.

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.

1.2. 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 Geography in SSE and guidance on assessment.

- **Part II: Sample lesson plan**

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

- **Part III: Unit development**

This is the core part of the tutor's guide. Each unit is developed following the structure below. The guide ends with references.

Structure of a unit

Each unit is made of the following sections:

- Unit title: From the syllabus
- Key unit competence: From the syllabus
- Prerequisites (knowledge, skills, attitudes and values)

This section indicates knowledge, skills and attitudes required for the success of the unit. 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. 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 suggestion of the 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-teachers.

Additional information which provides additional content compared to the Student-teachers for the tutor to have a deeper understanding of the topic.

End unit assessment which provides the answers to questions of end unit assessment in the textbook 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 (average and gifted) based on end unit assessment results.

Structure of each-sub heading

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

- Lesson /Sub-heading title
- Prerequisites/Revision/Introduction

This section gives a clear instruction to teacher 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 ones available in their respective TTCs 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 text 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 competence based curriculum for pre-primary, primary and general secondary education. This

review comes as response to the needs of Student-teachers, society and the labour market. With a holistic student-teacher-centered approach, it demands major changes in teaching methodology and the use of a wider range of assessment techniques focusing more on formative or on-going continuous assessment. This has implications for teacher education and the necessary provision of support and guidance provided to colleges to ensure an effective implementation. Since 2016 up to 2018, TTC curriculum have been revised to be competence-based in line with the basic education curriculum. The review was to align the pre-service teacher education programs to the new National Basic Education competence-based curriculum.

This called for changing the way of learning by shifting from teacher centered to a student-teacher-centered approach. Tutors are not only responsible for knowledge transfer but also for fostering Student-teachers'learning achievement, and creating safe and supportive learning environment. It implies also that a student has to demonstrate what he/she is able to do using the knowledge, skills, values and attitudes 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 Student-teachers can do rather than what Student-teachers 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 student-teacher-centered rather than the traditional didactic approach. The student 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 on how generic competences can be developed in the subject of Geography in the option of SSE.

- Critical Thinking: Student-teachers analyse their environment or community for problems or challenges faced and the causes. After, they suggest possible remedies to the identified problem.
- Research and problem solving: Student-teachers collect data using interviews, questionnaires and any other tool, analyse the data gathered and suggest solutions to the problems identified.

- Creativity and Innovation: Student-teachers analyse resources such as waste materials existing in the community or environment. They develop or come up with new ways of utilizing such resources or how they can be put to use.

- Communication Skills: Student-teachers can present themselves and their abilities by writing application letters or CVs to potential employers. They can write different documents such Memos, Notices in a clear and understandable language to convey on information effectively during interpersonal communication.

- Teamwork, Cooperation, Personal and Interpersonal management and life skills: Student- teachers in teams complete different tasks where each may take on a different role while complementing each other's strengths and weaknesses in team leadership.

- Lifelong Learning: Student-teachers lead a problem solving and decision making process in a team. It does a self-evaluation to identify own areas of strengths, areas of weaknesses and propose strategies for enhancing and improving in a team leadership. Alternatively, Student-teachers analyse a scenario involving conflicts at a workplace, identify the causes, suggest solutions and propose how they will apply the learned lessons to similar situations in real situations.

1.2.2. Cross-cutting issues to addressed

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. There are eight cross cutting issues identified in the national curriculum framework.

Some cross-cutting issues may seem specific to particular learning areas/ subjects but the teachers need to address all of them whenever an opportunity arises. In addition, student- teachers should always be given an opportunity during the learning process to address these crosscutting issues both within and out of the classroom.

Below are examples on how crosscutting issues can be addressed in Geography subject in the option of SSE:

- Gender education: Remind Student-teachers that both males and females have similar opportunities, rights and obligations in the workplace, and

therefore need to be treated fairly and equally when dealing with contracts or resolving conflicts. People's opinion of gender roles should not deny or hinder one's rights or responsibilities to meet his or her contractual obligations while teaching Geography in SSE.

- Environment and sustainability: During the teaching of geography, Student-teachers need to acknowledge the importance of protecting the environment in which we live in. So, throughout the unit/lesson there is need to appreciate and take great care for environment as it is paramount.
- Inclusive education: Student-teachers all need to realize that universal laws do not discriminate as they apply to all regardless of social, economic, political, physical background. Emphasis should be on how we all have the same rights. During the lessons of Geography, Student-teachers may discuss and appreciate the need to respect and advocate for employer's and worker's rights and responsibilities at workplace.
- Peace and Values: Right before the lesson begins; there are quite a lot of opportunities for tutors to promote peace and values among Student-teachers. Being punctual for activities (time management), involvement in various activities (teamwork), keeping their school environment clean (responsibility), greeting one another are among such opportunities (empathy).

In a lesson, encourage Student-teachers to greet one another, create a conducive learning environment, clean the chalkboard, arrange the classroom, books, class work, among others. Also in a case of conflicts within a lesson, take time to address the conflicts and discuss with Student-teachers the need to resolve conflicts amicably. You may also give Student-teachers an opportunity to participate in conflict resolution and decision making.

- Comprehensive sexuality education (HIV/AIDS, STI, Family planning, Gender equality and reproductive health): During the lessons/activities, Student-teachers should be given an opportunity to discuss freely about the various changes they are undergoing, as they are adolescents. They should be aware of how to manage the changes in their bodies, discuss HIV/AIDS without stigmatization, STIs and how to control them, family planning, gender equality and reproductive health. Student-teachers should be encouraged to seek for appropriate help whenever needed. This may not directly fit or come in the lessons but utilize opportunities observed among the Student-teachers both in and outside of the class.

- Financial Education: For example, in setting personal goals, Student-teachers may be requested to make a plan of what they plan to save, how much and when they plan to achieve their saving goals. Student-teachers may describe strategies to reduce spending and increase savings to become financially fit. In every lesson, Student-teachers can share briefly their progress towards their goals: how much, strategies that worked and what needs to improve on.

- Standardization Culture: In every lesson, take an opportunity to share with Student-teachers that standards should be respected since they are part of our lives. From school uniform, to class size, to lesson duration, language of instruction and among others. So always create opportunities to have Student-teachers discussing where standards apply and when they need to be cautious about standards during their everyday life. Throughout the unit, standardization will be the opportunity to learn all concepts related to standardization culture and to see how it can apply in different areas.

- Genocide Studies: Student-teachers need to become aware that all human beings are equal and have equal rights. At the work place they should avoid and denounce all instances that result into other's rights being violated. Give Student-teachers opportunities to share how Geography in the option of SSE can promote the fight against genocide ideologies. During rights and responsibilities session, Student-teachers relate the genocide of 1994 against the Tutsi and violation of human rights.

1.2.3 Attention to special educational needs and inclusive education

In the classroom, Student-teachers learn in different way depending to their learning pace, needs or any other special problem they might have. However, a tutor has the responsibility to know how to adopt his/her methodologies and approaches in order to meet the learning need of each student in the classroom. Also tutors need to 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 to the unit and the nature of the lesson.

In order to create a well-rounded learning atmosphere, tutors need to:

- Remember that Student-teachers learn in different ways so they have to offer a variety of activities. For example 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 over protective and does not do everything. Both students and 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.

Strategies to help a student-teacher with developmental impairment include:

- 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-teacher less help;
- Let the student-teacher work in the same group with those without disability.

Strategies to help a student-teacher with visual impairment

- Help Student-teachers to use their other senses (hearing, touch, smell and taste) to 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-teacher has some sight difficulties, ask them what they can see;
- Make sure the student-teacher has a group of friends who are helpful and who allow the child to be as independent as possible;
- Plan activities so that Student-teachers work in pairs or groups whenever possible.

Strategies to help a student-teacher with hearing impairment

- 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;
- Keep background noise to a minimum.

Strategies to help Student-teachers with physical disabilities or mobility difficulties

- Adapt activities so that Student-teachers who use wheelchairs or other mobility aids 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;
- Get advice from parents or a health professional about assistive devices.

Adaptation of assessment strategies

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

1.2.4. Guidance on assessment

Assessment is an ongoing process of identifying, gathering and interpreting information about students'achievement of the learning outcomes and can be integrated into the students' normal learning activities. Assessment is an

important part of teaching and learning. It is used to:

- Evaluate and improve teaching and learning
- Report achievement
- Provide feedback to students on their progress.

Types of Assessment

- Assessment for learning (Continuous / formative assessment): Assessment for learning is often called formative assessment and is assessment that gathers data and evidence about student learning during the learning process. It enables you to see where students are having problems and to give immediate feedback, which will help your students learn better. It also helps you plan your lessons to make student learning, and your teaching more effective. Often it is informal and students can mark their own work or their friends. An example is a quick class quiz to see if students remember the important points of the previous lesson.

- Assessment of learning (Summative assessment): Assessment of learning is often called summative assessment. It is used to obtain evidence and data that shows how much learning has occurred, usually at the end of the term or unit. End of year examinations are examples of summative assessment. It is usually done for formal recording and reporting purposes.

Assessing geography units

In the Geography syllabus, the key unit competences, which link to the broad learning outcomes, are assessed through specified assessment tasks using a range of assessment methods. Assessment criteria for each unit outcome provide clear indications of how, and to what extent, the achievement of the learning outcomes may be demonstrated. Performance standards, marking guides and assessment criterion help teachers with the marking process and this ensures that assessment is consistent across schools.

When you set a task, make sure that:

- The requirements of the task are made as clear as possible to the student
- The assessment criteria and performance standards or marking guides are provided to the student so that they know what it is that they have to do
- Any sources or stimulus material used are clear and appropriate to the task
- Instructions are clear and concise
- The language level is appropriate for the grade

- It does not contain gender, cultural or any other bias
- Materials and equipment needed are available to students
- Adequate time is allowed for completion of the task.

Feedback

- When you assess the task, remember that feedback will help the student understand why he/she received the result and how to do better next time.

Feedback should be:

- Constructive so that students feel encouraged and motivated to improve
- Timely so that students can use it for subsequent learning
- Prompt so that students can remember what they did and thought at the time
- Focused on achievement and effort of the student
- Specific to the unit learning outcomes so that assessment is clearly linked to learning.

Feedback can be:

Informal or indirect – such as verbal feedback in the classroom to the whole class, or person to person

- Formal or direct – In writing, such as checklists or written commentary to individual student either in written or verbal form.
- Formative – given during the topic with the purpose of helping the student know how to improve for example use of portfolios as a tool of assessment during, after or at end of the lesson.
- Summative – Given at the end of the unit with the purpose of letting the students know what they have achieved for example use of portfolios as a form of end of unit assessment.

Tests

A test is a formal and structured assessment of student achievement and progress which the tutor administers to the class. Tests are an important aspect of the teaching and learning process if they are integrated into the regular class routine and not treated merely as a summative strategy. They allow students to monitor their progress and provide valuable information for you in planning further teaching and learning activities.

Tests assist student learning if they are clearly linked to the outcomes. Evidence has shown that several short tests are more effective for student progress than one long test. It is extremely important that tests are marked and that students are given feedback on their performance.

There are many different types of tests. Tests should be designed to find out what students know and about the development of thinking processes and skills. Open questions provide more detailed information about achievement than a question to which there is only one answer.

Principles of designing classroom tests

Tests allow a wide variety of ways for students to demonstrate what they know and can do. Therefore:

- Students need to understand the purpose and value of the test
- The test must assess intended outcomes
- Clear directions must be given for each section of the test
- The questions should vary from simple to complex
- Marks should be awarded for each section
- The question types (true/false, full-in-the-blank, multiple choice, extended response, short answer, matching) should be varied.

Tests should:

- Be easy to read (and have space between questions to facilitate reading and writing)
- Reflect an appropriate reading level
- Involve a variety of tasks
- Make allowance for students with special needs
- Give students some choice in the questions they select
- Vary the levels of questions to include gathering, processing and applying information
- Provide sufficient time for all students to finish.

Tutor assessment

Assessment is a continuous process. You should:

- Always ask questions that are relevant to the outcomes and content
- Use frequent formative tests or quizzes
- Check understanding of the previous lesson at the beginning of the next lesson through questions or a short quiz

- Constantly mark/check the students' written exercises, class tests, homework activities
- Use appropriate assessment methods to assess the tasks.

Self-assessment and peer assessment

- Self and peer assessment helps students to understand more about how to learn.
- Students should be provided with opportunities to assess their own learning (self-assessment) and the learning of others (peer assessment) according to set criteria.
- Continues the learning cycle by making assessment part of learning
- Shows students their strengths and areas where they need to improve
- Engages students actively in the assessment process
- Enables students to be responsible for the learning .
- Helps students understand the assessment criteria and performance standards.

1.2.5 Students'learning styles and strategies to conduct teaching and learning process

How students learn:

- What I hear I forget.
- What I hear and see I remember a little.
- What I hear, see and discuss I begin to understand.
- What I hear, see, discuss and do, I acquire knowledge and skills.
- What I teach to another, I master.
  (Active Learning Credo statement by Silberman 1996)

In support of this are the findings that we remember:

- 20% of what we hear
- 40% of what we see
- 90% of what we see, hear, say and do or what we discover for ourselves.

A student-centered approach to learning

Different students learn in different ways. Some students learn best by writing, others by talking and discussing, others by reading and others by listening. Most students learn by using a combination of those. All students learn skills through practicing and repetition. You need to use a variety of teaching strategies to cater for the different ways your students learn.

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 materials available; the physical/sitting arrangement of the classroom, individual students' needs, abilities and learning styles.

Teaching and learning strategies

In order to cater for different students' learning styles and to assist and encourage students to learn, teachers need to perform certain tasks. These are teaching strategies.

You need to engage students directly in learning but there are times when you have to take charge of the learning in the class and teach particular concepts or ideas

Teaching strategies include:

- Group work
- Skills lab
- Research/inquiry
- Class discussions/debates
- Problem-solving activities
- Teacher talk, instructions, explanations, lectures or reading aloud
- Directed question and answer sessions
- Audio-visual presentations
- Text books or worksheets
- Directed assignments
- Demonstration and modelling
- Guest speakers
- Classroom displays.

i. Use of present boards and portfolios during skills lab

Present boards are boards made by Student-teachers using locally available resources that contain Student-teachers'work/achievements. When Student-teachers finish their work from presentations as a group, it's hang on the present board. This can be used by both the tutor and Student-teachers for reference.

The biggest sign of a successful skills lab is the activities students complete. And how do we know whether students completed their group activity? It's through present boards. Each team has their own board to display all the work they completed during the skills lab. At the end of each skill lab, each team makes a verbal presentation to the class and shows their present board.

	When?	**How?**	**Where?**
Present Boards	Last activity of each Skills Lab. Each lab team/group has their own 1 Present Board.	Made by students. Boards have cool designs to showcase the notes and work product of each lab	Boards are hung on the walls of classroom and kept there for others to see

ii. Relationship between portfolios and present boards

What is a Student Portfolio?

A portfolio is a collection of student work for individual assessment. Student-teachers fill their portfolios by completing a series of assignments. These individual assignments are the evidence that students have mastered a learning

objective. Each assignment requires Student-teachers to apply the skill they learned in that unit practically.

Portfolios are the basis for skills lab. First, teachers create the portfolio assessment for students to complete.

Skills lab is when students will work on group activities to prepare for completing the portfolio assessment individually. Skill lab is one of your teacher's normal lessons (no extra time is needed) that are especially designated for the purpose of students working in groups to complete their activities. Skills lab prepares students to complete portfolio assignments on their own after classes. So, the classroom activity should connect directly to the portfolio assignment.

For example, they set goals as a group in class, and set individual goals as portfolio assignment.

	Done by?	**When?**	**Where?**
Present boards	Groups	During Skills Lab	On Present Boards
Portfolios	An Individual	As an Assignment	In Portfolio Folder

1.2.6. Steps for a lesson in active learning approach

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 teacher makes connection between the previous and current lesson through appropriate techniques. The teacher opens short discussions to encourage Student-teachers to think about the previous learning experience and connect it with the current instructional objective. The teacher 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/prediction, presentation of student-teachers' findings, exploitation, synthesis/summary and exercises/application activities, explained below:

- **Discovery activity/prediction**

Step 1

- The teacher discusses with students to take responsibility of their learning
- He/she distributes the task/activity, necessary resources 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 teacher let the students work collaboratively on the task.
- During this period the teacher refrains to intervene directly in the working of activity or results/findings of the task
- He/she then monitors how the students are progressing towards the results, output, results, and expectations knowledge to be learned and boost those who are still behind (but without communicating to them the knowledge).

Presentation of Student-teachers' productions

- In this period, the teacher invites representatives of groups to share their productions/findings.
- After three/four or an acceptable number of presentations, the teacher decides to engage the class into exploitation of the students' productions.
- Exploitation of student-teacher's productions
- The teacher asks the students to evaluate the productions: which ones are correct, incomplete or false
- Then the teacher judges the logic of the students' products, corrects those, which are false, completes those, which are incomplete, and confirms those, which are correct.

Institutionalization (summary/conclusion/ and examples)

- The teacher summarizes the learned knowledge and gives examples, which illustrate the learned content. Then links the activities to the learning objectives, and guide Student-teachers to make notes.

Exercises/Application activities

- Exercises of applying processes and products/objects related to learned unit/sub-unit
- Exercises in real life contexts
- Teacher guides Student-teachers to make the connection of what they learnt to real life situations. At this level, the role of teacher 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 teacher avoids intervening directly. In fact, results from this assessment inform the teacher on next steps for the whole class and individuals. In some cases, the teacher can end with a homework assignment, or additional activities.

1.2.7. Template of a lesson plan in active learning approach

LESSON PLAN

School Name: …… **Teacher's name:**

……

Term	Date	Subject	Class	Unit N°	Lesson N°	Duration	Class size
	… /…/ 20……	……	….	….	… of …	…	….
Type of Special Educational Needs to be catered for in this lesson and number of learners in each category							
Unit title							
Key Unit Competence							
Title of the lesson							
Instructional Objective							
Plan for this Class (location: in / outside)							
Learning Materials (for all learners)							
References							

Timing for each step	Description of teaching and learning activity		Generic competences and Cross cutting issues to be addressed + a short explanation
	Teacher activities	Learner activities	
Introduction …min			
Development of the lesson …min			
Conclusion … min			
Teacher self-evaluation			

PART II: SAMPLE LESSON PLAN

School Name: ..... Tutor's name.....

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
I	…./…./2020	Geography	Y3	3	3/6	80 minutes	40 Student-teachers

Type of Special Educational Needs to be catered for in this lesson and number of Student-teachers in each category	1 slower student-teacher and 2 talented Student-teachers
Unit title	**External landform processes and related features**
Key Unit Competence	The Student-teachers should be able to demonstrate an understanding of different features resulting from the external processes.
Title of the lesson	Factors influencing weathering
Instructional objective	Through using local environment, internet and text books, Student-teachers explain the factors that influence weathering effectively.
Plan for this Class (location: in / outside)	The lesson shall be conducted in and outside of the classroom.
Learning Materials (for all Student-teachers)	Rock samples, internet, text books, photographs, illustrations, etc.
References	Bunnett, R.B. (2010). Physical Geography in Diagrams for Africa. Kigali: Longman. John whitton (1984). Dictionary of Physical Geography, New York, USA. Compound physical Geography by K. Kansime. Buckle C. (2007). Landforms and Landscapes in Africa. An introduction to geomorphology. Edinburgh: Pearson Education Limited. Monkhouse, F.J (2008). Principles of Physical Geography. London: Hodder Education.

Timing step for each step	**Description of teaching and learning activity** Tutor together with Student-teachers discuss on the topic provided. However, the Student-teachers will be asked to go outside for 10 minutes to observe and identify the factors that influence weathering. After they will come back for presentation.		**Generic competences to be developed and cross cutting issues to be addressed + a short explanation.**
	Tutor's activities	**Student-teacher's activities**	
Introduction (5min)	Student-teachers are organized into manageable groups and asked to identify types of weathering.	Student-teachers answer the questions asked by the Tutor on types of weathering.	**Cooperation** Cooperation and communication skills are addressed through working in groups **Critical thinking** through identifying the factors influencing weathering.
Development of the lesson: 50 min a) Discovery activity b) Presentations of Student-teachers' productions	The Tutor introduces the lesson of the day regarding factors influencing weathering. The tutor will invite Student-teachers to go outside to observe areas affected by weathering The Tutor will display the illustration on factors influencing weathering.	Listening. The Student-teachers in their groups discuss the factors that influence weathering. Based on observation and illustration they will discuss on the factors influencing weathering.	Critical thinking: This will be achieved when Student-teachers are outside and investigate briefly the factors that influence weathering. **Skills**: Cooperation and communication skills are enhanced through working in groups. **Communication skills:** Communication skills

c) Exploitations of Student-teachers' productions	– The Tutor invites representatives of groups to present their findings on factors influencing weathering. – After 3 or 4 presentations, the Tutor decides to engage the class into utilization of the students' productions on factors influencing weathering. The Tutor asks the Student-teachers to evaluate the factors influencing weathering and supplements the Student-teachers' presentations.	Presentation of their findings in class. Asking, noting down important points. Student-teachers evaluate the content presented by their colleagues and Supplement the content presented by their fellow Student-teachers.	are addressed through presentations. Environment and sustainability: This is addressed through realizing the need to conserve and protect the environment in general.
Institutionalization (summary, conclusions and examples) 5 minutes Application activities:10 min	– The Tutor summarises the content on the factors influencing weathering and gives local examples for clear understanding of the Student-teachers.		Communication skills: Communication skills are addressed through presentations.
	– The Tutor guide Student-teachers to go out briefly and observe and explain how relief and nature of the rock influence weathering.	Listening to the Tutor summary of the content and note down important aspects related to the lesson of the day.	

