Geography s6

Teacher's guide

Kigali, January 2019

FOREWORD

Dear teacher,

Rwanda Education Board is honoured to present Senior 6 Geography teacher`s guide which serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of Geography subject. The Rwandan educational philosophy is to ensure that learners achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

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

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

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

- Plan your lessons and prepare appropriate teaching materials.
- Organize group discussions for learners considering the importance of social constructivism suggesting that learning occurs more effectively when the learner works collaboratively with more knowledgeable and experienced people.
- Engage learners through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.

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

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

The part 1: Starts with general introduction and explains the structure of this book and gives you methodological guidance;

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

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

Even though this teacher`s guide contains the answers for all activities given in the learner's book, you are requested to work through each question and activity before judging learner's findings.

I wish to sincerely appreciate all people who contributed towards the development of this teacher`s guide, particularly REB staff who organized the whole process from its inception. Special appreciation goes to the teachers who supported the exercise throughout. Any comment or contribution would be welcome to the improvement of this for teacher's guide for the next edition.

Dr. NDAYAMBAJE Irénée

Director General, REB

ACKNOWLEDGEMENT

I wish to express my appreciation to all the people who played a major role in development of this Geography textbook for senior six. It would not have been successful without active participation of different education stakeholders.

I owe gratitude to different Universities and schools in Rwanda that allowed their staff to work with REB in the in-house textbooks production project. I wish to extend my sincere gratitude to lecturers, teachers and all other individuals whose efforts in one way or the other contributed to the success of writing of this textbook.

Special acknowledgement goes to the University of Rwanda which provided experts in design and layout services, illustrations and image anti-plagiarism.

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

Joan MURUNGI,

Head of Curriculum, Teaching and Learning Resources Department (CTLR)

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PART I. GENERAL INTRODUCTION

1.1. The structure of the teacher's guide

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

Overall structure

The whole guide has three main parts as follows:

Part I: General Introduction.

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

Part II: Sample lesson plan

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

Part III: Unit development

This is the core part of the 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 teacher 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; teachers 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 learner's book. This section of the teacher's guide provides guidance on how to conduct this activity and related answers. Note that learners may not be able to find the right solution but they are invited to predict possible solutions or answers. Solutions are provided by learners 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 on 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 teacher's guide provides the following sections:

- Summary of the unit which provides the key points of content developed in the student's book.
- Additional information which provides additional content compared to the student's book for the teacher 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 learner (slow, 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 1:**
- **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. Teachers are encouraged to replace the suggested teaching aids by the available ones in their respective schools and based on learning environment.

- **Learning activities**

  This section provides a short description of the methodology and any important aspect to consider. It provides also answers to learning activities with cross reference to 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 a competency based curriculum for pre-primary, primary and general secondary education. This called for changing the way of learning by shifting from teacher centered to a learner centered approach. Teachers are not only responsible for knowledge transfer but also for fostering children's learning achievement, and creating safe and supportive learning environment. It implies also that a learner must demonstrate what he/she is able to do using the knowledge, skills, values and attitude acquired in a new or different or given situation.

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

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

- **Critical Thinking**

These are activities that require students to think critically about subject content. Groups can be organized to work in different ways e.g. taking turns, listening, taking decisions, allocating tasks, disagreeing constructively etc.

- Collect geographical data locally through designing surveys, questionnaires, interview formats then analyse data, draw conclusions and present findings.
- Observe, Record, interpret – e.g. Mark out areas in the school and get different groups to record physical and human features and then try to explain why these features are found in such environment.
- Research and Discuss on causes and effects of different geographical phenomena.
- Compare physical and human features in different regions.
- Debate on different problems associated with different physical environment.
- Suggest ways of overcoming the above problems.

❖ **Research and problem solving**

- Use the Internet and the library to make research on the phenomena associated with the physical environment.
- Collect geographical data through observation and Recording.
- Collect geographical data through surveys, questionnaires and different kinds of interviews.
- Develop sampling rules for data collection.
- Creativity and Innovation
- Design a sketch map.
- Create an experiment to prove a Point.
- Develop graphs and diagrams to illustrate information.
- Create a flow chart to show the main stages in a process.
- Design geographical data collection survey/questionnaire.
- Identify a problem which requires data collection to solve.
- Conduct experiments with objectives, methodology, observations, results, conclusions.
- Make hypotheses and identify ways to test them.
- Identify local problems and devise ways to resolve them.
- Communication Skills

- Describe physical and human geographical features.
- Present geographical phenomena verbally, in writing, graphically and digitally.
- Argue a geographical case verbally, in writing, graphically (compare and contrast) and digitally.
- Observe, record, interpret geographical phenomena.

❖ **Team work, Cooperation, Personal and Interpersonal management and life skills**

- Work in Pairs.
- Particularly useful for higher grades for planning research, problem solving, etc.
- Small group work.
- Large Group Work.
- Data Collection from the Community.
- Collect community photographs and interview residents to make a class / school geography of the local Community.

Note: The teachers' Guide should improve support in the organization and management of groups.

❖ **Lifelong Learning**

- Take initiative to update knowledge and skills in geography with minimum external support.
- Cope with the evolution of knowledge and technology advances for personal fulfilment.
- Seek out acquaintances more knowledgeable in areas that need personal improvement and development.
- Exploit all opportunities available to improve on knowledge and skills.

1.2.2 Addressing cross cutting issues

Among the changes in the competence based curriculum is the integration of cross cutting issues as an integral part of the teaching learning process-as they relate to and must be considered within all subjects to be appropriately addressed. The eight cross cutting issues identified in the national curriculum framework are Peace and Values Education, Financial Education, Standardization Culture, Genocide Studies, Gender, Environment and sustainability, Inclusive Education and Comprehensive sexuality education.

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

Below are examples on how crosscutting issues can be addressed in your subject:

Environment and sustainability can be integrated in geography as standalone unit for many topics e.g when the learners study Environmental conservation.Environment and sustainability can also be integrated through all learning activities where the problems related to the environment such as pollution, erosion, are addressed.

Financial education can be integrated in learning activities when studying the relationship between different landforms and human activities.

Inclusive education can be integrated in geography for example if they have to make a field study, they should consider the learners with physical disabilities and react accordingly by choosing an appropriate methodology. The use of a video is recommended for those who will not be able to reach the place. For learners with visual impairment, tactile materials such as tactile maps can be used.

1.2.3. Attention to special educational needs specific to each subject:

When we think about inclusive education, often we just think about getting children *into school*, i.e. making sure they are physically present in school. However, we also need to ensure that children are participating in lessons and school life, and that they are achieving academically and socially because of coming to school. So, we need to think about presence, participation and achievement.

Some people may think that it is difficult to address the needs of a diverse range of children. However, by working as a team within your school, with support from families and local communities, and by making small changes to your teaching methods, you will be able to meet the needs of all children – including those with disabilities.

Teachers need to:

- Remember that children learn in different ways so they must offer a variety of activities (e.g. role-play, music and singing, word games and quizzes, and outdoor activities).
- Always demonstrate the objective of the activity; show children what they expect them to do.
- Vary their pace of teaching to meet the needs of each child. Some children process information and learn more slowly than others.
- Use clear consistent language – 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 child 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 for the child. Both children will benefit from this strategy.
- Have a multi-sensory approach to your activities.

Below are 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 child is unique with different needs that should be handled differently.

Strategies to help children with developmental disabilities:

- Be patient! If you find that the child takes longer than others to learn or to do an activity, allow more time.
- Do activities together with the child.
- Gradually give the child less help.
- Let the child do the activity with other children and encourage them to help each other.
- Divide the activity into small achievable steps.
- Remember to praise and say, 'Well done' when the child learns something new or makes a strong effort.

Strategies to help children with physical disabilities or mobility difficulties:

- Adapt activities so that children who use wheelchairs or other mobility aids, or other children, who have difficulty moving, can participate.

- Ask parents/caregivers to assist with adapting furniture – e.g. the height of a table may need to be changed to make it easier for a child to reach it or fit their legs or wheelchair under.
- Encourage peer support – friends can help friends.
- Get advice from parents or a health professional about assistive devices.

Strategies to help children with hearing disabilities or communication difficulties

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

In geography, learners with **developmental disabilities** can be helped in the same way as slow learners are helped, they will be given remedial activities according to their levels of disability.

The learners with **physical disabilities** can have problem in field study which is one of the learning techniques mostly used in geography, the field to visit should be considered and if some students will not be able to reach the place, use a video.

The learners with **hearing disabilities** or communication difficulties will be helped by using enough maps, illustrations, diagrams and sign languages.

Strategies to help children with visual disabilities

- Help children to use their other senses (hearing, touch, smell and taste) to play and carry out activities that will promote their learning and development.
- Use simple, clear and consistent language.
- Use tactile objects to help explain a concept.

- If the child has some sight, ask them what they can see. Get information from parents/caregivers on how the child manages their remaining sight at home.
- Make sure the child has a group of friends who are helpful and who allow the child to be as independent as possible.
- Plan activities so that children work in pairs or groups whenever possible.

Adaptation of assessment strategies

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

In geography, students with visual disabilities can use tactile learning materials such as maps, diagrams and other illustrations.

1.2.4. Guidance on assessment

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

Continuous/ formative assessment

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

Formative assessment will be applied in geography before, during and after the lesson by using learning activities and application activities.

Summative assessment

The assessment can serve as summative and formative depending to its purpose. The end unit assessment will be considered summative when it is done at end of the unit and want to start a new one.

It will be formative assessment, when it is done to give information on the progress of

students and from there decide what adjustments need to be done. The assessment done at the end of the term, end of year, is considered as summative assessment so that the teacher, school and parents are informed of the achievement of educational objective and think of improvement strategies. There is also end of level/cycle assessment in form of national examinations.

Summative evaluation will be applied in this subject at the end of each unit.

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

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

There are mainly **four different learning styles** as explained below:

a) Active and reflective learners

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

b) Sensing and intuitive learners

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

c) Visual and verbal learners

- **Visual learners** remember best what they see (pictures, diagrams, flow charts, time lines, films, demonstrations).

- **Verbal learners** get more out of words either written or spoken explanations.

d) Sequential and global learners

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

The diversity of learners has been catered for in elaborating the textbook, the teacher's guide in proposing a variety of activities such as:

- Learning and application activities.
- Consolidation activities which improve a deep development of competences.
- Remedial activities which help slow learners to develop some competences.
- Extended activities which are meant for gifted and talented learners.

1.2.6. Teaching methods and techniques that promote the active learning

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

What is Active learning?

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

The role of the teacher in active learning

- The teacher engages learners through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.
- He/she encourages individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.
- He provides supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem

solving, research, creativity and innovation, communication and cooperation.

- Teacher supports and facilitates the learning process by valuing learners' contributions in the class activities.

The role of learners in active learning

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

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

Main steps for a lesson in active learning approach

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

1) Introduction

Introduction is a part where the teacher makes connection between the current and previous lesson through appropriate technique. The teacher opens short discussions to encourage learners 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, Presentation of learners' findings, Exploitation, Synthesis/Summary and Exercises/Application activities.

❖ **Discovery activity**

Step 1

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

Step 2

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

❖ **Presentation of learners' productions**

- In this episode, the teacher invites representatives of groups to presents the students' 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 learner'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 correct.

❖ **Institutionalization (summary/conclusion/ and examples)**

- The teacher summarizes the learned knowledge and gives examples which illustrate the learned content.

❖ **Exercises/Application activities**

- Exercises of applying processes and products/objects related to learned unit/sub-unit
- Exercises in real life contexts
- Teacher guides learners 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, learners 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.

SAMPLE LESSON PLAN 1 ON PHYSICAL GEOGRAPHY

School Name: G.S Remera **Teacher's name:** MUKARUGWIZA Marie

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
I	24/02/ 2018	Geography	S6	4	3/12	40 minutes	40 learners
Type of Special Educational Needs to be catered for in this lesson and number of learners in each category				1 learner with visual impairment, 1 leaner with hearing difficulty.			
Unit title	External landform processes and related features						
Key Unit Competence	The learners should be able to demonstrate an understanding of the different land features resulting from external processes and their relationships with human activities.						
Title of the lesson	Factors influencing weathering						
Instructional objective	Using internet and text books learners explain the factors that influence weathering effectively.						
Plan for this Class (location: in / outside)	The lesson shall be conducted from the class. However, the learners will be asked to go outside for 10 minutes to observe and identify the factors that influence weathering.						
Learning Materials (for all learners)	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		Generic competences and cross cutting issues to be addressed + a short explanation.
	The learners using internet, the environment and past studies explain the factors that influence weathering.		
	Teacher's activities	Learner's activities	
Introduction (5min)	Learners are organized into manageable groups and asked to identify types of weathering.	Learners answer the questions asked by the teacher 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: 25 min a) **Discovery activity**	The teacher introduces the lesson of the day regarding factors influencing weathering. The teacher will display the illustration on factors influencing weathering.	Listening. The learners in their groups discuss the factors that influence weathering. With the help of the illustration, in their groups, they discuss the missing factor on the illustration.	**Critical thinking:** This will be achieved when learners are left to investigate briefly on the factors that influence weathering. **Skills**: Cooperation and communication skills are enhanced through working in groups.
b) **Presentations of learners' productions**	The teacher invites representatives of groups to present their findings on factors influencing weathering.	Presentation of their findings in class. Asking, noting down important points.	Communication skills: Communication skills are addressed through presentations.
c) **Exploitations of learners' productions**	After 3 or 4 presentations, the teacher decides to engage the class into utilization of the students' productions on factors influencing weathering. The teacher asks the students to evaluate the factors influencing weathering and supplements the learners' presentations.	Learners evaluate the content presented by their colleagues and Supplement the content presented by their fellow learners.	**Environment and sustainability:** This is through realizing the need to conserve and protect the environment in general.

Institutionalization (summary, conclusions and examples) 3 minutes Application activities: 7 min	The teacher summarises the content on the factors influencing weathering and gives local examples for clear understanding of the learners. The teacher guide learners to go out briefly and observe and explain how relief and nature of the rock influence weathering.	Listening to the teacher summary of the content and note down important aspects related to the lesson of the day.	Communication skills: Communication skills are addressed through presentation
Assessment	The teacher asks learners to identify 5 factors influencing weathering in their area. Teacher marks the exercises in the learners' books.	Learners write down the answers in their note books.	
Teacher-self evaluation	The lesson was successfully taught as evidenced by the learners' scores and performance. This proves that the pre-stated instructional objectives were achieved.		

SAMPLE LESSON PLAN 2 ON HUMAN AND ECONOMIC GEOGRAPHY

School Name: E. S KARAMA **Teacher's name:** NIYONGABO JAMES

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
II	20/06/2018	Geography	S6	10	2/3	40 minutes	38 learners

Type of Special Educational Needs to be catered for in this lesson and number of learners in each category	**1 learner with visual impairment, 1 leaner with hearing difficulty.**
Unit title	**POWER AND ENERGY PRODUCTION IN THE WORLD**
Key Unit Competence	The learner should be able to evaluate the success of sustainable development projects in the power and energy production in the world.
Title of the lesson	Factors of power and energy production in the world
Instructional objective	Using internet and text books learners explain the factors of power and energy production in the world appropriately.
Plan for this Class (location: in / outside)	The lesson shall be conducted in the classroom.
Learning Materials (for all learners)	Internet, text books, photographs, video, illustrations.
References	Herbert H. Gross, PhD. (1983) World Geography Revised. United States of America: follerr Social Studies, Allyn and Bacon, Inc. Byamugisha B.c. (2010) Focus on World Geography: selected Topics in World Problems and development, A'Level Geography Paper 2, Kabs Published Ltd. John whitton (1984). Dictionary of Physical Geography, New York, USA. Compound physical Geography by K. Kansime.

	Description of teaching and learning activity		**Generic competences and cross cutting issues to be addressed + a short explanation.**
Timing step for each step	The learners using internet, the environment and past studies explain the factors of power and energy production in the world		
	Teacher's activities	Learner's activities	

Introduction **(5min)**	Teacher asks questions related to the previous lesson on resources and forms of energy.	Learners answer questions related to the previous lesson on resources and forms of energy.	**Communication** Communication skills are developed through answering questions.
Development of the lesson : 30 min) **a) Discovery activity**	Form groups for discussion. Give materials to the learners and Guide them to identify the areas of power and energy production. Ask the learners to discuss the factors for power and energy production	Group formation Group identification of the areas of power and energy production Learners discuss factors for power and energy production and noting down important points	**Critical thinking:** This will be achieved when learners are discussing about the factors for power and energy production in the World. Cooperation and communication skills are developed through working in groups, discussions and presentation.
b) Presentation of learners' findings **c) Exploitation of learners' production**	Ask each group to present its findings/production Ask the learners to use their findings and explain the factors of power and energy production in the world Guide learners in their presentation by supporting their view and supplement them.	Group members present their findings Use their findings to explain the factors for power and energy production.	**Environment and sustainability:** The location of power plants should take into consideration the location /environment. This will reduce the explosion and carbon dioxide emission from power plants for example thermal and nuclear power production.

Institutionalization **(Conclusion/ summary)** **Application**	Ask each group to make a summary of what has been learnt and teacher summarizes the content studied. Ask learners to discover why some areas lack certain types of power and energy.	Write down the important points of the lesson.	**Communication skills:** Communication skills are addressed through presentation.
Assessment **5 minutes**	Students are assigned the assignment as drawn from the text book provided.	Students write the assignment in their revision books	
Teacher-self evaluation	The lesson was successfully taught as evidenced by the learners' performance. This proves that the pre-stated instructional objectives were achieved.		

SAMPLE LESSON PLAN 3 ON PRACTICAL GEOGRAPHY

School Name: GS GATABO **Teacher's name:** KAYIREBWA Marie Ange

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
I	20/03/2018	Geography	S6	1	1/6	**40 minutes**	**40 learners**
Type of Special Educational Needs to be catered for in this lesson and number of learners in each category				1 learner with visual impairment, 1 leaner with hearing difficulty.			
Unit title	Cross section and sketch maps						
Key Unit Competence	The learners should be able to draw cross sections and sketch maps by reduction or enlargement						
Title of the lesson	Contour, contour interval and importance of contours						
Instructional objective	Using the map provided, learners will identify contours on the map, calculate the contour interval and explain their importance appropriately.						
Plan for this Class (location)	The lesson shall be conducted from the class.						
Learning Materials (for all learners)	Sample maps, text books.						
References	D.N McMaster (2000): Map Reading for East Africa, Edinburgh, Longman. F.J. Monkhouse (2007): A dictionary of Geography, 2nd ed. Transaction Publishers, New Brunswick (USA).						
Timing step for each step		Description of teaching and learning activity					Generic competences and cross cutting issues to be addressed + a short explanation.
	The learners using sample maps and past studies explain contours, calculate contour interval and importance of contours.						

	Teacher's activities	Learner's activities	
Introduction (5min)	Learners are organized into small groups and asked to identify elements and types of maps.	Learners respond to the questions asked by the teacher on types and elements of a good map.	**Cooperation:** Cooperation and communication skills are addressed through working in groups Critical thinking through identifying the factors influencing weathering.
Development of the lesson: 30 min **a) Discovery activity** **b) Presentations of learners' productions / findings** **c) Exploitations of learners' productions/ findings**	The teacher introduces the lesson of the day regarding contours. The teacher will display sample topographic maps to be used in the lesson. The teacher invites representatives of groups to present their findings on the content learnt. After 2 or 3 presentations, the teacher decides to engage the class into utilisation of the students' findings on contours. The teacher asks the students to evaluate the content studied and supplements the learners' presentations.	The learners in their groups discuss the content related to contours. With the help of the topographic map, in their groups, they analyse contours, their interval and importance in map work. Presentation of their findings in class. Asking, noting down important points. Learners evaluate the content presented by their colleagues and Supplement the content presented by their fellow learners.	**Critical thinking:** This will be achieved when learners are left to investigate briefly on the factors that influence weathering. **Skills**: Cooperation and communication skills are enhanced through working in groups. **Communication skills:** Communication skills are addressed through presentations. **Environment and sustainability:** This is through realizing the need to conserve and protect the environment in general. **Environmental sustainability cross-cutting** issue through analyzing different forms of relief and how they can be protected

d) Institutionalization (summary, conclusions and examples)	The teacher summarises the content on contours and give local examples for clear understanding of the learners.		Communication skills: Communication skills are addressed through presentation
e) Application activities	The teacher guides learners to go out briefly and observe different forms of relief in their surroundings and explain how they can be represented on maps using contours.	Listening to the teacher's summary of the content and note down important aspects related to the lesson of the day.	
Assessment **(5 min)**	The teacher asks learners to define contour, calculate contour interval and give their importance.	Learners answer the questions of evaluation.	
Teacher-self evaluation	The lesson was successfully conducted due to good marks obtained by learners in the application activity. This proves that the pre-stated instructional objectives were achieved.		

UNIT 1: CROSSS SECTION AND SKETCH MAPS

1

1. Key unit competence

The learner should be able to draw cross sections and sketch maps by reduction or enlargement

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

Unit 2 of senior 4 introduced the study of map and cartographic projection. Learners studied the elements of a good map, types of maps and categories of maps, cartographic projection and location of phenomena on the map.

Unit 2 of senior 5 explained bearing, direction, distance and area on the map. They studied how to locate places by using grid reference, state direction and bearing on the topographic map, calculation of distance and area on the topographic map and calculation of vertical interval of the relief.

Unit 3 of senior 5 talks about map work interpretation. The learners interpreted physical and human aspects on the map and relationship between physical and human activities.

In the learner's book there is an introductory activity; it is intended to define contours, contours interval, importance of contours which will help learners to draw a cross section, determine vertical exaggeration, gradient, amplitude, intervisibility and draw sketch maps by enlargement and reduction. Therefore, a teacher emphasizes the cross cutting issue of environment and sustainability.

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 sustainability based on knowledge of contours and cross section; the learners should know how to distinguish steep slopes, gentle slopes and valleys which can help them in orientation and selection of settlement areas and environmental protection.

Financial education is another cross-cutting issue that is linked to the study of amplitude and intervisibility. The knowledge on these will lead to the good management of economic activities to increase the income of the people.

4. Guidance on introductory activity

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

a) Use the topographic map provided in learner's book to measure the distance from X to P.

b) How do we describe relief on that map?

c) Explain the steps followed in drawing a cross section.

d) What are the procedures followed in drawing a sketch map?

5. List of lessons (including assessment).

	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	Number of periods
1	Contours , contour interval and the importance of contours	-Identify the contours on a map -Analyze the appearance of the contours on the topographic map	1
2	Cross section or sketch section	-draw cross section using contours -develop an attitude of using topographic map and cross section to interpret relief	2
3	Determining the vertical exaggeration, the gradient, amplitude and inter visibility.	-calculate the vertical exaggeration, vertical interval, gradient and amplitude of relief.	1
4	Drawing a sketch maps	-Appreciate the importance of drawing a sketch map.	2
5	Enlargement and reduction of the map	Identify the number of time to reduce or enlarge the map and make a sketch of the reduced or enlarged map.	1
6	Assessment		1

6. Guidance on different lessons outlined above

Lesson 1: Contours, contour interval and the importance of contours

a) Prerequisites/ Revision /Introduction

This topic on cross section and sketch maps was discussed in senior 4 and senior 5. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners learnt elements of a good map, types and categories of map and location of phenomena on the maps while in senior 5, location of place by using grid references, direction, bearings on topographic maps, calculation of distance, area on a topographic map, representation of relief on the map were also studied.

Guide the learners to review senior 4 and senior 5 contents by asking them to interpret relief on the map by using contours. After this review using topographic map, learners will be able to show contours on the map, to define contours and describe their importance.

b) Teaching resources:

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

- Text books
- Sample of topographic maps
- Drawing materials
- Mathematical instruments

c) Learning activities

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

Guide learners to work in groups using topographic map, and content acquired in senior 5 on representation of relief on the map, they will be able to identify contours on the map and to discuss their importance. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

Learners are asked to explain the importance of contours. They will use the content given in the learner's book on importance of contours and the internet to explain the importance of contours.

d) Application activities

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

Learners are asked to show the contours and their interval. They will use the content given in the learner's book on contours and contour interval and other geographical documents to show contours and their intervals.

Lesson 2: Cross section or sketch section

a) Prerequisites/ Revision /Introduction

Briefly review the previous lesson by asking learners to identify the importance of contours. Afterwards display the topographic map of Rwinkwavu and ask learners to identify flat, gentle slopes and steep areas.

b) Teaching resources:

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

- Text books
- Sample of topographic maps
- Drawing materials
- Atlas.

c) Learning activities

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

Guide learners to work in groups using topographic map, and content acquired in senior 5 on representation of relief on the map, they will be able to identify flat, gentle slopes, steep slopes and draw a cross section asked on the map. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

Learners are asked to identify flat, gentle slopes, steep slopes and draw a cross section. They will use the content given in the learner's book about cross section and other geographical documents to identify flat, gentle slopes, steep slopes.

d) Application activities

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

Learners are asked to draw a cross section. They will use the content given in the learner's book on cross section to draw a cross section of the area identified on the map.

Lesson 3 : Determining vertical exaggeration, the gradient, amplitude and intervisibilty

a) Prerequisites/ Revision /Introduction

Briefly review the previous lesson by asking learners to define a scale and describe the type of scale. Thereafter the teacher introduces the concept of vertical exaggeration, gradient, amplitude and intervisibilty.

b) Teaching resources:

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

- Text books
- Sample of topographic maps
- Drawing materials
- Manila papers.

c) Learning activities:

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

Guide learners to work in pairs and make research on the types of scale, vertical exaggeration, gradient and describe them. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and research skills.

Let learners discuss, ask and answer questions and refer them to the learner's book for more information about vertical exaggeration, gradient and amplitude.

d) Application activities

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

Learners are asked to determine amplitude. They will use the topographic map of Akagera and content given in the learner's book on amplitude and other geographical documents to calculate amplitude that has been asked.

Lesson 4 : Drawing a sketch maps

a) Prerequisites/ Revision /Introduction

Review the previous work covered by asking learners to define amplitude and gradient. Later guide learners in drawing the site of the school compound.

b) Teaching resources:

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

- Text books
- Pencils
- Colored pencils
- Rulers
- Clip board files
- Manila papers.

c) Learning activities

Refer to the learning activity 1.4 in the learner's book

Help learners to work in groups and draw a sketch map of the school compound, their findings should be presented in class. Their answers should involve the integration of generic competences such as critical thinking, sketch drawing, creativity, cooperation and communication skills.

Learners are asked to draw a sketch map of the school compound on the piece of paper. They will get more information in the class presentation and learner's book on drawing a sketch map.

d) Application activities

Refer to the application activity 1.4 in the learner's book

Learners are asked to make a field trip around the school and draw a sketch map of the nearby market place. They will use the past experiences and learner's book on drawing a sketch map to draw a sketch map of the nearest market.

Lesson 5 : Enlargement and reduction of maps

a) Prerequisites/ Revision /Introduction

Briefly review the previous lesson by asking learners to highlight the steps taken in drawing a sketch map. Later the facilitator asks learners ways of making features clearly visible on the map provided.

b) Teaching resources:

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

- Text books
- Sample maps
- Drawing materials

c) Learning activities:

Refer to the learning activity 1.5 in the learner's book

Help learners to work in groups and draw a sketch map of the school, they identify and write down the names of the features found there. Their answers should involve the integration of generic competences such as critical thinking, creativity, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book about enlarging and reduction of maps.

d) Application activities

Refer to the application activity 1.5 in the learner's book

Learners are asked to study the map of Rwanda provided; they reduce it by two and draw its outline. They will use the content given in the learner's book on reduction of maps and other geographical documents.

7. Summary of the Unit:

This unit covers contours, contours interval, importance of contours, cross section, vertical exaggeration, gradient, amplitude, intervisibility, sketch maps, map enlargement and reduction.

This unit aims at helping the learners to describe relief of an area using contour lines as well as drawing a cross section and indicating features on a cross section. Other areas to be discussed in this unit are gradient, amplitude, intervisibility and sketch drawing which helps learners to develop a skill of map drawing.

8. Additional Information

Details about linear scale, representative fraction and statement scale are important in helping the learners to determine the distance from one place to another. Identification of different economic activities carried out in different relief regions and problems associated with such activities are also equally important for analysis.

9. End unit assessment

Questions:

1. a) Explain how contours help to describe relief in your area?

   b) Show how the above relief in your area can be conserved for environment sustainability.

2. Make a visit of the school garden, draw its sketch map on it indicate all the physical and human features.

3. Use the topographic map of Ihema and answer the questions that follow:

   a) Draw a cross section between point X and Y, make a class presentation.

   b)Enlarge two times the area on the map south of northing 85 and draw its outline.

Guidance to answer questions:

1. a) Explain how contours help to describe relief in your area?

Put learners in pairs and help them to discuss how contours can be a guide in understanding the forms of relief of a given area

b) Show how the above relief in your area can be conserved for environment sustainability.

Ask learners to brainstorm on how relief in their area has been conserved for sustainable development.

2. Make a visit of the school garden, draw its sketch map on it indicate all the physical and human features.

Guide learners on how to draw a sketch map by following all procedures required in drawing a sketch map.

3. a) Draw a cross section between point X and Y and make a class presentation.

Facilitate learners in drawing a cross section using a topographic map (map of Ihema). Make sure that they follow all steps used in drawing a cross section.

b) Enlarge two times the area on the map south of northing 85 and draw its outline.

Guide learners to enlarge the area on the topographic map of Ihema, South of northing 85 and draw its outline. The procedures followed in drawing should be related to the content in the learner's book.

10. Consolidation, Remedial and extended activities.

a) Consolidation activities:

i) How can we determine the Contour Interval?

ii) Explain how a sketch map is drawn?

Guide learners on how to answer the above questions using the learner's book and research. For example Vertical Interval is calculated by determining the distance in height between two adjacent contours lines .While a sketch map is drawn by following procedures in the learner's book.

b) Remedial activities (for slow learners)

i) Define the term relief.

ii) Define the term contour.

iii) why is the key important in mapwork?

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

i) Relief is the general appearance of the landscape.

ii) Contours are lines drawn on a map joining places of the same altitude.

iii) A key intepretes all symbols used on a map.

c) Extended activities (for gifted and talented learners)

Draw a cross section using contours on a topographic map provided.

Answer: Guide learners on how to answer the above question using the learner's book by drawing a cross section of the area asked.

UNIT 2: INTERPRETATION OF PHOTOGRAPHS AND VIDEO IMAGES

2

1. Key Unit Competence:

The learner should be able to interpret photographs, video images and draw sketches by reduction or enlargement of the photographs.

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

This unit presents interpretation of photographs and video images on a wide scale. Learners are expected to describe types of photographs, interpretation of physical and human aspects, sections of a photograph, drawing sketches of photographs by enlargement or reduction and analyzing the relationship between physical and human aspects on photographs and video images.

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

3. Cross-cutting issues to be addressed

In this unit learners 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 learners relate **financial education** to the efforts being put in place to carry out different human activities for sustainable development.

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 relationship between physical and human features on a photograph?

5. List of lessons (including assessment).

	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	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 type 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	Drawing sketches of photographs by reduction and enlargement	-Draw a sketch of a photograph -Appreciate the use of photograph and sketches on the photograph	2
4	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.	1
5	Assessment		1

6. Guidance on different lessons outlined above

Lesson 1: Definition and types of photographs.

a) Prerequisites/ Revision /Introduction

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

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

b) Teaching resources:

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

- Text books
- Sample of photographs

c) Learning activities

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

Guide learners to work in pairs using photographs provided and content in the learner's 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book on the definition and types of photograph.

d) Application activities

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

Learners are asked to identify the type of photograph shown and explain the reasons for their answer. They will use the content given in the learner'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). Prerequisites/ Revision /Introduction

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

Afterwards, learners will observe the photograph provided in the learner's book and they will be able to suggest physical and human aspects shown on the photograph provided.

b). Teaching resources:

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

- Text books

- Sample of photographs

c) Learning activities:

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

Let learners work in groups by using the photographs provided and content in the learner'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.

Learners are asked to identify sections of a photograph. They will use the content given in the learner'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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

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

Learners are asked to analyse physical and human aspects on a photograph. They will use the content given in the learner'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: Drawing sketches of photographs by reduction and enlargement.

a) Prerequisites/ Revision /Introduction

Guide learners to review the previous work and help them to interpret human and physical aspects on a photograph.

Afterwards, learners will observe the photograph provided in the learner's book and they will be able to draw a sketch of the photograph provided.

b) Teaching resources

For learning objectives to be achieved the following resources should be used:

- Text books
- Pencils and manila papers

- Sample of photographs

c) Learning activities

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

Put learners in groups, facilitate them to draw a sketch of the photographs provided using the content in the learner's book and explain the steps followed in drawing it. Their answers should involve the integration of generic competences like critical thinking, cooperation, communication, creativity, drawing and problem-solving skills.

Facilitate learners in activities like discussion, drawing, asking and answering questions and for more answers they are referred to the learner's book about drawing a sketch of photograph.

d) Application activities

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

Learners are asked to draw a sketch of the photograph provided. They will use the content given in the learner's book on drawing a sketch of a photograph and other geographical documents to draw the sketch of a photograph asked.

Lesson 4: Relationship between physical and Human aspects on Photographs and Video Images

a) Prerequisites/ Revision /Introduction

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

b) Teaching resources:

- Text books
- Sample of photographs

c) Learning activities

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

In groups learners are given a photograph in the learner's book. Basing on a photograph provided using the content in the learner'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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book on the relationship between physical and human aspects on a photograph.

d) Application activities

Refer to the application activity 2.4 in the learner's book

Learners 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 learner'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.

7. 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, drawing sketch of photographs by reduction and enlargement plus the relationship between physical and human aspects on photographs and video images.

This unit intends to help learners to analyze different sections of a photograph and drawing their sketches which helps learners to develop a skill of sketch drawing. 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 help learners to internalize financial education as a cross cutting issue.

8. 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 learners to understand different measures of conserving the environment. Thereby integrating the cross cutting issue of environment and sustainability.

9. End unit assessment

Questions:

1. Explain the key guidelines followed in drawing a sketch of a photograph.

2. Study the photograph of umudugudu settlement provided in the learner's book and answers 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.

Guidance to answers questions

1) Explain the key guidelines followed in drawing a sketch of a photograph.

Help learners to explore the guidelines followed in drawing a sketch of a photograph and relate them to the content in the learner's book.

2) Study the photograph provided in the learner's book and answer the questions below:

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

Ask learners 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 learners in groups to discuss the appropriate ways of conserving the area shown in the background of the photograph.

10. Consolidation, Remedial and extended activities

a) Consolidation activities:

i) Distinguish between ground photograph and aerial photograph.

ii) Show how drainage influences settlement in your area.

Help learners on how to answer the above questions using learner'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 learners)

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 learners)

Describe steps followed in drawing a sketch of a photograph

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

UNIT 3 : THE ORIGIN AND DISTRIBUTION OF THE CONTINENTS

3

1. Key unit competence

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

2. Prerequisite (knowledge, Skills, attitudes and values)

Unit 4 of senior 5 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 senior 5 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 Senior 5 introduced the study of the internal dynamics of the earth globe and associated landforms to the learners. 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 senior 5 mentioned above sets a strong prerequisite for the learning of unit 3 of senior 6 entitled the "origin and distribution of continents". The introductory activity presented in the student's book intends to remind learners that the earth globe is dynamic with features which constantly change. This enables learners 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.

3. Addressing Cross-cutting issues

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.

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 learners to observe impacts of continental drift and plate tectonics. e.g. (Refer to additional content).

3.2 Inclusive education

The teacher will give catch up lessons on density, magnetism, seismic waves to learners who don't have a strong background in physics. This will help learners to better understand process of continental drift, plate tectonics and isostasy. Learning activities should be within the ability range of all learners, including those with learning difficulties or special needs. For instance, if teachers plan field trip, he will consider how learners 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).

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 teacher needs to highlight the importance of money saving to learners. People and the government should be responsible for the cost of preventing resulting consequences or adaptation and preparedness for disastrous and unexpected events.

4. Guidance on introductory activity

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

5. List of lessons

The table below highlights all the lessons that have been prepared in relation to the content of Unit 3, as well as the period allocated to each of them.

N°	Lesson title	Learning objectives (knowledge, skills, attitudes and values)	Number of Periods
1	Theories of the origin and distribution of the continents.	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	2
3	Effects of continental drift on the evolution of physical features	Show concern to the causes, the effects of the continental drift and the desire to understand the distribution of the continents and ocean basins.	1
4	Concept of Plate Tectonics	Justify the view that the continents really drift.	4

5	Major plates and effects of plate tectonics	State the major types of plate boundaries and tectonic plates Explain the effects of tectonics plate on the landscape Do research on the causes of the continental drift and the distribution of continents relative to one another. Evaluate the effects of plate tectonics	2
6	The theory of Isostasy	Outline the evidences of the continental drift Justify the view that the continents really drifted.	2
7	End of unit Assessment		1

6. Guidance on different lessons outlined above

Lesson 3. 1.: Concept origin and theory of the distribution of continents and oceanic basins

a). Prerequisite/Revision/Introduction

In this lesson 3.1, learners are introduced to the definition and different theories of continental drift. Display the Figure 3.1 in the learner's book. Thereafter learners 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,

b) Teaching resources

The teacher should have in possession the print outs of the introductory activity of Unit 3 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

c) Learning activities

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

Introductory Activity and Learning activity 3.1 in the learners' book have been provided as the basis for discussion on theories of continental drift. The first activity will consist about engaging learners to explore maps on figure 3.1 so that they can realize how continents drifted. The second intends to engage learners to find probable causes of the continental drift. Research using books and internet, and explain briefly theories related to continental drift. The teacher shall provide a handout of the Figure and guides learners 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 learner's book Unit 3 for more details.

d) Application activity

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

Two application activities have been prepared to enable not only the teacher to evaluate learners but also learners to assess themselves their level of achievement. The teacher should make sure that each learner is able to relate researchers and respective theories described in lesson 3.1. To make this possible, the teacher should task learners to make a clear summary of researchers and corresponding theories as the lesson goes on.

- Question 1 is about discussing the contribution of each researcher's finding described in this section to the confirmation of continental drift. Theories of (A) Alfred Wegener about continental drift, (B) Harry Hess's theory about Seafloor spreading, (C) Maurice Ewig's finding about the discovery of Mid-oceanic ridge, and (D) Frank Taylor's theory about Moon's tidal attraction are discussed. Refer to pages 4-8 for more details.

- Question 2 consists of explaining why Taylor's theory of Moon's tidal attraction has been rejected. One of reasons of the rejection is that researchers of his time doubted that the moon could ever exert enough force to pull the huge landmasses (continents) as they are known today. For more details refer to learner's book.

Lesson 3. 2.: Evidence of continental drift

a) Prerequisite/Revision/Introduction

Review the previous lesson by asking learners to briefly identify different theories of continental drift. Thereafter display a map showing evidences of similar life on different continents (Figure 3.26 in Learner's book) and asks learners to locate continents with identical fossils. In this lesson 3.2, students will discover how continents fit when they are brought together.

b) 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

c) Learning activities

Refer to the learning activity 3.2 in the learner's book

The teacher should provide a handout of figure 3.26 to learners and guide them to observe it in group and answer to activities of lesson 3.2 hereafter presented:

- Question 1: Describe the edges of the continents. For activity 1, the teacher makes sure that learners 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.

d) Application activity

Refer to the application activity 3.2 in the learner's book

Application activities are intended to enable the teacher to assess the level of achievement of the learners, 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 learners 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 teacher makes sure that learners can identify the similarity between animal and vegetation remains on today separated continents.

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

a) Prerequisite/Revision/Introduction

In lesson 3.3, students will learn about the effects of continental drift on the evolution of physical features. Learners must have covered the content of lesson 3.1 and lesson 3.2. The knowledge on proofs of continental drift acquired in lesson 3.2. constitutes an asset to better understand the resulting effects. The teacher shall then engage learners in revision of previous lesson, and will establish the link between today lesson and the previous lesson one.

b) 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

c) Learning activity

Refer to the learning activity 3.3 in the learner'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 learner's book). It is important to note that effects of continental drift have been highlighted with the development of lessons 3.1 and 3.2. (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.

d) Application activity

Refer to the application activity 3.3 in the learner'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 learner's responses:

- How Gondwanaland and Laurasia have been formed from Pangaea, how today's continent were formed from the Gondwana 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 3. 4.: Plate Tectonics

a) Prerequisite/Revision/Introduction

In senior five, learners studied about fault, fold, wrapping, earthquake and vulcanicity and related processes. Briefly recall these concepts and ask learners about causes and their effects. In lessons 3.1, 3.2, and 3.3 of senior six students learnt about the definition of continental drift, evidences and effects. The knowledge acquired will help learners to link the content studied with what is going to be learnt in relation to plate tectonics. Then ask learners to explore and study in group the figure 3.7 to identify the causes of plate tectonics.

b) 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

c) Learning activity

Refer to the learning activity 3.4 in the learner's book

One instructional activity is provided where the teacher asks learners to explore and study in groups the Figure on the learning activity 3.4 and to answer questions (answers are given in brackets in front of questions):

1. Identify the types of crust found on the map (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 moving plates above)

d) Application activity

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

Three questions were provided for instructional activities. Refer to the learner's book for possible detailed answers, and addition information for question four.

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 3. 5. : Major plates and effects of plate tectonics

a) Prerequisite/Revision/Introduction

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

b) 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

c) Learning activity

Refer to the learning activity 3.5 in the learner's book

Two questions constitute the learning activity 3.5. Learners 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 figure related to the effects of plate tectoniccs must be provided, or learner's book availed to enable students successfully to fulfill the task. The task is performed in groups. The teacher refers students to learner's book to find related contents.

The teacher recommends learners to find complete answers in learner'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.

d) Application activity

Refer to the application activity 3.5 in the learner's book

Four application questions have been prepared to enable not only the teacher to evaluate learners but also learners to 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 figure 3.39 in earner'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.

Lesson 3.6: The theory of isostasy

a) Prerequisite/Revision/Introduction

Briefly review the previous lessons on plate movements. In few words, introduce the ideal theoretical balance of all large portions of Earth's lithosphere as though they were floating on the denser underlying layer, the asthenosphere. The point to note here is to differentiate plate tectonics which deals more with lateral movements of plates from isostasy which emphasizes on vertical movements of plates.

b) Teaching resources

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

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

c) Learning activities

Refer to the learning activity 3.6 in the learner's book

The teacher guides learners to read the content on isostasy in learner's book and to explain the concept.

Isostasy is principle describing the flotation of the lithosphere, which is less dense, on the plastic asthenosphere which is denser. The concept is concerned with vertical movements of plates which depend on lithospheric masses, and discharge or overloading consecutive to erosion/melting of ices or accumulation sediments or ice.

d) Application activity

Refer to the application activity 3.6 in the learner's book

One question was provided for instructional activity. Refer to the learner's book for more detailed answer.

Referring to Airy's theory, the principle of isostasy can be briefly explained as follows:

According to Airy, the rock density across the lithosphere is approximately the same, but the crustal blocks have different thicknesses. Therefore, mountains that shoot up higher also extend deeper roots into the denser material beneath. 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. In opposition to plate tectonics principle which deals with the lateral movement of plates, isostasy studies the vertical movement of plates.

7. Summary of the Unit

The Unit three 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.

8. 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 no 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 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

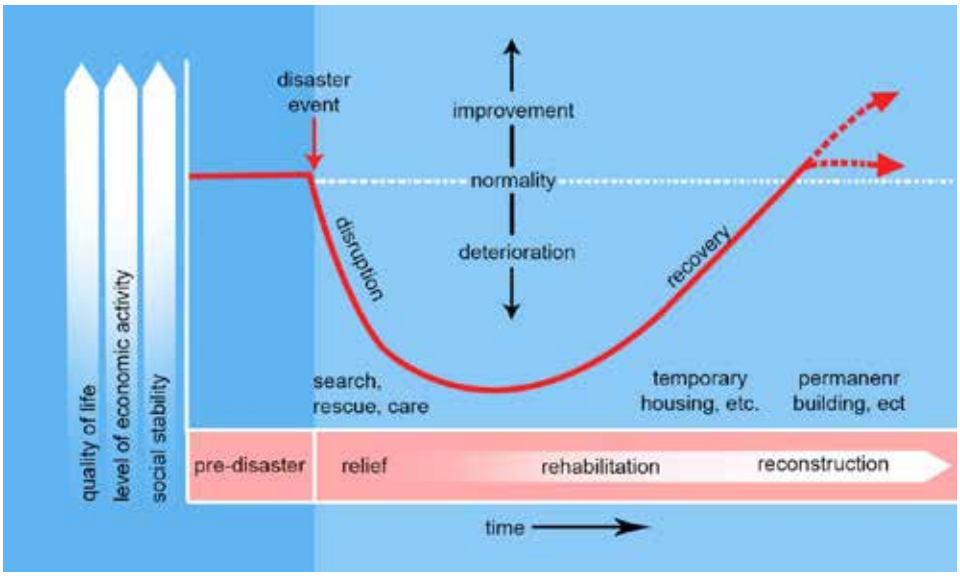
Many earthquakes occurred and have caused many deaths and properties damages. The table below summarizes some of deaths caused by earthquakes in various regions of the world.

Table. Summary of some deaths caused by earthquake

Year	Location	Richter value	Dearths
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	240,000
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

The scenario of life before and after a natural hazard can be hypothetical represented on the figure below as follows:



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.

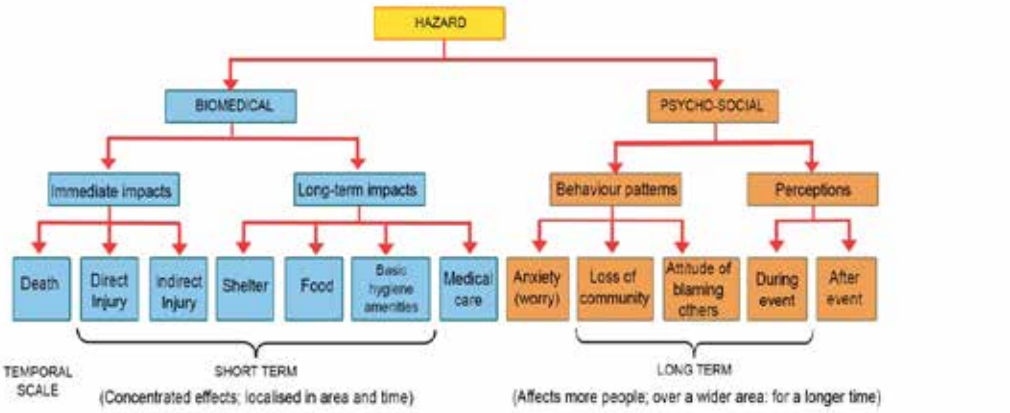
1. What are people's perception of the natural hazard?

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:



Types of responses

How is Rwanda organized to respond to natural disasters?

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 15 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.

9. End unit assessment

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

Contribution Wegener' theory of continental drift

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.

Other researchers' contribution provided more evidences to confirm Wegener's theory of continental drift:

Harry Hess: The Sea-Floor Spreading theory

The seafloor spreading occurs along mid-ocean-ridge; when the tectonic plates slowly move away from each other and hot magma from the mantle comes up to the surface. This magma reaches the surface along the Mid-oceanic ridges and flows away from them, cooling and hardening to form the rigid lithosphere. New lava emerging from the ridges attaches itself to the near of the solidified older lava plates and forces them to move laterally.

John Tuzo-Wilson: The plate tectonics theory

This theory suggests that earth's crust and upper mantle (lithosphere) are broken into sections, called plates that slowly move around over hotspots in the mantle. There is formation of new oceanic spaces and destruction of continental margins. This dynamic involves a "recycling" process, which carries off older sediment and fossils.

Frank Taylor: Moon's tidal attraction

According to this theory, the Moon came very close to the Earth during the cretaceous period. This closeness of the Moon to the Earth exerted powerful tidal attraction, which pulled the landmasses from their polar position towards the Equator. Where there was resistance to the outward spread of landmasses, the crust usually would fold, raising mountain ranges in front, while resulting in stretches (troughs and basins).

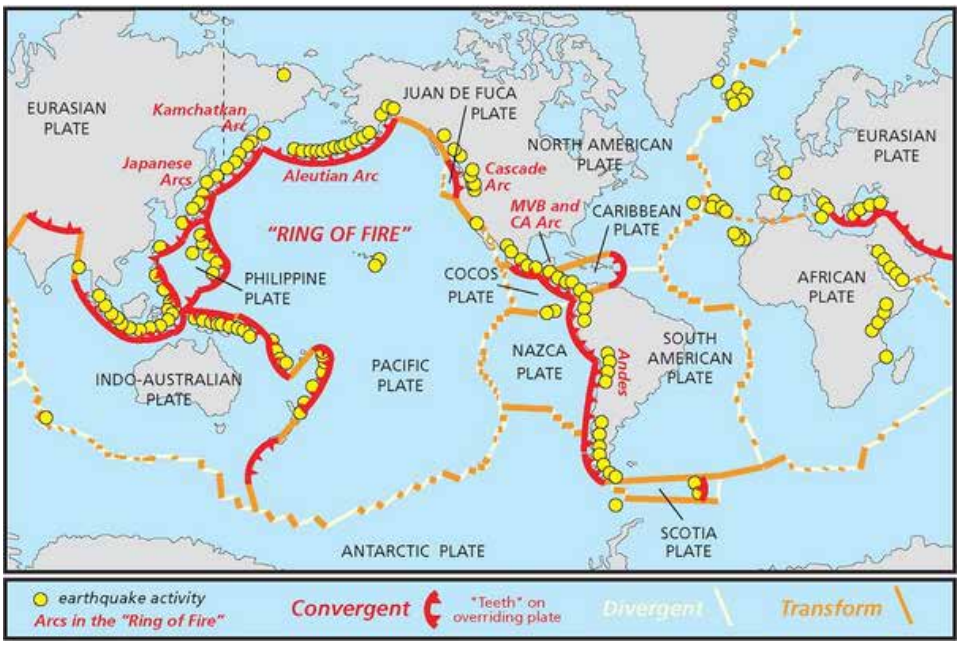
The theory was rejected because researchers of his time doubted that the moon could ever exert enough force to pull the huge landmasses (continents) as they are known today.

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 toward 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 it location in the western rift valley.

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

Learners 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.

10. Additional activities

a) Remedial activities

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

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

ii) Give 2 effects of plate tectonics.

- Earthquake; Volcanic eruption; Tsunami.

b) Consolidation activities

Hazards related to plate tectonics that occur in Rwanda and their consequences

Earthquakes that occur in the western rift valley of Africa is one impact of earthquakes in Rwanda.

Our country, Rwanda, is in the western rift valley of Africa, 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.

Explain how they can be mitigated or how humans can cope with them?

Rwandan geographers need to ask themselves the following questions studying either the risk of a potential natural hazard or a specific hazard event such as earthquake of volcanic activity:

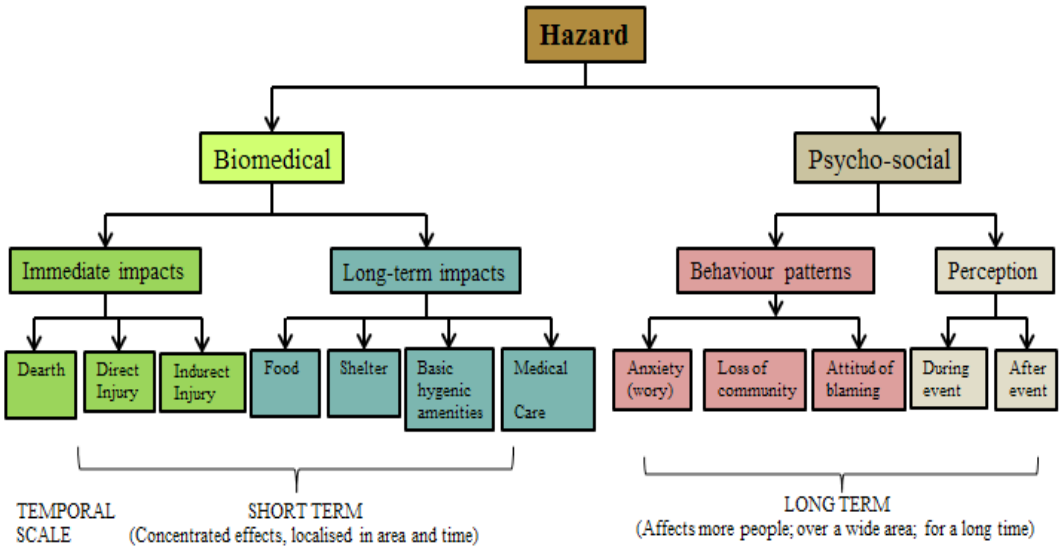
1- What are people's perception of the natural hazard?

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 to these questions are summarized in figure below:



Types of responses

How is Rwanda organized to respond to natural disasters?

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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 15 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.

c) 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.

UNIT 4 : EXTERNAL LANDFORM PROCESSES AND RELATED FEATURES

4

1. Key unit competence:

The learner should be able to demonstrate an understanding of different features resulting from external processes and their relationships with human activities.

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

Unit 3 of senior 4 introduced the study of exogenetic processes in Rwanda. They studied weathering and the resultant features in Rwanda; they also learnt erosion and deposition, effects of weathering and erosion on the relief features of Rwanda.

In the learner's book there is an introductory activity; it is intended to explain the phenomena that happened on the rock (i.e weathering), types and processes of weathering, factors influencing weathering, weathering in limestone, tropical, arid and glaciated cold regions, features resulting from weathering, types, causes, effects and measures to control mass wasting will be the centre of focus in this unit. This will help learners to understand appropriate measures to be taken in conserving the environment. Therefore, a teacher emphasizes the cross cutting issue of environment and sustainability.

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, glaciation and mass wasting, the learners should know how to protect their environment.

Financial education is another cross-cutting issue that is linked to the study of weathering, and glaciation. 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.

4. Guidance on introductory activity

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

a) Explain what happened to the rock shown in the photograph on page... in learner's book.

b) Evaluate the causes and effects of mass wasting.

c) Using your local environment describe the measures to control mass wasting

d) Analyze the importance of various landforms resulting from glaciation.

5. List of lessons (including assessment).

	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	Number of periods
1	Weathering:- Definition -Types and processes of weathering	-Identify and explain different types of weathering -Explain the external processes of weathering	3
2	-Factors influencing weathering -Interdependence of the chemical and physical weathering	-State and describe the major factors influencing weathering - Evaluate the relationship between physical and chemical weathering in different regions.	2
3	Weathering in limestone regions.	-Identify and explain the major features resulting from weathering in karst regions	4
4	Weathering in humid tropical and desert region	-Explain the features resulting from weathering in humid tropical and the desert regions	5
5	Weathering in the glaciated cold regions	-Identify and explain types of glacier and types of glacial flow.	4
6	Factors for the formation and movement of glaciers	Explain the factors influencing glacier formation and movement	3

7	-The work of glacier -Landforms resulting from glaciations	-Develop a curiosity to understand the role of glaciers and the interactive processes in the formation of landforms	4
8	Impact of the glaciation on the landscape and to the human activities	-Appreciate the importance of glaciers landform on landscape and on human activities.	3
9	Mass wasting: definition and types.	Identify and explain different types of mass wasting in different areas	3
10	Causes, effects and measures to control mass wasting	Show concern for the causes and the effects of mass wasting.	2
11	The relationship between weathering landforms and human activities	Explain the relationship between weathering landforms and human activities.	2
12	Assessment		1

6. Guidance on different lessons outlined above

Lesson 1: Weathering: Definition, Types and processes of weathering

a) Prerequisites/ Revision /Introduction

This topic on weathering was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners learnt weathering in Rwanda.

Facilitate the learners to review the senior 4 contents by asking them to explain the resultant landforms of weathering in Rwanda. After this review, using the photograph provided (Photograph of a devastated area) in the learner's book. Learners will be able to explain types and processes of weathering.

b)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

c) Learning activities

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

Help learners to work in groups, they will be guided to make research on the processes of weathering. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activity 4.1 in the learner's book

Learners are asked to use local environment to identify evidences of biological weathering. They will use the content given in the learner's book on types and processes of weathering and internet.

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

a) Prerequisites/ Revision /Introduction

Display the illustration in the learner's book showing factors influencing weathering. Then ask learners to identify and explain the factor that is not indicated on the illustration. Then put learners in groups and guide them to make research on interdependence of physical and chemical weathering.

b) Teaching resources:

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

- Text books
- Illustration
- Internet

c) Learning activities

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

Guide learners 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

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

Learners are asked to make a field study around the school and explain how relief and nature of the rock have influenced the rate of weathering. They will use the content given in the learner's book on factors influencing weathering.

Lesson 3: Weathering in Limestone regions

a) Prerequisites/ Revision /Introduction.

Learners are asked to explain landforms associated with weathering in limestone regions. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Illustrations.
- Internet

c) Learning activities

Refer to the learning activity 4.3 in the learner's book

In groups, learners are given illustrations from the learner's book on caverns, doline, uvala, Pillars, etc. showing landforms associated with weathering in limestone regions. Guide them to make research on the features that are not indicated in the learner's book. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activity

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

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

Lesson 4: Weathering in Humid tropical regions and Arid regions

a) Prerequisites/ Revision /Introduction.

Learners are asked to describe characteristics of desert regions. Briefly talk about characteristics of humid tropical regions, supplement the answers given by learners and introduce the content related to landforms resulting from weathering in arid regions.

b) Teaching resources:

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

c) Learning activities

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

Put learners in groups; guide them in discussing the characteristics of arid and humid regions. After wards refer them to the learner's book for discussion of the landforms associated with weathering in arid regions. 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

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

Learners are asked to explain features associated with weathering in arid regions. They will use the content given in the learner's book on weathering landforms in arid regions and geographical documents to explain features associated with weathering in arid regions.

Lesson 5: Weathering in glaciated cold regions.

a) Prerequisites/ Revision /Introduction.