Assessment 10 minutes	The Tutor asks Student-teachers to identify 5 factors influencing weathering in their area. Tutor marks the exercises in the the Students' books.	Student-teachers write down the answers in their note books.	
Tutor-self evaluation			

UNIT 1

INTERPRETATION OF PHOTOGRAPHS AND VIDEO IMAGES

1.1. Key Unit Competence

The student-teacher should be able to interpret photographs, video and images.

1.2. Pre-requisite (knowledge, skills, attitudes and values)

This unit presents interpretation of photographs and video images on a wide scale. Student-teachers are expected to describe types of photographs, interpret physical and human aspects, sections of a photograph, and analyse the relationship between physical and human aspects on photographs and video images.

At this level Student-teachers are expected to build a consolidated knowledge as they study photographs in details and related physical and human aspects on various photographs.

1.3. Cross-cutting issues to be addressed

In this unit Student-teachers will appreciate the importance of environmental conservation as it will be evident especially as they learn the relationship between physical and human aspects on photographs. You also need to help Student-teachers relate financial education to the efforts being put in place to carry out different human activities for sustainable development, methods and techniques that cater for students' diversities and encourage them to maximize their full potential in classroom.

1.4. Guidance on introductory activity

In this unit, the following are the key inquiry questions that will be the guide to the problem statement:

a) Describe other ways used in geography to show physical and human features.
b) Explain the procedures followed in drawing a sketch of any photograph.
c) What are types of photographs?
d) How do we analyze the relationships between physical and human features on a photograph?

1.5. List of lessons (including assessment)

	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Definition of photograph (horizon, dead ground…) and Types of photographs (ground and aerial).	– Define a photograph – Appreciate the importance of the photographs – Identify and analyze different types of photographs	2
2	Sections of photograph and Interpretation of physical and human aspects on photographs and video images.	– State and describe different sections of a photograph – Identify and interpret physical and human aspects on a photograph.	2
3	The relationship between physical and human aspects on photographs and video images.	– State and analyze the relationship between the physical and human aspects on photographs or video images.	2
4	Assessment		2

Guidance on different lessons outlined above

Lesson 1: Definition and types of photographs

a) Learning objectives

- Define a photograph
- Appreciate the importance of the photographs
- Identify and analyze different type of photographs

b) Pre-requisites/ Revision /Introduction

Guide Student-teachers in exploring other ways used in geography to show human and physical features apart from maps.

After this brief introduction, Student-teachers will observe the photograph provided in the student's book and they will be able to define a photograph and distinguish the different types of photographs provided.

c) Teaching resources

For learning objectives to be achieved the following resources must be available:

- Text books
- Sample of photographs

d) Learning activities

Refer to the learning activity 1.1 in the student's book

Guide Student-teachers to work in pairs using photographs provided and content in the Student-book, they will be able to define a photograph and to distinguish different types of photographs. Their answers should involve the integration of generic competences like critical thinking, cooperation, communication and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the Student-teachers on the definition and types of photograph.

e) Application activities

Refer to the application activity 1.1 in the student's book

Student-teachers are asked to identify the type of photograph shown and explain the reasons for their answer. They will use the content given in the student's book on the types of photographs and other geographical documents to distinguish different types of photographs.

Lesson 2: Section of a photograph and Interpretation of physical and human aspects on photographs and video images

a) Learning objectives

- State and describe different sections of a photograph
- Identify and interpret physical and human aspects on a photograph

b) Pre-requisites/ Revision /Introduction

Guide Student-teachers to review the previous work and help them to identify sections of photograph, interpret human and physical aspects on a photograph.

Afterwards, Student-teachers will observe the photograph provided in the student's book and they will be able to suggest physical and human aspects shown on the photograph provided.

c) Teaching resources

To achieve learning objectives, the following resources should be in place:

- Text books
- Sample of photographs

d) Learning activities:

Refer to the learning activity 1.2 in the student's book

Let student-teachers work in groups by using the photographs provided and content in the student's book, they will be able to distinguish sections of a photograph and to indicate physical and human features on a photograph. Their answers should involve the integration of generic competences like critical thinking, cooperation, communication and problem-solving skills.

Student-teachers are asked to identify sections of a photograph. They will use the content given in the student's book on Sections of a photograph and other geographical documents to identify sections of a photograph. (Sections of a photograph are: foreground, middle ground and background).

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the Student-book.

e) Application activities

Refer to the application activity 1.2 in the student's book

Student-teachers are asked to analyse physical and human aspects on a photograph. They will use the content given in the student's book on Interpretation of physical and human aspects on photographs and video images, they will also use other geographical documents to interpret the physical and human aspects on a photograph.

Lesson 3: Relationship between physical and Human aspects on Photographs and Video Images

a) Learning objectives

- State and analyze the relationship between the physical and human aspects on photographs or video images.

b) Pre-requisites/ Revision/ Introduction

Briefly review the previous lesson by asking Student-teachers to explain the steps followed when drawing a sketch of any photograph provided and Supplement their answers.

c) Teaching resources

- Text books
- Sample of photographs

d) Learning activities

Refer to the learning activity 1.3 in the student's book

In groups Student-teachers are given a photograph in the Student-book. Basing on a photograph provided and content in the student's book, they will be able to describe the relationship between physical and human aspects on a photograph. Their answers should involve the integration of generic competences like critical thinking, cooperation, communication and problem-solving skills.

Guide Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book on the relationship between physical and human aspects on a photograph.

e) Application activities

Refer to the application activity 1.3 in the student's book

Student-teachers are asked to describe the relationship between physical and human aspects on a photograph and video images. They will use the content given in the student's book on the relationship between physical and human aspects on photograph and video images. They will also use other geographical documents to appropriately describe the relationship between physical and human aspects on a photograph and video images.

1.6. Summary of the unit

This unit covers types of photographs, sections of a photograph, interpretation of physical and human aspects on photographs and video images, plus the relationship between physical and human aspects on photographs and video images.

This unit intends to help Student-teachers to analyze different sections of a photograph. Other areas to be discussed in this unit are types of photographs and analyzing the relationship between physical and human aspects on photographs and video images and how man has utilized the available physical aspects for sustainable development; this will enable Student-teachers to internalize financial education as a cross cutting issue.

1.7. Additional Information

More information about analyzing relief of the area shown on the photograph is important, discussion of problems faced by people living in the area shown on the photograph is also equally important. In cases of steep slopes, it helps Student-teachers to understand different measures of conserving the environment, thereby integrating the cross cutting issue of environment and sustainability.

1.8. End unit assessment

Questions:

Study the photograph of umudugudu settlement provided in the Student-book and answer the questions that follow:

a) Observe the above photograph, identify the economic activities taking place in the photograph and describe their importance to the people living in the area.
b) Suggest ways of conserving the area in the background of the photograph for environment sustainability.
c) Identify the human features which are predominant in the foreground of the above photograph.

Guidance to answers

Study the photograph provided in the Student-teachers and answer the questions below:

a) Identify the economic activity taking place in the photograph provided.

Ask Student-teachers to interpret the photograph provided and identify the activity shown.

b) Suggest ways of conserving the area in the background of the photograph for environment sustainability.

Put Student-teachers in groups to discuss the appropriate ways of conserving the area shown in the background of the photograph.

c) Identify the human features which are predominant in the foreground of the above photograph.

Put Student-teachers in groups and help them to Identify all human features which are predominant in the foreground of the photograph: crops, plants, settlements.

1.9. Additional activities

a) Consolidation activities

i) Distinguish between ground photograph and aerial photograph.

ii) Show how drainage influences settlement in your area.

Help Student-teachers on how to answer the above questions using Student's book and other geographical documents. For example, a ground photograph refers to any photograph taken from the ground level while an aerial photograph is a photograph taken from the air by a flying object. Drainage influences settlement in a way that well drained areas are heavily settled than river banks because of floods.

b) Remedial activities for slow Student-teachers

i) Define a photograph

ii) State the two types of photographs

iii) Identify the three parts of a photograph

These are questions that require low order thinking and are answered as follows:

i) A photograph is a picture of an object or environment taken by a camera at a time.

ii) The types of photographs are: ground and aerial photographs

iii) The three parts of a photograph are: foreground, middle ground and background

c) Extended activities for gifted and talented Student-teachers

Describe steps followed in drawing a sketch of a photograph

Answer: let Student-teachers make research on the steps followed in drawing a sketch of a photograph. There after Student-teachers make a class presentation of their findings.

Skills Lab

With help of knowledge, skills attitudes and values acquired in this unit, suggest ways of conserving the physical features and promoting economic activities in your school environment for sustainable development.

- Guide Student-teachers to work in groups so that they can bring together diversity of ideas.
- Ask them to focus on surrounding physical features and identify them.
- Let them apply what they have learnt to the new situation on how they can benefit from them in a sustainable manner.

UNIT 2

THE ORIGIN AND DISTRIBUTION OF THE CONTINENTS

2.1. Key unit competence

By the end of this unit, Student-teachers will be able to discuss the theories of the origin and the distribution of the continents.

2.2. Pre-requisite (knowledge, skills, attitudes and values)

Unit 5 of year 2 traced the background of the earth planet in the context of formation of the universe and other planets that constitute the solar system. The position of the earth in relation to the sun and other planets with its peculiar atmosphere, hydrosphere and lithosphere are explained; related explanations make student to realize that the earth is unique where life exists. Unit 5 of year 2 puts forwards the big bang theory which hypothesizes the origin of the universe with an emphasis on earth shape, internal structure, rocks and forming minerals. Unit 6 of year 2 introduced the study of the internal dynamics of the earth globe and associated landforms to the Student-teachers. Terms like fault, fold, earthquake and volcano are defined, and processes leading to their formation and distribution are explained.

The knowledge acquired from units of year 2 mentioned above sets a strong pre-requisite for the learning of unit 2 of year 3 entitled the "origin and distribution of continents." The introductory activity presented in the student's book intends to remind Student-teachers that the earth globe is dynamic with features which constantly change. This enables Student-teachers to appreciate the causes of distribution of continents and make the links between the resulting consequences and some of severe natural disasters that affect humanity. It was compulsory to integrate in this unit a cross-cutting issue of environment and sustainability, inclusive education, peace and values which are briefly developed in the following paragraphs.

2.3. Cross-cutting issues to be addressed

2.3.1. Environment and sustainability

It has been noticed that natural processes such as earthquakes, volcanic eruptions, floods (tsunami) among other processes have the potential to affect people and their environment and properties. It is compulsory that Geographers consider these hazards because they relate to plate tectonics and continental drift. The effects may be long-term as well as immediate; and the event can be costly to property and dangerous to people.

2.3.2. Inclusive education

This will help Student-teachers to better understand the process of continental drift and plate tectonics. Learning activities should be within the ability range of all Student-teachers, including those with learning difficulties or special needs. For instance, if teachers plan field trip, he will consider how Student-teachers will access the area to be visited. These activities are designed in such a way to address different learning styles (e.g. group work and discussion, field trips, DVDs where possible).

2.3.3. Financial education

Wherever earthquake causes damage to people and their properties there is inevitably implication of economic expenses. People and Country could face a systemic financial problem unless the government takes steps to avert the issue. Therefore, the lead agency should direct people and advise the government to plan ways of preparedness or adaptation or alternative livelihood in cases such disastrous and unexpected events occur. The tutor needs to highlight the importance of money saving to Student-teachers. People and the government should be responsible for the cost of preventing resulting consequences or adaptation and preparedness for disastrous and unexpected events.

2.4. Guidance on introductory activity

In this unit, the key inquiries that will be the guide to the introductory activity for Student-teachers are to be able to explain the origin and causes of distribution of continents and processes of plate tectonics. For this, Student-teachers should be able to explain the processes which led to the separation of the unique initial landmass into various continents as they appear today.

2.5. List of lessons

The table below highlights all the lessons that have been prepared in relation to the content of Unit 2, as well as the period allocated to each of them.

N°	Lesson title	Learning objectives (knowledge, skills and attitudes)	Number of Periods
1	Concept and theories of continental drift	- Name the theories of origin and distribution of the continents and ocean basins. - Describe and appreciate the origin and distribution of the continents and ocean basins.	2
2	Evidence of continental drift	- Outline the evidences of the continental drift. - Apply the knowledge to explain the shapes and the current positions of the continents.	1
3	Effects of continental drift on the evolution of physical features	- Do research on the causes of the continental drift and the distribution of continents relative to one another. - Show concern to the causes, the effects of the continental drift and the desire to understand the distribution of the continents and ocean basins.	2
4	Plate tectonics	- State the major types of plate boundaries and tectonic plates.	1
5	Major plates and effects of plate tectonics	- Evaluate the effects of plate tectonics. - Explain the effects of tectonics plate on the landscape.	2
5	End unit assessment		1

Guidance on different lessons outlined above

Lesson 1: Concept and theories of continental drift

a) Learning objectives

- Name the theories of origin and distribution of the continents and ocean basins.

- Describe and appreciate the origin and distribution of the continents and ocean basins.

b) Pre-requisite/Revision/Introduction

In this lesson 2.1, Student-teachers are introduced to the definition and different theories of continental drift. Display the Figure in the Student's book. Thereafter Student-teachers are asked to mention the difference between the three maps represented on the Figure. These include Wegener's theory of continental drift, Ewing's discovery of the Mid-oceanic ridge, Hess's theory of sea-floor spreading and Taylor's theory of moon's tidal attraction,

c) Teaching resources

The tutor should have in possession the print outs of the introductory activity of Unit 2 of student's book. To achieve learning objectives of this lesson, the following resources should be used:

- Geographical documents
- Maps
- Illustrations
- Internet/DVDs
- Manila Paper or flip chart
- Jaws software

d) Learning activities

Refer to the learning activity 2.1 in the student's book

Introductory Activity and Learning activity 2.1 in the student's book have been provided as the basis for discussion on theories of continental drift. The first activity will consist about engaging Student-teachers to explore maps in the student's book so that they can realize how continents drifted. The second intends to engage Student-teachers to find probable causes of the continental drift. Research using books and internet, and explain briefly the theory of Alfred Wegener related to continental drift. The teacher shall provide a handout of the figure and guides Student-teachers to work in groups. The summary of each group finding is written on a manila or flip chart and displayed in plenary.

The concept of continental drift is described as the slow interior earths' movements which resulted in the breaking-up of one single supercontinent into various continents that we have today. Refer to the student's book, Unit 3 for more details.

e) Application activity

Refer to the application activity 2.1 in the student's book

Two application activities have been prepared to enable not only the tutor to evaluate Student-teachers but also Student-teachers to assess themselves their level of achievement. The teacher should make sure that each student-teacher is able to relate researchers and respective theories described in lesson 2.1. To make this possible, the teacher should task Student-teachers to make a clear summary of researchers and corresponding theories as the lesson goes on.

- Question 1 is about discussing the meaning of the concept of continental drift.

This refers to the the study of the causes and the conseuqences of the distribution of continents and ocean basins. Refer to the student's book under the Concept and theories of continental drift.

- Question 2 consists of explaining why Taylor's theory on the origin and distribution of the continents and ocean basins was initially criticised. Refer to the student's book under Theories of the origin and distribution of the continents and ocean basins. Taylor's theory on the origin and distribution of the continents and ocean basins was initially criticised because he could not explain how solid continents have changed their positions.

  For more details, refer to Student's book.

Lesson 2: Evidences of continental drift

a) Learning objectives

- Outline the evidences of the continental drift.
- Apply the knowledge to explain the shapes and the current positions of the continents.

b) Pre-requisite/Revision/Introduction

Review the previous lesson by asking Student-teachers to briefly identify different theories of continental drift. Thereafter display a map showing evidences of similar life on different continents (figure in Student's book) and asks Student-teachers to locate continents with identical fossils. In this lesson 3.2, Student-teachers will discover how continents fit when they are brought together.

c) Teaching resources

For effective delivery of the lesson you should ensure you have the following resources or any other appropriate teaching aids:

- Geographical documents
- Maps,
- Illustration
- Internet/DVDs
- Manila Paper or flip chart
- Jaws software.

d) Learning activities

Refer to the learning activity 2.2 in the student's book

The teacher should provide a handout of figure from the Student's book and guide them to observe it in groups and answer to activities of lesson 2.2 hereafter presented:

Question 1: Describe the edges of the continents. For activity 1, the teacher makes sure that Student-teachers can identify good visual fits of continents edges if they are brought together.

Question 2: What suggests the distribution of the same animal and vegetation species over the different continents?

The answer to this question should consider that these animals and plants could not have swum across oceans if continents were separated by water bodies, so continents must have been close together for them to occur on different continents. All location where the fossils have been found may once have been connected and probably had a similar climate.

e) Application activity

Refer to the application activity 2.2 in the student's book

Application activities are intended to enable the teacher to assess the level of achievement of the Student-teachers, and to evaluate if the instructional objectives pre-stated are achieved. Two application activities have been provided.

- Question 1 is all about the description of rocks at the edge of the continents and showing how all continents formed a unique block. The teacher will make sure that Student-teachers are able to identify a good visual fit of continent edges and to match rocks of similar geology and age over the different continents if they are brought together.
- Question 2 is about, comparison of remains of animal species and vegetation species using some examples found on different continents, by showing how they mark the continental drift. The tutor makes sure that Student-teachers can identify the similarity between animal and vegetation remains on today separated continents.

Lesson 3: Effects of continental drift on the evolution of physical features

a) Learning objectives

- Do research on the causes of the continental drift and the distribution of continents relative to one another.
- Show concern to the causes, the effects of the continental drift and the desire to understand the distribution of the continents and ocean basins.

b) Pre-requisite/Revision/Introduction

In lesson 2.3, Student-teachers will learn about the effects of continental drift on the evolution of physical features. Student-teachers must have covered the content of lesson 2.1 and lesson 2.2. The knowledge on proofs of continental drift acquired in lesson 2.2.constitutes an asset to better understand the resulting effects. The tutor shall then engage Student-teachers in revision of previous lesson, and will establish the link between today lesson and the previous lesson one.

c) Teaching resources

To achieve learning objectives, the following resources should be used:

- Geographical documents
- Maps, Illustration
- Internet/DVDs
- Manila Paper or flip chart
- Jaws software

d) Learning activity

Refer to the learning activity 2.3 in the student's book

There is one instructional activity which consists of making a research and describing at least four major effects of continental drift. (Refer to the student's book). It is important to note that effects of continental drift have been highlighted with the development of lessons 2.1 and 2.2. (e.g. split of a single supercontinent into different landmasses, evidences of continental drift), Therefore, figures (maps) found in these previous lessons can be useful to support the effects of continental drift.

e) Application activity

Refer to the application activity 2.3 in the student's book

There is one instructional activity which consists to:

Explain the effects of continental drift on the evolution of physical landscape of the earth.

The teacher is expected to look at the following in the student-teacher's responses:

- How Gondwanaland and Laurasia have been formed from Pangaea, how today's continent were formed from the Gondwanan and Laurasia,
- How the drift has moved continents to different locations where climates were different.
- Impact of speciation which is a phenomenon that normally takes place when a group of animals of the same species find themselves isolated from one another.
- Collision and formation of mountains, drifting with formation of grabens plus examples.

Lesson 4: Plate Tectonics

a) Learning objectives

- State the major types of plate boundaries and tectonic plates.

b) Pre-requisite/Revision/Introduction

In senior five, Student-teachers studied about fault, fold, wrapping, earthquake and vulcanicity and related processes. Briefly recall these concepts and ask Student-teachers about causes and their effects. In lessons 2.1, 2.2, and 2.3 of

senior six students learnt about the definition of continental drift, evidences and effects. The knowledge acquired will help Student-teachers to link the content studied with what is going to be learnt in relation to plate tectonics. Then ask Student-teachers to explore and study in group the figure in the student's book and to identify the causes of plate tectonics.

c) Teaching resources

To achieve learning objectives, the following resources should be used:

- Geographical documents
- Maps, Illustration
- Internet/DVDs
- Manila Paper or flip chart
- Jaws software

d) Learning activity

Refer to the learning activity 2.4 in the student's book

One instructional activity is provided where the tutor tasks Student-teachers to explore and study in groups the figure in student's book and to answer questions (answers are given in brackets in front of questions):

1. Identify the types of crust found on the diagram (e.g. oceanic and continental).
2. Describe the difference between lithosphere (e.g. which is rigid) and asthenosphere (which is ductile).
3. Differentiate collision (two continental plates moving together), constructive (two continental plates moving apart), and destructive processes (one continental and one oceanic plates moving together).
4. Determine the position of plate movements (converging movement, diverging movement).
5. Explain how convection currents cause movement of plates (converging convection cells, diverging convection cells and moving plates above).

e) Application activity

Refer to the application activity 2.4 in the student's book.

Three questions were provided for instructional activities. Refer to the student's book for possible detailed answers.

Answers are provided next to questions.

1. Describe SIAL and SIMA in terms of thickness, age, weight and nature of rocks.
   - SIAL: continental crust, constituted by Silica and Aluminum, older, thicker 30-40 km under mountain on average, and lighter
   - SIMA: oceanic crust, constituted by Silica and Magnesium, younger, thinner 6-10 km on average and darker
2. Explain the difference between convergent movement, divergent movement and way past movement.
   - Convergent movement: Two crustal plates are colliding or one subsiding beneath the other.
   - Divergent movement: Two crustal plates are moving away from each other
   - Way past movement: plates' movement predominantly horizontal, where crust is neither produced nor destroyed as the plates slide horizontally past each other)
3. Describe the subduction, collision, spreading processes and give their effects corresponding motions.
   - Subduction: Oceanic crust denser, moves towards continental and sinks. The effect to form deep sea trench),
   - Collision: two continental crust collide and, as neither can sink, are forced up into fold mountains, e.g. Himalaya)
   - spreading processes: Two plates move away from each other, new oceanic crust appears, forming mid-oceanic ridges with volcanoes).

Lesson 5: Major plates and effects of plate tectonics

a) Learning objectives

- Evaluate the effects of plate tectonics.
- Explain the effects of tectonics plate on the landscape.

b) Pre-requisite/ Revision/ Introduction

Display the map in the Student's book showing different plates. Thereafter Student-teachers are asked to name the major tectonic plates and to identify features on the map and relate them with the legend.

c) Teaching resources

To achieve learning objectives, the following resources should be used:

- Geographical documents
- Maps, Illustration
- Internet/DVDs
- Manila Paper or flip chart
- Jaws software

d) Learning activity

Refer to the learning activity 2.5 in the student's book

Two questions constitute the learning activity 2.5. student-teachers are asked:

1. To make research and represent on the world map the major tectonic plates.
2. To identify the effects of plate tectonics

A handout of the figure or the Student'sbook should be provided to enable student-teachers successfully to fulfill the task. The task is performed in groups. The Tutor refers Student-teachers to s student's book to find related contents.

The Tutor recommends Student-teachers to find complete answers in student's book but at least the major related points can be highlighted as follows:

- Some of the major tectonic plates include (Eurasian plate, Pacific Plate, African plate, North American Plate, South American plate, Indo-Australian Plate, Antarctic plate)
- Many landforms are caused by plate tectonics. Other effects include earthquakes, volcanic eruption and tsunamis.

c) Application activity

Refer to the application activity 2.5 in the student's book

Four application questions have been prepared to enable not only the Tutor to evaluate Student-teachers but also they can assess themselves their level of achievement. Application activity includes one cross cutting question (number four) whose answer can be found in additional information.

1. Conduct your own research to identify the minor tectonic plates of

the world and locate them geographically (refer to the figures of the student's book).

2. Apart from the distribution of the continent, what are other effects of plate tectonics (formation of landforms, earthquakes, volcanic eruptions, tsunamis, loss of life and properties).
3. Identify the major seismic and volcanic zones in the world and explain the impact of those natural hazards referring to the tectonic plates (the margins between Pacific plate and Indo-Australian plate and Philippines Plate; between Nazca plate and South American plate).
4. Our country, Rwanda, is in a region which is tectonically active and subjected to earthquakes events. The more documented earthquake is the one which occurred on 3rd and 4th February 2008. It occurred on Sunday about 09h31 with the magnitude of 6.1 and 5, and on Monday the 4th February 2008 and affected mostly Nyamasheke and Rusizi Districts, Western Province. 37 people died, and 643 injured including 367 traumatized. Many houses were destroyed in these two Districts where 1,201 families were rendered homeless: Knowing the causes of the earthquake, explain how Rwandans can cope with it and its impacts and other resulting natural hazards.

   (Let Student-teachers make research and discuss in groups on how to cope with the effects of earthquake and volcanic eruptions).

2.6. Summary of the Unit

The Unit two is about the origin and distribution of the continents. Different theories converge to confirm that there was an old supercontinent Pangaea that broke-up into different landmasses which form todays' continents separated by large water bodies called oceans.

Various theories have been put forwards to support this idea. The theory of continental drift initiated by Alfred Wegener states that continents have moved to their present positions on Earth. The puzzle like fit of continents, fossils, climatic evidence, and similar rocks structures support Wegener's idea of continental drift.

Seafloor spreading is the spreading apart of the seafloor at the mid-ocean ridges. Seafloor spreading is supported by magnetic evidence in rocks and in the age of rocks on the ocean floor. The final bit evidence in support of the theory of sea-floor spreading came from magnetic clues found in the iron-bearing basalt rock from ocean floor. Recent researches confirmed that Earth's magnetic field has reversed itself several times in the past.

The theory of plate tectonics shows that plates move away from each other at divergent boundaries. Plates collide at convergent boundaries. At a transform fault, two plates move horizontally past each other. Hot plastic like material from the mantle is forced upward to the lithosphere, moves horizontally, cools, and then sinks back into the mantle. The movement of this material sets up convection currents, the driving force of plate tectonics. Convergent boundaries are the location of most mountain belts, volcanoes, and earthquakes. Mid-ocean ridges and rift zones occur at divergent boundaries. Major earthquakes occur at transform fault boundaries.

2.7. Additional Information

Magnetic evidence to confirm the seafloor spreading

Frederick Vine and Drummond Matthews researches on the ocean seafloor rocks suggest that the Earth's magnetic field switches direction over time, from its current (normal) direction to the opposite (reversed) direction. They published the idea in 1963 in a Nature paper called 'Magnetic anomalies over oceanic ridges.' It became known as the Vine-Matthews-Morley hypothesis, recognizing the work of Canadian geologist Lawrence Morley who had independently come up with the same idea. It became the first scientific test of sea floor spreading, and a crucial development in the theory of Plate Tectonics.

Their work looked at the patterns of magnetic stripes on the ocean floor. If Hess was right, they hypothesized, the symmetrical pattern of stripes was not accident, but indicated that the Earth's magnetic field switches direction over time, from its current (normal) direction to the opposite (reversed) direction.

When material from the mantle rises up through mid ocean ridges and cools, it preserves a record of the polarity of the Earth's magnetic field. This is because magnetite in the basalts is strongly magnetic, and aligns with the field when it cools.

Vine and Matthews noticed there was a symmetrical pattern of magnetic stripes on either side of the mid ocean ridges. In addition, when the basalts of the sea floor were dated, they were found to be the same age at similar distances away from the ridge on each side. This suggested that the ocean floor was created at the mid ocean ridges then was split in half by later activity and pushed sideways.

Plate tectonics and associated consequences

The Canadian geophysicist John Tuzo-Wilson was initially skeptical of the theory of Plate Tectonics, but eventually became one of its most famous supporters, proposing two important ideas. While evidence for Continental Drift was mounting, the theory still hadn't explained why active volcanoes are found at many thousands of kilometers from the nearest plate boundary. In 1963, Tuzo Wilson proposed that plates might move over fixed 'hotspots' in the mantle, forming volcanic island chains like Hawaii.

In 1965, he followed this discovery with the idea of a third type of plate boundary - transform faults. Also known as conservative plate boundaries these faults slip horizontally, connecting oceanic ridges (divergent boundaries) to ocean trenches (convergent boundaries). Transform faults were regarded as the missing piece in the puzzle of plate tectonic theory. They allowed for plates to slide past each other without any oceanic crust being created or destroyed. The most famous example is probably the San Andreas Fault between the North American and Pacific plates.

Consequences of earthquakes

Our country, Rwanda, is in the western rift valley of Africa, a region which is tectonically active and subjected to recurrent earthquakes events. The more documented earthquake is the one which occurred on 3rd and 4th February 2008. It occurred on Sunday about 09h31 with the magnitude of 6.1 and 5, and on Monday the 4th February 2008 and affected mostly Nyamasheke and Rusizi Districts, Western Province. 37 people died, and 643 injured including 367. Most lives lost during earthquake were due to the destruction of crumbling structures. This unit requires a field trip for Student-teachers to observe impacts of continental drift and plate tectonics. e.g. (Refer to additional content).

Many earthquakes occurred and have caused many deaths and properties damages. The table below summarizes some of deaths caused by earthquakes in various regions of the world.

Table: Summary of some deaths caused by earthquake

Year	Location	Richter value	Deaths
1556	Shensi, China	?	830,000
1737	Calcuta, India	?	300,000
1755	Lisbon, Portugal	8.8	70,000
1811-12	New Madrid, USA	8.3	Few
1886	Charleston, USA	?	60
1906	San Fransisco, USA	8.3	1,500
1920	Kansu Province, China	8.5	180,000
1923	Tokyo, Japan	8.3	143,00
1939	Concepcion, Chili	8.3	30,000
1960	Southern Chili	8.6	5,700
1964	Prince William Sound, Alaska	8.5	131
1970	Peru	7.8	66,800
1975	Laoning Province, China	7.5	Few
1976	Tangsha, China	7.6	2,400,000
1985	Mexico City, Mexico	8.1	9,500
1988	Armenia	6.9	28,000
1989	Loma Priesta, USA	7.1	62
1990	Iran	7.7	50,000
1990	Luzon, Philippines	7.8	1621
1993	Guam	8.1	None
1993	Marharashtra, India	6.4	30,000
1994	Norhridge, USA	6.7	61
1995	Kobe, Japan	6.9	5,378
2008	Western Province, Rwanda	6.1	37
2010	Haiti	7.3	230,000

How many people react to natural hazards?

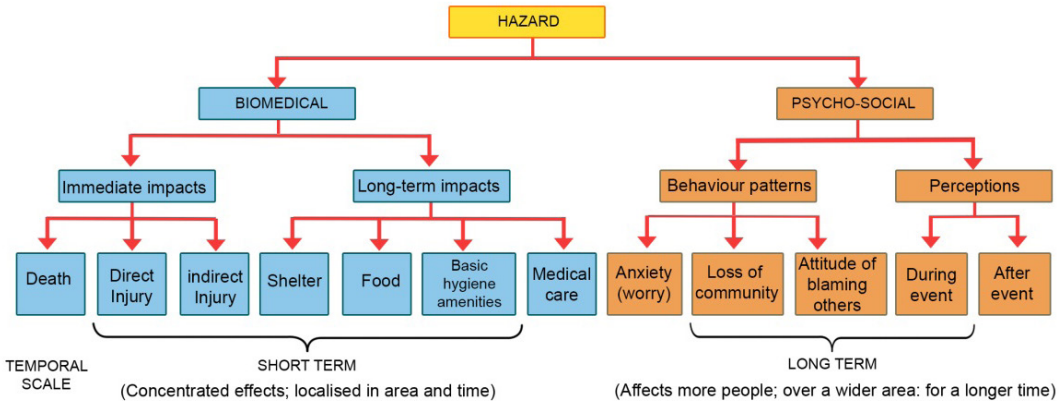
Geographers need to ask themselves the following questions studying either the risk of a potential natural hazard or a specific hazard event.

1. What are people's perceptions of the natural hazard?

   Perception is how individuals or groups of people view the hazard risk. This often depends on either knowledge or experience of the potential event.

2. What are the immediate and long-term effects of the event?
3. How do people respond to the event?

The answers for the questions are summarized in the figure below:



Examples of responses in Rwanda

In efforts to reduce disaster risks and ensure timely response when the disaster hits, Rwanda Red Cross has set up disaster response teams from the National, District to Sector levels which are charged with day today management of disaster risks and response whenever need arises.

These teams are supported by regular training to ensure they are well positioned to respond as expected and in this regard, Local Disaster Response Teams (LDRTs) were established in high risk sectors. Gakenke, Ngororero, Nyabihu, Karongi and Rutsiro Districts received refresher training in disaster management and first aid skills.

Contents of the training included largely disaster management skills with a greater focus on disaster risk reduction (DRR) which is implemented through Rwanda Red Cross' Model Village approach that aims at empowering community resilience to economic and disaster shocks.

2.8. End unit assessment

1. What is the contribution of Wegener's theory and others on the distribution of continents?

   The contribution of wegener's theory on continental drift include the following:

   A good fit of edges of continents and similar rock structures are found on different continents.

   Present shapes and relative positions of the continents are the result of fragmentation of Pangea by rifting and drifting apart of the broken landmasses following the formations of oceans and seas.

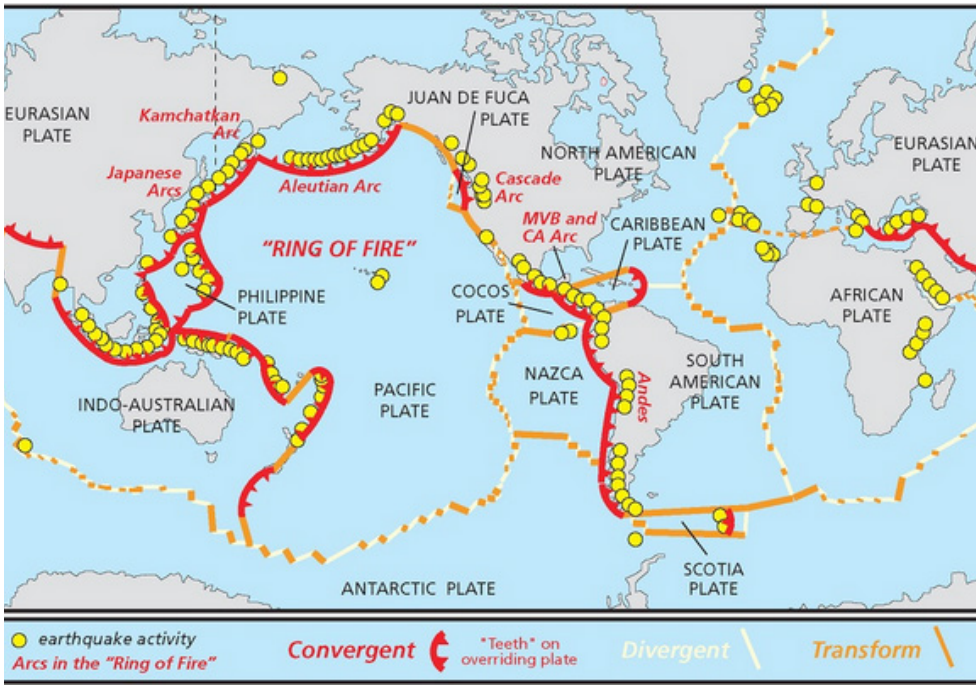
   There is similarity in the fossils and vegetation remains found on different continents. Remains of Glossopteris, a plant which existed when coal was being formed has only been in India and Antarctica. These animals and plants could not have swum across oceans if continents were separated by water bodies, so continents must have been close together for them to occur on different continents. All location where the fossils have been found may once have been connected and probably had a similar climate.

2. Basing on the knowledge acquired in this unit, explain the relationship between the earthquakes which occur in the region of the western rift valley of Africa where Rwanda is located, with the continental drift.

   The Earth is an active planet. Its surface is composed of many individual plates that move and interact, constantly changing and reshaping Earth's outer layer. Plates can converge towards one another or diverge away one from the other. But also, one single plate can break up into two plates due to diverging convection currents. Once this happens resulting plates diverge. This is what occurs in our region. The breaking up of African plate resulted in the formation of the East African Rift which extends from the Afar Triple Junction southward across eastern Africa, to Mozambique in Southeastern Africa in the process of splitting the African Plate into two new separate plates. The rifting caused by diverging convection currents is drifting apart the eastern landmass block away from the western plate. This process is associated with earthquakes and volcanoes which sometimes affect our country given its location in the western rift valley.

3. Represent graphically the main tectonic plates of the world map.

   Student-teachers should be able to draw, locate and name the major plates and regions of earthquakes and volcanic activities, e.g. ring of fire around the Pacific plate margins, between Eurasian plate and African plate.



4. Discuss the consequences of the plate tectonics on population in some specific areas of the world.

   The only case described here is the earthquake that hit Haiti in 2010 among many others. On January 12, 2010, a 7.3 magnitude earthquake ravaged Haiti. More than 230,000 people were killed. Another 300,000 were injured. More than 600,000 people left Port-au-Prince to stay with families outside the capital. The quake displaced 1.5 million people. Makeshift camps sprung up to shelter them. In total, the quake-affected 20 percent of the nation's 10.4 million population. Seven years later, 55,000 people still lived in the camps. The quake damaged the main airport, most of the ports and almost all the paved roads. It damaged 294,383 homes, destroying 106,000 of them.

   Causes

   Haiti sits above two tectonic plates, the Caribbean plate and the North American plate. These plates are rigid parts of the Earth's crust that slide separately on the planet's molten mantle. They were sliding past each other.

2.9. Additional activities

2.9.1. Remedial activities

a) Give 2 examples of major tectonic plates of the world.

- Pacific plate; African plate; Eurasian plate; North America Plate; South America Plate; etc.

b) Give 2 effects of plate tectonics.

- Earthquake; Volcanic eruption; Tsunami.

2.9.2. Consolidation activities

With reference to the knowledge and skills acquired from the unit 2, examine the difference existing between boundaries and movement of tectonic plates

Answer: refer to the student's book

2.9.3. Extended activities

- Discuss the difference between the plate tectonic theory and the isostasy theory.

Answer:

Plate tectonics: the theory that the earth's crust and the upper mantle (lithosphere) are broken into sections, called plates that slowly move around on the mantle.

Isostasy is principle describing the flotation of the less dense lithosphere on the denser mantle.

Plate tectonics emphasizes on lateral movements of plates under the influence of convection currents of the asthenosphere.

Isostasy theory is concerned with vertical movements of plates which depend on lithospheric masses. The loading of crust by ice or sediments may cause the subsidence of lithosphere, whereas the discharge resulting from ice melting or erosion may cause the up lift of lithospheric compartment.

Skills Lab

Basing on the distribution of continents and oceans basins, discuss the geological evidences of continental drift.

- Remind Student-teachers that they have some prerequisites on continental drift.
- Encourage Student-teachers to make research in order to find additional evidences

UNIT 3

EXTERNAL LANDFORM PROCESSES AND RELATED FEATURES

3.1. Key unit competence

The Student-teachers should be able to demonstrate an understanding of different features resulting from the external processes.

3.2. Pre-requisite (knowledge, Skills, attitudes and values)

Unit 5 of Senior 2 introduced the study of external landform processes in Rwanda. They studied weathering and the resultant erosion and deposition features, they studied also causes and effects of mass wasting. The Tutor has to conduct diagnostic assessment as a way of evaluating each student-teacher's abilities. The Tutor should refer to knowledge, skills, attitudes and values associated with weathering and mass wasting that Student-teachers acquired from the previous classes with the aim of establishing connections between the new learning activities and the previous ones.

This will help Student-teachers to understand appropriate measures to be taken in conserving the environment. Therefore, a tutor emphasizes the cross-cutting issue of environment and sustainability.

3.3. Cross-cutting issues to be addressed

A citizen must conserve his environment, by using it appropriately. The management of the environment must be emphasized and various methods should be adopted.

In this unit, emphasis must be put on the need for **environment and sustainability** based on knowledge of weathering and mass wasting, the Student-teachers should know how to protect their environment.

Financial education is another cross-cutting issue that is linked to the study of weathering, and mass wasting. The resultant features of these processes

promote human activities like agriculture, tourism, mining, fishing etc. Such economic activities have helped people to earn a living and national income for sustainable development.

3.4. Guidance on introductory activity

In the Student's book there is an introductory activity; it is intended to explain the phenomena that affected the rock shown on the photograph. The Student-teachers will try to answer the question. Student-teachers may not be able to get the right answer but they are requested to predict possible answers. When the Student-teachers fail to come up with right answers to the questions related to introductory activity, the tutor will not immediately provide the required answers rather he /she should let students get the real answers through the course of learning and teaching process. This implies that Student-teachers will associate this lesson with the content learnt in the previous lessons of Senior Two.

3.5. List of lessons (including assessment)

#	Lesson title	Learning objectives	Number of periods
1	Definition, types and process of weathering	– Explain the external processes of weathering. – Recognize the different weathering processes.	4
2	Factors influencing weathering and interdependence of physical and chemical weathering.	– Describe the factors affecting weathering – Identify the major factors influencing weathering.	2
3	Landforms associated to weathering and their importance.	– Appreciate the importance of the landforms resulting from the weathering.	3
4	Mass Wasting: Definition, types and causes of mass wasting	– Show concern for the causes of mass wasting. – Evaluate the causes of mass wasting.	3
		– Identify the different types of mass wasting in different areas and their causes.	

5	Effects and control measures for mass wasting	– Show concern for the effects of mass wasting. – Evaluate the effects of mass wasting.	1
6	End unit assessment		1

Guidance on different lessons

Lesson 1: Definition, types and process of weathering

a) Learning objectives

- Explain the external processes of weathering.
- Recognize the different weathering processes.

b) Prerequisites/ Revision/ Introduction

This topic on weathering was discussed in senior 2. It is important to link the content studied with what is going to be learnt in year 3. In Senior 2 Student-teachers learnt weathering in Rwanda.