Review the previous lesson and ask learners to distinguish between two mountains given in the learner's book and differentiate between valley and continental glaciers.

b) Teaching resources:

- Text books
- Illustrations.
- Internet
- Geographical documents

c) Learning activities

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

In groups, learners are given illustrations from the learner's book on mountainous landscape, showing landforms associated with weathering in glaciated cold regions. Guide them to explore the answers through discussion. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book on weathering in glaciated cold regions.

d) Application activities

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

Learners are asked to give clear differences between types of glaciers and glacier flow. They will use the content given in the learner's book on types of glaciers and glacier flow and internet to describe types of glaciers and glaciers flow.

Lesson 6: Factors for the formation and movement of glaciers

a) Prerequisites/ Revision /Introduction.

Briefly review the previous work and ask learners to explain why glaciation is common in high altitude regions, ask learners to identify factors influencing glacier formation and movement. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents.

c) Learning activities

Refer to the learning activity 4.6 in the learner's book

Facilitate learners in groups to explain why glaciation is dominant in high altitude regions and guide them to make class presentation on the factors discussed. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book about factors for formation and movement of glaciers.

d) Application activities

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

Learners are asked to explain other factors for glacier formation and movement. Under the guidance of the facilitator, they will use the content given in the learner's book about formation and movement of glaciers and internet to explain the factors influencing glacier formation and movement.

Lesson 7: The work of glaciers and resultant landforms

a) Prerequisites/ Revision /Introduction

Help learners to review the past work and ask them to distinguish between ice and glacier.

Guide them to explore the content in the learner's book related to glacial erosional and depositional features. Supplement the learners' answers and let them to present their answers in class.

b) Teaching resources:

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

- Text books
- Illustration
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activity 4.7 in the learner's book

Guide learners to work in pairs, they will be able to identify and differentiate between ice and glacier. They should use the content provided in the learner's book on types of glacier.

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

Engage learners in activities like discussion, asking and answering questions.

d) Application activities

Refer to the application activity 4.7 in the learner's book

Learners are asked to account for the limited coverage of glaciation in East Africa. They will use the content given in the learner's book about glacial erosional and depositional features and other geographical documents to account for the limited coverage of glaciation in East Africa.

Lesson 8: Impact of glaciation on the landscape and to human activities

a) Prerequisites/ Revision /Introduction

Facilitate learners to use the past experience and identify human activities carried out in mountain regions. They should brainstorm on the impact of glaciation both positive and negative.

b) Teaching resources:

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

- Text books
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activity 4.8 in the learner's book

Guide learners to work in pairs, they will be able to identify and describe the positive and negative impacts of glaciation to man. They should use the content provided in the learner's book about the impact of glaciation on the landscape and human activities.

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

Engage learners in activities like discussion, asking and answering questions.

d) Application activities

Refer to the application activity 4.8 in the learner's book

Guide learners to identify and describe other negative impacts of glaciation on human activities. They will use the content given in the learner's book on the impact of glaciation on human activities and internet to describe the negative impacts of glaciation to man.

Lesson 9: Mass Wasting: Definition and types

a) Prerequisites/ Revision /Introduction

Display the illustration in the learner's book showing mass wasting. Then ask learners to identify and explain the phenomenon that is indicated on the illustration. Then put learners in groups and guide them to make research on the types of mass wasting.

b) Teaching resources:

- Text books
- Illustration
- Internet
- Other geographical documents

c)Learning activities:

Refer to the learning activity 4.9 in the learner's book

Guide learners to work in pairs, they will be able to identify and describe the phenomena indicated on the illustration. Then help them to research on the types of mass wasting. They should use the content in the learner's book on mass wasting. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions.

d) Application activities

Refer to the application activity 4.9 in the learner's book

Learners are asked to analyse the types of mass wasting common in hilly areas of Rwanda . They will use the content given in the learner's book on the types of mass wasting and they will also use other geographical documents to analyse the types of mass wasting that are common in hilly areas of Rwanda.

Lesson 10: Causes, effects and measures to control mass wasting

a) Prerequisites/ Revision /Introduction

Display the illustration in the learner's book showing mass wasting. Then ask learners to identify and explain the phenomena that is indicated on the illustration. Then put learners in groups and guide them to make research on the causes, effects and control measures of mass wasting.

b) Teaching resources:

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

- Text books
- Illustration
- Internet
- Other geographical documents

c) Learning activities:

Refer to the learning activity 4.10 in the learner's book

In groups, help learners to identify and describe the phenomena indicated on the illustration. After, help them to research on the causes, effects and measures to control mass wasting. They should use the content in the learner's book on the causes, effects and measures to control mass wasting. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Let learners make discussion and they present their findings in class.

d) Application activities

Refer to the application activity 4.10 in the learner's book

Learners are asked to analyse the causes of mass wasting and propose sustainable solutions to control it. They will use the content given in the learner's book on the causes, effects and measures of mass wasting and geographical document to analyse the causes and effects of mass wasting that are common in hilly areas of Rwanda and to suggest solutions for sustainable development.

Lesson 11: Relationship between weathering landforms and human activities

a) Prerequisites/ Revision /Introduction

Review the previous work and ask learners if the landforms resulting from weathering are important in their area. Allow them to brainstorm and supplement their views.

b) Teaching resources:

- Text books
- Illustration
- Other geographical documents

c) Learning activities:

Refer to the learning activity 4.11 in the learner's book

Facilitate learners to work in groups and research on the importance of weathering landforms to man. They should use the content in the learner's book on the relationship between weathering landforms and human activities. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Let learners make an open discussion and present their views in class.

d) Application activities

Refer to the application activity 4.11 in the learner's book

Learners are asked to describe how weathering landforms have benefited people. They will use the content in the learner's book on the relationship between weathering landforms and human activities.

7. Summary of the unit

This unit covers types and processes of weathering, factors influencing weathering, interdependence between chemical and physical weathering, weathering in limestone, humid tropical, arid and glaciated cold regions, landforms resulting from glaciation (erosional and depositional), types, causes, effects and measure to control mass wasting. It also analyzes the relationship between weathering landforms and human activities.

This unit intends to help learners to explain various landforms formed as a result of external processes and analyze their importance in relation to human activities. This helps the learners 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.

8. Additional Information

This unit is linked to unit 3 in senior 4 on the formation of relief features in Rwanda. It is vital for learners to link the prior knowledge acquired in senior 4 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 and glaciation.

The learner's book has 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.

9. End unit assessment

Questions

1. Explain how community work (umuganda) has helped in reducing mass wasting in your area.

2.With reference to East Africa explain the formation of glacial upland landforms

3.Show how topography and parent rock have influenced the rate of weathering in your area.

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

Guidance to answers

1.**Explain how community work (umuganda) has helped in reducing mass wasting in your area.**

Facilitate learners in groups to share the answers by using experience in their community; they brainstorm on the role of umuganda in reducing mass wasting.

2. With reference to East Africa explain the formation of glacial upland landforms.

Guide learners to explain the formation of erosional features. Their answers must have clear illustrations.

3. Show how topography and parent rock have influenced weathering in your area.

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

4.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 learners 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.

10. Additional activities

a) Consolidation activities:

i) Discuss the processes of chemical weathering.

ii) Evaluate the causes of mass wasting.

Guide learners how to answer the above questions using learner'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 learners)

i) Define weathering

ii) Outline five factors that influence weathering

iii) Explain the meaning of the term glaciation or glacial activity.

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.

iii) The term glaciation or gracial activity means the process of movement of ice usually from mountain tops down hilly which results into erosional and depositional glacial landforms.

c) Extended activities (for gifted and talented learners)

Account for the limited coverage of glaciation in East Africa.

Answer: Let learners make research on the factors limiting glacial activity in East Africa. There after learners make class presentation of their findings.

UNIT 5: WAVE EROSION AND DEPOSITION

5

1. Key unit competence

The learners should be able to categorize different landforms resulting from wave action and their relationships with human activities.

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

Unit 8 of senior 4 introduced the study of drainage system in Rwanda. Learners 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 leaners studied the drainage system of Rwanda and explain its relationships with human activities. Furthermore, unit 3 of senior 6; dealt with the origin and distribution of the continents, where the lesson 3.6 was dedicated to the theory of Isostasy. The above mentioned lessons learnt previously by learners will constitute an asset for learners to understand the Isostatic and Eustatic changes on the coast.

In the learner's book there is an introductory activity; it is intended to describe the types of water bodies, identify the coastal landforms, explain the factors of the formation of the coastal land forms, justify the water sea level, and describe the importance of coastal areas to humans. It is in this regard; a teacher emphasizes the cross cutting issue of environment and sustainability.

3. Cross-cutting issues to be addressed

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

a)Environmental conservation 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 environmental conservation and sustainability will be integrated by helping students to identify the causes and effects of wave on the coast; in this lesson, ask learners 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 from 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 teacher 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 learners with different learning styles and other difficulties. Every learner 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 learner 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 learner's book on extended activity.

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 the types of water bodies.

b) Briefly, explain the formation of coastal landforms.

c) Explain the factors for the formation of coastal landforms.

d) Explain the causes of sea level change.

e) What are the economic activities that can be done at the coast of any water body?

5. List of lessons (including assessment)

#	Lesson title	Learning objectives (knowledge, skills, attitudes and values)	Number of Periods
1	Coastal landforms Definition of key terms: coast, shore, waves, long shore drift	Name the major features associated with wave erosion and depositional processes	1
2	Types, factors and action processes of waves Types of waves (plunging waves, spilling waves) Factors determining the strength of waves/energy of waves) Wave action processes (erosion, transportation and deposition)	Show continental desire to understand different types of coasts Identify the types of coasts Explain the process of wave erosion and deposition	4
3	Formation of coastal landforms Factors influencing the formation of coastal landforms Landforms produced by wave erosion Landforms produced by wave deposition	Recognize the different landforms resulting from wave erosion and depositional processes. Identify the factors influencing formation of coastal landforms. Name the major features associated with wave erosion and depositional processes.	7

4	Importance of coast landforms produced by wave action	State the importance of coast landforms produced by wave action. Appreciate the importance of different landforms produced by wave erosion and deposition.	1
5	Types of coasts: Submerged upland coast Submerged lowland coast Emerged coasts	Relate the types of coasts and how they influence human activities.	1

6	Coral reefs Nature, types, formation of coral reefs. A. Types of coral reefs B. Formation of coral reefs Theories of the origin of coral reefs: The subsidence theory Antecedence theory Glaciated control theory Impact and problems related to coral reefs. Positive and negative impact of coral reefs Activities and problems associated with development and growth of coral reefs	Identify the major types of coral reefs.	4
7	Isostatic and Eustatic changes on the coast Isostatic changes Eustatic changes	Differentiate between isostatic and eustatic changes on sea level and resultant features.	1

8	Sea level change: Meaning of sea level change and its resulting features Types of sea level changes Causes of sea level change Evidences of sea level changes Effects of the sea level changes	Differentiate between isostatic and eustatic changes on sea level and resultant features	4
10	End unit assessment		1

6. Guidance on different lessons outlined above

Lesson1: Coastal landform: Definition of key terms

a) Prerequisites/ Revision /Introduction

Find internet explorer and other geographical material 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, learners will use the materials in place to find the meaning of terms related to coast and describe the parts of wave.

b) 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

c)Learning activities

Refer to the learning activity 5.1 in the learner's book

You need to guide learners on how they can use internet and other geographical resources to search the meaning of the terms related to the coast.

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

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

Guidance to answer learning activities

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

d)Application activity

Refer to the application activity 5.1 in the learner's book

Learners are asked to give the meaning of coast, wave, shore and longshore drift and describe the parts of waves.

Guidance to answer application activities

Learners are asked to demonstrate the parts of wave using diagrams, to differentiate the shore from long shore drift and to identify the coastal features. They will use the content given in the learner's book on definitions of key terms and other geographical documents to define the key terms related to the coast and to identify parts of the wave.

Lesson 2: Types, factors and action processes of waves

a) Prerequisites/ Revision /Introduction

Learners are asked to give the meaning of different terms related to coastal landforms and identify the parts of waves. They will use the content given in the learner's book to define the key terms related to the coastal landform.

b) 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

c) Learning activities

Refer to the learning activity 5.2 in the learner's book

Guide learners to work in groups to search on the types of waves, factors and wave processes using internet, other geographical resources and content acquired in senior 4 on drainage of Rwanda. They will be able to describe the types of waves and explain the factors determining the strength of waves. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

Guidance to answer the learning activities

They will use the content given in the learner's book on types, factors and processes of wave action.

d) Application activity

Refer to the application activity 5.2 in the learner's book

Learners are asked to describe the types of waves, explain the different ways the waves hit the coast and explain the three ways of wave action processes.

Guidance to answer application activities

Learners are asked to identify the wave action processes and differentiate Tsunami from other types of waves. They will use the content given in the learner's book and other geographical documents to show the types, factors and action processes of waves.

Lesson 3: Formation of coastal landforms

a) Prerequisites/ 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 students you may clarify some hidden or confused situations.

Next, you must announce the topic of the lesson which is types, factors and action processes of waves.

b) 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

c) Learning activities

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

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

Guidance to answers to the learning activities

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

d) Application activity

Refer to the application activity 5.3 in the learner's book

Learners 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 describe the formation of features produced by wave erosion.

Guidance to answer application activities

They will use the content given in the learner'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

a) Prerequisites/ Revision /Introduction

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

b) 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

c) Learning activities

Refer to the learning activity 5.4 in the learner's book

The teacher should provide a photo to learners 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 learners 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 learners 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, restaurant 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 synthetize and conclude whether the reason is reliable.

Guidance to answer learning activities

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

d) Application activity

Refer to the application activity 5.4 in the learner's book

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

Guidance to answer application activities

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. The teacher will make sure that learners are able to identify all these cities by applying the experience learnt on coast and answering the question appropriately.

Question 2 is concerned with the economic activities that can be done along the shore of Lake Kivu. It is in this regard that students must relate what they have learnt on the importance of the coast and apply them to our major lake shores in Rwanda such as on Lake Kivu. The teacher makes sure that learners can describe all economic activities that can be carried out on the shores of Lake Kivu.

Lesson 5: Types of coasts

a) Prerequisites/ Revision /Introduction

Guide learners to revise the previous lesson by asking the questions related to the importance of coast to the people living nearby or other those who wish to carry out other economic activities related to the coastal landforms.

After the revision, the teacher will help students to search different types of coasts using internet and other geographical resources.

b) 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 of costs
- Internet

- Tactile materials
- Manila and flip chart papers

c) Learning activities

Refer to the learning activity 5.5 in the learner's book

Guide learners to work in groups according to their number in class in not more than eight students. Using internet, geographical resources and content in the learner's book, learners will be able to identify the types of coast and to find the areas likely to be attacked by fiords. The learners' answers should involve the integration of generic competences like critical thinking, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions

Guidance to answer learning activities:

For more answers they are referred to the learner's book on the types of coast.

d) Application activity

Refer to the learning activity 5.5 in the learner's book

Learners are asked to describe the different types of emerged coast. The teacher may also plan a field trip to the shores of lakes to identify the submerged shore in Rwanda.

Guidance to answer application activities:

They will use the content given in the learner's book on the types of coasts and other geographical documents to distinguish between different types of submerged coasts.

Lesson 6: Coral reefs

a) Prerequisites/ Revision /Introduction

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

b) 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 document
- Manila paper and flip charts
- Tactile materials
- Print outs for activities

c) Learning activities

Refer to the learning activity 5.6 in the learner'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 answers through discussions. Their answers should involve the integration of generic such as communication, critical thinking, cooperation, research and problem-solving skills.

For more answers on the activities, learners will refer to the learner's book on coral reefs

d) Application activity

Refer to the application activity 5.6 in the learner's book

Learners are asked to give clear illustrations of different types of coral reefs, explain the conditions for coral reef formation, identify the problems related to the coral reef, establish the relationship between the coral reefs' theories and describe the economic importance of coral reefs.

Guidance to answers for application activities:

Learners will use the content given in the learner's book on types of coral reefs.

Lesson 7: Isostatic and Eustatic changes on the coast

a) Prerequisites/ Revision /Introduction

Briefly review the previous tasks and ask learners to explain why coral reefs are important to the people living in the region where they are located. Remind them the key theories of coral reefs formation. Briefly clarify the answers given by learners relying on the objectives of the lesson.

b) 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 document
- Manila paper and flip charts
- Tactile materials
- Print outs for activities

c) Learning activities

Refer to the learning activity 5.7 in the learner's book

Guidance to answer learning activities

Facilitate learners in groups to answer the first question using the content in learners' book on isostasy and eustatic changes on the coast. Let them differentiate the isostatic from eustatic sea level change. The learners' answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage learners in activities like discussion, asking and answering questions.

For more answers they are referred to the learner's book about the isostatic and eustatic change.

d) Application activity

Refer to the application activity 5.7 in the learner's book

Learners are asked to describe the phenomena of isostatic and eustatic on the coast and the effects of isostatic and eustatic changes on the coast.

Guidance to answer application activities

Under the guidance of the teacher, learners will use the content given in the learner's book about the Isostatic and Eustatic changes on the coast.

Lesson 8: Sea level change

a) Prerequisites/ Revision /Introduction

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

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

b) 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 document
- Manila paper and flip charts
- Tactile materials
- Print outs for activities

b) Learning activities

Refer to the learning activity 5.8 in the learner's book

Guidance to answer learning activities

Form groups to observe photograph for better discussion. Let learners refer to the learner's book and answer the questions on the photographs. The learners 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 learner's book on the sea level change. Engage learners in activities like discussion, asking and answering questions.

The learners' 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 learner's book on sea level changes.

d) Application activity

Refer to the application activity 5.8 in the learner's book

Guidance to answer application activities

Guide learners for discussion to come up with good features (question 4). Guide the students to explain the effects of sea level change (question 5)

7. Summary of the unit

The unit 5 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, 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 learners 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 learners to internalize financial education as a cross cutting issue and know how man has utilized the available landforms for sustainable development. All this create a great understanding about environment hence application and integration of environment and sustainability as a cross-cutting issue.

8. Additional information

This unit is linked to unit 8 in senior 4 on the drainage system of Rwanda. It is vital for learners to link the prior knowledge acquired in senior 4 to 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 learner'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 learner'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.

9. End unit assessment

Questions

1) Describe the major features resulting from wave erosion and depositional processes.

2) Observe the photographs given in learner'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 isostatic and Eustatic changes on the environment.

4) Although Rwanda is a landlocked country, it has many lakes which may change their water levels. Describe the effects of water level changes on human activities in these lakes.

Guidance to answers

1. This question requires to describe briefly the features resulting from wave erosion and wave deposition. Guide learners to discuss again these features in groups. Remember to form groups that are heterogeneous to share and exploit different opportunities. This question may be answered referring to the content provided in learner's book 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 photography interpretation before they embark on the activities. (Look for topic learnt in the first term for photography interpretation).

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

i. That was for examining the economic activities that could be carried out at the coast and the following are some examples:

- 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 learners to discuss the advantages of the coast or shores to people living nearby Lake Kivu. 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.

Some disadvantages of coastal landforms are the following:

- Coastal defence becomes harder because of the vast coastline.
- Some people may drown into the coast lakes.
- There is an increased chance that oil spills may occur causing accidents.
- Bigger risk of dangerous aquatic animals that may harm the people living nearby.

Note that the above list is not exhaustive.

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 learner's book on effect of sea level changes.

Guide learners 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.

10. Additional activities

a) Remedial activities

i) Give two major types of waves

Answer:

- Constructive waves
- Destructive waves

ii) Enumerate any two features resulting from wave deposition.

Answer

- Tombolo
- Spits

b) Consolidation activities

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

ii) Discuss the features resulting from wave deposition likely to form in any lakes of Rwanda.

Guidance to answers

i) 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.

- Oceans tie the measured acceleration of sea level rise in this area to a simultaneous slowdown in the flow of the Gulf Stream. Even without faster-than-average sea level rise, America's East Coast would be at high risk. On average, scientists have projected that the oceans should rise by about 3 feet by 2100, inundating low-lying land, contaminating water supplies and undermining roads, airports, port facilities and power plants.

- Storms, hurricanes and other severe weather, and the danger gets even worse. A worldwide average of 8 inches of sea level rise since 1900 has already put millions of Americans at risk; 3 feet more will greatly multiply that risk; and the even higher levels that Americans could see will be a very bitter icing on top of that already unpleasant block.

- 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.

- The water along the Atlantic coast of the U.S. begins to rise at an accelerating rate. While scientists expect sea level to rise by about 3 feet over the next 90 years or so, in places like New York City and Norfolk, it could be significantly more. New York, where sea level is already a foot higher than it was in 1900, was just reminded of what happens when higher seas are pushed.

ii) Discuss the features resulting from wave deposition likely to form in any lakes of Rwanda.

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

c) Extended activities

Compare isostasy theory for continental driftand isostatic change on the coast.

Guidance to 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.

UNIT 6: ROCKS AND MINERALS

6

1. Key unit competence

By the end of this unit, learners will be able to assess the economic importance of rocks and minerals.

2. Prerequisite (knowledge, Skills, attitudes and values)

Unit 4 of senior 4 presented the different types of rocks and minerals of Rwanda, and explained their physical and chemical properties. Unit 5 of senior 5 described the internal structure of the Earth globe and the corresponding chemical composition. Unit 6 of Senior 5 introduced the study of the internal dynamics of the earth globe and associated landforms to the learners. Terms such as fault, fold, earthquake and volcano are defined, and processes leading to their formation and distribution are explained.

The knowledge acquired from units of senior 4 and 5 mentioned above sets a strong prerequisite for the learning of Unit 6 of Senior 6 entitled the "Rocks and minerals". The introductory activity presented in the student's book intends to remind learners the importance of rocks and minerals to the economic welfare of the society. This to be possible, rocks and minerals are classified according to their composition and their physical and chemical properties are presented. Characteristics shared by all minerals are presented but also distinctive characteristics that make a mineral a gem or conditions needed for rocks and minerals to be classified as more valuable are highlighted.

3. Addressing Cross-cutting issues

a) Environment and sustainability

Unit 6 is about rocks and minerals, with a key competence of assessing their economic importance. Rocks and minerals are extracted from the earth crust and are used for the economic welfare of the society. Construction of houses and other sustainable infrastructures require manufacturing of utensils and other useful products require materials from the earth such as rocks and minerals.

Many ores and minerals are obtained from open-pit mines. When the ore is mined it contains unwanted material along with the valuable mineral. The waste rock and material must be removed for them to be accessed. Extracting rocks or removing the waste rock to access ores can be expensive, and in some cases harmful to people and environment. Also earths and rocks waste may pollute stream water, water bodies and soils. This may require much efforts for their cleaning up for further consumptions and uses. The effects may be as well long-term as immediate and can affect marine lives.

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

b) Inclusive education

The teacher will give catch up lessons on mineral (inorganic) chemistry to enable learners to understand the properties of rocks and minerals, differentiate between metallic and non-metallic minerals. Also, this Unit requires samples during class sessions and a field trip for learners to observe different types of rocks and minerals. Learning activities should be within the ability range of all learners, including those with learning difficulties or special needs. For instance, if teachers plan field trip, he will consider how learners will access the area to be visited; otherwise he will think about rock or mineral samples, DVDs, work group and discussions for learners who cannot access the field study area due to their physical impairment.

c) Financial education

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

4. Guidance on introductory activity

The key inquiries in this Unit that will be the guide to the introductory activity are that learners in addition to understand and describe different rocks and minerals and their distinct characteristics, they should be able to explain their economic importance. For this, learners should be able to explain the types of rocks and minerals and their chemical and physical properties, which in turn determine their varied economic importance.

5. List of lessons

The lessons that have been prepared in relation to the content of Unit 6, as well as the period allocated to each of them are summarized in the table below.

N°	Lesson title	Learning objectives (knowledge, skills, attitudes and values)	Number of Periods
1	Rocks: Definition, types and characteristics	Identify and classify various types of rocks in the world and their characteristics, Show concern for various types of rocks and their characteristics	3
2	Rock composition and properties:	Identify and explain different components of rocks	2
	Chemical and Physical properties of rocks	State the economic importance of rocks. Evaluate the economic importance of rocks.	2
3.	Impact of rocks: advantages and disadvantages on the landscape and the society	Identify various types of minerals in the world. Apply knowledge to categorize and identify different types of minerals. Appreciate the importance of rocks.	2

4	Minerals: Definition and properties of minerals Types of minerals and ores Value of minerals and manufactured products	Identify various types of minerals in the world. Identify and categorize the physical and chemical properties of minerals. Explain the physical and chemical properties of minerals. Appreciate the importance of minerals in manufacture of different useful products.	4
5	End of unit assessment		1

6. Guidance on different lessons

Lesson 6. 1. Rocks: Definition, types and characteristics

Introduction

In this lesson 6.1, learners are introduced to the definition of rock, their types and respective characteristics. Display the Figure of introductory activity in the learner's book which represents the three major types of rocks. Thereafter learners are asked to mention the difference between the first two rocks and the second two and the third two rocks. The first two are sedimentary rocks (sandstone and conglomerate respectively); the second two are metamorphic rocks (gneiss and quartzite respectively); the third two are igneous rocks (scoria and basalt respectively). The teacher highlights different rock structures and colors to specify that related differences reflect the difference in the mineral composition.

a) Teaching resources

The teacher should have in possession the print outs of the introductory activity of Unit 6 of student's book and distribute it to learners. To achieve learning objectives of this lesson, the following resources should be used:

- Geographical documents including the learner's book of senior 6.
- Samples of rocks representing the three major groups of rocks
- Maps, Illustration

- Internet/DVDs
- Manila Paper or flip chart
- Jaws software

b) Learning activities

Refer to the introductory and learning activities 6.1 in the learner's book

Learning activity 6.1 in the learner's book has been provided as the basis for differentiating the major types of rocks. The teacher, prior to his/her lesson, shall collect some rock samples which he/she will use as didactic aids during introduction and development of the lesson. The first activity will consist about engaging learners to observe the figure of introductory activity of Unit 6 to describe rocks, to establish their differences in structure (rounded, stratified, etc.) and colour (dark, bright, etc.) The learning activity is the continuation of introductory activity. It consists of engaging learners to classify rocks depending on their structure and colour and ask them what could be the possible causes of observed differences. The teacher shall provide a handout of the figure, or indicate where the figure can be found in the learner's book, and shall organize learners to work in groups. The summary of each group finding is written on a manila or flip chart and displayed to learners. The teacher shall retain the righter answers from learners and shall continue in the same trends.

The answer to the introductory and learning activities 6.1

This will refer to samples used during the class session. The teacher will consider the following characteristics that differentiate the major categories of rocks. The more developed answer can be found under the sub-heading 6.1.3 (Characteristics of rocks) of lesson 6.1, Unit 6.

6. Sedimentary rocks exhibit some lithification. Rounded or angular fragments of rocks that have been cemented by precipitated silica or calcium can be found in structures of some sedimentary rocks. Both rounded and angular shapes reflect how far or not these rock debris have been transported and became rounded due to abrasion during the transport process. Sedimentary rocks that form from these fragments are called clastic sedimentary rocks. Examples of this category include sandstone, conglomerate, breccia, etc. The remaining types of sedimentary rocks are created either from chemical precipitation and crystallization (which often don't exhibit lithification), or by the lithification of once living organic matter.

Metamorphic rocks: some metamorphic rocks are characterized by a foliated texture which presents parallel bands of minerals, for example dark bands alternating with lighter (whiter) bands (e.g. Gneiss). They are called foliated rocks. Other metamorphic rocks which don't present banding are called non-foliated rocks.

Igneous rocks rocks are hard, and water does not pass through their joints easily, which is why they are less affected by erosion. They have a lot of minerals and do not have strata or layers.

c) Application activity 6.1.

Refer to the application activity 6.1 in the learner's book

Rocks: Definition, types and characteristics

In this activity two questions have been prepared so that the teacher can evaluate learners' achievement, but will also enable learners to assess themselves the level of understanding. The teacher should make sure that each learner is able to describe different categories of rocks based on their distinct characteristics described in lesson 6.1. He will provide samples of rocks including igneous rocks. Learners are asked to discuss in groups and to classify samples provided to them into the three major categories of rocks and to say in which region the respective rocks can be found.

To ***answer the question 1*** which consists of identifying area of Rwanda where igneous rocks are found and to explain their characteristics, the teacher will use the map below. The teacher should refer to the Northern Province (extensive parts of Musanze, Nyabihu and Rubavu Districts) and the Western Province especially in Rusizi District, where extrusive igneous rocks can be observed (for example: see Cenozoic **volcanic rocks**). He will refer to lesson 6.1 for details about characteristics of individual studied rocks.

The ***second question*** of application activity consists of classifying rocks that learners could find in their respective environments. The teacher should refer to characteristics of the three categories of rocks to know to which category the rocks found in learner's environment belong.