Facilitate the Student-teachers to review the year 3 contents by asking them to explain weathering in Rwanda. After this review, using the photograph provided (Photograph of a devastated area) in the student's book. Student-teachers will be able to explain types and processes of weathering.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Sample photographs
- Internet

d) Learning activities

Refer to the learning activity 3.1 in the student's book

Help Student-teachers to work in groups, they will be guided to differentiate physical weathering from chemical weathering and to outline the processes of chemical weathering. Their answers should involve the integration of generic competences such as critical thinking, problem solving, cooperation, communication and research skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student' book.

e) Application activities

Refer to the application activity 3.1 in the student's book

Student-teachers are asked to use local environment to identify evidences of biological weathering. They will use the content given in the student'book on types and processes of biological weathering and internet.

Lesson 2: Factors influencing weathering and interdependence of physical and chemical weathering

a) Learning objectives

- Describe the factors affecting weathering
- Identify the major factors influencing weathering.

b) Pre-requisites/ Revision/ Introduction

Display the illustration in the student's book. Then put Student-teachers in groups and guide them to make research on how the shown factors influence weathering.

c) Teaching resources

To achieve learning objectives, the following resources should be used:

- Text books
- Illustration
- Internet

d) Learning activities

Refer to the learning activity 3.2 in the student'book

Guide Student-teachers to work in pairs, they will be able to identify and explain how living organisms influence the rate of weathering and explain the interdependence of physical and chemical weathering. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book.

e) Application activities

Refer to the application activity 3.2 in the student'sbook

Student-teachers are asked to visit the local environment and explain how relief and climate have influenced the rate of weathering. They will use the content given in the student's book on factors influencing weathering.

Lesson 3: Landforms associated to weathering and their importance

a) Learning objectives

- Appreciate the importance of the landforms resulting from the weathering.

b) Pre-requisites/ Revision/ Introduction

Student-teachers are asked to explain landforms associated with weathering in limestone regions. Briefly supplement the answers provided by Student-teachers.

c) Teaching resources

- Text books
- Illustrations.
- Internet

d) Learning activities

Refer to the learning activity 3.3 in the student's book

In groups, Student-teachers are given two questions: question one consists of identifying the features associated to weathering and the question two is about analysing the importance of Cave and Oasis. Guide them to make research and find the appropriate answers. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book.

e) Application activity

Refer to the application activity 3.3 in the student's book.

Student-teachers are asked to examine the contribution of weathering on human activities and to discuss about how humid tropical regions are the most affected by weathering.

They will use the content given in the student's book on weathering landforms associated with limestone regions and internet to explain features associated with weathering in limestone regions.

The answers suggested to describe how the humid tropical regions are the most affected by weathering are:

The tropical climate is characterized by high amount of rainfall (more than 1000mm) and high temperature (more than 18° C). Weathering is favored in equatorial and tropical regions where the wetness and high temperature are permanent. During the rainy season, chemical weathering dominates through the process of hydration, hydrolysis, solution, oxidation, and reduction. In areas with alternating seasons, chemical weathering is temporary interrupted during drought periods because of lack of moisture. Physical weathering processes such as exfoliation, granular disintegration and block disintegration dominate. Therefore, in tropical (savanna) climate, both physical and chemical weathering processes dominate in dry and rainy seasons alternatively.

Lesson 4: Definition, types and causes of mass wasting

a) Learning objectives

- Show concern for the causes of mass wasting.
- Evaluate the causes of mass wasting.
- Identify the different types of mass wasting in different areas and their causes

b) Pre-requisites/ Revision /Introduction.

Student-teachers are asked to describe limestone regions. Briefly talk about characteristics of humid tropical regions, supplement the answers given by Student-teachers and introduce the content related to mass wasting.

c) Teaching resources

For the effective delivery of the lesson and achievement of learning objectives, use the following:

- Text books
- Illustrations
- Photographs
- Internet
- Other geographical documents

d) Learning activities

Refer to the learning activity 3.4 in the student's book.

Put Student-teachers in groups; guide them to Study the photograph taken in northern part of Rwanda and describe the cause of the phenomena which happened. They present their findings in class. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book.

e) Application activities

Refer to the application activity 3.4 in the student's book

Student-teachers are asked to examine the major causes of mass wasting and have to use diagrams to distinguish slumping from rock fall. They will use the content given in the student's book on types and causes of mass wasting and other geographical documents.

Lesson 5: Effects and control measures for mass wasting

a) Learning objectives

- Show concern for the effects of mass wasting.
- Evaluate the effects of mass wasting.

b) Pre-requisites/ Revision/ Introduction

Review the previous lesson and ask Student-teachers to account for the effects of mass wasting and their solution.

c) Teaching resources

For learning objectives to be achieved the following resources should be available: Text books, Illustrations, Internet, Geographical documents.

d) Learning activities

Refer to the learning activity 3.5 in the student's book.

In groups, Student-teachers are given illustrations from the student's book on mountainous landscape and they are asked to analyse the effects of mass wasting and to suggest any three measures to control mass wasting. The content in the student's book on effects and measures to control mass wasting should

be used. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book on effects of mass wasting.

e) Application activities

Refer to the application activity 3.5 in the student's book.

Student-teachers are asked to make a field trip to observe different areas affected by mass wasting. Analyse the causes of mass wasting and propose the sustainable measures to control it.

They will use the content given in the Student's book on the causes, effects and measures to control mass wasting and geographical documents to analyse the causes of mass wasting and solutions for sustainable development. The most areas affected by mass wasting are that hilly areas, deforested areas and where erosion is not well controlled.

3.6. Summary of unit

This unit covers types and processes of weathering, factors influencing weathering, interdependence between chemical and physical weathering, weathering in limestone, types, causes, effects and measure to control mass wasting.

This unit intends to help Student-teachers to explain various landforms formed as a result of external processes and analyze their importance in relation to human activities. This helps the Student-teachers to internalize financial education as a cross cutting issue and know how man has utilized the available landforms for sustainable development. Also, common phenomena like mass wasting which requires control measures creates awareness for environmental protection hence integration of environment and sustainability as a cross cutting issue.

3.7. Additional Information

This unit is linked to unit 5 in Senior 2 on weathering in Rwanda and Unit 3 in year One on the formation of relief features in Rwanda. It is vital for Student-teachers to link the prior knowledge acquired in past year to what is contained

in this unit. When you are teaching this unit, you should use local examples of landforms resulting from weathering in Rwanda. Make comparison between different continents in relation to the landforms resulting from weathering.

The Student's book contains some activities where group discussion is emphasized. It is therefore necessary that where possible methodology can be changed and activities adjusted to achieve learning objectives.

3.8. End unit assessment

1. Give the reasons why high land are the most affected by mass wasting.

   Facilitate Student-teachers in groups to share the answers by using experience in their community; they brainstorm but some of the reasons are steep slope and heavy rainfall received.

2. How have topography and parent rock influenced the rate of weathering in your area?

   In groups let Student-teachers brainstorm on how topography and parent rock have influenced weathering. They should use local examples from their area of origin.

3. Make a field trip in your local environment and explain how the weathering landforms identified in your area affect positively and negatively human activities.

   Facilitate Student-teachers in the field to observe and analyze landforms resulting from weathering and explain their negative and positive impact on human activities. They should use examples from their local environment.

3.9. Additional activities

a) Consolidation activities:

i) Discuss the processes of chemical weathering.

ii) Evaluate the causes of mass wasting.

Guide Student-teachers how to answer the above questions using Student's book and internet. For example, the processes of chemical weathering include carbonation, hydration, solution chelation, oxidation and hydrolysis on the other hand the causes of mass wasting include gradient, climate, nature of the soil, the work of animals, volcanicity etc.

b) Remedial activities (for slow Student-teachers)

i) Define weathering

ii) Outline five factors that influence weathering

These are questions that require low order thinking and are answered as follows:

i) Weathering refers to the breaking down of rocks into small particles.

ii) Factors influencing weathering are: time, nature of the rock, man's activities, climate, vegetation etc.

c) Extended activities (for gifted and talented Student-teachers)

Account for the formation of stalactite, stalagmite and pillar

Answer: Let Student-teachers make research on the landforms in limestone. Thereafter Student-teachers make class presentation of their findings.

Skills Lab

Identify any most area affected by mass wasting, examine how the community work/ Umuganda may help you to fight it.

- Tutor should tell Student-teachers that mass wasting is a serious problem that they should take in their concern.
- Tell Student-teachers to involve themselves in Umuganda so that they apply their skills to prevent mass wasting.

UNIT 4

WAVE EROSION AND DEPOSITION

4.1. Key unit competence

The Student-teachers should be able to categorise different features resulting from the wave action and their relationships with the human activities.

4.2. Pre-requisite (knowledge, Skills, attitudes and values)

Unit 8 of year 1 introduced the study of drainage system in Rwanda. Student-teachers studied the major rivers and drainage basins, major lakes and their mode of formation, the importance of wetlands to the development of Rwanda, relationships between the drainage system and human activities. The Student-teachers studied the drainage system of Rwanda and explain its relationships with human activities. Furthermore, unit 2 of year 3; dealt with the origin and distribution of the continents, where was dedicated to the theory of Isostasy. The above mentioned lessons learnt previously will constitute an asset for Student-teachers to understand the Isostatic and Eustatic changes on the coast.

It's very important to note that, they already have necessary knowledge, skills and attitudes. The difference is that, at this level the content as that in the student's book is more detailed and goes beyond what they have seen.

4.3. Cross-cutting issues to be addressed

The following are the cross-cutting issues to be addressed in this unit:

a) Environment and sustainability

Environment and sustainability is very important in this developing World under the tremendous effects of climate change. It is in this regard that when you are teaching the unit of wave erosion and deposition, the environment and sustainability will be integrated by helping students to identify the causes and

effects of wave on the coast; in this lesson, ask Student-teachers to plant the trees and others conservative plants along the coast, shores of lakes and river banks. In so doing, they will conserve their environment in their local areas in managing water systems in their daily activities.

b) Financial education

Financial education makes a strong contribution to the wider aims of education. The tutor should address the cross-cutting issues of financial education through different human activities like managing the coast for tourism practices and for sustainable development at the coastal areas in the World as well as in Rwanda.

c) Inclusive education

This involves the participation in education of Student-teachers with different learning styles and other difficulties. Every student-teacher is requested to learn and participate actively despite her/ his level of knowledge, physical or mental ability.

You are asked to apply the methodology that facilitates each student-teacher like using tactile drawing in teaching, keeping students with hearing impairment at the first front and occupying the talented students with the activities provided in the tutor'guide on extended activity.

4.4. Guidance on introductory activity

The introductory Activity aims at highlighting the knowledge, skills and attitudes that tutors, acquired previously in classes. This activity prepared, requires student-teacher to put to better use of all the competences, knowledge together with attitudes in understanding this topic of year 3 unit 4. Activities in this unit can be answered by most of the student-teacher. The Tutor could provide enough time for every student-teacher so that individual participation can be respected. The intention of this activity is to see the ability of each student-teacher so that throughout the unit the tutor plans on how to aid his/ her student-teacher.

The ways answers are provided for the introductory activity require Student-teachers to think deeply, to search and read geographical document.

4.5. List of lessons (including assessment)

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes)	Number of Periods
1	Coastal landforms: Definition of key terms and type of waves	– Identify the types of coasts. – Show the continual desire to understand the different types of coast	1
2	Factors determining the strength of waves and Wave action processes	– Explain the process of wave erosion and deposition – Name the major features associated with the wave erosion and depositional processes. – Recognise the different landforms resulting from the wave erosion and depositional processes.	4
3	Factors for Formation of coastal landforms and landforms produced by wave and their importance	– Explain the factors influencing the coastal landforms. – Identify the factors influencing the formation of the coastal landforms.	5
4	Importance of coast landforms produced by wave action and type of coasts	– State the importance of coast landforms produced by wave action. – Evaluate the importance of the coastal landforms created by the wave action. – Identify the type of coasts – Appreciate the importance of different landforms produced by wave erosion and deposition.	2
5	Coral reefs	– Identify the major types of coral reefs. – Do research using the internet websites for the types of coral reefs.	3
6	Theories of the origin of coral reefs, Problems facing the development and growth of coral reefs, Impact of coral reefs	– Describe the theories of the origin of coral reefs – Appreciate the importance of coral reefs to the economy – Explain the problem facing the development and growth of coral reefs.	4

7	Sea level change	– Differentiate between isostatic and eustatic changes on sea level and resultant features. – Evaluate the causes and effects of sea level change – Identify the features resulting from sea level change.	2
8	End unit assessment		1

Guidance on different lessons outlined above

Lesson 1: Coastal landforms: Definition of key terms and type of waves

a) Learning objectives

- Identify the types of coasts.
- Show the continual desire to understand the different types of coast

b) Pre-requisites/ Revision/ Introduction

Make a review on drainage, find internet explorer and other geographical materials for searching the terms to be learnt which are related to the coast. Then provide these terms as written in student's book on definition of key terms.

After providing all required materials for searching the terms related to the coast, Student-teachers will use the materials in place to find the meaning of terms related to coast and describe the parts of wave.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Different geography books
- Internet
- Tactile materials

d) Learning activities

Refer to the learning activity 4.1 in the student's book

You need to guide Student-teachers on the ways of using internet and /or other geographical resources to search the meaning of the terms related to coast.

Ensure that generic competences are developed in this lesson like critical thinking, cooperation, communication and research.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book.

Guidance to answer learning activities.

They will use the content given in the student's book on definition of terms related to the coast, the internet and other geographical materials you find to be relevant to define the terms related to coast and to mention the parts of waves.

e) Application activity

The suggested answers on application activity 4.1 are the following:

1. Refer to student's book on types of wave.
2. Student-teachers are asked to describe the coastal features they would be interested to discover if they find an occasion to visit the ocean coast. For this activity, the teacher will give Student-teachers an opportunity and time to reflect and answer the questions. And also he will refer them to student's book on coastal features.

Lesson 2: Factors determining the strength of waves and Wave action processes

a) Learning objectives

- Explain the process of wave erosion and deposition.
- Name the major features associated with the wave erosion and depositional processes.
- Recognise the different landforms resulting from the wave erosion and depositional processes.

b) Pre-requisites/ Revision/ Introduction

Student-teachers are asked to make a brief review on the meaning of different terms related to coastal landforms and the types of waves. They will use the content given in the student's book on definition of key terms on coastal landform.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books

- Geography books
- Internet
- Tactile materials

d) Learning activities

Refer to the learning activity 4.2 in the student's book

1. Analyse the factors that determine the strength of waves on the coast
2. Explain how waves can cause erosion along the coast.

Guide Student-teachers to work in groups to analyse the factors that determine the strength of waves on the coast and explain how waves can cause erosion along the coast.

The internet, other geographical resources, content acquired in year 1on drainage of Rwanda and content in Student's book may help them. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book.

e) Application activity

Refer to the application activity 4.2 in the Student's book

1. Wave erosion is done in four ways, differentiate them
2. Explain the impact of wind and tides on the strength of the waves.

Guidance to answer application activities

They will use the content given in the student's book on Factors determining the strength of waves and Wave action processes and other geographical documents.

Lesson 3: Factors for Formation of coastal landforms and landforms produced by wave and their importance

a) Learning objectives

- Explain the factors influencing the coastal landforms.
- Identify the factors influencing the formation of the coastal landforms.
- Analyse the importance of landforms produced by waves.

b) Pre-requisites/ Revision/ Introduction

You are required to start the lesson by reviewing the previous lesson and asking questions related to the types, factors and waves action processes. As well as you are asking questions to Student-teachers you may clarify some confusing situations.

Next, you must announce the topic of the lesson which is Factors for Formation of coastal landforms and landforms produced by wave and their importance.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Photographs
- Internet
- Tactile materials
- Video clips on coastal features
- Print outs for the activity
- Manila or flip chart papers

d) Learning activities

Refer to the learning activity 4.3 in the student's book.

1. Identify the landform shown on the picture.
2. What are the major factors for these landforms to be formed?

Guide student-teachers to work in groups and make research on the landforms shown and factors for formation of coastal landforms. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and research skills.

Let student-teachers discuss, ask and answer questions and refer them to the student's book for more information related to coastal landforms.

e) Application activity

Refer to the application activity 4.3 in the student's book

Student-teachers are asked to apply what they have learnt in the lesson to describe the landforms produced by wave action, explain the factors influencing the formation of coastal landform, and examine the landforms likely to be found around lake in Rwanda.

Guidance to answer application activities

They will use the content given in the student's book on formation of coastal landforms and other geographical documents related to the application activities.

Lesson 4: Importance of coast landforms produced by wave action and type of coasts

a) Learning objectives

- State the importance of coast landforms produced by wave action.
- Evaluate the importance of the coastal landforms created by the wave action.
- Identify the type of coasts
- Appreciate the importance of different landforms produced by wave erosion and deposition.

b) Pre-requisites/ Revision/ Introduction

Review the previous lesson by asking Student-teachers to briefly describe the factors for landforms formation at the coast and the features resulting from the coast wave erosion. Thereafter demonstrate the coastal photograph whereby there are many people on it enjoying the costal life (picture on importance of coastal landforms) and ask student-teachers to discuss the economic activities that may be carried at the displayed picture.

c) Teaching resources

For effective learning and teaching of this lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Photographs
- Internet
- Atlases
- Manila papers and flip charts
- Print outs of activities

d) Learning activities

Refer to the learning activity 4.4 in the student's book

The teacher should provide a photograph to Student-teachers and guide them to observe it in group and answer to only one activity of lesson.

Describe the landform on the picture and make sure that all Student-teachers can identify all features on the picture to relate it to the asked question which is about; describing the economic activities that can be carried at the displayed picture. For this activity make sure that all Student-teachers can interpret the picture clearly according to the intention of the lesson. The answers to this question should ensure that all the activities done are related to the coast including tourism as many people from different places gather on the beach for recreation purposes. In this opportunity, commercial activities may be carried like selling beverages particularly soft ones, air time for calling, restaurants services as out catering all these on the beach. When advancing at inshore the fishing activity is a major. For some coast, students may raise the issues of other activities like cement industries along the coral reefs. So, it is up to the teacher to synthesize and conclude whether the reason is reliable.

For more answers, they will refer to the student's book on importance of landforms produced by waves

e) Application activity

Refer to the application activity 4.4 in the student's book

Application activities are intended to enable the teacher to assess the level of achievement of the Student-teachers, and to evaluate if the instructional objectives set are achieved. Two application activities have been provided.

Question 1 is all about to give five examples of cities which are located on the coast. Among them two should be located in East African countries: New York, Mombasa, Rotterdam, Dar es Salaam, Cap Town, Casablanca, Lagos, etc. The teacher will make sure that Student-teachers are able to identify all these cities by applying the experience learnt on coast and answering the question appropriately.

Question 2 refers to student's book on types of coasts

Question 3 is concerned with the business opportunities that they may carry out near coasts and the challenges they can face. It is in this regard that students must relate what they have learnt on the importance of the coast. The Tutor makes sure that Student-teachers can describe all economic activities that can be carried out on the shores and challenge like climate change, robbery, language barrier, etc.

Lesson 5: Coral reefs

a) Learning objectives

- Identify the major types of coral reefs.
- Do research using the internet websites for the types of coral reefs.

b) Pre-requisites/ Revision/ Introduction

Review the previous lesson and ask student-teachers to describe the types of coasts including the submerged upland and low land, emerged upland, low land given in the Student's book. You are advised to check if all Student-teachers have understood the lesson before embarking on the lesson of coral reefs.

c) Teaching resources

- Text books
- Illustrations and photographs
- Internet
- Manila paper and flip charts
- Tactile materials

d) Learning activities

Refer to the learning activity 4.5 in the student's book

An illustration showing the features of coral reefs is displayed to the formed groups.

Guidance to answer learning activities

Guide them to explore the illustration through discussions. Their answers should involve the integration of generic competences such as communication, critical thinking, cooperation, research and problem-solving skills.

For more answers on the activities, Student-teachers will refer to the student's book on coral reefs

e) Application activity

Refer to the application activity 4.5 in the student's book

Student-teachers are asked to give clear illustrations of different types of coral reefs, explain the conditions for coral reef formation. Student-teachers will use the content given in the student's book on types of coral reefs.

Lesson 6: Theories of the origin of coral reefs, Problems facing the development and growth of coral reefs, Impact of coral reefs

a) Learning objectives

- Describe the theories of the origin of coral reefs
- Appreciate the importance of coral reefs to the economy
- Explain the problem facing the development and growth of coral reefs.

b) Pre-requisites/ Revision/ Introduction

Briefly review the previous tasks and ask Student-teachers to explain the types of coral reefs, formation of coral reefs and condition for coral reef formation. Briefly clarify the answers given by Student-teachers relying on the objectives of the lesson.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Illustrations and photographs
- Internet
- Geographical documents
- Manila paper and flip charts
- Tactile materials
- Print outs for activitie

d) Learning activities

Refer to the learning activity 4.6 in the student's book.

Facilitate student-teachers in groups to answer the questions of explaining why coral reefs are important to the people living in the region where they are located. Mention the key theories of coral reefs formation. The Student-teachers' answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage Student-teachers in activities like discussion, asking and answering questions.

For more answers they are referred to the student's book about Theories of the origin of coral reefs, problems facing the development and growth of coral reefs and Impact of coral reefs.

e) Application activity

Refer to the application activity 4.6 in the student's book

Under the guidance of the tutor, Student-teachers will use the content given in the student's book about the Theories of the origin of coral reefs, Problems facing the development and growth of coral reefs, Impact of coral reefs.