Lesson 6. 2.: Composition and properties of rocks

a) Revision

The teacher conducts the revision of the previous lesson by asking learners to briefly recall the definition of rocks, their major groups and distinctive characteristics. Thereafter, the teacher asks learners why rocks are different ones from others. In this lesson 6.2, students will discover the mineralogical composition of rocks, and their chemical and physical properties.

b) Teaching resources

For effective delivery of the lesson the teacher ensures he has the following resources or any other appropriate teaching aids:

- Geographical documents
- At least one sample for each category of rocks (igneous, sedimentary, metamorphic rocks)
- Maps, Illustration
- Internet/DVDs
- Manila paper or flip chart
- Jaws software

c) Learning activities

Refer to the learning activity 6.2 in the learner's book

The teacher should provide a handout of figure 6.4 (Types of stress and resulting rock deformation depending on physical properties) to learners or indicate them where it is found in learner's book (Unit 6). He will guide learners to observe it in groups and answer to activities of lesson 6.2 hereafter presented. Improvised teaching aids for illustration of how rocks behave when they are subject to stress are needed. The teacher could either use a bendable stuff and rigid stuff to show how rocks are bent to form fold when subject to compressional forces, or how rigid rock breaks down when subject to compressional forces or tension forces.

The teacher will refer to lesson 6.2 at its subheading 6.2.2 Properties of rocks.

The **answer** will consider aspects briefly described in the following paragraphs.

Physical properties of rocks

In general, the physical properties of rocks determine their behaviour to respective deformations when a rock is subject to stress such as folding, faulting or warping, and their resulting landform deformation. Rocks respond to stress in one of two ways: they break if they are hard, or they bend if they are ductile.

- When a rock breaks, it is called brittle deformation. Any material that breaks into pieces exhibits brittle behaviour.
- When rocks bend or flow, like clay, it is called ductile deformation.

To answer ***chemical properties*** of rocks, refer to lesson 6.2 of Unit 6 Rock and minerals. The following paragraph is to complement the answer teacher will find in the indicated lesson in the learner's book. Some rocks are resistant to weathering and erosion whereas others are not. The difference determines the configuration of the landscape, where depression and valleys correspond to less resistant, and interfluves, hills, mountains and crests reflect the more resistant rocks. This difference in resistance of rocks is determined by 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 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.

d) Application activity

Refer to the application activity 6.2 in the learner's book

Two questions have been prepared for learners:

1. Explain how rocks react to the stress and the resulting deformations depending on their physical properties.

2. Identify a sedimentary rock in learner's local environment and describe the process under which it might have been formed.

ANSWERS

1) The physical properties of rocks determine their behaviour and respective deformations when a rock is subject to stress 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). Find also the figure onTypes of stress and resulting rock deformation.

2) The process under which sedimentary rocks might have been formed.

Sedimentary rocks are derived from accumulated sediment, that is, unconsolidated mineral materials. The main processes involved in the formation of sedimentary rocks are erosion, stratification, compaction, and cementation. They are briefly described as follows:

- **Erosion** of weathered rock provided sediments that have been transported, and deposited in horizontal layers. Most sedimentary rocks display distinctive layering referred to as **stratification**. The many types of sedimentary deposits produce distinctive **strata** (layers or beds) within the rocks. **The bedding planes**, or boundaries between sedimentary layers, indicate changes in energy in the depositional environment but no real break in the sequence of deposition.
- **Compaction** occurs when pressure from the material above compacts the sediment, expelling water and reducing pore space.
- **Cementation** occurs when silica, calcium carbonate, or iron oxide precipitates between particles of sediment. The processes of compaction and cementation transform sediments into solid, coherent layers of rocks.

Lesson 6. 3 Impacts of rocks: advantages and disadvantages on the landscape and the society

a) Prerequisite/Revision/Introduction

In lesson 6.3, students will learn about the impact of rocks, their advantages and disadvantages on landscape and the society. Learners must have covered the content of lesson 6.1 and lesson 6.2. The knowledge in lesson 6.1. and lesson 6.2 constitute an asset to better understand the lesson 6.3. The teacher shall then engage learners for revision of previous lesson.

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

c) Learning activity

Refer to the learning activity 6.3 in the learner's book

One learning activity has been prepared for learners. It consists of explaining advantages of rocks on landscape and society. The answer to the question can be found in Unit 6, lesson 6.3. Impact of rocks: advantages and disadvantages on the landscape and human. The group discussion is recommended for learners to brainstorming advantages and disadvantages of rocks on the landscape and the society. The teacher will then establish the link between today lesson and the previous lesson one.

To answer the question about advantages of rocks on landscape and society, the teacher shall refer to lesson 6.3.

Advantages of rocks on the landscape and human

The difference in rock resistances provides various landscapes such as alternation of elevated topographies (hills, mountains or interfluves) and depressions (valleys and low-lying areas) which are sometimes drained. Rocks have a wide variety of uses. Many of them are used as building materials of houses and infrastructures such as roads and rail ways. Refer to the learner's book about usages of rocks.

d) Application activity

Refer to the application activity 6.3 in the learner's book

In this lesson, there are three instructional activities which consist of (1) identifying in learners' environments objects made from different rocks, (2) describing rocks used to build houses or foundations of houses and (3) discussing *advantages* and *disadvantages of rocks on landscape and society.* Refer to lesson 6.3 (Unit 6 Impact of rocks: advantages and disadvantages on the landscape and society) for exhaustive answers.

Briefly answers will include the following:

Advantages of rocks on the landscape

- Some rocks are more resistant to weathering and others are less resistant. This difference in rock resistances provides various landscapes such as alternation of elevated topographies (hills, mountains or interfluves) and depressions (valleys and low-lying areas) which are sometimes drained;
- Gravel and sand, being among products of rock weathering make beautiful landscape at some location of the earth.

Disadvantages of rocks on the landscape

- Hard and resistant rocks hinder the penetration of plant roots hence, limiting the weathering process or hindering the growth of vegetation.
- Rock forming minerals have different colours. The differences in colours make minerals to absorb differently the heat.
- In tropical semi-arid or arid climates, dark-coloured minerals absorb much heat during daytimes and therefore expand, causing the cracking and fragmentation of rocks.

Advantages of rocks on human activities

- Weathering of rocks provides different types of soils including sand, silt and clay which are useful at varying points for agriculture.
- Some rocks present beautiful landscapes which may attract tourists.
- Some rocks store, purify water and act as water sources to rivers.
- Rocks have a wide variety of uses. Many of them are used as building materials of houses and infrastructures such as roads and rail ways.

Disadvantages of rocks on human activities

- 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;
- Light-coloured rocks reflect sunlight and increase the temperature around the plants during the daytime;
- Some environments such as sand rocks (dunes, reg, erg, etc.) are not suitable for human settlement because of lack of water and soils.

Lesson 6. 4. Minerals

a) Prerequisite/Revision/Introduction

In lesson 6.4, students will learn minerals and their economic values. Learners must have covered the content of lesson 6.1, lesson 6.2. and lesson 6.3. The knowledge in lesson 6.1, lesson 6.2 and lesson 6.3 constitute prerequisites to better understand the lesson 6.4. The teacher shall then engage learners to differentiate a **mineral** from an **ore**, and categorize minerals into **metals** and **non-metals**. The teacher shall specify that minerals are found within ores. An emphasis should be put on distinctive properties of minerals that are **physical** (form, hardness, fracture, cleavage, colour, streak, luster, mass, density, taste, odour, feel, magnetism) and **chemical** which depends on the

chemical composition of minerals (silicates and non-silicates).

The teacher shall engage learners in discussion about factors that make the minerals more valuable than another. These **factors** include among others the -chemical composition, rarity, commercial value, form of a mineral, beauty of a mineral, size of a mineral, hardness of a mineral, unusual characteristics and associated minerals-. The teacher should provide to learners a hand out of table on minerals and derived manufactured products, or guide them to lesson 6.4 of Unit 6 of learner's book to find related content.

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

c) Learning activity

Refer to the learning activity 6.4 in the learner's book

Two questions constitute the learning activity 6.4 related to minerals. The first one relates to types and characteristics of minerals and the second refers to uses of minerals for the welfare of the society.

To answer to ***question one***, the teacher should make sure on the following:

- Types of minerals: ***metallic minerals*** and ***non-metallic minerals***.

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.

To answer the question on **use of some minerals to the society**, the teacher refers to the learner's book under minerals and table 6.8: Minerals and derived manufactured products.

d) Application activity

Refer to the application activity 6.4 in the learner's book

Three questions have been provided for instructional activities. Refer to the learner's book Unit 6 for possible detailed answers.

1) The five characteristics shared by all minerals are briefly mentioned.

2) 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.

   An ore called also an ore-deposit is a rock that contains extractable valuable (profitable)

3) Factors that influence the value of minerals include chemical composition, rarity, commercial value, form of a mineral, beauty of a mineral, size of a mineral, hardness of a mineral, unusual characteristics and associated minerals.

4) Minerals that are extracted in learners' district environments and their advantages and disadvantages. The answer to this question will depend on minerals highlighted by learners that are extracted in their regions of origin. The teacher will complement learners and search on the advantages. If the minerals identified by learners are included in the list provided in Table 6.9: Minerals and derived manufactured products, the teacher will use the table for complementing learners' answers.

7. End unit assessment

The elements of answers of questions that constitute the end unit assessment are briefly presented in the following paragraphs.

1) The distinctive characteristics of igneous rocks, metamorphic rocks and sedimentary rocks and the places where they are found.

Igneous rocks are hard, and water does not pass through their joints easily, that is why they are less affected by erosion. They have a lot of minerals and do not have strata or layers. They do not contain fossils, Igneous rocks are mostly associated with magma and volcanic activities and are mainly most of them have been formed underneath other rocks, and in the volcanic zones by volcanic lavas. That is why they are also called volcanic rocks.

Sedimentary rocks are the product of other rocks that have already formed. They are formed from materials weathered from pre-existing rocks, remains of plants and animals. Most of sedimentary rocks have layers (strata) and contain fossils.

Metamorphic rocks are harder than the original rocks. They are not easily eroded and do not split easily. They contain varied minerals; but some are made up of just one mineral.

2) Forming processes of each major group of rocks include.

Igneous rocks: Melting (magma), crystallization (intrusive), consolidation (extrusive);

Sedimentary rocks: Erosion, lithification, cementation, compaction;

Metamorphic rocks: Increase in pressure and temperature. The process is called metamorphism.

3. Discuss the economic importance of rocks and minerals. What is their negative effects on the environment.

(Refer to the subheading 6.4.4 Value of minerals and manufactured products, lesson 6.4 Minerals of Unit 6 for an exhaustive answer).

4. The difference between the physical and the chemical properties of the rocks is briefly described in the following paragraphs.

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.

8. Additional Information

Composition and properties of rocks

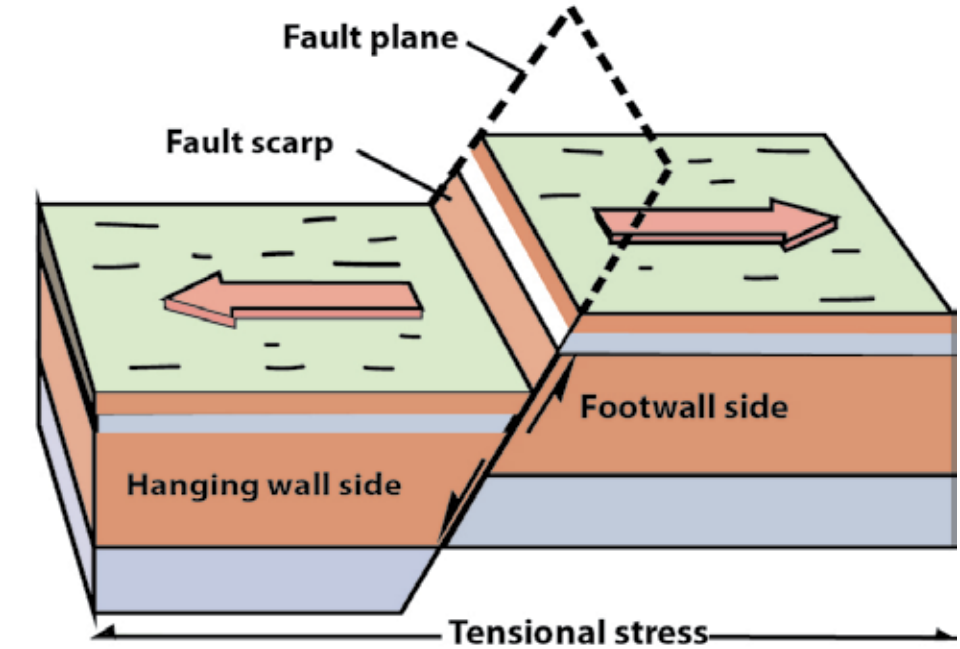
The table below is related to the content of the subheading 6.2.1 of **lesson 6.2 Rock Composition**

Table 6.1. Common chemical elements abundantly found in minerals of the Earth's rocks

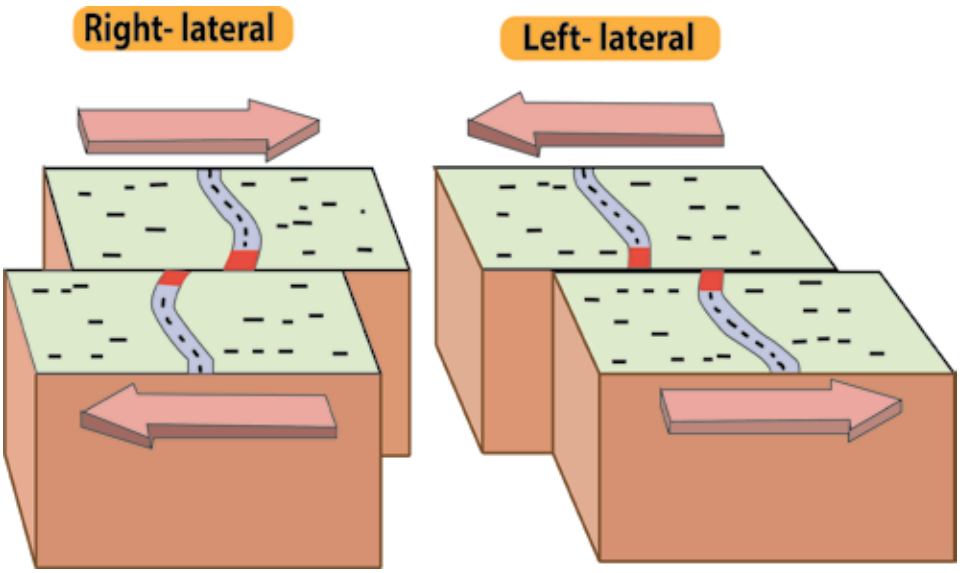
Element	Chemical Symbol	Weight in Earth's Crust (%)
Oxygen	O	46.6
Silicon	Si	27.7
Aluminium	Al	8.1
Iron	Fe	5.0
Calcium	Ca	3.6
Sodium	Na	2.8
Potassium	K	2.6
Magnesium	Mg	2.1
All others	-	1,5
Total	-	100

Stress and surface deformation

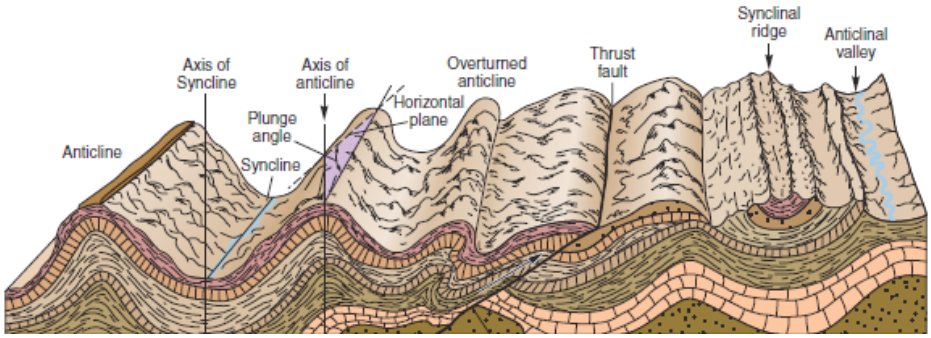
The figures below relate to the subheading 6.2.2 properties of rocks, of learner's book Unit 6. it shows three types of stress: tension (stretching), shear (twisting or tearing and compression (shortening) and associated deformations of the earth These deformation can generate many landforms, whose some are shown on the figure (a, b, and c)



(a)Normal fault (tension)



(b) Strike-slip fault (lateral shear)



(c) Folded landscape (compression)

Figure6. 1.Stress and surface deformation

Igneous rocks

In the learner's book, igneous rocks have been described and classified according to their forming minerals. The figure below shows minerals which form the intrusive and extrusive magmatic rocks. Refer to lesson of unit 6, to complement the table.

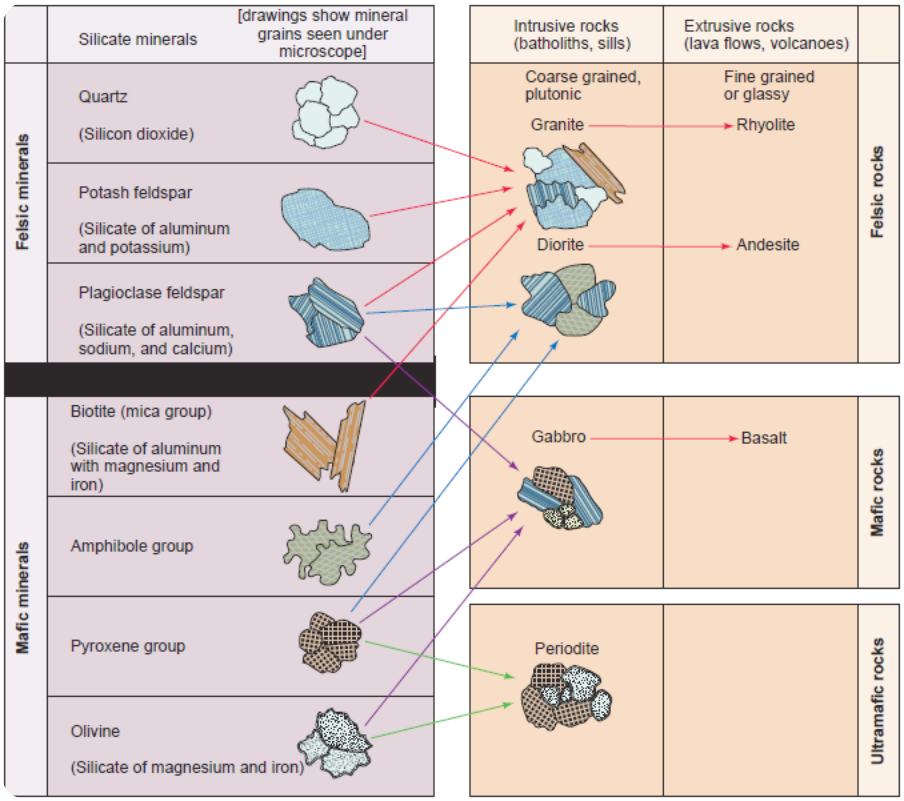


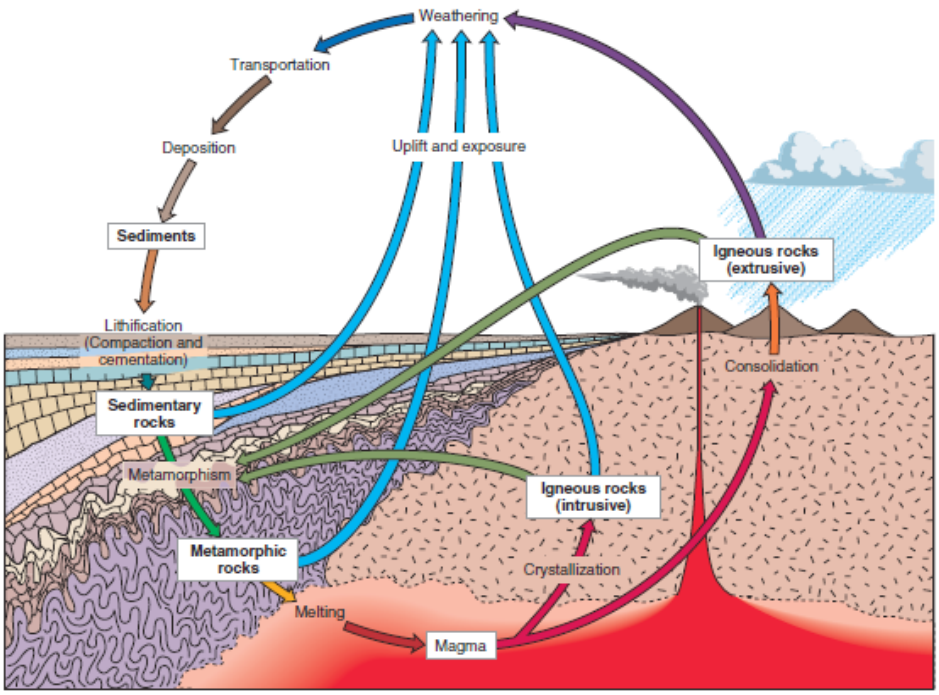
Figure 6. 2 Igneous rocks and constituting minerals

Common sedimentary rock types and their composition

Subclass	Rock Type		Composition
Clastic (composed of rock and/or mineral fragments)	Sandstone		Cemented sand grains
	Siltstone		Cemented silt particles
	Conglomerate		Sandstone containing pebbles of hard rock
	Mudstone		Silt and clay, with some sand
	Claystone		Clay
	Shale		Clay, breaking easily into flat flakes and plates
Chemically precipitated (formed by chemical precipitation from sea water or salty inland lakes)	Limestone		Calcium carbonate, formed by precipitation on sea or lake floors
	Dolomite		Magnesium and calcium carbonates, similar to limestone
	Chert		Silica, a microcrystalline form of quartz
	Evaporites		Minerals formed by evaporation of salty solutions in shallow inland lakes or coastal lagoons
Organic (formed from organic material)	Coal		Rock formed from peat or other organic deposits; may be burned as a mineral fuel
	Petroleum (mineral fuel)		Liquid hydrocarbon found in sedimentary deposits; not a true rock but a mineral fuel
	Natural gas (mineral fuel)		Gaseous hydrocarbon found in sedimentary deposits; not a true rock but a mineral fuel

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 $3SiO_2{\cdot}Al_2O_3{\cdot}5FeO{\cdot}4H_2O$ (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 $CaMg(CO_3)_2$.

Anhydrite (CaSO4), also called hydrous calcium sulphate and Gypsum, also called hydrated calcium sulphate (CaSO4 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 (Fe2O3), 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)·nH2O).

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.

9. Summary of the Unit

Unit six is about rocks and minerals with a key competence of their economic importance. **Minerals** are the building blocks of rocks. A mineral is an inorganic, naturally occurring substance represented by a distinct chemical formula and a specific crystalline form. A rock, in contrast, 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 rocks constituting each category. The major forming processes of Igneous (magmatic) rocks include **melting** (magma), **crystallization** (intrusive), **consolidation** (extrusive), whereas the formation of metamorphic rocks follows the increase in **pressure** and **temperature**. Processes of the formation of sedimentary rocks include **erosion**, **lithification** (stratification), **cementation** and **compaction**.

The most common elements found in Earth's crust, and therefore in the minerals and rocks that make up the crust, are oxygen and silicon, followed by aluminum and iron, and the bases: calcium, sodium, potassium, and magnesium. Igneous rocks are dominated by Quartz, Feldspars, Plagioclase, Micas (Muscovite, Biotite), Pyroxene, Amphibolite and Olivine; Sedimentary rocks are dominantly made up by the following minerals: Silicates, Clay, Dolomite, Gypsum, Anhydrite, Hematite and Limonite. Metamorphic rocks are constituted by Quartz, Muscovite, Sillimanite, Andalusite, Kynite, Garnet, Sericite and Staurolite minerals.

Some rocks are resistant to weathering and erosion whereas others are not. The difference determines the configuration of the landscape, where depression and valleys correspond to less resistant, and interfluves, hills, mountains and crests reflect the more resistant rocks. This difference in resistance of rocks is determined by 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.

Rocks and minerals have a wide variety of uses for the welfare of society. Rocks are used as building materials of houses floor tiles and infrastructures such as roads and rail ways, some minerals such as coal, are used in power plants to make electricity. Minerals provide the material used to make most of the things of industrial- based society; roads, cars, computers, fertilizers and watches. Some minerals have high economic value because of their uses or they are rare and beautiful. For example, gems or **Gemstones**, a mineral with a distinctive colour which makes it expensive. That is why it is used for jewellery.

10) Additional activities

a) Remedial activities (for slow learners)

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 (find answers next to questions)

i) The amount of silica

- Acidic igneous rocks (having more silica, more 65% of SiO_2)
- Basic igneous rocks (having low amount of silica, less than 45% of SiO_2)

ii) The chemical and mineral composition, especially lighter

- Felsic igneous rocks (composed of the dominant minerals of the light group, Silica, Aluminum)
- Mafic igneous (composed of the dominant mineral of dark group: magnesium and iron)

iii) the mode of occurrence

- **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.

- 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 do not have a layered or banded appearance.

c). Extended activities (for gifted and talented learners)

Question 1. Classification of igneous rocks based on texture of grains

- Pegmatitic igneous rocks (very coarse grained igneous rocks) for example, granite
- Phaneritic igneous rocks (coarse grained igneous rocks)
- Aphanitic igneous rocks (fine grained igneous rocks)
- Glassy igneous rocks (without grains of any size)
- Porphyritic igneous (mixed grained igneous rocks)

Question 2. Categories of intrusive igneous rocks

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 3. Categories of extrusive igneous rocks

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.

Question 4. Why is a fuel not classified as a mineral?

Fuels like oil are not minerals because they do not meet the following criteria of minerals:

- Inorganic (Oil is organic)
- Naturally occurring
- Solid (Oil is a liquid, and natural gas is not solid)
- Have a specific chemistry (Oil is mixture of various hydrocarbons with varying chemistry)
- Internal crystalline structure

However, while Petroleum is not a mineral, it can contain mineral particles such as sand, and sand often contains Quartz which is a mineral.

UNIT 7 : CLASSIFICATION OF SOILS AND SOIL FORMATION

7

1. Key unit competence

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

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

Unit 5 of Senior 4 introduced the study of Soil to the learners. 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.

Unit 7 of Senior 5 provided a specific study on soils constituents, morphological properties of soils and factors affecting soil fertility.

In Senior 6 learner's book there is an introductory activity. It is intended to remind learners the meaning of soil, how soil is formed, and its constituents. The solutions to the same activity highlight the importance of looking after our soils in a sustainable way. This therefore, calls for conservation measures which will be studied later. However, as a teacher, emphasize the cross cutting issue of environment and sustainability. This introductory activity provides a foundation upon which learners 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.

3. Cross-cutting issues to be addressed

a 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 learners 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.

b) 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 learners to properly manage the soils in their local environment, so as to uplift farmer's income and improve their standards of living. Ask learners 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.

c) Inclusive Education

Special focus should be given to the children with learning impairments (children with special educational needs). In all the activities ensure that the participation of learners 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 learners to work in groups (including those with special needs) to brainstorm on processes and factors of soil formation. Let the gifted children help learners with special needs especially in group discussion, research and presentations to make them understand. Give learners with special needs and slow learner's remedial activities and guide them in answering.

4. Guidance on introductory activity

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

- How is soil formed?
- What are the constituents of soil?
- What are the processes involved in the formation of soil?
- What are the factors influencing soil formation?
- What are the causes and effects of soil erosion?
- How can we conserve our soil?
- Why is soil important to human beings ?

5. List of lessons (including assessment)

	Lesson title	Learning objectives (from the syllabus including knowledge, skills, attitudes and values):	Number of periods
1	Classification of the major types of soil in the world (Zonal, Azonal, Intrazonal soils)	- Differentiate between the zonal, azonal and intrazonal soils. - Identify the major types of soils in the world. - Classify the major types of soil in the world.	1
2	Distribution of the major types of soil in the world.	- Investigate the distribution of the major types of soil in the world - Appreciate the distribution of the major soil types in the world.	1
3	Processes and factors of soil formation	- Identify the processes of the soil formation. - Describe the processes of the soil formation. List the factors responsible for the soil formation. - Explain the factors favouring the formation of the soils.	2
4	Soil erosion: causes, areas of severe soil erosion and the effects of soil erosion.	- Outline the causes and the effects of the soil erosion. - Explain the causes and the effects of the soil erosion in the world.	1

5	Appropriate soil management and the conservation measures	- Outline the appropriate soil conservation measures in the world. - Evaluate the appropriate soil conservation measures in the world. - Show respect for the soil conservation measures in the world.	1
7	Economic importance of soil	- Give the importance of soils. - Recognise the economic importance of the soils in the world. - Appreciate the economic importance of the soils in the world.	1
8	End unit Assessment		1

6. Guidance on different lessons outlined above

Lesson 1: Classification of the major types of soil in the world

a) Introduction

This topic on soil is not new to learners in Senior 6. It was studied in S4 and S5 respectively. It is therefore, important to link the content studied with what is going to be learnt in S6. In S4 learners learnt various types of soil and where they are found, soil erosion in Rwanda, its causes and effects, soil conservation and management measures as well as the importance of soils in Rwanda. In S5, soil constituents, morphological properties of soils and factors affecting soils fertility were also studied.