Lesson 7: Sea level change

a) Learning objectives

- Differentiate between isostatic and eustatic changes on sea level and resultant features.
- Evaluate the causes and effects of sea level change.
- Identify the features resulting from sea level change.

b) Pre-requisites/ Revision/ Introduction

Help Student-teachers to review the past work and ask them to distinguish between isostatic and eustatic changes on the coast.

Guide Student-teachers to explore much more on the previous lesson because it has core relationship with the sea level change. Supplement the Student-teachers' answers and clarify more on the ideas that might bring the confusion.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Illustrations and photographs
- Internet
- Geographical documents
- Manila paper and flip charts
- Tactile materials
- Print outs for activities

d) Learning activities

Refer to the learning activity 4.7. in the student's book

Form groups to observe photograph for better discussion. Let Student-teachers refer to the Student's book and answer the questions on the photographs. The student-teachers must discuss deeply the second question as it requires them

to analyze and take a good position. For question three, you must verify if all photographs given to students are clearer especially to students with visual impairment. They should use the content provided in the student's book on the sea level change. Engage Student-teachers in activities like discussion, asking and answering questions.

The Student-teachers' answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

For more answers, you will refer to the student's book on sea level changes.

e) Application activity

Question one refers to student's book on sea level change.

Question two, let Student-teachers explain their answers.

Question three, refer to student's book on sea level change.

4.6. Summary of the unit

The unit 4 entitled wave erosion and deposition covers the following: Coastal landforms; definition of key terms, types; factors and action processes of waves; types of waves, factors determining the strength of waves, Wave action processes, formation of coastal landforms, factors influencing the formation of coastal landforms, landforms produced by wave erosion, landforms produced by wave deposition, importance of coast landforms produced by wave action, types of coasts, coral reefs and Sea level change. It emphasizes on categorization of different features resulting from wave action and their relationships with human activities.

This unit intends to help Student-teachers to explain types of waves and describe the features resulting from wave erosion, transportation and deposition. It analyzes their importance in relation to human activities. This helps the Student-teachers to internalize financial education as a cross cutting issue and know how man has utilized the available landforms for sustainable development. All this creates a great understanding about environment hence application and integration of environment and sustainability as a cross-cutting issue.

4.7. Additional information

This unit is linked to unit 8 in year 1on the drainage system of Rwanda. It is vital for Student-teachers to link the prior knowledge acquired in year 1to what is contained in this unit. When you are teaching this unit, you should use local examples of features resulting from wave action processes (where possible). If it is not possible you may use illustrations or videos. Make a comparison of different features produced by wave erosion in different areas by analyzing different causes and effects of wave erosion and deposition.

It is therefore necessary that where possible methodology can be changed and activities adjusted to achieve set learning objectives.

In addition to the content in student's book, the following is helpful for better understanding and better teaching-learning of that unit.

The theories for coral reefs formation have been presented in student's book. However, the evidences were not there. So, the following are theories and evidences for and against to coral reefs formation.

Darwin's Subsidence Theory

Darwin assumes that along a suitable platform, coral polyps compacted together and grew upward towards a low water level. The resulting reef, in this stable condition, would be a fringing reef. But, at the same time, Darwin assumes, the sea floor and the projecting land in coral seas started submerging, and the living corals found themselves in deeper waters. Hence, an urge to grow upward and outward would be balanced by the subsidence of the land.

Because of this, Darwin postulated that the fringing reef, barrier reefs and atolls are only three stages in the evolutionary growth of a reef. As the land subsides, the fringing reef would grow upwards and outwards, resulting in the formation of a shallow lagoon.

Further subsidence would convert it into a barrier reef with wide and comparatively deeper lagoon. The width of the reef is increased due to the rapid outward growth of the reef and deposition of coral debris along it. The last stage of submergence (comparable to thousands of feet) results in partial or complete disappearance of the land and the existence of a coral ring enclosing a lagoon.

Despite continued subsidence, Darwin maintains that the shallowness of the lagoon would be due to the deposition of the sediment from the nearby subsiding land. Hence, the lagoon always remains flat and shallow.

i) Evidence in support of the theory

There is much evidence of subsidence in coral areas.

- For example, submerged valleys in the east of Indonesia and the coastal areas of Queensland. Had there been no subsidence, the sediment produced by the erosion of coral reefs would have filled the lagoons and caused the death of corals.
- The material produced by erosion gets continuously accumulated at the subsiding lagoon bottom. That is why the lagoons are shallow. During an experimental boring, done to a depth of 340 m in the island atoll of Funafuti, dead corals were discovered at these depths.
- Only subsidence can explain existence of corals at this depth because, generally, corals cannot grow below 100 metres. Also, these dead corals showed the evidence of their having got 'dolomitised' which is possible only in shallow waters. All this evidence goes to prove the subsidence theory.

ii) Evidence against the subsidence theory

- Many scientists, like Agassiz and Semper, have argued that the corals have developed in places where there is no evidence of subsidence. Timor is one such area. Similarly, lagoons, with depths of 40m to 45m and many kilometres wide, cannot be explained based on subsidence.
- The question arises as to why there is uniform subsidence in the tropical and sub-tropical areas and not so in other areas. Kuenon has described some areas where the fringing and barrier reefs are found close to each other.
- This is not possible if the subsidence has been a continuous process. Finally, if it is supposed that the coral islands are a product of subsidence, we will have to assume the existence of a vast area in the Pacific Ocean which has submerged, leaving behind corals as islands. There is no evidence of the existence of such a vast land area in Pacific Ocean which existed in the ancient times.

Murray's antecedence theory and against evidences

Evidences against the Murray's antecedence theory

The following are the evidences against the Murray's antecedence theory:

- The theory suggested that the tops of islands were washed away than pelagic deposits which would be much less compacted to move away.
- Studies has shown that the platforms on which corals are formed are inorganic instead of being pelagic. The typical examples are Mayotte; atoll

located on volcanic islands, Aldabra; atoll situated between Madagascar and Zanzibar.

- Organic deposits did not account for the marine platforms on which coral reefs are built but pelagic deposits compacted at very low rate and takes a long time.

Daly's glaciated control theory

Daly, while studying the coral reefs of Hawaii, was greatly impressed by two things. He observed that the reefs were very narrow and there were marks of glaciations. It appeared to him that there should be a close relationship between the growth of reefs and temperature.

According to Daly's hypothesis, in the last glacial period, an ice sheet had developed due to the fall in temperature. This caused a withdrawal of water, equal to the weight of the ice sheet. This withdrawal lowered the sea level by 125-150 m.

The corals which existed prior to the ice age had to face this fall in temperature dining this age and they were also exposed to air when the sea level fell. As a result, the corals were killed and the coral reefs and atolls were planed down by sea erosion to the falling level of sea in that period.

When the ice age ended, the temperature started rising and the ice sheet melted. The water returned to the sea, which started rising. Due to the rise in temperature and sea level, corals again started growing over the platforms which were lowered due to marine erosion.

As the sea level rose, the coral colonies also rose. The coral colonies developed more on the circumference of the platforms because food and other facilities were better available there than anywhere else.

Hence, the shape of coral reefs took the form of the edges of submerged platforms, a long coral reef developed on the continental shelf situated on the coast of eastern Australia. Coral reefs and atolls developed on submerged plateau tops. After the ice age, the surface of platforms was not affected by any endogenic forces and the crust of the earth remained stationary.

Evidence in support of Daly's hypothesis

The following are evidences for supporting Daly's hypothesis:

The experimental borings done on the Funafuti atoll provide evidence in support of Daly's hypothesis.

In the ice age, all the platforms were cut down to the sea level by marine erosion. Hence, the depth of these platforms and that of lagoons with barrier reefs and coral atolls were almost equal.

Study shows that the depths of the platforms and of lagoons are equal at all places. The greatest merit of this hypothesis is that it needs no subsidence of the crust, as is the case with Darwin's hypothesis. Finally, the sea waves and currents could have easily cut down the islands and converted them into low platforms.

Evidence against Daly's hypothesis

The following are evidences against the Daly's hypothesis:

- There are some platforms which are so long and broad that their formation cannot be considered as the work of marine erosion alone. One such platform is the Nazareth Platform 350 km long and 100 km wide. It is about 600 m high everywhere.
- Daly could not explain the existence of coral colonies at depths of 100 metres. He had to admit local subsidence to be able to explain coral colonies in some deeper areas. Daly had also calculated that the fall of sea level during the ice age was around 80 metres.
- It appears that this calculation is not correct. In fact, the fall of sea level can be correctly measured by the angle of walls of submerged V-shaped valleys. If calculation is done on this basis, the sea level should have fallen by more than 80m. Finally, Daly had stated that the temperature was lowered during the ice age. It must have caused the death of corals, but there is no evidence of this phenomenon.

4.8. End of unit assessment

Questions

1. Describe the major features resulting from wave erosion and depositional processes.
2. Observe the photographs given in Student's book on economic activities and answer the questions that follow:
   i) Examine the economic activities that should be carried in the regions demonstrated on photographs.
   ii) According to you, what are the advantages of the shore or coast to people living nearby?
3. Demonstrate the impacts of sea level changes on the environment.

Guidance to answers

1. This question requires to describe briefly the features resulting from wave erosion and wave deposition. Guide Student-teachers to discuss again these features in groups. Remember to form groups that are heterogonous to share and exploit different opportunities. This question may be answered referring to the content provided in Student-teachers on the formation of coastal landforms.
2. This question has a link with photographic interpretation. Now, it will be better when you remind students some principles of photograph interpretation before they embark on the activities (look for topic learnt in the unit one for photograph interpretation).

   Both pictures represent the coast at Lake Kivu in western province of Rwanda. Guide Student-teachers to examine the economic activities that could be carried out in that area.

   i) Proposed answers on the economic activities are

- **Tourism:** This part of the country hosts many tourists from many parts of the country, the East African region and Worldwide.
- **Trade and commerce:** There are many tourists who are main clients for the region by buying different items.
- **Language translators** explaining Kinyarwanda words to tourists and earning money.
- **Fishing activities:** even though fishing is practiced on shores, the fishermen and women sell their product at the coast.
- **Arts and crafts:** This sector has tremendous clients from different regions of the World. Tourists buy arts craft from Rwanda.

   ii) Guide Student-teachers to discuss the advantages of the coast or shores to people living nearby. This can be answered by comparing the opportunities for people living near and far from the coast. The following are examples of some advantages of the coast to the people living nearby:

- Easy access to water because lakes, seas, and oceans have water that can be trapped and distributed to the inhabitant of the region.
- Good weather condition as it receives conducive humidity compared to the surrounding areas
- The area has a variety of aquatic life especially fish.
- Mineral resources can be mined from under the water like Methane gas from Lake Kivu.
- Better quality beaches for tourists who bring in foreign currency to the country.

3. It requires thinking of high degree where there is an analysis of effects of sea level change and apply to environmental impact. It is in this regard that you have to be aware that students should bring diversified opinions and judge what is fitting with the asked question. For more answers refer to the Student's book on effect of sea level changes.

   Guide Student-teachers to demonstrate the impacts of sea level changes referring to the content provided in student's book on impact of sea level change. Try to apply these impacts to the context of our country.

4.9. Additional activities

Remedial activities

a) Give two major types of waves

Answer:

- Constructive waves
- Destructive waves

b) Enumerate any two features resulting from wave deposition.

Answer

- Tombolo
- Spits

Consolidation activities

1. Sea level change may cause positive effects as well as negative effects. Compare these effects at the eastern coast of America.

Proposed answer:

1. Sea level change may cause positive effects as well as negative effects. Compare these effects at the eastern coast of America.
   - When the effects of sea level change were assessed by experts at the coast of East American coast, sea level rise triggered by climate change have long known that it will proceed faster in some places than others. The mid-Atlantic coast of the U.S. is one of them, and the reason — in theory, anyway — is that global warming should slow the flow of the Gulf Stream as it moves north and then east toward northern Europe.
   - The slowing of the Gulf Steam is not the only reason the U.S. coast will see higher sea level than the world average in coming decades. In some places, the land itself is slowly sinking as it readjusts to the disappearance of continental ice sheets more than 10,000 years ago.
   - Melting ice, mostly from Greenland, dilutes the surface waters where the Gulf Stream reaches its northernmost extent. Since fresh water is less dense than salty water, the water has a more difficult time sinking to begin its journey southward. Second, the surface water is warmer than it used to be, and since warm water is less dense than cold water, this just adds to the problem.
2. Discuss the landforms resulting from wave deposition likely to form in any lakes of Rwanda.

For this question, refer to the content in the student's book on landforms produced by wave deposition.

Extended activities

Compare isostasy theory for continental drift from isostatic change on the coast.

Proposed answer:

The concept of Isostasy comes from "iso" = equal, and "stasis" = equilibrium. It describes how various continental and oceanic crusts, stay in equilibrium over the asthenosphere. The following are the main characteristics of isostasy:

- By isostasy, the lighter crust must float on the denser underlying mantle.
- It explains how different topographic heights can exist on the earth's surface.
- Isostatic equilibrium is an ideal which state where the crust and mantle would settle in equilibrium in absence of disturbing forces.
- Isostasy theory is concerned with vertical movements of plates which depend on lithospheric masses.
- The loading of crust by ice or sediments may cause the subsidence of lithosphere, whereas the discharge resulting from ice melting or erosion may cause the up lift of lithospheric compartment.
- The waxing and waning of ice sheets erosion, sedimentation, and extrusive volcanism are examples of processes that perturb isostasy.
- Isostasy controls the regional elevations of continents and ocean floors in accordance with the densities of their underlying rocks.

While

Isostatic sea level change is the result of an increase or decrease in the height of the land. When the height of the land increases, the sea level falls and when the height of the land decreases the sea level rises. Isostatic change is a local sea level change whereas Eustatic change is a global sea level change.

- During an ice age, isostatic change is caused by the build-up of ice on the land. As water is stored on the land in glaciers, the weight of the land increases and the land sinks slightly, causing the sea level to rise slightly. This is referred to as compression.
- When the ice melts at the end of an ice age, the land begins to rise again and the sea level falls. This is referred to decompression or isostatic rebound.
- Isostatic rebound takes place incredibly slowly and to this day, isostatic rebounding is still taking place from the last ice age.
- Isostatic sea level change can also be caused by tectonic uplift or depression. As this only takes place along plate boundaries, this sort of isostatic change only takes place in certain areas of the world.

Skills Lab

With reference to knowledge and skills acquired, suggest ways beaches may be preserved and more productive

- Tell Student-teachers to suggest an appropriate techniques of preservation that fit beach.
- Ask Student-teachers to think bigger so that they can discover other opportunities around water bodies.

UNIT 5

ROCKS AND MINERALS

5.1. Key unit competence

The Student-teachers should be able to compare different types of rocks and minerals and evaluate their importance.

5.2. Prerequisite (knowledge, skills, attitudes and values)

In Senior 1, unit 6 they studied the Rocks: types and characteristics of rocks and the importance of rocks. These units give the student-teacher the prerequisites on rocks. They are introduced on different types of rocks: sedimentary rocks, metamorphic rocks and igneous rocks; the characteristics of rocks: hard rocks and soft rocks. The importance of rocks was also introduced to the student-teacher. In Senior 2, unit 7, the Student-teachers learnt weathering and rocks; they are here introduced on the characteristics of different types of rocks.

With help of the knowledge and skills acquired in ordinary level, the student-teacher will be well equipped to study this unit.

5.3. Cross-cutting issues to be addressed

a) Environment and sustainability

Unit 5 is about rocks, with a key competence of assessing their economic importance. Rocks are extracted from the earth crust and are used for the economic welfare of the society. Construction of houses and other sustainable infrastructures require materials from rocks.

Many ores and minerals are obtained from open-pit mines. When the ore is mined it contains unwanted materials along with the valuable mineral. The waste rock and material must be removed in order to access the valuable mineral.

Extracting rocks or removing the waste rock to access ores can be expensive, and in some cases harmful to people and environment. Also rock wastes may pollute stream water, water bodies and soils. This may require much efforts for their cleaning up for further consumption and uses. The effects may be as well long-term as immediate and can affect marine lives.

For this, the tutor is required to talk about the role of rocks for the economic and social welfare of people, but also negative impacts of their extraction should be discussed with Student-teachers, with an emphasis on the environmental impacts.

b) Inclusive education

This unit requires samples during class sessions and a field trip for Student-teachers to observe different types of rocks. Learning activities should be within the ability range of all Student-teachers, including those with learning difficulties or special needs. For instance, if tutors plan field trip, they will consider how Student-teachers will access the area to be visited; otherwise they will think about rock samples, DVDs, work group and discussions for student-teachers who cannot access the field study area due to their physical impairment.

c) Financial education

Extraction of rocks is very beneficial because it contributes to the welfare of the society. For this reason, student-teacher need to get introduced with the importance of money saving and investment in the mining and quarrying sector. Wherever extractions of rocks impact on people and natural resources, there is inevitably implication of money expenses. Money for remediation of sites affected by quarrying is needed. Furthermore, impacts of quarrying are extended to surrounding and remote environments. There is a need that Student-teachers are introduced with these resulting environmental issues. Notions about financial means for alleviation of these impacts are therefore needed for student-teacher to realize that extraction of rocks requires planning and suitable techniques that minimize the negative effects.

5.4. Guidance on introductory activity

The key inquiries in this unit that will be the guide to the introductory activity are that Student-teachers in addition to understand and describe different types of rocks and their distinct characteristics, they should be able to explain their economic importance. For this, student-teacher should be able to explain the types of rocks which in turn determine their varied economic importance.

5.5. List of lessons/sub-heading

#	Lesson title	Learning objectives	Number of periods
1	Rocks: Definition, types and characteristics	– Identify the various types of rocks in the world and their characteristics. – Classify the different types of rocks and their characteristics. – Appreciate different types of rocks and minerals found in Rwanda.	5
2	Composition, properties of rocks and impact of rocks	– Explain the various components of the rocks. – Identify different components of the rocks. – State the economic importance of the rocks. – Evaluate the economic importance of the rocks. – Explain the physical and the chemical properties of the rocks.	4
3	Minerals	– Apply the knowledge to categorise and identify the different types of minerals. – Explain the physical and the chemical properties of the minerals. – Evaluate their importance – Identify the various types of minerals in the world. – Identify the physical and the chemical properties of the minerals.	4
4.	End unit assessment		1

Lesson 1: Rocks: Definition, types and characteristics

a) Learning objectives

- Identify the various types of rocks in the world and their characteristics.
- Classify the different types of rocks and their characteristics.
- Appreciate different types of rocks and minerals found in Rwanda.

b) Prerequisites/ Revision/ Introduction

The tutor conducts the revision of the lessons taught in ordinary level by asking Student-teachers to briefly recall the definition of rocks, their major groups and distinctive characteristics. Thereafter, the tutor asks student-teachers why rocks are different from each other. In this lesson Student-teachers will be able to identify the major types of rocks and to differentiate their characteristics.

c) Teaching resources

To achieve the learning objectives of this lesson, the following resources should be used:

- Geographical documents including the Student-teachers book
- Samples of rocks representing the three major groups of rocks.
- Maps, Illustrations.
- Internet/DVDs.
- Manila Paper or flip chart.

d) Learning activity

The student-teachers will use observation of rock samples and research to identify the types of rocks found and differentiate their characteristics. The tutor can also provide a handout presenting different types of rocks and ask student-teachers to identify them and to indicate where they are found. He/she will guide student-teachers to observe it in groups and give answers to activities. Thereafter presentation is done.

e) Application activities

The application activity 5.1 in the student's book, there are two instructional activities which consist to Identify an area in Rwanda where igneous rocks are mostly found; the proposed answer is the northern part of Rwanda

The answer for question two; the Student-teachers will identify the types of rocks which are predominant in his/ her local environment and identify their characteristics.

Lesson 2: Composition, properties of rocks and impact of rocks

a) Learning objective:

- Explain the various components of the rocks.
- Identify different components of the rocks.
- State the economic importance of the rocks.

- Evaluate the economic importance of the rocks.
- Explain the physical and the chemical properties of the rocks.

b) Teaching resources

To achieve learning objectives, the following resources should be used:

- Geographical documents.
- Observation of stones used to build foundations of houses and houses roofing tiles.
- Maps.
- Illustrations.
- Internet/DVDs.

c) Prerequisites/ Revision/ Introduction

Student-teachers will learn about the composition, properties, impacts of rocks. The tutor shall then engage the student-teachers for revision of previous lessons on the types of rocks and their characteristics.

d) Learning activities

Use geographical documents and internet to identify the importance of rocks.

Refer to the learning activity 5.2. in the student's book.

One learning activity has been prepared for student-teachers. It consists of description of the physical and chemical properties of rocks. The tutor will guide Student-teachers in discussion and presentation.

The answer to the question can be found in student's book on the content about Composition, properties of rocks and impact of rocks.

e) Application activities

Refer to the application activity 5.2. in the student's book, in this lesson, the proposed answers are the following:

1. Rocks, whether igneous, sedimentary or metamorphic, are subject to powerful stress or pressure by tectonic forces (tension /stretching), compression / shortening, and shear /twisting or tearing.) and the weight of overlying rocks. Therefore, resulting landscape formation as results of stress like folding, faulting or warping.
2. The answers for this question depend to student-teacher and his/ her environment. For more information, refer them to the content in student's book on Composition, properties of rocks and impact of rocks.

3. The answer for this question refer them to the content in student's book on Composition, properties of rocks and impact of rocks. The Student-teachers will have to discuss the disadvantages of rocks on landscape and society.

Lesson 3: Minerals

a) Learning objectives

- Apply the knowledge to categorise and identify the different types of minerals.
- Explain the physical and the chemical properties of the minerals.
- Evaluate their importance
- Identify the various types of minerals in the world.
- Identify the physical and the chemical properties of the minerals.

b) Pre-requisites/ Revision/ Introduction

Briefly review the previous tasks and ask Student-teachers to discuss about minerals, briefly clarify the answers given by Student-teachers relying on the objectives of the lesson.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Illustrations and photographs
- Internet
- Geographical documents
- Manila paper and flip charts
- Tactile materials

d) Learning activities

Refer to the learning activity 5.3 in the student's book

Facilitate Student-teachers in groups to answer the questions of accounting for the types and characteristic of mineral. They also examine the use of minerals to their society. The Student-teachers' answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage Student-teachers in activities like discussion, asking and answering questions.

For more answers they are referred to the student's book about minerals.

e) Application activity

Refer to the application activity 5.3. in the student' book

The proposed answers are:

1. The following five characteristics shared by all mineral should be described:
   - Minerals are formed by natural processes;
   - Minerals are inorganic;
   - Minerals are solid and have a definite volume and shape;
   - Every mineral is an element or a compound with a chemical composition unique to that mineral;
   - The atoms in a mineral are arranged in a pattern that is repeated.
2. Ore- is a mineral occurring in sufficient quantity and containing enough metal to permit its recovery and extraction at a profit. While a mineral is a solid chemical compound that occurs naturally in pure form.
3. Minerals that are extracted in Student-teachers' district environments and their advantages and disadvantages. The answer to this question will depend on minerals highlighted by Student-teachers that are extracted in their regions of origin. The teacher will complement Student-teachers and search on the advantages. If the minerals identified by Student-teachers are included in the list provided in the table of Minerals and derived manufactured products, the teacher will use the table for complementing Student-teachers' answers.

5.6. Summary of the unit

Unit five is about rocks and minerals with a key competence which is to be able to compare different types of rocks and minerals and evaluate their importance. **A rock** is an aggregate (collection) of various types of minerals or an aggregate of multiple individual pieces (grains) of the same kind of mineral.

Rocks are classified into three major groups: Igneous rocks, sedimentary rocks and metamorphic rocks. This classification was based on the origin and individual processes involved in the formation of rocks constituting each category. Some rocks are resistant to weathering and erosion whereas others are not.

Rocks have a wide variety of uses for the welfare of the society. Minerals provide the material used to make most of the things of industrial- based society; roads, cars, computers, fertilizers, watches. Some minerals have high economic value because of their uses or they are rare and beautiful.

5.7. Additional Information

This unit is linked to unit 6 in year 2 on the internal landform processes: vulcanicity and earthquakes. It is vital for Student-teachers to link the prior knowledge acquired in year 1to what is contained in this unit. When you are teaching this unit, you should use local examples of rocks and mineral and vulcanicity. If it is not possible you may use illustrations or videos. Make a comparison of different rocks found in Rwanda and those in the world.

It is therefore necessary that where possible methodology can be changed and activities adjusted to achieve set learning objectives.

In addition to the content in student's book, the following is helpful for better understanding and better teaching-learning of that unit.

Rock cycle

Students have learnt about different types of rocks. However, like landforms, many rocks do not remain in their original form indefinitely but instead over a long time, tend to undergo processes of transformation. The rock cycle is a conceptual model for understanding processes that generate, alter, transport, and deposit mineral materials to form different kinds of rocks. The term cycle means that existing rocks supply the materials to make new and sometimes very different rocks. Whole existing rocks can be "recycled" to form new rocks. The geologic age of a rock is based on the time when it assumed its current state; metamorphism, or melting, and other rock- forming processes reset the age of origin. The rock cycle helps explain the formation of igneous, sedimentary, and metamorphic rocks. Note the links that bypass some parts of the cycle.

Silicates and clay minerals

Silicate SiO_2 (the most abundant mineral in rocks)

Clay mineral is a natural material with plastic properties, of particles of very fine size smaller than 2 micrometres (7.9 × 10-5 inch), and very fine mineral fragments or particles composed mostly of hydrous-layer silicates of aluminum, though occasionally containing magnesium and iron.

Some clay minerals may be expressed using ideal chemical formulas as the following: $2SiO_2 \cdot Al_2O_3 \cdot 2H_2O$ (kaolinite), $4SiO_2 \cdot Al_2O_3 \cdot H_2O$ (pyrophyllite), $4SiO_2 \cdot 3MgO \cdot H_2O$ (talc), and $3SiO \cdot Al_2O_3 \cdot 5FeO \cdot 4H_2O$ (chamosite). The SiO_2 ratio in a formula is the key factor determining clay mineral types. These minerals

can be classified on the basis of variations of chemical composition and atomic structure into nine groups: (1) kaolin-serpentine (kaolinite, halloysite, lizardite, chrysotile), (2) pyrophyllite-talc, (3) mica (illite, glauconite, celadonite), (4) vermiculite, (5) smectite (montmorillonite, nontronite, saponite), (6) chlorite (sudoite, clinochlore, chamosite), (7) sepiolite-palygorskite, (8) interstratified clay minerals (e.g. rectorite, corrensite, tosudite), and (9) allophane-imogolite.

Other minerals

Dolomite is an anhydrous carbonate mineral composed of calcium magnesium carbonate, ideally CaMg (CO3)2.

Anhydrite ($CaSO_4$), also called hydrous calcium sulphate and Gypsum, also called hydrated calcium sulphate ($CaSO_4$ Â· 2H2O) are the major minerals in the sedimentary rocks of rock gypsum and rock anhydrite respectively.

Hematite, also spelled haematite, heavy and relatively hard oxide mineral, ferric oxide (Fe_2O_3), that constitutes the most important iron ore because of its high iron content (70 percent) and its abundance.

Limonite is one of the major iron minerals, hydrated ferric oxide ($FeO(OH)\cdot nH_2O$).

Value of minerals, Gemstones and ores

What makes one mineral more useful or valuable to us than another? Why are Diamonds and Rubies considered to be valuable? Some standards have been set to determine the value of minerals, such as among others, rarity, beautiful and mineralogical composition. Gems also, called Gemstones are highly prized minerals because they are rare and beautiful. Many Gemstones are cut and polished and used for jewellery. They are brighter and more colourful than common samples of the same mineral. The difference between a Gem and the common form of the same mineral can be slight. Amethyst, a Gem form of Quartz, contains just traces of Manganese in its structure. This Manganese gives Amethyst a desirable purple colour. And sometimes, a Gem has a crystal structure that allows it to be cut and polished than that of a non-gem mineral.

You may have some utensils used to cook food like sauce pan, spoon, and knives among others. These things are made from mineral resources. For instance, the aluminium in soft-drink cans comes from the ore bauxite. If there is anything in your home with iron in it, the iron may have come from the mineral Hematite.

Hematite is a mineral that can also be called an ore. A mineral is an ore if it contains useful substance that can be mined at a profit. Ore must be processed

and refined into more useful materials. Aluminium can be refined from bauxite, and made into the useful products. These products are worth more money than the cost of the mining, so bauxite is an ore. If the cost of removing the waste rocks gets higher than the desired material, the mineral will no longer be classified as an ore.

5.8. End unit assessment

1. Classification of the different types of rocks and their characteristics.

   The Student-teachers will answer basing on their own experience in their local environment, past knowledge and refer to the Student's book unit 5 under "The Rocks and Minerals "

2. Evaluate the economic importance of rock and minerals in your society:

   Formation of soils: Rocks are broken down into tiny particles through the process of weathering. This leads to the formation of soil that supports plant growth. For example, the igneous rocks around the volcanic mountains in the Northern and Western provinces of Rwanda have been weathered leading to the formation of fertile volcanic soils.

   Tourism development: There are many rocks in Rwanda that attract tourists from all over the world. For example, in Rwanda there are wonderful cliffs and rocks such as *"Ibere rya Bigogwe"* (Bigogwe Breast), *"Urutare rwa Ndaba"* (Ndaba Rock) and *"Urutare rwa Kamegeri"* (Kamegeri Rock).

   Fertilizers: Rocks are very useful in the manufacturing of fertilizers. For example, phosphate bearing rocks are used to make phosphate fertilizers.

   Minerals: Rocks provide humans with valuable minerals that are used in various ways. For example, micro- diamonds in Gicumbi and Tin in Muhanga are Igneous rocks. These are exported hence earning foreign exchange.

   Sources of energy: Peat coal is used as a source of energy in some homes in Rwanda. Hot rocks found beneath the Earth's surface are responsible for the generation of geothermal energy. This project is still underway in Rwanda but has already picked up in places like Eburru in Kenya.

3. The physical properties of rocks determine their behaviour and respective deformations when a rock is subject to stress such as folding, faulting or warping, and their resulting landscape deformation. Stress refers to forces that constantly push, pull, or twist the earth crust. There are three types of stress: tension (stretching), compression (shortening), and shear (twisting or tearing).

Strain is how rocks respond to stress whether by stretching, shortening or shearing.

The surface expressions refer to the structure of landforms resulting from the stress depending on whether the rock is brittle (hard) or ductile (pliable). Surface expressions can be folding (bending) or faulting (breaking). Brittle rock breaks (brittle deformation) while ductile rocks like clay bend or flow (ductile deformation).

The chemical properties of rocks relate to their mineralogical composition. This reflects the chemical bonds that hold together the atoms and molecules that compose a mineral. The strength and nature of these chemical bonds affect the resistance and hardness of minerals and of the rocks that they form. Minerals with weak internal bonds undergo chemical alteration most easily. Charged particles, that is, ions, that form part of a molecule in a mineral may leave or be traded for other substances, generally weakening the mineral structure and forming the chemical basis of rock weathering.

5.9. Additional activities

a) Remedial activities (for slow student-teachers)

Question 1: Differentiate the rock from the mineral

A rock is a natural aggregate of minerals in the solid state; usually hard and consisting of one, two, or more mineral varieties.

A mineral is a pure inorganic substance that occurs naturally in the earth's crust. A mineral deposit is a concentration of naturally occurring solid, liquid, or gaseous material, in or on the earth's crust. Mineral resources are non-renewable.

Question 2: Disadvantages of rocks on human

- Some rocks may reflect landscape with steep slopes where human activities such as agriculture or settlement cannot be possible;
- The sand can blow; rocks can roll risking injury to people;
- Some environments such as sand rocks (dunes, reg, erg, etc.) are not suitable for human settlement because of lack of water and soils;
- Light-coloured rocks reflect sunlight and increase the temperature around the plants during the daytime.

Question 3: Establish the difference between a Gemstone and an ore

Gemstone is a mineral with a distinctive colour which makes it expensive, which is why it is used for jewellery.

An Ore is a mineral containing a useful substance, such as metal, that can be mined at a profit.

b) Consolidation activities

Question 1: Classify igneous rocks based on the mode of occurrence.

Answer:

- **Intrusive igneous rocks:** They are formed when the rising magma, during a volcanic activity, does not reach the earth's surface but rather cools and solidifies below the surface of the earth.
- **Extrusive igneous rocks:** They are formed due to the cooling and solidification of hot and molten lava on the earth's surface (examples are basalt, Gabbro).

Question 2: Differentiate a foliated metamorphic rock and a Non-foliated metamorphic rock.

Answer:

- Foliated metamorphic rocks such as gneiss, phyllite, schist and slate have a layered or banded appearance that is produced by exposure to the heat and pressure.
- Non-foliated metamorphic rocks such as hornfels, marble, quartzite does not have a layered or banded appearance.

c) Extended activities (for gifted and talented Student-teachers)

Question 1: Explain the categories of intrusive igneous rocks.

Answer:

a) Plutonic igneous rocks: Are formed due to the cooling of magma very deep inside the earth.

b) Hypabyssal igneous rocks: Are formed due to the cooling and solidification of rising magma during volcanic activity in cracks, pores, crevices and hollow places just beneath the earth's surface.

Question 2: Distinguish quiet type and explosive type of volcanicity

Answer:

a) Explosive type: The igneous rocks formed by a mixture of volcanic materials ejected during explosive or violent volcanic eruptions.

b) Quiet type: The appearance of lava through minor cracks and openings on the earth's surface is called 'lava flow'. The lava forms basaltic igneous rocks after cooling and solidifying.

Skills Lab

Show how you are going to use available rocks for the economic development of your society.

- Guide Student-teachers to carry out research on possible techniques that can be used to fully exploit rocks.
- Ask them to carry out an excursion at quarrying site or enterprise dealing with rocks products to be inspired and motivated.

UNIT 6

CLASSIFICATION OF SOILS AND SOIL FORMATION

6.1. Key unit competence

The Student-teachers should be able to explain the factors and the processes responsible for the formation of soil.

6.2. Pre-requisite (knowledge, Skills, attitudes and values)

Unit 8 of senior 2 introduced the study of soil to the Student-teachers. They learnt the definition of soil and explored the various types of soil. They also learnt about soil erosion in Rwanda, its causes and effects, soil conservation and management measures as well as the importance of soils in Rwanda.

In year three Student-teachers' there is an introductory activity. It is intended to remind Student-teachers of the meaning of soil, how soil is formed, and its constituents. The solutions to the same activity highlight the importance of using our soils in a sustainable way. This therefore, calls for conservation measures which will be studied later. However, as a tutor, emphasize the cross cutting issue of environment and sustainability. This introductory activity provides a foundation upon which Student-teachers can understand the classification of soils and soil formation; specific study will also be on soil erosion, appropriate soil management and conservation measures and economic importance of soils in the world.

6.3. Cross-cutting issues to be addressed

a) Standardization Culture

It is the responsibility of every Rwandan citizen to conserve soil since it is a vital natural resource. Careful emphasis on management of soil and various conservation techniques should be adopted. Soil management is done to maintain the original structure of soil. Ask Student-teachers to discuss in groups

what they can do in their local environment to preserve the beauty of Rwandan environment. Allow them to present the findings in class.

b) Environment and sustainability

In this unit, emphasis must be put on the need for environmental protection and sustainability to maintain life on this planet. Soils are very important in supporting human economic activities. We should keep in mind that failure to conserve soils can led to desertification and famine in various parts of the world. Guide Student-teachers to discuss in groups the ways they can apply to control soil erosion in their local environments. Let them present the control measures in class. Supplement their answer by encouraging them to apply such measures like crop rotation, contour banding, strip cropping, afforestation etc. in their local environment.

c) Financial education

This is yet another cross cutting issue that is closely linked to the study of soil. The mismanagement of soil has led to soil deterioration and poor yields; this has lowered people's income and has led to poverty. Guide Student-teachers to properly manage the soils in their local environment, so as to uplift farmer's income and improve their standards of living. Ask Student-teachers to brainstorm how soil management techniques can increase incomes of the local people. In groups ask them to discuss how good soils can boost trade and make local people economically rich. Supplement their answers by showing them the value of good soils, good harvest and market prices.

d) Inclusive Education

Special focus should be given to children with learning impairments (children with special educational needs). In all the activities ensure that the participation of Student-teachers with disabilities is given special attention. Improvise with some learning materials like tactile and talking materials, magnifying lenses, local touchable samples etc. to aid learning for special needs children. Facilitate Student-teachers to work in groups (including those with special needs) to brainstorm on processes and factors of soil formation. Encourage the gifted children help Student-teachers with special needs especially in group discussion, research and presentations to make them understand. Give Student-teachers with special needs and slow student-teacher's remedial activities and guide them in answering.

6.4. Guidance on introductory activity

The introductory Activity aims at highlighting the knowledge, skills and attitudes that Student-teacher, acquired previously in classes. This activity prepared, requires student-teacher to put to better use of all the competences, knowledge together with attitudes in understanding the new topic of year three unit 6. Activities in this unit 6 can be answered by most of the Student-teachers. The tutor can provide enough time for every student-teacher so that individual participation can be respected. The intention of this activity is to see the ability of each Student- teacher so that throughout the unit the tutor plans on how to aid his/ her Student-teacher.

The ways answers are provided for the introductory activity, some require reviewing the past studies while others require Student-teachers to read the passage provided and think deeply.

6.5. List of lessons (including assessment)

	Lesson title	**Learning objectives (from the syllabus including knowledge, skills and attitudes)**	**Number of periods**
1	Cla Classification of the major types of soil in the world, factors influencing soil formation and processes of the soil formation	– Differentiate between the zonal, azonal and inter-zonal soils – Classify the major types of soil in the world. – Explain the factors favouring the formation of the soils. – Identify the processes of the soil formation.	6
2	Soil erosion: causes, effects, appropriate soil management and the conservation measures and importance of soil	– Outline the causes and the effects of the soil erosion. – Outline the appropriate soil conservation measures in the world – Explain the causes and the effects of the soil erosion in the world. – Evaluate the appropriate soil conservation measures in the world. – Show respect for the soil conservation measures in the world.	6
3	Assessment		1

Lesson 1: Classification of the major types of soil in the world, factors influencing soil formation and processes of the soil formation

a) Learning objectives

- Differentiate between the zonal, azonal and inter-zonal soils
- Classify the major types of soil in the world.
- Explain the factors favouring the formation of the soils.
- Identify the processes of the soil formation.

b) Prerequisites/ Revision/ Introduction

The tutor should engage the Student-teachers into a reviewing activity that diagnoses what they may be knowing about Classification of the major types of soil in the world, factors influencing soil formation and processes of the soil formation. The tutor should know that this is not the first time the Student-teachers are studying the concept under his lesson tittle.

c) Teaching resources

For effective delivery of the lesson, the following are the necessary resources or appropriate teaching aids:

- Recommended text books;
- Internet;
- Soil samples;
- Atlases with soil maps;
- Geography video clips on types of soils;
- Tactile, touch and talking materials
- Print out for activities
- Manila and flip chart papers
- Photographs

d) Learning activity

The Student-teachers are expected to answer the learning **activity 6.1** using the following:

1. Refer to the student's book under Classification of the major types of soil in the world
2. Refer to the student's book on factors influencing soil formation
3. Refer to the student's book under processes of the soil formation.

e) Application activity

The suggested answer to the first question of **application activity 6.1** are the following

1. a. Micro-organisms such as bacteria cause plant and animal remains to decay into humus. - Burrowing animals and worms mix organic remains with mineral soil component. - Roots penetrate and add more porosity, improve soil depth and aeration.

   b. Refers to the student's book under processes of the soil formation
2. Refers to the student's book under Classification of the major types of soil in the world

Lesson 6. 2: Soil erosion: causes, effects, appropriate soil management and the conservation measures and importance of soil

a) Learning objectives

- Outline the causes and the effects of the soil erosion.
- Outline the appropriate soil conservation measures in the world
- Explain the causes and the effects of the soil erosion in the world.
- Evaluate the appropriate soil conservation measures in the world.
- Show respect for the soil conservation measures in the world.

b) Prerequisites/ Revision /Introduction

The tutor should make preview of the previous lesson by asking Student-teachers to give a recap of what was covered. Then, he or she introduces the lesson with a couple of questions that can enable Student-teachers to connect to the lesson at hand.

c) Teaching resources

- Use of text books.
- Use of physical map of Rwanda.
- Manila papers for group work drawing.

d) Learning activities

Guidance to answer the learning activities consists of facilitating Student-teachers to work in groups:

1. Let them make research on meaning of the soil.
2. Refer to the student's book under causes of soil erosion.
3. Refer to the student's book on the effects of the soil erosion.

Their answers should develop the generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage Student-teachers (including those with learning impairments) in activities like discussions, map drawing, asking and answering questions.

e) Application activity 6.2

Possible answer to the application activity are the following:

1. The colored water is due to the soil erosion where washed soil is transported and deposited into water body.
2. Refer to the student's book under the effects of soil erosion.
3. Refer to the student's book on appropriate soil management and the conservation measures.

6.6. Summary of the unit

This unit covers the major types of the world, their distribution, soil formation processes, factors favoring soil formation, causes and effects of soil erosion, appropriate soil conservation measures in the world and the economic importance of soil. It is worth noting that soils vary from place to place, from continent to continent and they are mainly influenced by climate.

It is intended that Student-teachers do not only cover soil types but also the general factors that favour soil formation. These factors are general in that they apply to any type of soil regardless of the location. It is noted that the factors are interdependent. Other areas to be analyzed in this unit are soil erosion, and soil conservation measures which aim at environmental sustainability for sustainable development.

6.7. Additional Information

Other major types of soils found in the world include:

Ferrallitic soils: They are red soils of Tropical rain forested areas. These soils are highly leached. They are mainly found within the Congo basin and Eastern parts of Madagascar.

Regosols: These are desert soils that are made up of rock debris and sand. In Semi-arid regions such as the areas between Sahara Desert and the Sahel region and Kalahari semi desert have brown soils. The soils are mainly of sand texture and contain much salt because of the absence of leaching. The vegetation here is very scarce.

Ferruginous soils are found within the savannah regions within the tropics. They are rich in iron. The type of vegetation found here is Savanna grassland.

Vertisols are also known as tropical block soils. They are mainly found in Sahel savannah region, Western Ethiopia, Chad basin, Southern part of Lake Victoria in Tanzania and part of Kenyan Coast. They are sticky when wet and crack when dry. These areas have Savanna grasses.