Therefore, guide learners to review the Senior 5 contents by asking learners how soil is formed and its constituents. What are the processes involved in the formation of soil and how can we conserve our soil? Although they learnt about soil in previous years, they did not clearly cover. The study of soil in S6 will complement what was covered in S4 and S5.

After this review, guide learners to use geographical documents or internet to research on major soil types in the world and to differentiate between zonal soils, azonal soils and intraoral soils.

Supplement their answers by telling them that the major types of soils in the world include Zonal soils, Intrazonal soil and azonal soils.

b) 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 soil
- Tactile, touch and talking materials
- Print out for activities
- Manila and flip chart papers
- Photographs

c) Introductory and Learning activities

Refer to the introductory activity 7and learning activity 7.1 in the learner's book

Guidance to answer the learning activities

Guide learners to work in groups and discuss the components of soils using the illustration of the introductory activity in the learner's book and the content provided on soil in Senior 5. Then, they will make research on the types of soils and differentiate between zonal soils, azonal soils and intraoral soils with the help of geographical documents or internet. Their answers should develop the generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with special needs) in activities like listening touching (for some children with disabilities: if any), discussions, asking and answering questions.

For more answers refer them to the learner's book on classification of major soil types of the world.

d) Application activity

Refer to the application activity 7.1 in the learner's book

Guidance to answer the application activities

i) Facilitate them to use internet or other geographical documents to identify the major types of soils in the world. Ask learners to identify the major types of soils in the world. Guide them to use the content given in the learner's book on major types of soil.

(There are three major types of soils namely: zonal soils, Intrazonal soils and azonal soils).

ii) Ask learners to make research on the difference between zonal soils, azonal soils and intrazonal soils. Guide them to use the content given in the learner's book on classification of soils and use the internet or other geographical documents to give the difference between Zonal soils, Azonal soils and Intrazonal soils.

Lesson 2.: Distribution of the major types of soil in the world

a) Introduction

Guide learners to review the previous lesson by asking them to identify different types of soils in the world. Thereafter facilitate them to display a world map on soils and ask them to locate areas where these soil types are found.

b)Teaching resources:

To achieve learning objectives, the following resources are important:

- Recommended text books;
- I nternet
- 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

c) Learning activity

Refer to the learning activity 7.2 in the learner's book

Guidance to answer the learning activities

Guide learners to work in groups; to identify and locate different types of zonal soils on the world map. Let them make research on other types of soils (intrazonal soils and azonal soils) and give the examples of each type.

Their answers should develop the generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage learners (including those with learning impairments) in activities like discussions, map drawing, asking and answering questions. For more answers, refer to the learner's book on major soil types of the world.

d)Application activities

Refer to the application activity 7.2 in the learner's book

Guidance to answer the application activities

Ask learners to locate appropriately the major types of soil on the world map. Then, let them use the map from the learner's book on major soil types to locate the major types of soil.

Lesson 3: Processes and factors of soil formation

a) Introduction:

Guide learners to research on processes and factors of soil formation. Let them work in groups and present the findings in class.

b) Teaching resources

To achieve learning objectives, the following resources are needed:

- 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

c) Learning activity

Refer to the learning activity 7.3 in the learner's book

Use the diagrams in the learner's book (showing factors of soil formation and another showing weathering as one of the processes of soil formation) to display the factors and processes of soil formation. Thereafter, ask learners to mention and describe the factors and process of soil formation indicated on the illustrations. Let Learners identify and explain different soil formation factors and processes.

Guidance to answer the learning activities

Their answers should develop generic competences such as critical thinking, cooperation, communication and research skills.

Engage learners (including those with learning impairments) in activities like discussions, photographic interpretation, asking and answering questions.

For more answers, refer to the learner's book on processes and factors of soil formation.

d) Application activity

Refer to the appliction activity 7.3 in the learner's book

Guidance to answer application activities

Ask learners to visit their local environment to identify and describe the factors and processes of soil formation. Let them use the content from the learner's book on factors and processes of soil formation. Facilitate them to use internet or other geographical documents to properly do an assessment on processes and factors of soil formation.

Lesson 4. Soil erosion: causes, areas of severe soil erosion and the effects

a) Introduction:

Facilitate learners to review the previous lesson by asking learners to explain the factors influencing soil formation. In few words, supplement the answers given by learners.

b) Teaching resources

- 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

c) Learning activity

Refer to the learning activity 7.4 in the learner's book

Guidance to answer learning activities

In groups, give learners a diagram from the learner's book indicating some of the causes of soil erosion. Guide learners to interpret the diagram and analyze human made and natural causes of soil erosion. Thereafter, facilitate them to make research on the causes and effects of soil erosion in their local environment. In groups let them discuss the areas with severe erosion, causes and effects of erosion in their local environment. Guide them to make a class presentation on the findings.

Their answers should develop generic competences such as critical thinking, cooperation, communication and research skills.

Engage learners (including those with learning impairments) in activities like discussions, photographic interpretation, asking and answering questions.

For more answers to the activity, use the learner's book on soil erosion, causes and effects

d) Application activities

Refer to the application activity 7.4 in the learner's book

Guidance to answer the application activities

Guide learners to make a fieldwork around the school. In the field work, ask them to research on the causes and the effects of soil erosion. Facilitate them to compare the effects of severe soil erosion in different provinces of Rwanda. Guide them to use the content from the learner's book on soil erosion and the internet or other geographical documents to clearly explain causes and the effects of soil erosion.

Lesson 5: Appropriate soil management and the conservation measures

a) Introduction

Guide learners to review the previous lesson by asking them to explain the causes and effects of soil erosion. Guide learners to use the pictures provided in the learning activity on soil conservation measures. Facilitate them to make research on other soil conservation techniques. In few words, supplement the answers given by learners.

b) Teaching resources

- 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

c) Learning activity

Refer to the learning activity 7.5 in the learner's book

Guidance to answer the learning activities

In groups, give learners an illustration from the learner's book showing some of the techniques of reducing soil erosion. Some of the techniques used are strip faming, mulching, crop rotation, dry farming, terracing and agro-forestry.

Guide learners to research on other techniques that are not shown by the illustrations. Let them brainstorm in groups and present the findings in class.

Their answers should integrate environment and sustainability as a cross cutting issue since techniques like afforestation and reforestation will be highlighted. The activity to be done by learners should develop competences such as critical thinking, cooperation, communication and research skills. Engage learners (including those with learning impairments) in activities like discussions, photographic interpretation, asking and answering questions. For more answers, refer to the content in the learner's book on appropriate soil management and conservation measures.

d) Application activity

Refer to the apllication activity 7.5 in the learner's book

Guidance to answer the application activities

Ask learners to make a field study in their local environment to analyze the measures used by local communities to conserve soils. Guide learners to discuss the role of communal work in soil conservation. Facilitate learners to use an illustration in the learner's book and let them describe how to address soil erosion. Ask them to outline and evaluate soil conservation measures in the world. They will use the content from the learner's book on soil conservation and management, the internet or other geographical documents to evaluate soil conservation measures in the world.

Lesson 6: Economic importance of soil

a) Introduction:

Facilitate learners to review the previous lesson by asking learners to evaluate soil conservation measures. Guide them to do research and explain how soil has influenced the development of activities. Let them to form groups and discuss the role of soil in socio-economic development. Supplement the answers given by learners.

b) Teaching resources

- 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

c) Learning activity

Refer to the learning activity 7.6 in the learner's book

Display the photograph from the learner's book showing agricultural activity. Ask learners to explain the relationship between the activity shown on the photograph and soil. In groups, ask learners to make research on other economic uses of soil for sustainable development. Let learners present the findings in class and note down the economic uses.

The activity to be done by learners should also integrate financial education as a cross cutting issue when discovering the content.

Guidance to answer the learning activities

Their answers should develop competences such as critical thinking, cooperation, communication and research skills.

Engage learners (including those with learning impairments) in activities like discussions, photographic interpretation, asking and answering questions.

For more answers about the activities, they can refer to the content in the learner's book on the economic importance of soil.

d) Application activity

Refer to the application activity 7.6 in the learner's book

Guidance to answer the application activities

Guide learners to do a field work study around their school. Let them investigate the impact of soils to the community. Ask learners to explain the importance of soils. They will use the content from the learner's book on economic importance of soil, the internet or other geographical documents to clearly explain all economic uses of soil.

7. 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 learners 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.

8. 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. 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.

Ferralitic soils also known as Oxisols are found within the equatorial climates of the world. The vegetation found here is the evergreen tropical rain forest.

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.

9. End unit assessment

Questions

1) Deforestation in many parts of the world has resulted into severe soil erosion and its associated effects.

   i) Make a field study in your home area and evaluate the effects of soil erosion

   ii) Identify other major causes of soil erosion in your area.

2) Most farmers in the northern province of Rwanda use terracing as a measure of soil conservation.

   a) Explain why terracing is mostly used in this area.

   b) Describe other soil conservation techniques used in your area.

   c) Show how these techniques are helpful to the environmental sustainability.

3) Soil is a source of livelihood in the world because it is used in many ways. Apart from agriculture, how can you use soil for your own survival in your area?

Guidance to answers

1. Deforestation in many parts of Rwanda has resulted into severe soil erosion and its associated effects.

i) Make a field study in your home area and evaluate the effects of soil erosion.

- Guide learners to make a field study in their home areas and evaluate the effects of soil erosion.
- Let learners explore the effects of soil erosion in the field and note them. They analyze and relate them to the content in the learner's book on soil erosion

ii) Identify other major causes of soil erosion in your area.

Ask learners to interpret the observed causes of erosion in the field and relate them to the content in the learner's book on soil erosion. Let them use their local environment and discuss in groups the causes of soil erosion. Supplement their answers with reference to learner's book on causes of soil erosion

2. Most farmers in the northern province of Rwanda use terracing as a measure of soil conservation.

i) Explain why terracing is mostly used in this area.

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 learners 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.

ii) Describe other techniques of conserving soil used in your area.

Let learners brainstorm on appropriate techniques of conserving soil in their area and relate them to the content in the learner's book.

iii) Show how these techniques are helpful to the environmental sustainability.

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

3. Soil is a source of livelihood in the world because it is used in many ways. Apart from agriculture, how can you use soil for your own survival in your area?

Put learners in groups of 5 and ask them to make a discussion on how soil is used in their area. Relate their findings to the content in the learner's book on importance of soil.

10. Consolidation activities

a) Remedial activities (for slow learners)

i) Why are volcanic soils common in North western Rwanda?

ii) State the types of soils common in desert zones.

iii) Outline five factors that favour soil formation.

iv) Why is it important to conserve soil?

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

i) The volcanic soils are common in Northwestern Rwanda because this area experienced large scale volcanic eruption activities.

ii) The type of soils common in desert zones are desert soils

iii) Five factors that favour soil formation are climate, parent rock, relief, living organism and Time.

iv) It is important to conserve soil because it helps man to survive mainly through agricultural activities.

b) Consolidation activities:

i) How can we conserve soil in our communities?

ii) In what ways is soil misused by local communities in your province?

Guide learners on how to answer the above questions using the learner'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.

c) Extended activities (for gifted and talented learners)

i) Draw a world map and on it locate zonal soils.

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

Guidance to answer questions

i:

- Guide learners on how to answer the above question using the learner'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 learners make research on how these factors influence soil formation: Parent Rock, Living organisms and Time. They share their findings in a class presentation.

ii:

- Guide the learners 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.

UNIT 8: CLIMATE CHANGE

8

1. Key unit competence

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

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

Unit 6 of senior 4 introduced the Climate in Rwanda which has the objective of investigating the climate and seasons of Rwanda and explaining their impact on human activities. Learners 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. Unit 8 of senior 5 focusing on weather and Climate of the World explained the impact of climate on the environment and human activities. Unit 8 of senior 1 talks about Impact of weather and climate on 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 learner'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 teacher emphasizes the cross cutting issue of environment and sustainability.

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 learners with different learning styles and other difficulties where all learners 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 learners with special education needs like students with physical and visual impairment, talented and slow learners 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 learners who will help them. This can be applicable in the learning activity 8.3

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 learners 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 learners 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 learners' understanding of the importance of standards as a pillar of economic development and in the practices, activities and lifestyle of the citizens. It is 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 learners to develop the culture of using the materials which are in line to rules and regulation of our country.

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:

   - Climate change
   - Global warming
   - Green house phenomena
   - 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 synthetize 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, learners will be able to identify the regions of Rwanda likely to experience the desertification and give reasons.

5. List of lessons (including assessment)

	Lesson title	Learning objectives (knowledge, skills, attitudes and values)	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 Show concern for man's contribution towards climate degradation	2

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	Refine 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	2
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	2
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	1

5	**End unit assessment**		1

6. Guidance on different lessons outlined above

Lesson 1: Climate change

a) 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 senior 4 introduces the Climate in Rwanda, unit 8 of senior 5 talks about weather and Climate of the World.

Guide learners to revise the senior 4 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.

b) 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 of photographs
- Internet
- Print out of activities
- Manila papers
- Maps
- Flip charts

c) Learning activities

Refer to the learning activity 8.1 in the learner's book

Help learners to work in groups, they will be able to explain what climate change is, explain the causes and effects of climate change.

Guidance to answer the learning activities

Their answers should involve the development of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage learners in activities like discussion, asking and answering questions. For more answers they are referred to the learner's book on the content of climate change.

d) Application activity

Refer to the learning activity 8.1 in the learner's book

Guidance to answer the application activities

Learners 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. Learners will use the content given in the learner's book on the lesson of climate change to answer the above questions.

Lesson 2: Global warming and green house phenomena

a) Revision /Introduction

Form groups and guide learners 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 learners to present their finding in class.

b) 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

c) Learning activities

Refer to the learning activity 8.2 in the learner's book

Guide learners to work in pairs, they will be able to identify and explain the causes of global warming and green house phenomena and effects of global warming and green house phenomena.

Guidance to answer the learning activities

Their answers should involve the development of generic competences such as critical thinking when they are thinking about the application of greenhouse farming, cooperation in case they are working in groups the involvement of collaboration is needed, without leaving communication, research and problem-solving skills. Engage learners in activities like discussion, asking and answering questions.

For more answers they are referred to the learner's book on the content of global warming and green house phenomena.

Refer to the learning activity 8.2 in the learner's book

d) Application activity

Refer to the application activity 8.2 in the learner's book

Guidance to answer the application activities

Learners are asked to explain why causes of climate change and green house differ in rural and urban areas like Kigali, to observe in their local environment and establish the effects of climate change, describe the importance and the advantages of the farming practiced in greenhouse.

They will use the content given in the learner's book on global warming and green house phenomena.

Lesson 3: Adaptation and mitigation measures for climate change

a) Revision /Introduction

Learners will be helped to revise the previous lesson by asking key questions related to the global warming and green house phenomena. And remember to supplement the learners' answers whereby there were incomplete.

b) 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

c) Learning activities

Refer to the learning activity 8.3 in the learner's book

Before starting this lesson, you should identify an area where effects of climate change are observable and guide learners at place for observation for answering the learning activity. Their answers should involve development of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book. Once learners are back to class, guide them to brainstorm the adaption and mitigation measures by comparing what they observe locally and globally. Learners will use the content given in the learner's book on adaptation and mitigation measures for climate change.

d) Application activities

Refer to the application activity 8.3 in the learner's book

This activity requires high thinking and flash back on what students have learnt, help learners to feel as they are the managers of said institutions and propose the strategies for climatic adaption as well as mitigation. Guide learners 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.

Lesson 4: Climate change and Desertification

a) Revision /Introduction

Learners are asked to describe the ways of adaption and mitigation measures for climate change. Guide them to give their views and supplement with yours because you are experienced.

b) 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 document
- Print out of activities
- Manila papers
- Maps
- Flip charts

c) Learning activities

Refer to the learning activity 8.4 in the learner's book

Facilitate learners to work in groups and search the explanation on how climate change contributes to desertification. Help learners to observe and analyze the picture on the content of desertification. Guide them to brainstorm the challenges facing by the people living in the region portrayed on the picture.

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

d) Application activities

Refer to the application activity 8.4 in the learner's book

Guide learners 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 teacher should verify if learners 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 learner's book on the climate and desertification.

7. 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 learners to discuss climate change and its impact on Rwanda and other countries.

8. Additional information

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 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.

In students' book, the causes of global warming and green house effects are discussed at the level that a student would understand them, it is now very crucial that the more information are provided here below:

Causes of global warming and green house phenomena

The following are the causes of global warming and green house phenomena:

A. Human causes

It has been said that human activities are responsible for the global warming. These activities are destroying Earth at fast rate. The emission of carbon dioxide from vehicles, the burning of fuels, cutting of trees and forests to build some new buildings and new malls, dumping of trash everywhere and not even recycling it, excessive use of the plastics, smoke from factories, tetrameter. All the activities performed by human beings are factors for polluted gases in air and warming up of Earth which destroys the ecological balance of the nature leading to the global warming.

- **Burning of fossil fuels**

Fossil fuels are burnt on day-to-day basis and they contain large percentage of carbon, petroleum, coal and many other different gases. So, burning of these fuels also releases large amount of the extra carbon which was entombed inside Earth millions of years ago. The carbon that is emitted by the burning of these fuels is extra carbon which is not part of cycle. So, carbon dioxide being greenhouse gas is provided in excess in our atmosphere which leads to global warming.

- **Use of chemical fertilizers**

The use of the artificial chemicals for crops has become one reason for the global warming. These chemicals are dangerous not only for the Earth but also for the human beings. These fertilizers are rich in the nitrogen oxide which is more dangerous than the carbon dioxide. These oxides of the nitrogen destroy ozone layer even faster than other greenhouse gas and hence lets harmful ultraviolet rays enter atmosphere thus making Earth warm and leading to the global warming.

- **Industrial Advancement**

More and more different industries and factories are set up in modern world to meet needs of the human beings. These factories need large amount of fuels like some coal, petroleum for power generation and electricity required by machines to work. Burning of these fuels also releases large amount of the carbon dioxide which absorbs harmful radiations from sun making it warm, hence increasing global warming. The smoke that is produced from the factories is mixed with air, making it rather harmful for breathing.

- **Deforestation**

Plants give us some oxygen which is most important thing for survival. They undergo process of photosynthesis in which they give oxygen and take the carbon dioxide. Plants consume air, sunlight and carbon dioxide which we breathe out to make food and the oxygen. So, if the trees are cut, plants will not be able to produce oxygen and concentration of the carbon dioxide will increase. Increase of the carbon dioxide in air is very harmful for the human beings and disturbs water cycle and hence total imbalance of our ecosystem. So being one of greenhouse gases it will lead to the global warming.

- **Air Pollution**

Another factor included in the list of 10 Main Causes of Global Warming is the Air Pollution. The harmful gases emitted from vehicles and the factories and greenhouse gases cause some pollution in the air and these gases get captured in atmosphere. The smoke gather up in atmosphere forming some clouds full of harmful gases which later fall as the acid rain which destroys buildings and also lead to dangerous diseases like cancer, some skin burns and death of plants. Plants provide us with oxygen and if they die level of carbon dioxide will increase in atmosphere which is known as a harmful gas. These gases emit heat which increases temperature of Earth following same pattern as in above paragraph and thus causes global warming.

B. Natural causes

- **Melting of the glaciers**

Melting of glaciers is natural phenomenon. Large mountains of the ice melt due to the warmer temperature of Earth so that the new ice can accumulate. These ice mountains help to equalize temperature by beating up heat. But there is some excess melting of ice due to greenhouse gases in our atmosphere. These gases contribute to melting of ice at faster rate which leads to the increased sea levels and eventually even floods. If temperature keeps on rising, then there is chance that the glaciers might disappear which leads to flooding of the earth and destruction of the land resources.

- **Volcanic Eruptions**

Volcanic eruptions are also one of the major 10 Main Causes of Global Warming. These eruptions contain the dust particles and gases like the sulfur dioxide which stays in the atmosphere for years and blocks the sunlight from reaching surface of Earth making it somewhat cool. These dust particles affect balance of atmosphere and becomes contributing factor of the global warming. Even though these volcanic eruptions cannot be controlled but the efforts can be made to decrease sulfur dioxide levels.

- **Depletion of Ozone Layer**

Depletion of Ozone Layers another important factor included in the list of 10 Main Causes of Global Warming. The ozone layer is known as the layer outside the atmosphere which protects surface of Earth from harmful Ultra-violet and the infrared radiations causing some dangerous diseases like the skin cancer. Ozone layer depletion is one of causes of the global warming; entering of the harmful gases which helps in heating up our Earth but other greenhouse gases like the carbon dioxide and methane that helps in heating up and tears up ozone layer making a hole called "Ozone Hole". Mostly CFCs chlorofluorocarbon damages ozone layer. So ozone layer depletes due to these gases which allow UV radiations to enter Earth making Earth more warm than normal and also affects temperature leading to the global warming. It is interesting to note that

the 'Ozone Holes' are created mainly on the poles which is the reason for the melting glaciers, increase in water level of sea and of course significant rise in the temperature.

- **Effects of global warming and green house phenomenon**

There is a direct relationship between a geographical condition such as global warming and green house phenomenon. Below are some effects of global warming and green house effects.

- **Increase in temperature rise heat waves and rising temperatures**

The intense heat waves and rising temperatures are becoming more common as greenhouse gases are trapped in the atmosphere. Experts state that this will become 100 times more likely to occur over the next 4 decades. The energy from the sun which is responsible for the earth's weather and climate is radiated back into space. While this happens the greenhouse gases (water vapor, carbon dioxide, and other gases) trap some of the outgoing energy and retaining the heat. This process is like the mechanism of a glass paneled greenhouse. The greenhouse effect thus leads to a rise in temperature on, and as it becomes stronger, more heat is trapped within the planet. Majority of these greenhouse gases come from the process of burning fossil fuels to produce energy, deforestation, industrial processes.

- **Rising sea levels**

Warm surface temperatures cause glaciers, polar ice shelves and other ice bodies to completely destabilize and melt. This in turn increases the amount of water in the world's oceans thus contributing to a rise in sea levels. This rise especially threatens populations located in low-lying coastal areas because of their higher vulnerability to flooding. Scientists speculate that the melting ice from Greenland and Antarctica can rise the sea level to more than 20 feet by 2100.This is a dangerous situation especially because most of the people live in coastal areas there. At the same time, nations such as Maldives, is already considering relocation and rehabilitation.

- **Extinction of some animal and plant species**

Warming temperature of water bodies, desertification and deforestation can all contribute to the irreversible impact on natural habitat and thus threaten endangerment and even extinction of plant and animal. Eg: the polar bear is an endangered species whose numbers are falling because of their inability to adapt to the volatile temperature changes in the Polar Regions. Biodiversity is a crucial phenomenon for the existence of human beings and a loss of species of flora and fauna would threaten the entire planet. Around 30 % of plant and animal species alive today risk a chance of getting extinct by 2050 if the average temperature rises more than 2 – 11 degrees F

- **Effect on plants and animals**

All plants and animals live in regions with extremely specific climate and geological conditions, such as temperature and rainfall patterns, that enable them to survive and reproduce. Any change in the climate of the specific habitat can affect the plants and animals that exist there, as well as the overall makeup of the environment. Some species respond to warmer climatic conditions by migrating to cooler locations. Eg: Some North American animals and plants have moved to the farther north of the region or to higher elevations to meet their requirements. Climate change is also capable of altering the life cycles of plants and animals. For E.g.: warmer temperatures would imply plants would possibly grow and bloom earlier in the spring and survive longer into the fall

- **Effects on human health**

Research states that more than 1, 50,000 people die from climate change-related diseases on a yearly basis. Changes in weather conditions can lead to health conditions ranging from heat-related heart and respiratory problems to malaria. Droughts, floods and warmer temperatures combine in order to create an apt habitat for insects and creatures such as mosquitoes and other disease-carrying agents. Diseases like West Nile virus, cholera, Lyme disease and dengue fever which were earlier considered to be confined to tropical areas are now spreading worldwide due to the globally rising temperatures. The ability of mankind to react or adapt to the new conditions is completely dependent upon the magnitude and speed of it. The outcome of the scenario will also depend on our ability to recognize such epidemics early, restrict their spread, and effectively provide appropriate treatment so as to effectively cure them and to commit adequate resources, time and energy to prevention and research of other arising and upcoming diseases.

- **Storms**

The phenomenon of global warming is bound to increase the degree of severity in terms of storms. Warmer temperatures and warmer ocean waters would fuel the intensity of these storms thus leading to a high number of devastating hurricanes. On observing the pattern of storms in the past decade it can be noted that the frequency has literally doubled. Along with floods comes loss of lives, damage to property, resources

We should realize that there is a direct relationship between a geological condition such as global warming and civil unrest. Production of weapons, the oil industry etc. is often considered to be the most common reasons for global politics.

- **Ecosystem failure**

An Increase in greenhouse gases can cause drastic and irreversible changes both in the upper atmosphere and within the planet thus affecting it's every component including land, water, air etc. and the processes that occur at all these levels. If not becoming extinct, animals and plants move away to non-native habitats when the very ecosystems that they were adapted to for survival lose its quality or probably even disappear. Similarly, humans will also migrate due to changing weather conditions thus leading to a high demand for limited resources in a particular place. The effects of a climate change on physical and biological systems are already reflecting through cases like depletion of coral reefs, migration of vulnerable plants and animals, melting glaciers, formation of acidic water etc.

- **Economic collapse**

The results of climate change have a direct relationship with a nation's economy. Natural disasters such as hurricanes and floods are among effects of the global warming process which end up by becoming a costly problem for the government in terms of clean-up costs, property damage and rehabilitation costs. Crisis like this in turn result in a hike when it comes to food and energy costs. Looking at the pace of things, it has been predicted that global warming crises could be labelled with a $20 trillion price tag by 2100. Many countries run a huge risk daily because the national income is dependent on one particular area such as oil, tourism, plantation, etc. and can lose everything with the loss of that single particular sector. The presence of globalization can thus create a domino effect which means that if a country is affected, several other countries are bound to get affected too even if they might be on the other end of the globe.

- **Droughts**

A warmer climate owing to global warming will eventually lead to diminishing water supplies and pathetic agricultural conditions in turn resulting in crop failures. If these water shortages are persistent it will cause a lot of disruptions in global food production by affecting agriculture and is thus paving a way for situations such as starvation. Research states that the drought conditions are said to increase by at least a minimum of 66% by 2020. Almost more than 60% of Africa by this time will have to live in a country where the continent's agricultural output is going to drastically decrease by 50 %

- **War**

Hostilities and conflicts amongst countries are constantly on the rise as nations are competent and ruthless when it comes to acquiring resources. An important example of this is the genocide in the Darfur region situated in Sudan or the Somalian war with roots in the reduction of its natural resources due to the sole reasons of climate change. The increasing number of wars that commence on the foundation of food and water scarcities may lead to uncontrollable levels of aggression, security trouble, regional

instability, panic etc. We should realize that there is a direct relationship between a geological condition such as global warming and civil unrest. Production of weapons, the oil industry is often considered to be the most common reasons for global politics.

9. End unit assessment

Questions

1. Deforestation in many parts of the world has resulted into severe soil erosion and its associated effects.

    a) Make a field study in your home area and evaluate the effects of soil erosion

    b) Identify other major causes of soil erosion in your area.

2. Most farmers in the northern province of Rwanda use terracing as a measure of soil conservation.

    a) Explain why terracing is mostly used in this area.

    b) Describe other soil conservation techniques used in your area.

    c) Show how these techniques are helpful to the environment and sustainability.

    d) Soil is a source of livelihood in the world because it is used in many ways. Apart from agriculture, how can you use soil for your own survival in your area?

Guidance to answer:

1. a) Deforestation in many parts of Rwanda has resulted into severe soil erosion and its associated effects.

- Guide learners to make a field study in their home areas and evaluate the effects of soil erosion.
- Let learners explore the effects of soil erosion in the field and note them. They analyze and relate them to the content in the learner's book on soil erosion

b) Identify other major causes of soil erosion in your area.

- Ask learners to interpret the observed causes of erosion in the field and relate them to the content in the learner's book on soil erosion. Let them use their local environment and discuss in groups the causes of soil erosion. Supplement their answers with reference to learner's book on causes of soil erosion

2) Most farmers in the northern province of Rwanda use terracing as a measure of soil conservation.

a) Explain why terracing is mostly used in this area.

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 learners 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) Describe other techniques of conserving soil used in your area.

- Let learners brainstorm on appropriate techniques of conserving soil in their area and relate them to the content in the learner's book.

c) Show how these techniques have helped to the environment and sustainability.

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

d) Soil is a source of livelihood in the world because it is used in many ways. Apart from agriculture, how can you use soil for your own survival in your area?

- Put learners in groups of 5 and ask them to make a discussion on how soil is used in their area. Relate their findings to the content in the learner's book on importance of soil.

10. Additional activities

a) 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

b) Consolidation activities

1) Compare the effects of climate change in different provinces of Rwanda.

Rwanda has four provinces and Kigali city. The effects of climate change are not at the same level because they are influenced by different factors due to the physical conditions of the given area like the nature of slopes, vegetation type, altitude, drainage and human influences like economic activities of people in the region as industrialization and type of farming practiced.