Fluvisol also known as alluvial soils are found along river valleys or basins and at the mouth of some rivers that have a delta. They are because of deposition of silt along the river profile. They are found along main rivers of Africa.

Tundra soils: These are soils that are found at the Polar Regions. They are referred to as soils of the cold zones where Polar Tundra climate is found. The type of vegetation found here are mosses, lichens shrubs and heath.

Chestnut soils (clay loams): Found in areas that experience tropical hot steppe and mid-latitude steppe climate. Vegetation experienced here is short grasses and shrub.

Prairie soils: Found in areas that experience humid continental climate which are cold to warm winter and warm to hot summers. The area is covered by tall grasses.

Vertisol: They are also known as black cotton soils (clay) found in areas that experience wet and dry season. Much of the vegetation is Savanna grasses.

6.8. End unit assessment

1. Refer to the student's book under classification of major soils in the world.
2. Soil erosion affects agriculture in different ways:
   - When soil is washed away, it goes with grasses that should be used to feed domesticated animals.
   - Soil erosion disturbs the land making it very fragile.
   - It affect the soil quality hence soil become poor in terms of nutrients.
   - Fertile soil disappears and causes decline of agriculture.
3. Refer to the student's book under economic importance of soil
4. a. Remind them that the districts in Northern Province are Gicumbi, Burera, Musanze, Gakenke and Rulindo. These areas are mountainous with steep slopes that are prone to severe erosion.

Put Student-teachers in groups and guide them to brainstorm on the reasons why terracing is mostly used in the Northern Province of Rwanda. Let them present the finding and note them down.

b. Let Student-teachers brainstorm on appropriate techniques of conserving soil in their area and relate them to the content in the student's book.

c. Put Student-teachers in groups for an open discussion on techniques that have helped in environment sustainability. Let them make a class presentation.

Otherwise refer to the student's book under appropriate soil management and the conservation measures.

6.9. Additional activities

6.9.1 Remedial activities

1. Why are volcanic soils common in North western Rwanda?
2. State the types of soils common in desert zones.
3. Outline five factors that favour soil formation.
4. Why is it important to conserve soil?

Answers: These are questions which require low order thinking and are answered as follows:

1. The volcanic soils are common in Northwestern Rwanda because this area experienced large scale volcanic eruption activities.
2. The type of soils common in desert zones are desert soils.
3. Five factors that favour soil formation are climate, parent rock, relief, living organism and Time.
4. It is important to conserve soil because it helps man to survive mainly through agricultural activities, safety and other economic activities.

6.9.2 Consolidation activities

1. How can we conserve soil in our communities?
2. In what ways is soil misused by local communities in your province?

Answer: Guide Student-teachers on how to answer the above questions using the student's book and research. For example, soil is conserved through: crop rotation, terracing, mulching, use of fertilizers, etc. While soil is misused through: land pollution, bush burning, overgrazing, over cultivation, etc.

6.9.3 Extended activities

1. Draw a world map and on it locate zonal soils.

   Answer:

   - Guide Student-teachers on how to answer the above question using the student's book by drawing a map and guide them to locate on it areas covered by different types of zonal soils.
   - Explain how each of the following factors influences soil formation: Parent Rock, Living organisms and Time.
   - Let Student-teachers make research on how these factors influence soil formation: Parent Rock, Living organisms and Time. They share their findings in a class presentation.

2. Discuss the view that soil is the most important resource for the survival of plants, animals and human beings.

   Answer:

   - Guide the Student-teachers to brainstorm on the importance of soils to plants, to animals and to human beings.
   - Let them discuss the importance of soil to each of the above living things.
   - Remind them that although soil is important, there are other basic resources that the above living things require.
   - Guide them to outline other resources needed for the survival of plants animal and man. Such resources include, water, air/warmth, sunlight and other economic resources especially required by human beings.

Skills Lab

Identify an area affected by any form of soil erosion, and explain to the local people what should be done to slow down the washing away of soil.

- Encourage Student-teachers investigate on possible areas affected by soil erosion so that they can critically think on suitable techniques to prevent it.
- Motivate Student-teachers to actively engage themselves in such preventive actions.

UNIT 7

CLIMATE CHANGE

7.1. Key unit competence

To be able to discuss climate change and its impact on Rwanda and other countries.

7.2. Pre-requisite (knowledge, attitudes, and skills

Unit 6 of year one introduced the Climate in Rwanda which has the objective of investigating the climate and seasons of Rwanda and explaining their impact on human activities. Student-teachers studied climatic zones in Rwanda, factors that influence the climate of Rwanda (Altitude, latitude, vegetation, presence of water bodies, influence of wind and human activities). Seasons in Rwanda: Dry and wet seasons and relationship between climate and human activities. Although they have studied the above content, there is a need to complement their knowledge by studying the upgraded content associated with climate change.

In the Student's book there is an introductory activity. It is intended to establish the relationship among the climate change, global warming, greenhouse phenomena and desertification. It assesses the consequences of climate change in Rwanda and identify the regions in Rwanda likely to experience the desertification by giving tangible reasons. Therefore, a tutor emphasizes the cross cutting issue of environment and sustainability.

7.3. Cross-cutting issues to be addressed

The following are the main cross-cutting issues to be interpreted by using the following:

a) Inclusive education

This involves the participation in education of Student-teachers with different

learning styles and other difficulties where all Student-teachers are asked to learn and participate actively in spite of her/ his level of pace in teaching and learning.

In this unit, you will help Student-teachers with special education needs like students with physical and visual impairment, talented and slow Student-teachers assigning different tasks and paying attention to them according to their needs. For example, in the activity that requires to carry out a field trip, make sure that students with physical disability have facilities like wheel chairs and Student-teachers who will help them. This can be applicable in the learning activity 7.3.

b) Environmental conservation and sustainability

Normally, it is an obligation that everyone must conserve the environment through his/ her daily activities. It is in this regard that this unit must cater the cross-cutting issues of environment and sustainability. When teaching this unit, the emphasis must be put on the conservation of environment basing on the competences gained from all lessons in this unit such as adaption and mitigation measures to climate change and Student-teachers will come up with the skills of protecting our environment worldwide.

The environment conservation and sustainability will be integrated in by helping students to identify the mitigation measures to climate change and the strategies to fight against the desertification processes. In this lesson, ask Student-teachers to plant the trees and others conservative plants in their living environment as the way of fighting the desertification in their local environment.

c) Standardization culture

Standardization Culture develops Student-teachers' understanding of the importance of standards as a pillar of economic development and in the practices, activities and lifestyle of the citizens. It is in this regard that this unit of climate change has to integrate the standardization culture. In the activities of suggesting the strategies for fighting against desertification, tell the students to use substances with standard chemical properties this will help Student-teachers to develop the culture of using the materials which are in line to rules and regulation of our country.

7.4. Guidance on introductory activity

In this unit, the key inquiry questions that will be the guide to the introductory activity are the following:

1. Make a research on internet and other geographical materials and establish a relationship between the following concepts:
   i) Climate change
   ii) Global warming
   iii) Green house phenomena
   iv) Desertification
2. Basing on the knowledge acquired in the first question, assess the consequences of climate change in Rwanda.
3. Which area of Rwanda is likely to experience the desertification? Give reasons supporting your answer.

For the first question, form heterogeneous groups of students and assign them the task of searching these terms related to the unit. Once the first question is finished, guide to present their finding and synthesize them for whole class before embarking on the second question. At last but not least, as students have understood well the phenomena of desertification and how it occurs, Student-teachers will be able to identify the regions of Rwanda likely to experience the desertification and give reasons.

7.5. List of lessons (including assessment)

	Lesson title	**Learning objectives (from the syllabus including knowledge, skills and attitudes).**	**Number of periods**
1	Climate change • Definition of climate change • Causes of climate change • Effects of climate change worldwide (Global, Africa, Rwanda)	– Define the concept of climate change. – State the causes of climate change. – Explain the causes of climate change. – Identify the effects of climate change. – Locate areas most affected by climate change in the world.	4

		– Show concern for man's contribution towards climate degradation.	
2	Global warming and green house phenomena • Definition of global warming and green house phenomena • Causes of global warming and green house phenomena • Effects of global warming and green house phenomena	– Define the concept of climate change – State the causes of climate change – Explain the causes of climate change – Evaluate effects of climate change. – Identify the causes and effects of global warming and green house effects. – Show concern for the impact of climate change. – Show concern for the impact of global warming and green house effects.	4
3	Adaptation and mitigation measures for climate change: • Adaptation measures • Mitigating measures	– Appreciate the importance of adaptation and mitigation on climate change. – Outline the measures of climate adaptation. – Examine the ways of adaptation and mitigation to climate change. – Outline the measures of climate adaptation and mitigation.	4
4	Desertification • Definition of desertification • Causes of desertification • Effects of desertification	– Identify the causes and effects of desertification – Examine the causes and effects of desertification	4
5	End unit assessment		2

Lesson 1: Climate change: definition, causes and effects

a) Learning objectives

- Define the concept of climate change.
- State the causes of climate change.
- Explain the causes of climate change.
- Identify the effects of climate change.
- Locate areas most affected by climate change in the world.
- Show concern for man's contribution towards climate degradation.

b) Prerequisites/Revision/ Introduction

This topic of climate change is linked to the other units studied in previous levels as unit 8 of senior 1 talking about the impact of weather and climate on human activities. Unit 6 of year one introduces the Climate in Rwanda.

Guide Student-teachers to revise the year one contents by asking them to establish the relationship between climate and human activities in Rwanda. Then ask them if they may give the meaning of climate change. Once students come up with good feedback, help them to analyze the pictures in student's book on the content of climate change. They are required to describe the causes and effects of climate change.

c) Teaching resource

During the teaching and learning process, the tutor will refer to the following teaching resources where possible:

- Diagrams
- Pictures
- Flip charts
- Manila papers
- Print outs for the activity
- Text books
- Internet
- Maps
- Field work to the surrounding area.

d) Learning activities

Here are the suggested responses for activity 7.1

1. Refer to the student's book under definition of climate change
2. Help Student-teachers to work in groups, they will be able to explain the causes of climate change but more specifically emphasizing on role of industries. For more answers refer to the student's book on causes of climate change.

3. Refer to the student's book on the content of effects of climate change.

e) Application activity

This application activity 7.1 consists of two questions that are associated with critical thinking.

Student-teachers are asked to establish the relationship between the observable effects of climatic change worldwide and in Rwanda, to identify the areas of Africa that are susceptible to face the climate change challenges and to compare the effects of climate change in Eastern and Western provinces of Rwanda. Student-teachers will use the content given in the student's book on the lesson of climate change under effects of climate change in the world (global, Africa, Rwanda) to answer the above questions.

Lesson 2: Global warming and green house phenomena

a) Learning objectives

- Define the concept of climate change
- State the causes of climate change
- Explain the causes of climate change
- Evaluate effects of climate change.
- Identify the causes and effects of global warming and green house effects
- Show concern for the impact of climate change
- Show concern for the impact of global warming and green house effects

b) Prerequisites/ Revision/ Introduction

Form groups and guide Student-teachers to find the meaning of global warming and green house phenomena, and as they have understood the meaning of above terms, demonstrate the photo of greenhouse farming and ask them to answer the question regarding it. Guide Student-teachers to present their findings in class.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Internet
- Print out of activities
- Manila papers
- Photograph
- Maps
- Flip charts

d) Learning activities

The suggested answers for Activity 7.2 in student's book are set as follow:

1. Guide Student-teachers to work in pairs, they will be able to identify the meaning of global warming and the greenhouse phenomena. For more answers they are referred to the student's book on the content of global warming and green house phenomena.
2. Greenhouse farming is the unique farm practice of growing crops within sheltered structures covered by a transparent, or partially transparent material.
   - The main purpose of greenhouses is to provide favorable growing conditions and to protect crops from unfavorable weather and various pests.
   - The most powerful advantage of greenhouse farming is that it enables effective management and reduces risks caused by unfavorable weather conditions.
   - More concretely, greenhouse farming optimizes growing conditions and protects the crops from extreme weather events.
   - Additionally, some types of greenhouse farming (greenhouses with managed heating) extend the growing season or even allow farmers to grow the crops outside of the typical season.
   - Greenhouses that are additionally equipped offer the possibility to take complete control of the crop production, which leads to faster growth and higher yields.

e) Application activity

Possible answers for application activity 7.2 are the following:

1. Better to guide Student-teachers to work in groups. As long as all Student-teachers do not come from the same place. Some are from rural others from urban areas. This help Student-teachers to discuss and share accurate information.
2. From the above discussion, the answer will be dependent on where one comes from either rural areas or from urban areas.
3. The description of advantages and disadvantages of greenhouse farming are given in the below table:

Advantages	Disadvantages
Increased production: Greenhouse farming is considered as implementation of intensive agriculture and can provide an increase in crop production. **Minimizing production risks**: Being in an enclosed space can help prevent crops from suffering damage from climate change related events such as sudden increases or drops in temperature, as well as keeping crops away from birds and other animals. **Maximizing profits**: Multiple studies have stated that the profits per crop per square meter can be even twice or thrice as big when implementing greenhouse farming as an alternative to open field agriculture. It also helps to create less waste, which in turn can translate into bigger profits. **Increased pests, weeds and disease control**: A well designed and optimally built greenhouse can prevent problems such as pests and weeds, as well as provide more control against other diseases. **Ability to grow year-round produce, even off-season**: A greenhouse is relatively independent to the world outside, which eliminates the limitation of growing crops only on a specific season. **More stability and security**: Since you don't depend on climate conditions, an increase in stability and security, not only for the crops but also for the workers, can be obtained by greenhouse farming.	**You need a sizeable initial investment:** Greenhouse structure and design is relatively expensive, which can be challenging for many farmers. **Precise greenhouse design:** If the greenhouse isn't built properly from the beginning, that could affect the desired results and also mean spending more money down the line. **High production costs:** Operational costs for greenhouse farming are generally higher than those from open field agriculture. **Higher skill level required:** Inside the greenhouses your workers are entirely responsible for the plants. This requires prepared and trained professionals that can ensure that the operation can be carried efficiently and safely. **Optimal conditions for diseases:** Just as the conditions inside a greenhouse will be optimal for crop production, the same can be said for diseases that can affect them. **You need an established market operation:** In order to truly take advantage of greenhouse farming it's imperative that you have your distribution and selling operation already in place.

Lesson 3: Adaptation measures and mitigation for the climate change

a) Learning objectives

- Appreciate the importance of adaptation and mitigation on climate change.
- Outline the measures of climate adaptation.
- Examine the ways of adaptation and mitigation to climate change.
- Outline the measures of climate adaptation and mitigation.

b) Revision /Introduction

Student-teachers will be helped to revise the previous lesson by asking key questions related to the global warming and green house phenomena. If answers given by Student-teachers are not complete, the tutor will help to complete them.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Photograph
- Internet
- Print out of activities
- Manila papers
- Maps
- Flip charts

d) Learning activities

Tutor should engage Student-teachers in activities like discussion, asking and answering questions and for more answers they are referred to the student's book. Once Student-teachers are back to class, guide them to brainstorm the adaptation and mitigation measures by comparing what they observe locally and globally. Student-teachers will use the content given in the student's book on adaptation and mitigation measures for climate change.

e) Application activities

1. This activity requires high thinking and flash back on what students have learnt, help Student-teachers to feel as they are the managers of the said institutions and propose the strategies for climatic adaption as well as mitigation. Guide Student-teachers to be free in giving their opinions. The teacher should pay attention on the accuracy of arguments, whether they are in line with rules and regulation of environmental conservation.

2. Student-teachers are asked to describe the ways of adaption and mitigation measures for climate change. Tutor should guide them to give their views and supplement with his/hers because he/she is experienced

3. Tutor should engage Student-teachers in discussion and encourage them to make a research on the role of refrigerator to the climate change.

Lesson 4: Desertification (Definition, causes and effects)

a) Learning objectives

- Identify the causes and effects of desertification
- Examine the causes and effects of desertification

b) Prerequisite/Revision /Introduction

The tutor has to introduce this lesson and linking it with the previous lessons by asking some questions. The activity 7.4 intended to introduce the lesson 4 which has a link with two previous lessons studied before. The tutor will help Student-teachers to recall the previous knowledge and skills about climate change and global change in Rwanda

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Illustrations
- Photographs
- Geographical documents
- Print out of activities
- Manila papers
- Map

d) Learning activities

Facilitate Student-teachers to work in groups and search the explanation on how climate change contributes to desertification. The Tutor will encourage Student-teachers to observe and analyze the picture on the content of desertification. He/she will guide them to brainstorm the challenges faced by the people living in the region portrayed on the picture.

Student-teachers should use the content in the Student's book on climate and desertification. Their answers should develop competences such as critical thinking, cooperation, communication and problem-solving skills.

e) Application activities

Guide Student-teachers to observe the picture and ask them to describe the causes of phenomena which are shown on the picture. Suggest the effects of desertification and the districts in which that phenomenon is likely to happen. Therefore, the tutor should verify if Student-teachers have found the answers which are right in comparison with the given questions, here the reasons for giving such or that district is a key. They will use the content in the Student's book on the climate and desertification.

7.6. Summary of the unit

This unit covers climate change; causes, effects, global warming, green house phenomena, adaptation, mitigation measures and desertification. The emphasis should be put on the climate change and its impact on Rwanda and other countries.

This unit intends to help Student-teachers to discuss climate change and its impact on Rwanda and other countries.

7. 7. Additional information for tutors

In addition to the content in student's book, the following is helpful for better understanding and teaching-learning of this unit.

The following are two key terms to teach the climate change and desertification:

Greenhouse effect: It is a process in which atmosphere of earth trap some of heat coming from sun, making Earth warm but due to the burning fuels, cutting of trees, concentration of the heat on earth is increased to some abnormal levels making the greenhouse effect as one of major causes of the global warming.

Climate variability: It refers to the year–to-year or decade–to-decade variations of atmospheric conditions at a specific location or globally. Climate variability denotes short-term spatial and temporal deviations of mean climatic conditions. Therefore, climate variability is an integral part of climate change.

7.8. End unit assessment

Suggested answers to the end unit assessment

1. Refer to the student's book on effects of climate change in Rwanda
2. Refer to the student's book under causes of climate change

3. Refer to the student's book on mitigation measures for climate change

4. Suggested answers to this question (a) are the follow:

- The total area affected by desertification being between 6 and 12 million square kilometres, that about 1–6% of the inhabitants of drylands live in desertified areas, and that a billion people are under threat from further desertification.
- All areas situated in the Sahel region are characterized by a dry climate, hot temperatures, and low rainfall (300–750 mm rainfall per year).
- Lake Chad, located in the Sahel region, has been hit particularly hard by this phenomenon. The cause of the lake drying up is due to irrigation withdrawal and the annual rainfall dropping.
- Another major area that is being impacted by desertification is the Gobi Desert. Currently, the Gobi desert is the fastest moving desert on Earth; according to some researchers, the Gobi Desert swallows up over 1,300 square miles (3,370 km^2) of land annually.
- South America is another area affected by desertification, as 25% of the land is classified as drylands. In Argentina specifically, drylands represent more than half of the total land area, and desertification has the potential to disrupt the nation's food supply
- Mongolia is an area affected by desertification due to overgrazing.

(b) Some measures to prevent desertification are the following:

- The first step is to replace destructive agricultural techniques at the grassroots level.
- Planting more trees in strategic locations (Planting trees on crop boundaries, maintaining hedgerows or practicing agroforestry has proven to be very beneficial for the land).
- Use less water for irrigation.
- Reduce the number of domesticated animals in areas being affected by desertification
- Ensuring long-term productivity of grazing lands is to protect diversity of native plant species that are well-adapted to local conditions.
- Educating local communities about the principles of the Sustainable Land Management and empowering women can go long way in helping to stop land degradation by desertification.

7.9. Additional activities

7.9.1. Remedial activities

1. Give two effects of climate change in Rwanda.
   - Floods, Prolonged drought.
2. Give two ways that Rwanda is using to adapt to climate change.
   - Creation of progressive radical terraces.
   - Training farmers about climate change.

7.9.2. Consolidation activities

Examine the major effects of water shortage

Answer:

A lack of water affects more than just physical health. Let's see how drought can affect us in other ways.

Lack of adequate drinking water: Water is important to our health. When there is shortage, people lack enough clean water to drink.

Lack of education : When there is water shortage in an area, children often abandon school to help their parents look for water. Some of them grow too weak to go to school.

Hunger: Water shortage makes it difficult to grow crops especially in dry areas that depend on irrigation. When crops are not planted, there won't be enough food for people.

Diseases and parasites: Water is used for different domestic purposes including bathing. When there is shortage, people may not bath. Their bodies will be dirty hence susceptible to infection by diseases and attack by parasites.

Sanitation problems: Lack of enough water makes cleaning of dishes, clothes and other household items difficult. They will remain dirty and unhygienic. This will have a negative effect on the health of an individual.

7.9.3 Extended activities

Question: In your local environment (where you are studying), make a project that proposes the strategies to fight against the effects of climate change.

Guidance: Considering the local environment of a school, sector or district level, talented students will be asked to design a long-term project to fight against the effects of climate change. Guide Student-teachers and make sure that they are using the local opportunities and problems of their locality to verify if the designed projects are responding to the above environmental issue.