Northern and Western provinces are subjected to almost the same effects of climate change. These are a result of high mountains with steep slopes and a lot of valleys. The following are the effects of climate change likely to happen in the above provinces:

- Significant increase in precipitation at a rate of between 2 and 6.5 mm per year over the Congo-Nile crest and the northern mountains and highlands for the period of 1935–1992.
- The floods that occurred in May 2002 have caused the death of 108 persons in North western regions while the one that occurred in 2007 has resulted into displacement of more than 456 families and destruction of hundreds of hectares of crops in Bigogwe sector in Nyabihu District.
- During September 2008 heavy rainfall accompanied with winds have affected 8 of the 12 sectors of Rubavu district and have provoked the displacement of more than 500 families and the destruction of about 2,000 hectares of crops and many other infrastructures.
- The landslides and floods caused by heavy rainfall are regularly observed mainly in north western part of Rwanda (Rulindo, Gakenke, Musanze, Nyabihu and Rubavu districts). For instance, the floods which occurred on 2nd and 3rd April 2016 caused the death of 12 people and injured 19 people and destroyed 196 houses across the country. The floods which took place in Musanze district on 20th April 2016, caused the destruction of 64 houses and many hectares of crops as well as cattle.
- More occurrences of lightning combined with the thunderstorms in 2013 caused 12 deaths in Karongi, 12 in Rubavu, 4 in Rusizi and 5 death Rutsiro districts, respectively.

After the above effects of climate change occurring mostly in Northern and western provinces of the country, the following are some of the effects which are significant in Southern and Eastern parts of the country:

Since 1902, many famines following prolonged droughts episodes have been registered in Rwanda notably in eastern and south-eastern (Nyaruguru, Muhanga) regions.

Kigali city experiences almost the same as the East and South Provinces but particularly the tremendous increase in temperature caused by high population pressure, gases emitted from the industries and exhaust fumes from vehicles.

c) Extended activities

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

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 these students 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.

UNIT 9: GLOBAL DRAINAGE SYSTEMS

9

1. Key unit competence

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

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

Unit 8 of senior 4 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 senior 4 will help learners in S6 to clearly learn more about the global drainage. In the learner'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.

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 teacher, guide learners 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 learner'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, 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 learners in groups to discuss 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 learners but also transforms what they have acquired into action. The learners can manage water properly at their homes and save money. Ask learners 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.

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:

    i) Drainage system, a river and associated terms like river discharge, river velocity, catchment area, a river divide and a river basin.

    ii) How does a river erode, transport and deposit its load?

2) Referring to the nearest river or Lake in your local environment or near your school

   i) Explain the usefulness of drainage systems.

   ii) Discuss why there is need to conserve drainage systems.

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

5. List of lessons (including assessment)

#	Lesson title	Learning objectives(from the syllabus including knowledge, skills, attitudes and values):	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	5
2	The 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 capture Effects of river capture	Explain river capture and river rejuvenation Differentiate between the river capture and river rejuvenation	2
4	Drainage in the world -Drainage pattern in the World (Trellis, Dendritic, Rectangular, Radial, Centripetal, Annular, Barbed drainage pattern, Pinnate, Herringbone drainage pattern and Parallel drainage patterns) -Superimposed and antecedent drainage	Identify the different drainage patterns of the world Explain the different drainage patterns in the environment Appreciate the classification of the drainage patterns	3
5	Impact of rivers Impacts of rivers Case Study: The River Nile/ Amazon or Ganges	Identify the importance of a river Evaluate the importance of the rivers	3

6	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.	6
7	Marine Relief Case studies in Australia on ocean management projects The great Barrier Reef	Describe the distribution of the oceans, seas and the marine relief.	2
8	Ocean currents Definition, Location Types Causes Characteristics Influence on climate and adjacent lands	State the characteristics of the ocean currents, their causes and the effects Explain the characteristics of the ocean currents, their causes and the effects Show concern for the causes and the effects of the ocean currents	3
9	Tides Definition Types Causes Effects	State the types of the tides Explain the causes and the effects of the tides Show concern for the causes and the effects of the tides	1

10	Reasons for protection of global water bodies	Show continual desire to protect the water bodies (wet lands) for the conservation of the environment	1
11	End unit assessment		1

6. Guidance on different lessons

Lesson 1: River system

a)Introduction

This topic on drainage was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners learnt drainage system in Rwanda.

Facilitate the learners to review the senior 4 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 learner's book, the learners 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.

b)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

c)Learning activities

Refer to the introductory and learning activities 9.1 in the learner's book

Help learners to work in groups, they will be able to define a river and the terms used in the study of rivers, explain the work of a river and the characteristics of a river profile. The learners are also guided to make research on the river profile and its characteristics.

Guidance to answer learning activities

Use pictures and objects as much as possible and peer learning to help children with special needs. Learners do similar activities on every stage of a river, identify, discuss in groups and present their findings in class. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills. Engage learners (including those with special needs) in activities like discussion, asking and answering questions

For more answers they are referred to the learner's book on river system

d)Application activity

Refer to the application activities 9.1 in the learner's book

Guidance to answer application activities:

Guide learners to do research, discuss and write down the findings. Learners 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 learner's book on river systems.

Lesson 2: The landforms associated with a river profile

a)Introduction

Display the drainage illustration in the learner's book showing a cross and long profile of a river from its source to its mouth. Then ask learners 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 put learners in groups and guide them to make research on the landforms associated with a river profile.

b)Teaching resources:

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

- 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

c)Learning activities

Refer to the learning activities 9.2 in the learner's book

Guidance to answer learning activities

Guide learners 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 learners observe the diagrams in the learners' book on landforms associated with a river profile. Let them do research and discuss in groups. The learners present their findings in class. Supplement their answers. Pair children who have 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, research and problem-solving skills.

Engage learners (including those with special needs) in activities like discussion, asking and answering questions.

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

d)Application activity

Refer to the application activities 9.2 in the learner's book

Guidance to answer application activities

Learners 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 learner's book on landforms associated with a river profile.

Lesson 3: River capture and river rejuvenation

a)Introduction.

Learners 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 learners.

b)Teaching resources:

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

c)Learning activities

Refer to the learning activities 9.3 in the learner's book

Guidance to answers the learning activities

Learners 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 learners' answers and presentations. Pair children with disabilities with other children. Let them do things together and learn from each other. Give remedial activities to learners 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 learners (including those with learning impairments) in activities like discussions, presentation, asking and answering questions. For more answers they are referred to the learner's book on river capture and river rejuvenation.

d)Application activity

Refer to the application activities 9.3 in the learner's book

Guidance to answers application activities

Ask learners to illustrate and describe the features associated with river capture and river rejuvenation. They will use the content given in the learner's book on river capture and river rejuvenation to describe the features associated river capture and rejuvenation, their causes and effects.

Lesson 4: Drainage in the world

a)Introduction.

Learners are asked to describe the global drainage patterns. Briefly talk about the characteristics of global drainage patterns. Let learners use drainage in their local environment or do research to describe drainage. Supplement the answers given by learners and introduce the content related to drainage patterns.

b)Teaching resources:

- 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

c)Learning activities

Refer to the learning activities 9.4 in the learner's book

Guidance to answer learning activities

Put learners in groups; guide them to research, illustrate and describe the drainage patterns. Afterwards refer them to the learner's book to discuss and illustrate the global drainage patterns. They present their findings in class. Pair children with special needs are with other children during group work and discussions. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers they are referred to the learner's book on global drainage.

d)Application activity

Refer to the application activities 9.4 in the learner's book

Guidance to answer application activities

Learners are asked to visit the nearby river in their district or province to identify drainage pattern and the factors influencing the development of global drainage patterns. They compare drainage patterns in their districts to other drainage patterns in Rwanda. They describe the formation of antecedent and superimposed drainage. They also use the content given in the learner's book on drainage patterns.

Lesson 5: Impact of rivers

a)Introduction

Learners visit any river in their locality and identify the value of that river or stream to human beings. They are guided to discuss and write down the positive and negative impacts of rivers. They will use the learner's book and explain the impact of rivers. They present the findings in class.

b) Teaching resources:

- 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

c)Learning activities

Refer to the learning activities 9.5 in the learner's book

Guidance to answer learning activities

In groups, learners discuss the impact of rivers from the learner's book. Guide them to distinguish the positive from negative impacts through discussion. Let them identify and discuss the relationship between the river and human activities. They may also visit any nearby river in their local environment and describe the relationship between that river and human beings living there. Guide them to study the diagrams and maps used in the learner's book on impact of rivers. Let them read the case study on river Nile. Let them compare the developmental activities along river Nile and relate these to other development projects on other rivers in their locality. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions.

For more answers they are referred to the learner's book on impact of rivers.

d)Application activity

Refer to the application activities 9.5 in the learner's book

Guidance to answer application activities

Learners are asked to refer to rivers like Mukungwa and Nyabarongo to discuss their impacts to people living near them. They will also use the content given in the learner's book on the impact of rivers, case study and internet to describe the impact of rivers.

Lesson 6: Lakes, Seas and oceans

a)Introduction.

Review the previous work on rivers and ask learners to identify the major lakes, oceans and seas. Let them identify the lakes in Rwanda and describe their mode of formation. Guide learners to research on Lakes, seas and oceans in the world. Briefly supplement the answers given by learners.

b)Teaching resources:

- Text books
- llustrations
- 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

c)Learning activities

Refer to the learning activities 9.6 in the learner's book

Guidance to answer learning activities

Guide learners to use internet and other geographical documents to research on types of lakes, seas and oceans. Group learners with special needs with other children to research on lakes, seas and oceans. Let learners describe the mode of formation of Lakes and the impact of lakes, seas and oceans. In groups guide learners to use diagrams and maps in the learner's book to locate lakes, oceans and seas. Let them explain the impact of Lakes, seas and oceans. Guide learners to make class presentation on Lakes, seas and oceans. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers they are referred to the learner's book about Lakes, seas and oceans.

d)Application activity

Refer to the application activities 9.6 in the learner's book

Guidance to answer application activities

Learners draw a sketch map of Rwanda and locate the major types of Lakes. Then, they explain the mode of formation of lakes in Rwanda in relation to other Lakes in the world. They discuss and explain the influence of oceans and seas to Rwanda. The learners use the content given in the learner's book about the impact of Lakes, oceans and seas.

Lesson 7: Marine relief and case studies of ocean management project of the Great Barrier Reef in Australia

a) Introduction

Guide learners to research on Marine relief and Great Barrier Reef of Australia. Learners discuss and illustrate different kinds of marine relief. Let them research on the Great Barrier Reef of Australia. Guide learners to explore the content in the learner's book related to Marine relief and Great Barrier Reef. Supplement the learners' answers.

b)Teaching resources:

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

- 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

c) Learning activities

Refer to the learning activities 9.7 in the learner's book

Guidance to answer learning activities

Guide learners to work in groups, they will be able to identify and differentiate between marine features. Ask learners to research the case study on the Great Barrier Reef. In research, discussions and presentation, pair learners with disabilities with other learners especially those that are very friendly to them. After guiding the learners in discussions and research on Marine relief and barrier Reef, let them present the findings in class. They should use the content provided in the learner's book on Marine Relief and the Great Barrier Reef. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers to the activities refer to the learner's book on marine relief.

d)Application activity

Refer to the application activities 9.7 in the learner's book

Guidance to answer application activities

Learners are asked to describe the contribution of marine relief to aquatic life. The learners are asked to discuss the economic importance of the Great Barrier Reef to people living in Australia. They will use the content given in the learner's book and other geographical documents about Marine Relief and the Great Barrier Reef.

Lesson 8: Ocean currents

a)Introduction

Guide learners to use the geographical resources to research on ocean currents in the world. Let them observe critically the map in the learner's book on ocean currents. They locate and name the ocean currents. They should observe waves over the surface of water on any lakes in their locality and explain the meaning of ocean currents.

b)Teaching resources:

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

- 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

c)Learning activities

Refer to the learning activities 9.8 in the learner's book

Guidance to answer learning activities

Guide learners to work in groups, they will be able to identify and describe the major types and location of ocean currents in the world. Let them do research or use internet and identify the types of ocean currents. Guide them to discuss in groups about ocean currents. Let them present the findings in class. In doing the activity, group learners with disabilities with other learners and those that are friendly to them. They should use the content provided in the learner's book about the Ocean currents. Their answers should develop competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers on the activity, refer to the learner's book on ocean currents.

d)Application activity

Refer to the application activities 9.8 in the learner's book

Guidance to answer application activities

Guide learners to describe the relationship between ocean currents and the climate of Rwanda. Let learners brainstorm on the reasons why some ocean currents are warm whereas others are cold. They will use the content given in the learner's book on ocean currents.

Lesson 9: Ocean Tides: Definition, types, causes and effects

a)Introduction

Help learners to use internet and other geographical resources to do research on tides, types of tides causes and effects. Ask learners to identify and explain tides, types, causes and effects. Then put learners in groups and guide them to discuss about tides.

b)Teaching resources:

- 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

c)Learning activities

Refer to the learning activities 9.9 in the learner's book

Guidance to answer learning activities

Guide learners (including those with special needs) work in pairs, they will be able to identify the types of tides and describe tides in the world. Then help them to research on the causes and effects of tides. They should use the content in the learner's book on tides. They will present the findings in class. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers refer to the learner's book on causes and effects of tides.

d)Application activity

Refer to the application activities 9.9 in the learner's book

Guidance to answer application activities

Learners are asked to discuss the relationship between tides and winds. They refer to Rwanda and describe the effects of tides on Lake Shores of Rwanda. They will use the content given in the learner's book on the tides and they will also use other geographical documents to analyze the types, causes and effects of tides in the world.

Lesson 10: Reasons for protection of global water bodies

a)Introduction

Guide learners to refer to their local area and identify the human activities carried out along rivers or lakes in Rwanda. Then ask learners to explain why there is need to protect water bodies in Rwanda. Then put learners in groups and guide them to make research on the reasons for protecting the global water bodies.

b)Teaching resources:

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

- 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

c)Learning activities

Refer to the learning activities 9.10 in the learner's book

Guidance to answer the learning activities

In groups, help learners to identify and describe what is being done by people along lakes and river valleys of Rwanda. Then, ask them to describe why people are doing such activities along rivers and lakes. After that, help them to research on the reasons for protection of global water bodies. They should use the content in the learner's book on the reasons for protection of global water bodies. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

For more answers about the activities, refer to the learner's book on reasons for the protection of global water bodies.

d)Application activity

Refer to the application activities 9.10 in the learner's book

Guidance to answer application activities

Learners are asked to discuss the reasons for water protection at their schools. They describe the role of protecting their local environment as well as the global water bodies. They will use the content given in the learner's book on the reasons for protection of global water bodies and geographical document to internalize the reasons for protecting the water bodies in Rwanda as well as protecting global water bodies.

7. 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, Marine relief: (The Great Barrier Reef case study), the ocean currents (their definition, location, types, causes, characteristics and their influence on adjacent lands, Tides (their definition, types, causes and effects, importance of ocean currents and seas and the Reasons for the protection of the global water bodies.

This unit intends to help learners to explain various types of drainage systems and the landforms associated with them as a result of the work of a river. It helps learners to analyze the importance of rivers, lakes, seas and oceans in relation to the surrounding environments and human activities. This will help learners 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 helps learners acquire environmental conservation and global management skills (control measures) that creates awareness for environment and global drainage protection for future economic development and sustainability.

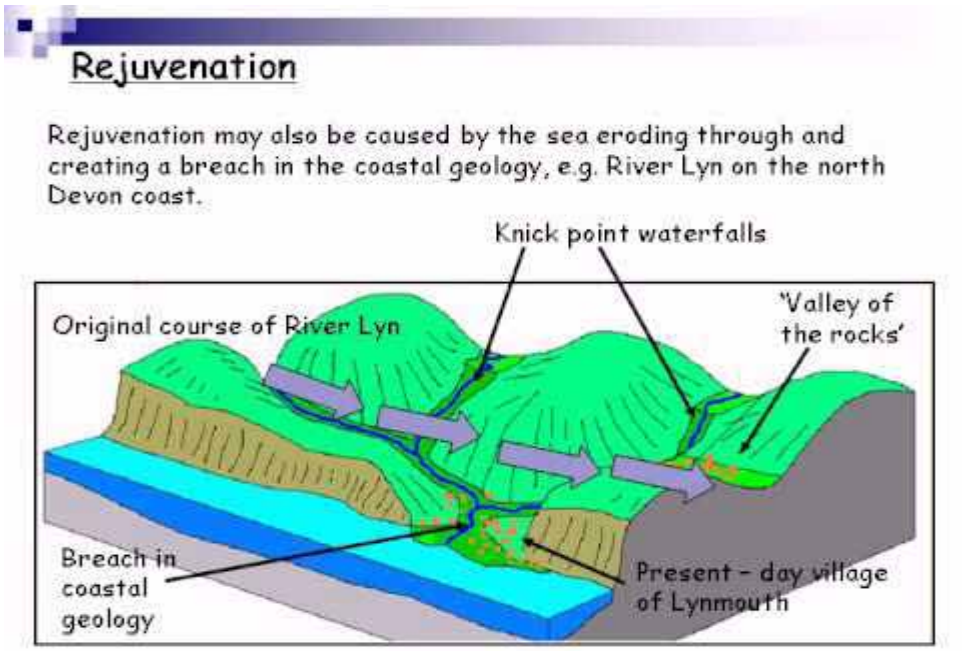
8. Additional Information

This unit is linked to unit 8 in senior 4 on the Drainage system in Rwanda. It is vital for learners to link the prior knowledge acquired in senior 4 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 learner'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.

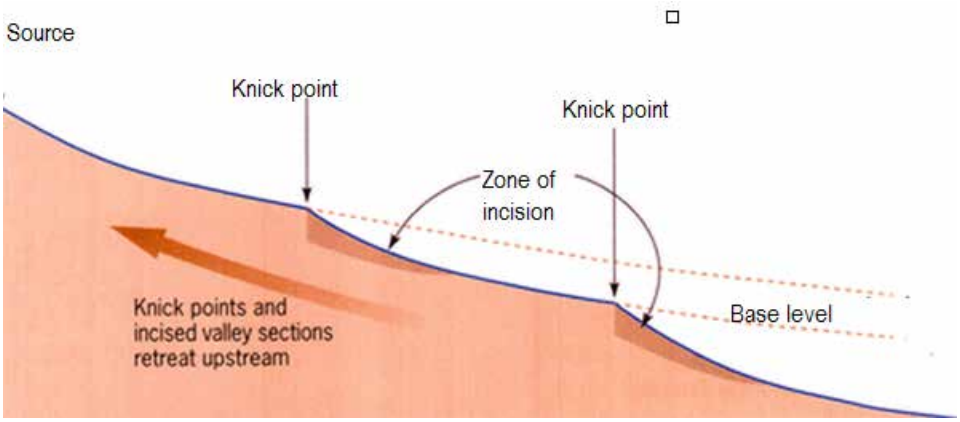
The learner's book doesn't contain illustrations on river rejuvenation. You will guide the learners to do research on diagrams or illustrations related to river capture and river rejuvenation. Below are some of the additional content and illustrations on river rejuvenation.

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.

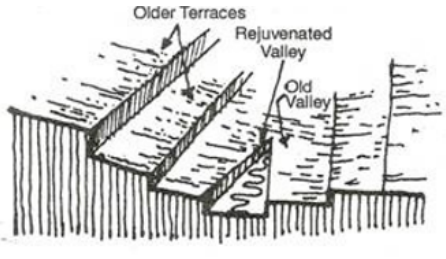


2)Paired terraces

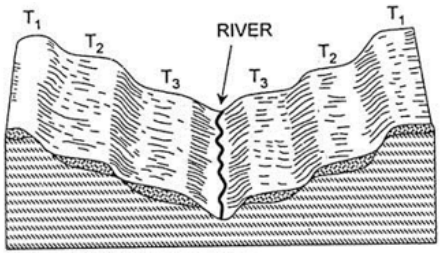
Paired terraces are steps or bench like cuts on the sides of a rejuvenated river valley. They are occupied by layers of old gravel and alluvial deposits. It is also the former flood plain that is at a higher elevation due to a river that has renewed its erosive activity causing it to deepen its valley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



Paired terraces.



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.

Incised meanders

Advantages of ocean tides

Seawater is a non-polluting source of energy that can be used to generate electricity. Its advantages are many: no burning fossil fuels. No polluting the air, no worry about running out of electricity for heat air condition.

Electric power-generation plants that use tidal energy already have been built in France, Russia, and China. For instance, in the Bay of Fundy in Nova Scotia (Canada), the tidal range reaches 16 m. it is a perfect location for trapping energy of the tides. The water moves through a narrow opening into a funnel-shaped bay. At high tides, the water is trapped in the bay by the force of the incoming tide. Then at low tides, the bay flashes out. The large gates of the dam would let water enter the bay at high tides. Then the gates would close. Water would be stored behind the dam. As the tide went out, the dammed water would pass over turbines in the dam, generating electricity. A turbine is similar to a fan blade. When the water pushes, against the blades, a turbine spins and generates electricity.

9. End unit assessment

Questions

1) Some ocean currents originate from warm regions and others from cold regions. Describe the relationship between ocean currents and the atmospheric circulation.

2) Conduct your own research to describe the major ocean management projects in the world.

3) Discuss the economic advantages of drainage in Rwanda, and in the world.

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

Guidance to answers

1) Describe the relationship between ocean currents and the atmospheric circulation.

   - Guide learners to describe why some ocean currents are warm and why others are cold referring to their origin.
   - Facilitate learners in groups to discuss how each of the ocean currents (named above) influence atmospheric circulation.
   - Guide learners to share the answers by using experience in their local environment; they brainstorm on the relationship between ocean currents and atmospheric circulation (especially influencing winds and other weather elements of the adjacent areas).

2) Conduct your own research to describe the major ocean management projects in the world.

   - Guide learners 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.
   - Refer them also to the learner's book on the Great Barrier Reef. Their answers must have clear examples of global management techniques (where possible).

3) Discuss the economic advantages of drainage in Rwanda, and in the world.

   - In groups let learners discuss and brainstorm on economic advantages of drainage.
   - Refer them to the learner's book on importance of drainage.
   - Guide them to suggest the advantages 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 learners 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.

10. Additional activities

a) Remedial activities (for slow learners)

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) 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 learner'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.

b) Consolidation activities:

i) Account for the conservation of the environments along Lakes and rivers in Rwanda.

ii) Assess the economic importance of rivers and Lakes in the world

Guidance for answers to consolidation activities

i) Account for the conservation of the environments along Lakes and rivers in Rwanda.

- Guide learners how to answer the above questions using learner's book and internet.

ii) Assess the economic importance of rivers and Lakes in the world

- Facilitate learners 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 learner's book on economic importance of rivers and lakes

c) Extended activities (for gifted and talented learners)

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

Guidance to answer:

- Let the learners 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.

UNIT 10: POWER AND ENERGY PRODUCTION IN THE WORLD

10

1. Key unit competence

By the end of this unit, learners should be able to evaluate the success of sustainable development projects in power and energy production in different parts of the world

2. Prerequisite (knowledge, Skills, attitudes and values)

Unit 19 of senior two, unit 14 of senior three and Unit 15 of Senior 4 introduced the study of power and energy in Africa and discusses about major sources and forms of energy sources, different problems associated with the physical, human and economic environment and suggest solutions in Rwanda. This unit greatly constitutes a strong prerequisite that learners can use to understand better the content of this unit 10 of senior six. It's very important to note that, they already have necessary knowledge, skills and attitudes. The difference is that, at this level the content in the student's book is more detailed and almost differ from what they learnt previously.

The already acquired knowledge, skills, attitudes and values from previous classes, should be used by the teacher to conduct diagnostic assessment as a way of evaluating each learner's abilities. The teacher should refer to knowledge, skills, attitudes and values associated with power and energy that learners acquired from the previous classes with the purpose of establishing connections between the new learning activities and the previous ones.

In unit 10 of senior 6 entitled the **"Power and Energy Production in the world"**, the introductory activity presented in the student's book intends to remind learners that the power and energy sources are used and exploited in different countries of the world. This enables learners evaluate the success of the sustainable development projects in the power and energy production in different parts of the world. 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.

3. Addressing Cross-cutting issues

There are many cross-cutting issues that can be highlighted in this lesson. The following list of cross-cutting issues can be applied where possible depending on occasion, for example:

a) Environment and sustainability

The issue of environment and sustainability will be integrated through all learning activities to address the problems related to the power and energy. Thus, the teacher is required to explain to students about the alternative sources of power and energy that are friendly to the environment, for the use of natural gas for cooking and heating purposes in their local environment.

b) Peace and Values Education

Education on peace and values will constitute a component that will be addressed during the class situation whereby a teacher can refer to learning activities where people work together to get public lighting which strengthens security.

c) Financial Education

On one side it can be addressed during the class situation whereby a teacher explains to the learners the most appropriate use of power and energy either at school or at home. For instance, learners should not waste power and energy. They should remember to switch off lights especially during the day or other power tunnels when they are not in use.

d) Inclusive education

The teacher should ensure that the learners with impairments or special needs like physical disability to cope with the situation. In this context the teacher can use a video or film on different sources of energy or the teacher can even bring different source energy in classroom setting for those who will not be able to reach the place. For learners with hearing disabilities or communication difficulties, in different learning activities the teacher will help them using enough illustrations, diagrams and sign languages where possible.

For learners with visual impairment, the teacher helps children to use their other senses like hearing and touch because these senses can help them to play and carry out some of learning activities thus promoting their learning and development. In this context the teacher will be supposed to provide sufficient explanations related to different learning activities so that learners with visual impairment can carry out the designed learning activities using their hearing.

4. Guidance on the introductory activity

The teacher should let his /her students read carefully the introductory activity and answer the questions linked to the given activity.

When the learners fail to come up with right answers to the questions related to introductory activity, the teacher will not immediately provide the required answers rather he /she should let students get the real answers through the whole learning and teaching process.

Some answers for the introductory activities are set in the form of statement and diagrams and the learners are required to think out of the box. This implies that they must associate with other lessons studied in previous lessons of S2, S3 and S4.

5. List of lessons (including assessment)

The table below highlights all the lessons that have been prepared in relation to the content of Unit 10, as well as the period allocated to each of them.

s/n	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	Number of Periods
1	sources and forms of Energy used in the world • Classification of energy sources • Non-renewable energy sources A. Nuclear energy (Uranium) B. Coal i) Types of Coal ii) Uses of coal c) Petroleum Oil i) Three grades of crude oil according to gasoline yields ii) Uses of petroleum D. Natural gas • Renewable energy sources A. Wind energy B. Water energy i) Physical conditions ii) Economic conditions C. Solar energy D. Biomass i. Wood fuel ii. Waste products (Biogas) iii. gasohol E. Geothermal energy F. Tidal energy	Identify the major world's sources of energy.	6

2	Factors and importance of power and energy production in the world. Factors favoring power and energy production in the World. Importance of power and energy in the development of the world.	Explain the factors affecting power production. Explain the importance of the power and energy in the world.	4
3	Problems and possible solutions for power and energy Problems hindering the development of power and energy production in the world. Possible solutions for power and energy in the World.	State the problems hindering the development of the power and energy and suggest the solutions.	3
	End unit assessment		1

6. Guidance on different lessons outlined above

Lesson 1: Sources and forms of energy used in the world 0

a) Introduction:

Tell the learners to observe critically the pictures in the learner's book on different forms of power and energy. Learners should identify different types of power and energy. Ask learners to research on other types of energy and describe their contribution to sustainable development.

b) Teaching resources:

During the teaching and learning process, the teacher should refer to the following teaching resources where possible.

- Pictures
- Flip charts
- Manila papers
- Print outs for the activity
- Text books
- Internet

- Maps
- Field work to the surrounding area.

c) Learning activities

Refer to the learning activities 10.1 in the learner's book

Guidance to answer learning activities

Let students read carefully the questions related to learning activity and answer them. Let learners predict possible solutions or answers. Let students get the real answers through the whole learning and teaching process. They should use the content in the learner's book on sources and forms of energy used in the world. They should discuss and present the findings in class. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions. For more answers refer to the learner's book on sources and forms of energy used in the world.

d) Application activity

Refer to the application activities 10.1 in the learner's book

Guidance to answer application activities

They should use the content given in the learner's book on sources and forms of energy used in the world.

1. i) For the activities that require power and energy at your school, we can list transport and communication, ICT, industrial products and development, education, banking, cooking, etc.

   ii) The Forms of Power and Energy needed include: coal, charcoal, petroleum, hydroelectric power, biomass, etc. Refer to student's book on sources and forms of energy used in the world.

2. i) Sources of power and energy exploited in Rwanda include: biomass; hydropower, solar energy, thermal energy, etc. Refer to student's book on sources and forms of energy used in the world.

   ii) Sources of power and energy non-exploited in Rwanda include uranium energy, tidal energy, wind energy, etc. refer to student's book on sources and forms of energy used in the world

Learners should be asked to discuss the sources and forms of energy used in the world. They should use the content given in the learner's book on sources and forms of energy used in the world.

Lesson 2: Factors and importance of power and energy production in the world

a) Introduction

Ask questions related to the previous lesson. Guidelearners to answer questions critically. Refer to the learner's book on factors and importance of power and energy production in the world for answering.

b) Teaching resources

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

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

c) Learning Activities

Refer to the learning activities 10.2 in the learner's book

Guidance to answer learning activities

Guide students to describe the areas of power and energy production in Rwanda. Let them discuss the challenges faced by using power and energy. Present the findings in classrooms.

They should use the content in the learner's book on factors and importance of power and energy production in the world. They should discuss and present the findings in class. Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions.

- The areas of power and energy production in Rwanda, showing the reasons of their geographical location. - Western Province we have hydropower dams like Rusizi I & Rusizi II because of the presence of enough water from Lake Kivu, waterfalls and rapids. There is also solar energy because the climate allows it with high solar radiation. – Ntaruka hydropower in Northern Province between lakes Burera and Ruhondo due to favourable river (Ntaruka), relief favouring conditions for the construction of dam, water fall and rapids.

Refer to the student's book (Unit 10) on factors and importance of power and energy production in the world.

- Challenges that Rwandans would face if those areas had not been identified: shortage of power and energy in different forms, delay in development of industries, etc. Refer to the student's book on factors and importance of power and energy production in the world.

For more answers refer to the learner's book on sources and forms of energy used in the world.

d) Application activity

Refer to the application activities 10.2 in the learner's book

Guidance to answer application activities

1. The learners are expected to give a wide range of answers. But all should rotate around the requirements for Rwanda to fully exploit its available power and energy sources. The learners are expected first of all to provide some requirements like availability of power and energy sources, enough capital, skilled manpower, encourage experts to do a scientific research, improved technology, etc.

2. For this question the students will visit the local industrial areas and identify the role of power energy in daily activities of such an industry. Here, the local industrial areas can include Masoro Industrial Free zone, CIMERWA Plant Ltd, BRALIRWA Ltd, Inyange Industries Ltd, etc. The role of power and energy in daily activity can be the following: enable production process, enable packaging process, work day and night, infrastructure development, etc. For more details please refer to student's book on factors and importance of power and energy production in the world.

Lesson 3: Problems and possible solutions for power and energy

a) Introduction

Ask questions related to the previous lesson. Guide learners to answer questions critically. Refer to the learner's book on factors and importance of power and energy production in the world for answering.

b) Teaching resources

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

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

c) Learning Activities

Refer to the learning activities 10.3 in the learner's book

- Guide students to identify problems of power production and suggest solutions to them.
- Let students discuss the problems and solutions of power production.
- Students should present their findings in class.
- They should use the content in the learner's book on problems and possible solutions for power and energy.
- Their answers should develop competences such as critical thinking, cooperation, communication, research and problem-solving skills.
- Engage learners (including those with learning impairments) in activities like discussion, asking and answering questions.

Guidance to answers for learning activities

i. Problems of power production sector include the following:

- Biomass energy source remains dominant for cooking and other household uses.
- The supply side must be more productively managed, and charcoal more efficiently produced and used.
- The country requires funding for the development of the energy sector. There are unfavorable conditions associated to the loans and grants from suppliers of funding.
- There is an urgent need of developing adequate local expertise to manage the energy sector.
- The high cost of transport of imported oil products to produce power. The transport is higher than in the neighboring countries.
- The challenge of ensuring efficient and safe use of oil products especially in the transport sector.
- There is insufficient standardization and quality control of petroleum products and inadequate enforcement and uncoordinated safety measures.
- There is need for awareness by both consumers and producers of the renewable energy alternatives and technology availability.
- There is low consumption of commercial energy as people still rely on wood fuel.
- Low generation capacity to meet the increasing demand and low access to electricity.
- Lack of sufficient institutional, legal & regulatory framework and human capacity.
- Ineffective modalities for implementation and management of shared generation resources in case Rwanda was to partner with other neighbouring countries.

Refer to the student's book (Unit 10) on problems and solutions for power and energy.

ii. The possible solutions to the identified problems

Refer to the student's book on problems and solutions for power and energy.

c) Application activities

Refer to the application activities 10.3 in the learner's book

Learners are expected to provide a wide range of answers that rotate on the power and energy.

Possible answers:

1. The learners are expected to give a wide range of answers. But all should rotate around the energy status of Rwanda and its importance to national development. The present electricity supply in Rwanda is derived principally from thermal and hydropower sources. Rwanda has variety of potential energy resources from biomass, water, solar, petroleum, methane gas, wind and geothermal. For more details please refer to student's book on problems and possible solutions for power and energy.

2. Description of the problems highlighted in the interview. For more details please refer to student's book on problems and possible solutions for power and energy.

3. Basing on East African Community countries experience, explanation of the importance of power distribution can be the following:

- participating in development of country members.
- The power energy can be exported in neighboring country and in that way, it is contributing in earning the foreign money. The economy of many countries is depending on the production of petroleum which is the most used worldwide as source of energy.
- The engine that moves the industrial sector is energy and without it the whole sector would ground to a standstill. Most industries use petroleum and its by-products to run the machines. Electricity is also used to run machines while wood fuel is used in various processing industries such as tea processing.
- Petroleum is used in road transport, water transport and air transport meaning that it is the basic element in transport.
- The generation of electricity is offering employment to a good number of people.
- Solar energy is used to dry grains and other products such as tobacco, cocoa and coffee. Petroleum and its by-products are used to run water pumps and other agricultural machinery. Wind power is used in dry regions to pump water for irrigation.
- Various forms of energy are used for various purposes such as cooking, lighting and heating. In the rural areas, the main sources of energy are firewood, charcoal and liquid petroleum. In Urban sector, charcoal, kerosene, liquid petroleum, gas and electricity are used.

For more details please refer to student's book on problems and possible solutions for power and energy.

7. Summary of the unit

Unit 10 of senior 6 deals with power and energy. The key points of content to be highlighted in the unit are sources and forms, types of power and energy, importance of power and energy, problems and possible solutions to power and energy. This unit content gives more details about the exploitation, distribution and location of power and energy to the world.

8. Additional Information

List of countries by electricity production from renewable sources

This article is a list of countries by electricity generation from renewable sources every year. Note that most countries import and/or export electricity, so the percentage figures do not reflect the percentage of consumption that is renewable based.

Based on REN21's 2016 report, renewables contributed 19.2% to humans' global energy consumption and 23.7% to their generation of electricity in 2014 and 2015, respectively. This energy consumption is divided as; 8.9% coming from traditional biomass, 4.2% as heat energy (modern biomass, geothermal and solar heat), 3.9% hydro-electricity and 2.2% is electricity from wind, solar, geothermal, and biomass. Worldwide investments in renewable technologies amounted to more than US$286 billion in 2015, with countries like China and the United States heavily investing in wind, hydro, solar and biofuels. Globally, there are about 7.7 million jobs associated with the renewable energy industries, with solar photovoltaic being the largest renewable employer. As of 2015 worldwide, more than half of all new electricity capacity installed was renewable.

9. End unit assessment

However, the learners should give their own opinion/view or self-constructed answers, their answers will rotate to the content in reference with the following possible answers for end unit assessment:

1. Even if it is known that the school environments are not the same in terms of sources and forms of power and energy used. For further information, refer to student's book on power and energy production in the world
2. Refer to student's book on power and energy production in the world
3. Refer to student's book on power and energy production in the world
4. Refer to student's book on power and energy production in the world
5. Refer to student's book on power and energy production in the world

10. Additional activities

a) Remedial Activities

The following are questions that the teacher can use for remedial activities (activities for slow learners). They are rephrased in a way that the slow learners can also be assisted to raise their self-confidence and at the same time learn in the simplest possible way.

1. Identify the main sources of power and energy in Rwanda

   Answer: hydropower, solar energy, thermal energy

2. Give 2 examples of renewable energy sources

   Answer: wood fuel, hydroelectricity, solar energy

3. Give 1 importance of power and energy

   Answer: for cooking, lighting and heating

b) Consolidation activities:

Establish the link between power and energy

Answer: Power is the capacity of energy, which is being used, while energy is 'joules', power is 'joules per second'. In other words, Power is 'watt' and Energy is 'watt-hour'. Another difference is that energy can be stored whereas power cannot be stored.

c) Extended activities

Describe the following energy sources.

(i) Non-renewable energy sources;

(ii) Renewable energy sources

Possible answers:

Before coming up with answers to this question, students should first define each sources of energy. The definitions associated with the key terms are very important. The students may say that Non-renewable resources are those when exhausted they cannot be re-used, whereas renewable resources are inexhaustible.

UNIT 11: INDUSTRIALISATION IN THE WORLD

11

1. Key unit competence

The learners should be able to evaluate the success of the sustainable development projects in the industry in different parts of the world.

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

Unit 16 of senior 4 introduced the study of industry in Rwanda. They studied types of industries, factors, importance, problems of industrial development in Rwanda. They also studied solutions to mitigate the problems of industries as well as case studies related to industries in Rwanda.

In the learner's book there is an introductory activity, it is intended to identify categories of industry in the world, factors for location of industries and industrialized regions. This will help learners to understand appropriate measures to be taken in conserving the environment. Therefore, a teacher emphasizes the cross cutting issue of environment and sustainability.

3. Cross-cutting issues to be addressed

A citizen has to 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 to mitigate the problems caused by industry; the learners should know how to protect their environment.

Financial education is another cross-cutting issue that is linked to the study of the economic importance of industries. This economic activity has helped people to earn a living and national income for sustainable development.

Standardization culture is another cross-cutting issue that is linked to the study of various industrial products produced by major industries indicated in different case studies. These products must have a measurable standard for people's health.

4. Guidance on introductory activity

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

1. According to you, in which category of industry does Mr. Gatete belong to?
2. Explain the factors on which Amahoro Cooperative Society base on to establish the factory which transforms Gatete's products and the problems that may be associated to the factory.
3. Make research on internet and find out five examples of more industrialized countries in the world and describe the factors for their industrial development.

5. List of lessons (including assessment)

	Lesson title	Learning objectives (knowledge, skills, attitudes and values)	Number of periods
1	Definition, classification of industries, factors influencing location of industries and major world industrial regions	Identify and explain different types of industries. Explain the factors influencing location of industries	2
2	Importance of industries and problems affecting industrial development	Identify and evaluate the importance of industrial development and problems affecting industries in the world.	2
3	Problems resulting from industrial development and ways to mitigate them	Explain the problems resulting from industrial development and possible ways to mitigate them.	2
4	Case studies on major world industrial regions	State the major industrial areas and describe the major factors influencing industrial development in different regions	7
5	Assessment		1

6. Guidance on different lessons outlined above

Lesson 11.1: Definition, classification of industries, factors influencing location of industries and major world industrial regions.

a) Pre-requisites/ Revision /Introduction

This topic on industrialization was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4, learners learnt industry in Rwanda.

Facilitate the learners to review senior 4 contents by asking them to explain the types and factors influencing industrial development in Rwanda. After this review, using the passage provided in the learner's book, learners should be able to explain types, factors and problems related to industrialization.

b) 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 maps
- Internet

c) Learning activities:

Refer to the learning activities 11.1in the learner's book

Help learners to work in groups, they should be able to identify categories of industries and describe the factors that influence their location. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 11.1 in the learner's book

Learners are asked to give examples of each categories of industries in Rwanda and explore factors influencing location of industries in their area. They will use the content given in the learner's book on definition, types and factors for the location of industries and internet.

Lesson 11. 2: Importance of industries and problems affecting industrial development

a) Prerequisites/ Revision /Introduction.

Learners should briefly explain factors for industrial development in the major industrial regions of the world. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activities 11.2 in the learner's book

In groups, learners are asked to explain the importance of industries in a country. Guide them to get the answers in the learner's book. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 11.2 in the learner's book

Learners are asked to explain why industries in developed countries are highly developed than the ones in developing countries and to suggest strategies for industrial development in Rwanda. They will use the content given in the learner's book and other geographical documents on the importance and problems affecting industrial development.

Lesson 11. 3: Problems resulting from industrial development and ways to mitigate them.

a) Prerequisites/ Revision /Introduction.

Learners are asked to briefly explain the role of industries in economic development. Supplement the answers given by learners and introduce the content related to problems resulting from industrial development and ways to mitigate them.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

C) Learning activities

Refer to the learning activities 11.3 in the learner's book

Put learners in groups; guide them in discussing about the problems resulting from industrial development and ways to mitigate them. Afterwards refer them to the learner's book for problems resulting from industrial development and ways to mitigate them. They should 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the learning activities 11.3 in the learner's book

Learners are asked to examine the ways of reducing problems caused by industries. They will use the content given in the learner's book and other geographical documents to explain ways to mitigate problems resulting from industrial development.

Lesson 11.4: Case studies on major world industrial regions

a) Prerequisites/ Revision /Introduction

Let learners highlight the types and factors for location of industries previously studied. Then put learners in groups and guide them to make research on the major world industrial regions.

b) Teaching resources:

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

- Text books
- World map
- Internet

- Other geographical documents

c) Learning activities

Refer to the learning activities 11.4 in the learner's book

Guide learners to work in pairs, they will be able to name and locate major industrial regions of the world and explain factors for their industrial development. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

e) Application activities

Refer to the application activities 11.4 in the learner's book

Learners are asked to compare the factors that led to the development of industrialization in Japan with those of South Africa and analyse the importance of industrialization in USA, Egypt, Russia. They will use the content given in the learner's book on the major world industrial regions.

6. Summary of the unit

This unit covers classification of industries and factors influencing location of industries, major world industrial regions, importance of industries and problems affecting industrial development, problems resulting from industrial development and ways to mitigate them.

This unit intends to help learners to classify industries, explain various factors influencing their location and analyze their importance in relation to sustainable development. This helps the learners to internalize financial education as a cross cutting issue and know how man has utilized the available resources for industrial development. The common phenomena like industrial pollution which requires control measures creates awareness for environmental protection hence integration of environment and sustainability as a cross cutting issue.

7. Additional Information

This unit is linked to unit 16 in senior 4 on industry in Rwanda. It is very important for learners to link the prior knowledge acquired in senior 4 to what is contained in this unit. When you are teaching this unit, you should use local examples of industries in Rwanda. Make comparison between different continents in relation to industrial development.

The learner's book has 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.

8. End unit assessment

Questions

Make a field trip in any industrialized area around your school and answer the following questions:

1) Discuss the physical and human factors influencing location of industries in an area.

2) Describe the role of industries in sustainable development.

3) Analyse the ways of improving the level of industrialization in developing countries.

Guidance to answers

1. Discuss the physical and human factors influencing the location of industries in an area.

Facilitate learners in groups to share the answers by using experience in their community; and refer to the learners' book on factors influencing industrial location.

2. Describe the role of industries in sustainable development.

Guide learners to describe the role of industries in economic development. Their answers must have local examples.

3. Analyse the ways of improving the level of industrialization in developing countries.

In groups let learners brainstorm on how to improve the level of industrialization. They should use local examples developing countries and get references in learner's book.

a. Consolidation, Remedial and extended activities

a) Consolidation activities:

i) Evaluate the effects of industrial pollution in your area.

ii) Give an example of an industry in your area and describe the factors for its location.

Guide learners how to answer the above questions using local examples.

i) For example, the effects of industrial pollution include: destruction of Ozone layer, Acidic rain, creation of barren land, global warming, etc.

ii) Example of industries such as Inyange industry, Utexrwa. The factors for their location include: availability of power, availability of raw materials, market, land, favorable climate, etc.

b) Remedial activities (for slow learners)

i) Define an industry.

ii) Outline five examples of industries in Rwanda.

iii) Explain the meaning of industrialization.

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

i) An industry is an establishment that involves production of goods and offering of services or an industry is commonly used to describe factories that process or transform raw materials into finished goods.

ii) Example of industries in Rwanda: Tolirwa, Cimerwa, Azam, Sulfo, Rwandafoam.

iii) Industrialization refers to the concentration of industries within an area. It is a process whereby countries increasingly get involved in the production of manufactured goods.

c) Extended activities (for gifted and talented learners)

Account for the high level of industrialization in developed countries

Answer: Guide learners to make research on the factors for industrial development in developed countries. Their findings should be presented in class.

UNIT 12: TRANSPORT AND COMMUNICATION IN THE WORLD

12

1. Key unit competence

The learners should be able to analyse the impact of transport and communication projects on the sustainable development of the different countries in the world.

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

Unit 17 of senior 4 introduced the study of transport and communication in Rwanda. Learners studied the types of transport, their advantages and disadvantages, factors, importance, problems and solutions of transport. Different means of communication, factors, importance problems and solutions of communication were also learned.

In the learner's book there is an introductory activity; it is intended to read the passage and answer the questions related to it. Therefore, a teacher should emphasize the cross cutting issue of financial education.

3. Cross-cutting issues to be addressed

A citizen must understand the importance of transport as a source of income and government revenue and to know how that income should be used appropriately to enhance economic sustainability. Financial education therefore should be emphasized.

4. Guidance on introductory activity

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

a) What are the types of transport mentioned above?

b) Explain the economic importance of the transport that Gatabazi introduced in that area.

c) Describe the types of transport that he uses to import goods from China.

d) What form of communication does he use to get his products?

e) Mention other types of communication he can use to order his goods.

5. List of lessons (including assessment)

	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	Number of periods
1	Meaning and types of transport.	• Identify the major types of transport. • Explain the advantages and disadvantages of the different types of transport.	3
2	Factors influencing the development of transport and importance of transport	• Identify the factors influencing the development of different types of transport. • Appreciate the importance of different types of transport.	2
3	Problems/ challenges affecting transport and strategies of improving transport.	• Show concern for the challenge encountered in transport and the desire to improve it.	2
4	Case studies on transport	• Appreciate the importance and challenges of transport in different countries.	4
5	Meaning and Types of communication	• State the different types of communication.	1
6	Importance of communication, problems and possible solutions to the problems affecting communication	• Evaluate the importance of communication. • Show concern for the challenges encountered in communication and desire to improve it.	1
7	Assessment		1

6. Guidance on differwent lessons outlined above

Lesson 12.1: Meaning and types of transport

a) Prerequisites/ Revision /Introduction

This topic on meaning of transport and types of transport was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners discussed about the types of transport, their advantages and disadvantages, factors, importance, problems and solutions of transpor.

Guide the learners to review senior 4 contents by asking them to give the meaning of transport and types of transport in Rwanda. After this review, learners should be able to analyse the means of transport and types of transport in the world.

b) 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
- Other geographical documents

c) Learning activities

Refer to the learning activities 12.1 in the learner's book

Guide learners to work in groups using photographs in learner's book to identify the means of transport. They should be able to identify the type of transport common in their areas. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

Learners are asked to explain the different types of transport. They should use the content given in the learner's book on the means and types of transport.

d) Application activities

Refer to the application activities 12.1 in the learner's book

Learners are asked to explain why road transport is commonly used in Rwanda and describe its challenges. They will use the content given in the learner's book on the meaning and types of transport and other geographical documents to answer these questions.

Lesson 12.2: Factors influencing the development of transport and importance of transport

a) Prerequisites/ Revision /Introduction

Briefly review the previous lesson by asking learners to differentiate the types of transport. Thereafter guide learners to make research and analyse the physical and human factors that influence the development of transport in their area.

b) Teaching resources:

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

- Text books
- Internet.
- Other geographical documents

c) Learning activities

Refer to the learning activities 12.2 in the learner's book

Facilitate learners to work in groups using text books and local environment. They should be able to explain why Rwanda air is improving its business worldwide and analyse the factors influencing the development of transport in their district. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 12.2 in the learner's book

Learners are asked to analyse the economic impacts of transport on the taxi park visited. They should use the content given in the learner's book on the importance of transport.

Lesson 12.3: Problems/challenges affecting of transport and strategies of improving transport.

a) Prerequisites/ Revision /Introduction

Review the previous lesson by asking learners to explain the importance of transport. Later the teacher should introduce the new lesson on challenges and solutions of transport.

b) Teaching resources:

For learning to be successful, the following resources are required:

- Text books
- Sample of photographs
- Internet

c) Learning activities

Refer to the learning activities 12.3 in the learner's book

Help learners to work in pairs and observe the challenges related to the transport sector with reference to Nyabugogo photograph. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and research skills.

Let learners discuss, ask and answer questions and refer them to the learner's book for more information about problems affecting types of transport and ways to mitigate them.

d) Application activities

Refer to the application activities 12.3 in the learner's book

Learners are asked to explain the challenges affecting transport in Rwanda and suggest ways used by Rwanda to improve international transport system for sustainable development. They should use the content given in the learner's book on ways to improve transport and other geographical documents to answer this question.

Lesson 12.4: Case studies on transport

a) Prerequisites/ Revision /Introduction

Review the previous work covered on problems and ways to improve transport. Later guide learners in exploring the new content to be studied.

b) Teaching resources:

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

- Text books
- Pencils
- Internet
- Sample Maps

c) Learning activities

Refer to the learning activities 12.4 in the learner's book

Help learners to work in groups and draw a sketch map of the World showing countries linked by Trans-Africa Highway, Tanzam railway, Trans-Siberian railway, Rotterdam and St Lawrence Sea way. Their findings should be presented in class. Their answers should involve the integration of generic competences such as critical thinking, sketch drawing, creativity, cooperation and communication skills.

d) Application activities

Refer to the application activities 12.4 in the learner's book

Learners are asked to suggest problems that were met during the construction of Tran-Siberian and Tanzam Railways, analyse the factors for the growth of Rotterdam and describe the importance of St. Lawrence Seaway and Trans- African Highways to their respective countries and continents. They should use the learner's book about case studies on transport.

Lesson 12.5: Meaning and types of communication

a) Prerequisites/ Revision /Introduction

Review the previous content learnt in Senior 4 by asking learners to highlight the means of communication used in Rwanda. Later the facilitator will supplement the learners' ideas.

b) Teaching resources:

- Text books
- Photographs
- internet

c) Learning activities

Refer to the learning activities 12.5 in the learner's book

Help learners to work in groups and observe the photographs. They should identify and explain how devices of communication observed are used. Their answers should involve the integration of generic competences such as critical thinking, creativity, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book about types of communication.

d) Application activities

Refer to the application activities 12.5 in the learner's book

Learners are asked to explain the most forms of communication used in Rwanda and explain why. They should use the content given in the learner's book on types of communication and other geographical documents.

Lesson 12.6: Importance of communication, problems affecting communication and possible solutions

a) Prerequisites/ Revision /Introducti

Review the previous lesson on different means of communication. Thereafter the teacher should introduce the new lesson to be studied.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

c)Learning activities

Refer to the learning activities 12.6 in the learner's book

Let learners work in pairs on consequences and importance of communication. Their answers should involve the integration of generic competences such as critical thinking, creativity, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book on the importance of communication.

d) Application activities

Refer to the application activities 12.6 in the learner's book

Ask the learners to identify the factors hindering effective communication in their area and what is being done by Rwandan government to improve communication. They should use the content given in the learner's book on the challenges of communication and other geographical documents.

7. Summary of the Unit:

This unit covers types of transport, their advantages and disadvantages, factors influencing transport, importance, challenges and ways of improving transport. It also covers case studies regarding transport. It also covers forms of communication, importance, problems and ways to improve communication.

8. Additional Information:

This unit is linked to unit 17 in senior 4 on transport and communication in Rwanda. It is therefore necessary for learners to link the prior knowledge acquired in senior 4 to what is covered in this unit. When teaching this content, you should use local examples on forms of transport and communication in Rwanda. Analysis of case studies outside Rwanda are very important when you are teaching this Unit.

The learner's book has some activities where group discussion is emphasized. Therefore, it is important to adjust teaching methods where possible for successful learning.

9. End Unit Assessment

Questions:

I. Examine the relationship between communication and transport.

II. Explain the role of the government in ensuring effective communication in Rwanda.

III. Referring to MTN, TIGO and AIRTEL, explain the importance of telecommunication companies in the development of the country.

IV. Explain the factors that have contributed to the development of transport in developed countries than developing countries.

V. Analyze the level of transport and the improvement of technology in communication in Rwanda and describe how this process can support the sustainable development of the country.

Guidance to answers:

a) Examine the relationship between communication and transport.

Facilitate learners in groups to share the answers by using experience in their community; and refer to the learners' book on transport and communication.

b) Explain the role of the government in ensuring effective communication in Rwanda.

Guide learners to work in pairs to show how the government has tried to ensure effective communication in different parts of the country.

c) Referring to MTN, TIGO and AIRTEL, explain the importance of telecommunication companies in the development of the country.

Ask learners to use the local experience to explain the extent to which telecommunication companies have played a big role on improvement of communication in the country.

d) Explain the factors that have contributed to the development of transport in developed countries than developing countries.

Refer to the learner's book on factors influencing the development of transport in developed countries than developing countries. Where necessary use other geographical documents to get the answers.

c) Analyze the level of transport and the improvement of technology in communication in Rwanda and describe how this process can support the sustainable development of the country.

Make a comment on the level of technological development in Rwanda by using group discussions and class presentations.

10. Consolidation, Remedial and extended activities.

a) Consolidation activities:

i) Explain the advantages of road transport.

ii) Describe how the following factors influence transport:

a) Relief

b) Capital

c) Government policy

Guide learners on how to answer the above questions using the learner's book and

research and group discussion to brainstorm on how relief, capital and government policy have influenced the development of transport.

b) Remedial activities (for slow learners)

i) Define the term trasnport.

i) Define the term communication.

iii) Mention any three types of transport used in your country.

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

i) The term trasnport means the process whereby passenger and goods move from one place to another.

i) The term communication is the transmission of information in form of news and messages.

iii) Types of transport used in Rwanda are: Land transport, Air transport and Water transport.

C) Extended activities (for gifted and talented learners)

i) Discuss the advantages and disadvantages of air transport.

Guidance to answer:

Facilitate learners to answer the above question using the learner's book by discussion awbout the advantages and disadvantages of air transport.

UNIT 13: TRADE AND COMMERCE IN THE WORLD

13

1. Key Unit Competency:

The learner should be able to evaluate the impact of trade and commerce on the sustainable development of different countries in the world.

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

Unit 17 of senior 4 introduced the study of Trade in Rwanda. Learners studied the types of trade, factors, importance, problems and solutions of trade.

In the learner's book there is an introductory activity; it is intended to identify different regional integration blocs and highlight their advantages. Therefore, a teacher emphasizes the cross cutting issue of financial education, standardization culture, peace and value,

3. Cross-cutting issues to be addressed

A citizen has to understand the importance of trade as a source of income and government revenue and to know how that income should be used appropriately enhancing economic sustainability, financial education therefore should be emphasized. Commodities involved in trade must be to the standard (not expired), there is a need therefore to highlight standardization culture as a cross-cutting issue. Furthermore, both home trade and foreign trade requires stability and peace for their smooth running. It is therefore necessary emphasize peace and value as a cross- cutting issue in this unit.

4) Guidance on introductory activity

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

a) Identify different regional integrations operating with Rwanda.

b) What advantages does a country benefit from being in a trading bloc?

5. List of lessons (including assessment).

	Lesson title	Learning objectives (knowledge, skills, attitudes and values):	Number of periods
1	Meaning, types of trade and factors influencing international trade.	-Describe the major types of trade and commerce. -Describe the factors influencing trade and commerce.	2
2	Causes of low levels of international trade in Developing Countries and importance of international trade in development.	-Appreciate the importance of trade and commerce.	2
3	Major financial centers and trading blocs of the world.	-state the major financial centers of the world.	1

4	World trading blocs and regional integration: definition, advantages and disadvantages, factors and problems affecting regional integration and possible solutions.	-Identify the major trading partners and the world trading blocs. -Explain the advantages and disadvantages of international trade. - State the problems affecting international trade.	4
5	Case studies on regional integration and trading blocs.	-Identify the major trading patterns and the world trading blocs. -Appreciate the importance of the regional integration.	4
6	Assessment		1

6. Guidance on different lessons outlined above

Lesson 13. 1: Meaning, types of trade and factors influencing international trade.

a) Prerequisites/ Revision /Introduction

This topic on meaning of trade and types of trade was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners discussed about the types of trade, factors, importance, problems and solutions of trade.

Help the learners to review senior 4 contents by asking them to give the meaning of trade, types of trade in Rwanda. After this review, learners will be able to discuss about the meaning, types and factors influencing international trade.

b) Teaching resources:

For learning objectives to be achieved ensure that you have the following resources and other appropriate teaching aids:

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

c) Learning activities

Refer to the learning activities 13.1 in the learner's book

Guide learners to work in groups to identify the major imports of Rwanda, mention types of trade and explain the factors influencing trade between Inyange industry and overseas countries. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 13.1 in the learner's book

Learners are asked to brainstorm how regional integration; government policy and population have influenced international trade in Rwanda. They should use the content given in the learner's book on the meaning and types of trade, factors influencing international trade and other geographical documents to answer this question.