Skills Lab

Giving specific examples, analyze how human activities affect climate change.

- Ask Student-teachers to enumerate all activities that are likely to affect the climate change in Rwanda and elsewhere in the world.
- Encourage Student-teachers analyse the extent at which each activity affects climate.

UNIT 8

GLOBAL DRAINAGE SYSTEMS

8.1. Key unit competence

The Student-teachers should be able to investigate the economic importance of global drainage systems and the reasons for their conservation.

8.2. Pre-requisite (knowledge, skills, attitudes and values)

Unit 8 of year 1 introduced the study of drainage system in Rwanda. They studied major rivers and the drainage basins, major lakes and their mode of formation, major wetlands in Rwanda, the importance of wetlands to the development of Rwanda, wetland destruction: causes and the effects, measures to promote the sustainable use of wetlands and the relationships between drainage system and human activities. The experience acquired in this unit in year one will help Student-teachers of year three to clearly learn more about the global drainage.

In the student's book there is an introductory activity. It is intended to explain the drainage systems, the major terms associated with the drainage systems, the work of a river, the usefulness of drainage patterns and the need to conserve global drainage systems.

8.3. Cross-cutting issues to be addressed

a) Standardization Culture

Proper management of global drainage is one of the pillars of economic development. All citizens should actively be involved in proper drainage management practices and activities. Proper drainage management improves our health. Water is also helpful to Rwandan societies for economic, industrial, trade and general welfare growth of the people. As a tutorr, guide Student-teachers to discuss the ways of managing water properly at school or in their local areas. Let them discuss how proper management of water is helpful in

their communities. In the student's book on impact of drainage, water used in daily lives is tapped from rivers or Lakes. There is a standardization during the treatment of water for domestic use.

b) Environment and sustainability

This is another cross-cutting issue that is linked to the study of global drainage systems. The management of global drainage systems promotes human activities like wetland agriculture, tourism, and mining, fishing as well as playing a vital role in environmental protection especially with regard to climate and weather modification. Such economic activities and environmental roles have helped people to live in a healthy environment. Guide Student-teachers to discuss in groups how to protect the shores of rivers and lakes. Ask them to outline the management techniques of drainage along lakes and rivers.

c) Financial Education

Global management of water bodies will not only improve knowledge of Student-teachers but also transforms what they have acquired into action. The Student-teachers can have a good use of water at their homes and save money. Ask Student-teachers to discuss in groups how they can purify or use water economically at home using local techniques. Let them discuss how the purification methods and water uses (above) can help to save money that would otherwise be spent by the family on either buying water for drinking, for household chores etc. Supplement their answer and encourage them to manage water economically or for financial benefits in their local areas. Let them show how to avoid improper uses of water that may result in loss of money.

d) Inclusive Education

Special focus should be given to children with learning impairments (children with special educational needs). Improvise with some learning materials like tactile and talking materials, magnifying lenses, local touchable samples etc. to aid learning for special needs children. Guide gifted and talented children to aid children with special needs especially in group discussion, research and presentations.

8.4. Guidance on introductory activity

In this unit, the key inquiry questions that will be the guide to the introductory activity are:

1. Do research using the internet and other geographical resources to explain the following drainage terms: Drainage system, a river and associated

terms like river discharge, river velocity, catchment area, a river divide and a river basin.

2. How does a river erode, transport and deposit its load?
3. Discuss why there is need to conserve drainage systems.

Guide Student-teachers to do research and use their local environment to discover the lesson using the above questions. Facilitate Student-teachers to discuss in groups and present the findings in class.

8.5. List of lessons (including assessment)

#	Lesson title	Learning objectives(from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Definition of a river and the associated terms – the types of rivers, – the work of a river and; – a river profile and its characteristics	– Outlining the characteristics of a river profile – Examining the characteristics of a river profile	6
2	Formation of the major landforms associated with a river profile. – Formation of landforms in youthful stage (waterfalls, rapids) – Formation of landforms in mature stage (meanders) – Formation of landforms in lower/old stage (developed meanders, ox-bow lakes, flood plains, braided channels, deltas, estuaries, levees)	– Identify the landforms resulting from the work of a river – Describe the landforms resulting from the work of a river	5

3	River capture and river rejuvenation – Definition of river capture – Causes of river capture – Effects of river capture – Definition of river rejuvenation – Causes of river rejuvenation – Effects of river rejuvenation	– Explain river capture and river rejuvenation – Differentiate between the river capture and river rejuvenation	5
4	Lakes, Seas and oceans – Types of lakes – Mode of formation of lakes – Impact of lakes, Seas and Oceans – Distribution of seas and oceans – Importance of the oceans and seas	– State different types of lakes – Identify the importance of the lakes – State the different seas and oceans of the world – Explain the mode of formation for the different types of lakes and their importance – Describe the distribution of the oceans, seas and the marine relief.	5
5	End unit assessment		1

Lesson 1: River system

a) Learning objectives

- Outlining the characteristics of a river profile
- Examining the characteristics of a river profile

b) Prerequisite/ Revision/ Introduction

This topic on drainage was discussed in year one. It is important to link the content studied with what is going to be learnt in year three. In year one Student-teachers learnt drainage system in Rwanda.

Facilitate the Student-teachers to review the year one content by asking them to explain the drainage system, terms associated with rivers, the work of a river and the characteristics of a river profile. After this review, using the learning activity provided in the student's book, the Student-teachers will be able to define a river and its associated terms, identify the types of river, explain the triple function of a river and describe the characteristics of a river profile.

c) Teaching resources

For effective delivery of the lesson you should ensure that you have the following resources and other appropriate teaching aids:

- Text books
- Illustrations
- Photographs
- Geographical documents
- Print out of activities
- Manila papers and Flip charts
- Drainage maps
- Tactile and talking materials (for children with disabilities – if any)
- Drainage video clips

d) Learning activities

These are suggested answers to the learning activity 8.1

1. Allow Student-teachers to make a research on provided terms. For more clarification they are referred to the student's book on types of river
2. Refer to the student's book under: The river profile and its characteristics

e) Application activity

Guidance to answer application activity 8.1

1. Refer to the student's book on work of a river
2. Guide Student-teachers to do research, discuss and write down the findings. Student-teachers use rivers in their local environment and describe the characteristics of a river. They then discuss in groups and describe how that river affects the environment around. More answers are given in student's book on river systems.

Lesson 2: Formation of the major landforms associated with a river profile

a) Learning objectives

- Identify the landforms resulting from the work of a river
- Describe the landforms resulting from the work of a river

b) Prerequisites/Revision/Introduction

Display the drainage illustration in the student's book showing a cross and long profile of a river from its source to its mouth. Ask Student-teachers to identify the landforms on the illustration and explain how they are formed. Ask them other landforms that are not named on the illustration. Then organise Student-teachers in groups and guide them to make research on the landforms associated with a river profile.

c) Teaching resources

The Tutor should prepare the teaching learning resources in advance so that effective teaching-learning exercise can take place. These resources will enable the instructional objectives to be achieved. Some teaching resources are listed below:

- Text books
- Illustrations
- Photographs
- Geographical documents
- Print out of activities
- Manila papers and Flip charts
- Drainage maps
- Tactile and talking materials (for children with disabilities – if any)
- Drainage video clip

d) Learning activities

Guidance to answer learning activity 8.2

Guide Student-teachers to work in pairs, they will be able to identify and explain all the landforms in upper stage, middle stage and lower stages of a river. The Student-teachers observe the diagrams in the book on landforms associated with a river profile. Let them do research and discuss in Student-teachers'groups. The Student-teachers present their findings in class. Supplement their answers. Pair children who has a disability with others. Let them work together and learn from each other. Their answers should develop competences such as critical thinking and analysis, cooperation, communication, and problem-solving skills. Engage Student-teachers (including those with special needs) in activities like discussion, asking and answering questions.

For more answers they are referred to the student's book on landforms associated with a river profile.

e) Application activity

Guidance to answer **application activity 8.2**

Student-teachers are asked to make a field tour around any nearest river or stream, identify the landforms in the stage visited and explain how such features are formed. They explain the usefulness of such features to human beings and how they can protect such rivers. They will also describe the relationship between riverine landforms and human activities. They will use the content given in the student's book on landforms associated with a river profile.

Lesson 3: River capture, river rejuvenation, superimposed and antecedent drainage and impact of rivers

a) Learning objectives

- Explain river capture and river rejuvenation
- Differentiate between the river capture and river rejuvenation

b) Prerequisites/Revision/Introduction

Student-teachers are asked to research on river capture and river rejuvenation. Guide them to visit their local environments and identify the causes and effects of river capture and river rejuvenation. Briefly supplement the answers given by Student-teachers.

c) Teaching resources

During the teaching and learning process, the tutor will refer to the following teaching resources where possible:

- Text books
- Illustrations
- Photographs
- Geographical documents
- Print out of activities
- Manila papers and Flip charts
- Drainage maps
- Tactile and talking materials (for children with disabilities – if any)
- Drainage video clips

d) Learning activities

Guidance to answer the learning activity 8.3

Student-teachers are guided to use the text books, watch a video clip (if available) observe photographs and use illustrations to research on river capture and river rejuvenation. Then, they will present their findings in class. Supplement the Student-teachers' answers and presentations. Pair children with disabilities with other children. Let them do things together and learn from each other. Give remedial activities to Student-teachers with special needs. Let them explain river capture and river rejuvenation using local environment. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage Student-teachers (including those with learning impairments) in activities like discussions, presentation, asking and answering questions. For more answers they are referred to the Student's book on river capture and river rejuvenation.

e) Application activity

Guidance to answers application activity 8.3

1. Refer to the student's book on causes of river capture
2. They will discuss deeply and critically about the difference between river capture and river rejuvenation. For more clarification they will use the content given in the student's book on river capture and river rejuvenation.
3. Refer to the student's book on importance of river

Lesson 4: Lakes, Seas and oceans

a) Learning objectives

- State different types of lakes
- Identify the importance of the lakes
- State the different seas and oceans of the world
- Explain the mode of formation for the different types of lakes and their importance
- Describe the distribution of the oceans, seas and the marine relief.

b) Prerequisites/ Revision/ Introduction

This activity is intended to introduce the lesson four and link it with the previous lessons studied before. Allow Student-teachers to identify the lakes in Rwanda and describe their mode of formation. Guide Student-teachers to research on Lakes, seas and oceans in the world. Briefly supplement the answers given by Student-teachers.

c) Teaching resources

During the teaching and learning process, the tutor will refer to the following teaching resources where possible

- Text books
- Illustrations
- Photographs
- Geographical documents
- Print out of activities
- Manila papers and Flip charts
- Drainage maps
- Tactile and talking materials (for children with disabilities – if any)
- Drainage video clips

d) Learning activities

Guidance to answer learning activity 8.4

1. Guide Student-teachers to use their prerequisite knowledge about drainage in Rwanda to recall major lakes that exist in Rwanda.

2. Guide and facilitate Student-teachers to use internet and other geographical documents to research on types of lakes, seas and oceans. Group Student-teachers with special needs with other children to research on lakes, seas and oceans. Let Student-teachers describe the mode of formation of Lakes and the impact of lakes, seas and oceans.

e) Application activity

Guidance to answer application activity 8.4

1. Let Student-teachers use the knowledge and skills acquired in this unit and other skills get from the previous units. Then, they draw a sketch map of Rwanda and locate the major types of lakes.
2. Guide Student-teachers to research on major ocean management projects.

   Facilitate group discussions and presentation of findings in class.

   Help them to refer to the management of drainage systems in Rwanda like management of rivers and lakes.

8.6. Summary of the unit

This unit covers the definition of a river and the associated terms, the types of rivers, the work of a river, the river profile and its characteristics, the formation of the landforms in different stages of a river, the river capture and river rejuvenation, the drainage patterns of the world, Superimposed and antecedent drainage, the impact of rivers, Lakes, their types, mode of formation and impacts, the distribution of Seas and Oceans,

This unit intends to help Student-teachers to explain various types of drainage systems and the landforms associated with them as a result of the work of a river. It helps Student-teachers to analyze the importance of rivers, lakes, seas and oceans in relation to the surrounding environments and human activities. This will help Student-teachers to internalize the importance of environmental conservation and financial education as cross cutting issues. They will know how human beings have utilized the available global drainage systems and their associated landforms for sustainable development. It also enables Student-

teachers acquire environmental conservation and global management skills (control measures) that creates awareness for environment and global drainage protection for future economic development and sustainability.

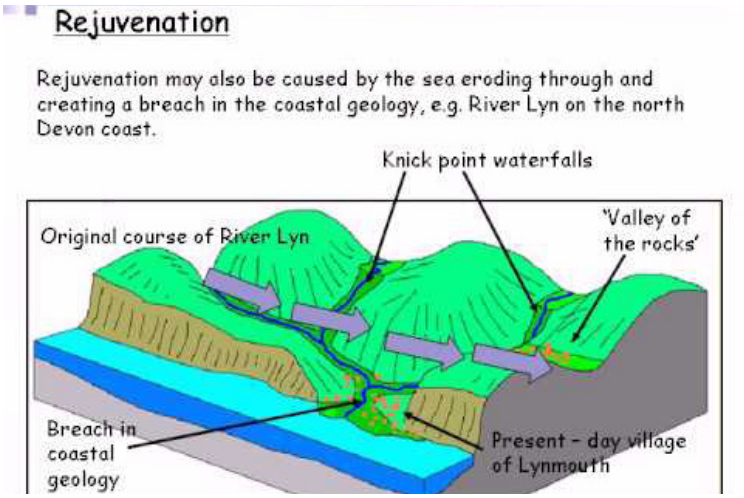
8.7. Additional Information

This unit is linked to unit 8 in year one on the Drainage system in Rwanda. It is vital for Student-teachers to link the prior knowledge acquired in year one to what is contained in this unit. When you are teaching this unit you should use local examples of landforms resulting from drainage system in Rwanda. Make comparison between different drainage systems and associated landforms of Rwandan rivers and lakes in relation to the drainage systems and landforms of rivers, lakes, seas and oceans in the world.

The student's book has some activities where group discussion, research, cooperation and class presentation are emphasized. It is therefore necessary that where possible methodology can be changed and activities adjusted in order to achieve learning objectives.

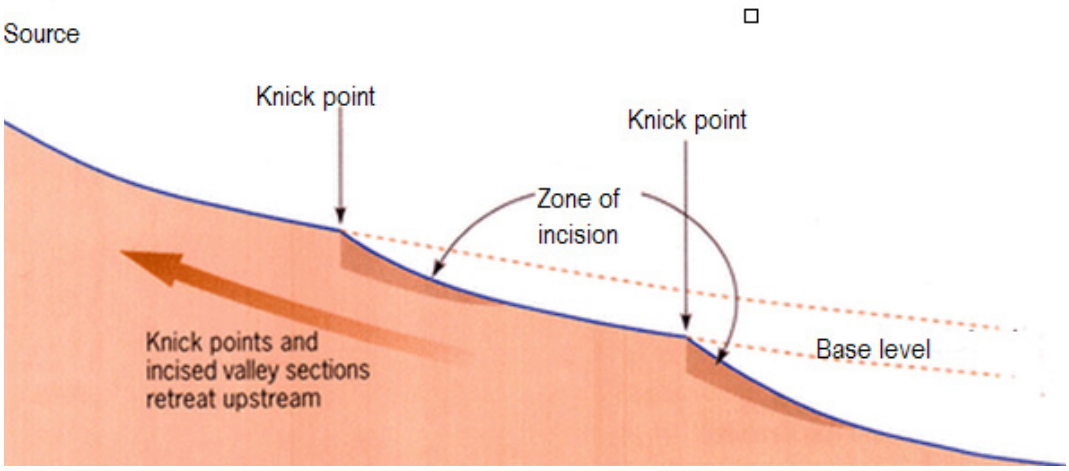
The student's book doesn't contain illustrations on river rejuvenation. The Tutor will guide the Student-teachers to do research on diagrams or illustrations related to river capture and river rejuvenation. Below are some of the additional content and illustrations on river rejuvenation.

Features associated with river rejuvenation



1. A knick point

Knick point, simply called as nick point or only 'nick' represents breaks in slope in the longitudinal profile of a river caused by rejuvenation. The nick point is also called as head of rejuvenation which registers gradual recession upstream. These breaks in channel gradient or nick points denote sudden drops of elevation in the longitudinal profile of the rivers and allow water to fall down vertically giving birth to waterfalls of varying dimensions.



2. Paired terraces and valley within a valley :

Paired terraces are steps or bench like cuts on the sides of a rejuvenated river valley. They are occupied by layers of old gravel and alluvial deposits. It is also the former flood plain that is at a higher elevation due to a river that has renewed its erosive activity causing it to deepen its valley or sinking deeper in its channel.

3. A valley within a valley

This is a new valley that has formed in the former flood plain valley. It is the part of the old river bed that was left at a higher elevation when vertical erosion creates a new and narrower river channel at the former river bed.

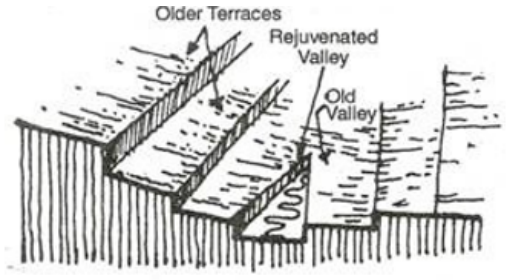


Figure 1: Paired terraces

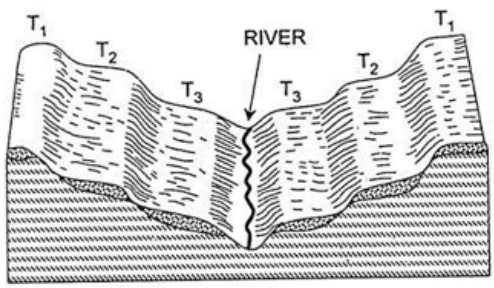


Figure 2: Paired terraces and valley within a valley

4. Incised meanders

These are curved bends of a river that has been incised or cut deeper by vertical erosion of a rejuvenated river. The river winds between steep valley walls. Incised meanders result from the already meandering river due to fall in base level.

Figure 4: Incised meanders

8.8. End unit assessment

1. Water is unequally distributed over time and space. Much of it is wasted, polluted and unsustainably managed.

   a) Identify the main causes of water scarcity

   b) Suggest possible solutions to the water crisis

Guide Student-teachers to describe the main causes of water crisis in the world.

Guide Student-teachers to share the answers by using experience in their local environment.

Some of the causes of water shortage are outlined here:

- Water pollution
- Agriculture
- Population growth
- Overuse of water
- Conflict
- Drought

Facilitate Student-teachers in groups to discuss on how to deal with water scarcity.

Solutions to water crisis are also suggested here:

- Education
- Improve practice related to farming
- Prevent pollution

- Etc.

2. Explain the process that leads to river meander

- In pair let Student-teachers discuss and share their experience get from their studies about drainage.
- For more clarification refer to content related with the formation of landforms in old stage

3. How could a river be both a valuable resource and a problem for a region?.

- In groups let Student-teachers discuss and brainstorm on economic advantages of drainage.
- Refer them to the Student's book for more details on importance of the drainage.
- Guide them to suggest the disadvantages of drainage. They should use local examples from their area of origin referring to the influence of Lakes and rivers.

4. Explain the strategies to mitigate natural hazards associated with drainage system.

- In groups ask Student-teachers to identify the hazards caused by drainage system in Rwanda. Then, let them discuss how they can mitigate the risks caused by those drainage systems.

8.9. Additional activities

8.9.1 Remedial activities (for slow Student-teachers)

i) Outline any 5 importance of lakes and rivers to human beings.

ii) Explain the difference between the following:
   - a river and a lake
   - a lake and a sea
   - a sea and an ocean.

Guidance for answers to remedial activities

These are questions that require low order thinking and are answered as follows:

i) 5 importance of Lakes are: provision of water for domestic use, source of water for irrigation, source of fish, modification of climate around them, attraction of tourists etc. Refer them to Student's book on impact of lakes and rivers.

ii) A river is a mass of water flowing from a known source to a destination. A Lake is a mass of water contained in a depression. A lake is smaller than a sea. A sea is smaller than an ocean.

8.9.2 Consolidation activities

i) Account for the conservation of the environments along Lakes and rivers in Rwanda.
   - Guide Student-teachers how to answer the above questions using student's book and internet.

ii) Assess the economic importance of rivers and Lakes in the world
   - Facilitate Student-teachers to work in groups and brainstorm on economic importance (both positive and negative) of rivers and Lakes giving specific examples in the world.
   - Use the student's book on economic importance of rivers and lakes

8.9.3 Extended activities (for gifted and talented student-teachers)

To what extent are ocean currents responsible for the climate of the adjacent areas?

Guidance to answer:

- Let the Student-teachers make research on the influence of ocean currents to the climate of the surrounding areas.
- Let them research also on other factors (apart from ocean currents) that may influence climate for example; the relief of the area, the human activities carried out in the area, the latitudinal location, etc.

Skills lab

Water pollution is a result of human activities. Give advice on how to prevent it.

- Guide Student-teachers to work in groups to share ideas on activities that can contaminate water.
- Ask Student-teachers to suggest appropriate measures for water conservation and water resources.

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