Lesson 13.2: Causes of low levels of international trade in Least Developed Countries (LDC's) and importance of international trade in development.

a) Prerequisites/ Revision /Introduction

Briefly review the previous lesson by asking learners to differentiate the types of trade. Thereafter guide learners and introduce the new lesson.

b) Teaching resources:

The following resources are required:

- Text books.
- Internet.
- Other geographical documents.

c) Learning activities

Refer to the learning activities 13.2 in the learner's book

Guide learners to work in pairs using passage in the learner's book, they will be able to identify the products exported by European countries, outline the major exports of Rwanda and explain the causes of inequality between exports and imports. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 13.2 in the learner's book

Learners are asked to assess the role of international trade in the economic development of their country and suggest ways of reducing the gap between low exports and high imports in developing countries. They should use the content given in the learner's book on the causes of low level and importance of international trade.

Lesson 13.3: The Major financial centers and trading blocs of the world

a) Prerequisites/ Revision /Introduction

Review the previous lesson by asking learners to describe the importance of trade. Later the teacher introduces the new lesson on the major financial centers and trading blocs of the world.

b) Teaching resources:

For learning to be successful the following resources are necessary:

- Text books
- Sample of maps
- Internet

c) Learning activities

Refer to the learning activities 13.3 in the learner's book

Facilitate learners to work in pairs and make research on the objectives of International Monetary Fund and explain how trading blocs improve economic development of member countries. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication and research skills.

Let learners discuss, ask and answer questions and refer them to the learner's book for more information about major financial centres.

d) Application activities

Refer to the application activities 13.3 in the learner's book

Learners are asked to discuss the reasons why Rwanda should trade with other countries, challenges faced by Rwanda in trading with other countries, explain why rich countries benefit more from international trade than developing countries and suggest what the city of Kigali can do to become an international financial center. They should use the content given in the learner's book on major trading blocs and other geographical documents to answer this question.

Lesson 13.4: Case studies

a) Prerequisites/ Revision /Introduction

Review the previous work covered on problems and ways to improve international trade. Thereafter guide learners in exploring the new content to be studied on different case studies related to regional integration.

b) Teaching resources:

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

- Text books
- Internet
- Pencils
- Sample Maps

c) Learning activities

Refer to the learning activities 13.4 in the learner's book

Help learners to work in pairs and describe the major objectives of East African Community and challenges faced by ECOWAS member states in implementing its objectives. Their answers should involve the integration of generic competences such as critical thinking, creativity, cooperation and communication skills.

d) Application activities

Refer to the application activities 13.4 in the learner's book

Learners are asked to explain how ECOWAS member states have benefited from this integration and to describe the major objectives of OPEC. They should use the content in the learner's book on regional integration.

7. Summary of the Unit:

This unit covers types of trade, factors influencing international trade, importance, challenges and ways of improving trade. This unit also covers case studies related to trading blocs and regional integration.

8. Additional Information:

This unit is linked to unit 17 in senior 4 on trade in Rwanda. It is therefore necessary for learners to link the prior knowledge acquired in senior 4 to what is covered in this unit. When teaching this content, you should use local examples on forms of trade in Rwanda. Analysis of case studies outside Rwanda are very important when you are teaching this Unit.

The learner's book has some activities where group discussion is emphasized. Therefore, it is important to formulate teaching methods to achieve learning objectives.

9. End unit assessment

Questions:

1) Draw a map showing the member states of EAC

2) Conduct your own research to identify different regional integration operating with Rwanda and show their main objectives.

3) Examine the role of regional integration in the social, economic development of Rwanda for sustainable development.

4) Analyse the reasons for low levels of international trade in developing countries.

5) What types of major commodities are involved in the international trade? With reference to any two major commodities from different parts of the world, explain geographical conditions which favour their production and state two major countries for each of the commodities which import them in large quantities.

6) With reference to either Western Europe or Africa discuss the geographical background of its export trade.

Guidance to answers:

1) Draw a map and locate the member states of EAC.

Guide learners to draw a sketch map showing the EAC member states (Rwanda, Burundi, Uganda, Tanzania and Kenya).

2) Conduct your own research to identify different regional integration operating with Rwanda and show their main objectives.

Guide learners in groups to share the answers by using experience in their communities; and refer to the learners' book on regional integration.

3) Examine the role of regional integration in the social, economic development of Rwanda for sustainable development.

Allow learners to work in pairs to discuss on the role of regional integration towards the sustainable development of Rwanda.

4) Analyse the reasons for low levels of international trade in developing countries.

Use the learner's book on the content related to international trade. Where necessary, use other geographical documents to explain the reasons for low level of international trade in developing countries.

5) What types of major commodities are involved in the international trade? With reference to any two major commodities from different parts of the world, explain geographical conditions which favour their production and state two major countries for each of the commodities which import them in large quantities.

The learners will use the learner's book under the content on Commodities involved in the World trade to give the major commodities involved in the international trade, to explain the geographical conditions which favour the production of commodities for different parts of the world.

6) With reference to either Western Europe or Africa, discuss the geographical background of its export trade.

Learners will discuss on the geographical background of the export trade of Western Europe or Africa. They will use the content of the learner's book under the Major Trading Zones of the World.

10. Additional activities

a) Consolidation activities:

i) Explain the meaning of the following terms:

a) Billateral trade

b) Multi lateral trade

c) Wholesale trade

ii) Describe how the following factors influence trade:

a) Transport

b) Capital

c) Government policy

Let learners answer the above questions using the learner's book, research and group discussions to brainstorm on how tranport, capital and government policy have influenced the development of trade and explain the meaning of billateral trade, multi-lateral trade and wholesale trade.

b) Remedial activities (for slow learners)

i) Define the term trade.

ii) Define the term international trade.

iii) Write in full EAC.

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

i) The term trade refers to the act of selling and buying goods and services for money.

ii) The term international trade is a type of trade between many countries

iii) EAC: East African Community

C) Extended activities (for gifted and talented learners)

Analyse the challenges faced by regional integration blocs in developing countries.

Guidance to answer:

Facilitate learners to answer the above question using the learner's book by discussion about the challenges faced by regional integration blocs in developing countries.

UNIT 14.: WORLD MULTIPURPOSE RIVER PROJECTS

14

1. Key Unit Competence

By the end of the Unit, the learners should be able to evaluate the impact of multi-purpose river projects on sustainable development of different countries in the world.

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

In Unit 8 of senior 4 learners were introduced with drainage system in Rwanda. The unit presented the relationship between the drainage system and human activities, such as role and importance of rivers and water bodies in the development of human activities in Rwanda, the consequence of rapid population growth on natural resources. Unit 15 of senior 4 introduced the lesson on Power and Energy in Rwanda, in which the water of rivers is considered as the source of electric power the most used in the country, which contribute significantly to the social and economic development. Rusizi II, Mukungwa I, Mukungwa II, Ntaruka are examples dams which generate the Hydro-electric power. Unit 10 of Senior 6 dealt with Power and Energy Production in the world. Renewable and non-renewable source of energy are presented.

The knowledge acquired from units 8 and 15 of senior 4 and unit 10 of senior 6 mentioned above sets a strong prerequisite for the learning of Unit 14 of Senior 6 entitled the **"Multipurpose river Projects"**. In the context of the unit, Multipurpose River Projects are projects based on embankments, called dams that are built on rivers to help man benefit from resource potentials of rivers for the development of various social and economic sectors.

The introductory activity presented in the student's book intends to remind learners of the importance of an efficient and profitable use of water of rivers not only for domestic and agriculture uses but also as source of energy for a sustainable development of countries and inhabitants. Importance and Benefits, approaches, achievements, challenges associated with Multipurpose River Projects as well for developed as developing countries are explained.

3. Cross-cutting issues to be addressed

a) Environment and sustainability

The unit 14 of senior 6 is about **Multipurpose River Projects**, with a key competence of evaluating their impacts on sustainable development of different countries in the world. Although the projects present many advantages, construction of dams is reported however to be responsible of many problems which are mostly ecological, environmental and socio-economic nature. For instance, clearance of vegetation on sites where dams are to be constructed, exposes the land to rainfall which erodes the soil, accumulation of silt of dam floor may cause the change in dam depth. These dams block the migration of fish, upsetting the ecological balance and putting several aquatic species in danger. Large dams obstruct the free flow of river water, resulting in disputes between different states over water sharing, and also over the sharing of costs and benefits of the project. Floating and invasive vegetation is likely to kill the aquatic animals and vegetation.

For this, the teacher is required to interact with learners about the advantages of Multipurpose River projects on sustainable development of different countries worldwide and the welfare of inhabitants, but also challenges resulting from the projects should be discussed with learners, with an emphasis on the environmental and ecological impacts. Solutions need also to be introduced for learners to know that for each challenge arising from such project there must be long lasting solution.

b) Inclusive education

The learning process of this Unit requires a field trip for all learners to observe nearby industries, urban centres, Hydro-electric power stations. This will enable learners to realise that the energy and power used for structure systems to operate are generated by water of rivers where dams are constructed.

c) Financial education

Most multipurpose river projects are very expensive. They are funded by governments, often supported by international development partners because attracting private investors for financing multipurpose projects is difficult. Firstly, achieving a sensible balance between the interests of the private investors, the consumers and the host government is complicated and often results in complicated and potentially vulnerable contract structure. Secondly, low creditworthy of various users causes multipurpose projects often lacking financial viability, making it unattractive for private investors. Since single purpose dams secure higher returns on investment, they are promoted as more economically attractive.

There is need that learners are introduced with these financial challenges to run and construct the project. Teacher and Learners need to discuss and understand why people or beneficiaries of the project need to adopt a positive attitude about taxes on their business and activities that have to be collected for the purpose of constructing a project for common long-lasting development. Therefore, learners need to understand that they will benefit from the outcome of the project. For instance, they can think about their individual businesses that can be run based on services provided by the project: provision of electricity can enable the creation of some businesses such as hair cut saloon, carpentry, welding, irrigated agriculture facilitated by generator pumps, etc.

4. Guidance on introductory activity

The key questions that will be the guide to the introductory activity of lesson 14.1 have been presented in the learners' book. Answers to questions provided should be constructed around the following:

1) Sources of power the most produced in Rwanda include wood and hydro-electricity.

2) Two types of sources of energy include: renewable energy (e.g. wind, water) and non-renewable energy (e.g. wood, fuel).

3) Two elements that are found on the image and their uses: Water and power lines.

4) On the provided image (photo of Aswan High Dam): In addition to understand aims and importance of Multipurpose river projects, learners should be able to explain how such projects, for instance water and hydro-electric power and related services contribute to employment opportunities and development of various economic sectors (e.g. agriculture, industry, settlement, education, health, etc.) of countries worldwide. For this, it is important that learners understand the related advantages and can identify and explain problems that affect such projects and possible solutions based on case studies discussed in this Unit. Moreover, learners should understand why inhabitants, as partners and beneficiaries of the project, should adopt a positive attitude towards taxes collected (to be collected) which will enable the governing and organizing institutions to accomplish the task.

5. List of lessons

The lessons that have been prepared in relation to the content of Unit 14, as well as the period allocated to each of them are summarized in the table below:

#	Lesson title	Number of Periods
1	Definitions, Aims and importance of Multipurpose River Projects.	2
2	Problems affecting Multipurpose River Projects.	1
3	Solutions to the problems affecting Multipurpose River Projects.	1
4	Case studies:	9:
	1 .The Tennessee Valley Authority – USA	3
	2. Akasombo Dam (Volta) – Ghana	2
	3. Aswan High Dam – Egypt	2
	4. Huang HeBasin Development – China	2
5	End Unit Assessment	1

6. Guidance on different lessons

Lesson 14.1:. Definition, aim, objectives and importance of world multipurpose river projects

(Refer to learner's book, lesson 14. of Unit 14 Definition, aim, objectives and importance of world multipurpose river projects)

a) Prerequisite - Introduction

In this lesson, learners are introduced to the definition of key terms such as multipurpose river project, dam, and sustainable development of countries. Thereafter learners are guided to explore the figure of introductory activity so that they can mention some basic uses of water, power and energy and to establish the link between them. The teacher uses the same figure provided for introductory activity. He will highlight that the power used to light our houses, energy used by industries to manufacture products, are often generated by water of rivers where the hydro-electric power plants are constructed. Some examples can be given for illustration, such as the Hydro-electric Power dam of Ntaruka I, Ntaruka II and Rusizi II.

b) Teaching resources

The teacher should have in possession the print outs of the introductory activity of Unit 14 and learning activity of lesson 14.1 of student's book and distribute it to learners. All the same, learners should have learner's book of senior six. To achieve learning objectives of this lesson, the following resources should be used:

- Geographical documents including the learner's book of senior 6.
- Maps, Illustration.
- Internet/DVDs.
- Manila Paper or flip Chart.
- Jaws software.

c) Learning activities

Refer to the learning activities 14.1 in the learner's book

The teacher guides learners to lesson 14.1 of learner's book for exhaustive answers.

Learners are tasked to observe and state the components of the dam illustrated on the figure used to introduce the lesson.

1) The components of the dam include among others power lines, lake (water, reservoir) behind the dam, the basement (solid rock), rock fill, gate, tunnel, Generator, turbines, etc.

2) Two components on the figure which are very useful for human life and activities include water and power lines which transfer electricity.

3) The water and energy are very useful in daily life. For example, water and energy are used to cook, to run industries; water is used for irrigation, navigation. Electricity is used as source of light. The teacher will find more answers as he goes through the lesson itself.

d) Application activity

Refer to the application activities 14.1 in the learner's book

This activity is provided to enable the learners to assess himself the level of achievement after the learning of the lesson. Prior to explain the aim, objectives and importance of multipurpose river projects, the learner should be able to define and understand the key terms used in this lesson such as **multipurpose river projects, dam, sustainable development**, etc. Related answers are found in learners' book, lesson 14.1

Multipurpose river projects are so important for the sustainable development of countries for many reasons:

They provide water and cheap hydro-electric power;

River water is a renewable source of energy on which we can rely for long periods;

They contribute to the:

- development agriculture (irrigation) and tourism
- generation of government revenue
- increase of employment opportunities and industrial development
- development of infrastructures
- promote the international relations
- control flooding of rivers
- reduce importation

Lesson 14.2.: Problems affecting Multipurpose River Projects

(Refer to learner's book, lesson 14.2. of Unit 14 Problems affecting Multipurpose River Projects)

a) Revision

The teacher conducts the revision of the previous lesson by asking learners to briefly recall the definition of Multipurpose River Projects, dam, sustainable development; and to mention some benefits of multipurpose river projects. Thereafter, the teacher guides learners to work in groups of four, and will guide them to the appropriate content of the lesson in the Learner's book. Learners are tasked to highlight and discover some of the problems that affect multipurpose river projects.

b) Teaching resources

The teacher should make sure that learners have in possession the learner's book of senior six, and the print outs of the introductory activity of Unit 14 of student's book and distribute it to learners. To achieve learning objectives of this lesson, the following resources should be used:

- Geographical documents including the learner's book of senior 6.
- Maps, Illustration.
- Internet/DVDs.
- Manila Paper or flip Chart.
- Jaws software.

c) Learning activities

Refer to the learning activities 14.2 in the learner's book

The learning activity is about to identify problems that Rwanda can face if the Government decides to construct on river Nyabarongo a dam to generate hydro-electricity and water for industrial and domestic uses.

Rwanda as one of developing countries would face many problems. The response to the above question should be constructed around the following elements:

- Projects require large funds to support construction activities. Rwanda would in part rely on loans and donations, or private investments, which are refunded with interests.
- Rwanda is densely populated and does not have enough space for large reservoir and resettlement of relocated people.

- The country would face the problem of limited water resource. If water of the dam is used for agricultural irrigation, the ecological balance would be disturbed. The amount of river flows downstream of the dam would be sensible reduced.
- Limited human resource: such projects require experts and skilled workers for construction and maintenance, who are hired through contacting companies.
- Accelerated soil erosion, water evaporation and change in ecological conditions.

d) Application activity 14.2

Refer to the application activities 14.2 in the learner's book

This activity provided at the end of the lesson, will enable the learners to assess themselves the level of achievement. For the learner to be able to answer the question, he should have revised the content and understood problems associated with the multipurpose river projects.

Lesson 14.3.: Solutions to the problems affecting Multipurpose River Projects

a) Revision

In lesson 14.3, students will learn about the solutions to problems affecting multipurpose river projects. Review the previous lesson by asking learners to highlight some importance of multipurpose river projects as well as problems that can affect their establishment. The knowledge on importance and problems associated with the establishment of the project (lesson 14.1. and Lesson 14.2) constitute an asset to better understand the related possible solutions.

b) Teaching resources

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

- Geographical documents including the learner's book of senior 6.
- Maps, Illustration.
- Internet/DVDs.
- Manila Paper or flip Chart.
- Jaws software.

c) Learning activities

Refer to the learning activities 14.3 in the learner's book

There is one instructional activity which consists to research on the solutions to problems affecting multipurpose river projects. The teacher guides learners to use relevant geographical documents and internet and indicates the corresponding contents in the learner's book. The answer is found in Lesson 14.3.

d) Application activity

Refer to the application activities 14.3 in the learner's book

This activity is about to discuss the impacts of multipurpose river project in developing countries. The teacher will guide learners to consider both positive and negative impacts of such projects. Also, the teacher will guide learners to consider the lesson on importance of such projects, the problems and possible related solutions, and indicate to learners the corresponding contents in the learner's book.

The following are examples of some components of the answers that are discussed, but learners would further complete and develop the list. Each component needs to be discussed:

> **Positive impacts** of multipurpose river valley projects include: electrical generation, flood control and irrigation water for farms, provide water for domestic, agriculture and industrial use, help to encourage new types of architecture, provides work for people in the area.
>
> **Negative impacts** include: loss of forests and orchards and fish habitats, and the growth of unhealthy bacteria and unwanted flora. These projects increase the risk of insect-borne diseases; they can increase earthquake risk and threaten any ecosystems in the area that are fragile.

Lesson 14.4.: Case Studies

a) Prerequisite /revision

Lesson 14.4 is about Case Studies of multipurpose river projects from both developed (e.g. USA) and developing countries (Ghana, Egypt and China). The knowledge on importance, problems and solutions acquired in lessons 14.1-3 constitutes an asset to better understand the reasons why different countries adopted the establishment of such projects, and how such project was very beneficial to the sustainable development of respective countries.

The teacher shall then engage learners in revision of previous lesson, and will establish the link between today lesson and the previous lesson one.

a) Teaching resources

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

- Geographical documents including the learner's book of senior 6.
- Maps, Illustration.
- Internet/DVDs.
- Manila Paper or flip chart.
- Jaws software.

b) Learning activity

Refer to the learning activities 14.4 in the learner's book

There is one instructional activity for lesson 14.4 which consists of reading the text provided to learners and describing at least four major effects of continental drift (refer to learner's book, lesson 14.4. of Unit 14).

The case studies presented include Tennessee Valley Authority (USA), countries (Ghana, Akasombo Dam called Volta River Authority (Ghana), Egypt, Aswan High Dam (Egypt) and Huang He Basin Development (China).

The teacher shall provide a handout of the text to be exploited by learners. He will guide learners to work in groups of four. The summary of each group finding will be written on a manila or flip chart and displayed and compared in plenary.

The outcomes of learners' group works will answer the following questions:

Questions

1) Discuss the common problems faced by countries mentioned above before the establishment of multipurpose river projects

Regions were often subject to recurrent and sometimes devastating floods.

Flooding often caused many human deaths and a lot of damage to properties.

Problems of soil erosion due to inappropriate traditional farming methods.

People in the region were poor and suffered from famine and starvation as consequence of flooding, droughts, soil erosion.

2) Identify common objectives found in multipurpose river projects of respective countries.

The overall aim is the sustainable development of the regions. Specifically:

- To control and regulate the flows and recurrent flooding in river basin.
- To generate hydro-electric power.
- To promote agriculture through development of irrigated farming and communication.
- To enhance fishing and to create employment opportunities for the population.
- To improve the standards of living for the people in the area.
- To sustainably develop the countries.

3) Based on the text above, explain why a country can decide to construct a multipurpose river project.

Multipurpose river projects have multiple purposes. Many reasons can bring a country to decide for multipurpose river project.

These projects are mainly based on water of rivers whose supply is maintained through the year and replenished by rainfall, runoff, and snow melt.

Water is a renewable source of energy it is non- pollutant for producing cheap electricity.

Once irrigation canals are constructed, they are maintained and replenished through the storage system, so it's good for agricultural purpose.

Water thus stored can be used for afforestation and fisheries. Electricity produced can be taken from some hundreds up to thousands of kilometers away from the dam and various industries, urban centres and cities can be supplied in cheap power. Urban centres and industries can be supplied in water.

Such projects help solve problems of flooding, drought and soil erosion and their negative impacts on people and properties.

If successfully established, the projects contribute greatly to the sustainable development of countries in various economic sectors and increase employment opportunities for population in the area.

The teacher should guide learners to read strategies by the USA central government to develop the Tennessee region and resulting benefits.

d) Application activity

Refer to the application activities 14.4 in the learner's book

Seven questions were provided for application activity 14.4. Refer to the learner's book Lesson 14.4 Case studies. The questions were set in such way to enable learners to revise the whole content. But also, based on the case studies the learner will be able compare and to judge the importance of multipurpose river project for the sustainable development of countries.

Below is the set of questions prepared for leaners but the teacher could to add more:

1) Discuss the problems faced by the region before TVA project was created.

The answer for this question is found under section b of the sub-heading 14.4.1 The Tennessee Valley Authority, Lesson 14.4 Case studies.

For instance, problems include: Severe soil erosion, Silting and flooding, Famine, High population growth, Poor housing facilities, Poor living standards, Problem of transport, Lack of fuel, epidemies

2) Discuss the strategies used to solve identified problems in the Tennessee region

The answer for this question is found under section C of the subheading 14.4.1 The Tennessee Valley Authority, Lesson 14.4 Case studies. The teacher should make sure answers given by the learner include the following elements:

Strategies were sequenced in 4 major steps:

- **Step 1: Assignments tasked to the Tennessee Valley Authority**

The establishment of Tennessee Valley Authority, definition and allocation of duties

- **Step 2: Concrete actions undertaken to control soil erosion**

These include the training of farmers, creation of demonstration farms, re-afforestation programs, filling the gullies, terracing and introduction of modern farming methods.

- **Step 3: Construction of Dams and results**

Several dams were constructed: 9 on the main Tennessee and 23 on its tributaries.

The huge reservoirs created by the dams hold back enormous quantities of water.

Elimination of swamps which previously hosted malaria and bilharzia vectors.

Development of tourism due to created parks, scenic beauty around dams and falls.

Supply of Electricity to industries.

- **Step 4: Construction of important infrastructures and industries**

Electric Power Station and urban development.

Transport Infrastructures.

Educational and research Institutions.

Industrial centres.

Health Centres and Hospitals.

3) Explain the benefits of TVA projects

The answer for benefit of TVA is found under section d of the subheading 14.4.1 The Tennessee Valley Authority, Lesson 14.4 Case studies. The teacher should make sure answers given by the learner include the following elements:

The control of floods and soil erosion has been successfully and sustainably mastered

Cheap hydro-electric power was availed

Diversified food products

Local farmers joined the established demonstration farms

Diversified and improved transport networks

Many and diversified industries in the region process ores and other raw materials

The tourism was greatly promoted

The production of motor vehicles, boats and aircraft parts

4) Identify aims and objectives of multipurpose river projects in the studied countries

Aims and objectives of multipurpose river projects are stated at the beginning of each studied case. The teacher shall guide learners to work in group of 4 and will assign to each group a case to revise. He will indicate page or the heading of lesson where learners will find the content to be exploited. Outcomes from respective groups will be written down on manila and completed.

In general, the common aims are to rehabilitee regions and sustainably develop various economic sectors, to improve the welfare of local populations and to increase employment opportunities.

Objectives are:

To control and regulate the flows and recurrent flooding of rivers in their respective basins

To produce cheap electricity for industrial and domestic uses

To control soil erosion and rehabilitate degraded lands

To promote agriculture using irrigation (water from reservoir) and modern farming methods

To create employment opportunities for local population

5) Compare factors that favoured the construction of multipurpose river projects in Ghana and Egypt.

Factors which favoured the construction of Akasombo Dam (Ghana) Aswan High Dam (Egypt) are presented in learner's book, lesson 14.4 under the sub-heading of Akasombo and Aswan. Guide the learners to work in groups of 4 and indicate pages and sub-headings where learners will find the content to be exploited.

Outcomes from respective groups will be written down on manila and completed in plenary.

The answer to this question should consider both natural and human factors as the key to the success of multipurpose river projects in the respective countries.

6) Based on each of the cases studied in this lesson, compare the problems faced by respective countries before the establishment of multipurpose river projects.

Problems caused by multipurpose river projects are presented in the content of each studied case. The teacher shall guide learners to work in group of 4 and will assign to each group a case to revise. He will indicate page or the heading of lesson where learners will find the content to be exploited. Outcomes from respective groups will be written down on manila and completed.

In general, the common problems faced by countries selected as case studies include: severe soil erosion, Silting and flooding, Famine, High population growth, Poor housing facilities, Poor living standards, Problem of transport, Lack of fuel, epidemics.

7) Based on each of the case studies analyzed above, explain problems that result from multipurpose river projects in developing countries and how these problems are solved.

Problems

Flooding of traditional farm lands and displacement of people and properties.

Water flooded traditional farm lands behind Akasombo Dam, and 80,000 people were displaced with 200,000 animals belonging to them.

There was high cost of resettlement.

Seasonal lowering lake levels and decreasing in power output.

The development of industries leads to environmental pollution.

The development of the project has been dependent on overseas finance.

Pollution of water, soil and air: this was due to the establishment of industries in the area.

Increase of diseases like bilharzia and malaria caused by stagnant water.

High evaporation of water.

Solutions

- **Regular dredging** is carried out to remove waste matter which affect the drainage of the new valleys.
- Treatment of waste (recycling) is performed before their disposal.
- Some environmental laws have been set to regulate dumping in the river.
- Use of ferry and steamers to ease the communication around lakes.
- Spraying to control diseases such as Bilharzia caused by snails from the stagnant water which gives a breeding ground for them.
- There is a **legislation against brick making** along the river bank, for instance in Egypt.
- Farmers are sensitized to the use of organic manure as opposed to inorganic fertilizers to reduce salinity and soil pollution.
- Sensitization of population for new settlement plans. There has been a general sensitization for new settlement along the river banks against dumping of garbage in the river which is partly responsible for making the river burst its banks.

7. Summary of the Unit

The Unit 14 is about the World Multipurpose River Projects. These are projects based on embankments called dams built on rivers to help man benefit from resource potentials of rivers. These dams may have a specific purpose, e.g. water storage for irrigation, Hydro-Electric Power (HEP) generation, flood control, navigation, or they may be multipurpose, involving all or some of these. In Africa, many river dam projects serve more than one purpose, hence referred to as multi-purpose river dam projects. These projects contribute greatly to enhance the sustainable development of countries and the social and economic welfare of inhabitants.

Multipurpose river projects are so important because they contribute to the sustainable development of countries. The projects rely on water of rivers which is long lasting renewable source of energy and less pollutant. The water for domestic and industrial use is supplied easily and the hydro-electric power produced is cheap. The projects also contribute to the development of agriculture (irrigation) and tourism, generation of government revenue, increase of employment opportunities and industrial development, enhance the development of infrastructures and boost many activities in cities, promote the international relations, control flooding of rivers and reduce importation of manufactured product.

The studied case studies showed that:

- Though the projects present many benefits, they are however reported to be associated with number of problems, mostly in developing countries. The projects require much fund for construction and resettlement of relocated people, the local people have little gain from the project because large quantities of energy go to industries, construction of dams causes ecological problems such as pollution caused by industries and cities, problem of shortage in skilled human resources for construction and maintenance, changes in river regime, accelerated soil erosion, water evaporation and change in ecological conditions.

- The lesson we can learn from Tennessee Valley Authority is the well planned and coordinated multipurpose river projects which greatly contribute to the sustainable development of countries. Many problems are solved such as river floods, the uses of electricity and water are regulated efficiently for the benefit of humans and their activities. TVA established from 1933's in USA, and the Huang He Basin Development Project established from 1950's are up to now engines for sustainable development of the region.

8. Additional Information

Types of resources of energy

There are two types of resources of energy: Renewable energy (e.g. wind, water, sunlight) and non-renewable energy (e.g. coal, natural gas, petrol).

Importance of Hydro-electric power

Hydro-electric power has certain advantages over other sources of energy. It is continually renewable owing to the recurring nature of the hydrologic cycle and produces neither atmospheric nor thermal pollution. Hydro-electric power is a preferred energy source in areas with heavy rainfall and hilly or mountainous regions that are in reasonably close proximity to the main load centres.

The Tennessee Valley Authority is the largest public hydro-power company in USA

Today, the TVA ranks as America`s largest public power company, with a generating capacity of 31,658 megawatts. Seventeen thousand miles of transmission lines deliver power through 158 locally owned distributors to 8.5 million residents of the Tennessee Valley.

The TVA has become a major recreation provider as well. The reservoirs behind its dams provide opportunities for fishing, sailing, canoeing, and many other activities, while some 100 public campgrounds provide facilities close to the water`s edges

Online readings

The teacher should read about some of the most successful multipurpose river projects. There are many websites dedicated to the subject. For instance, details about project of Han River, Nakdong River, Geum River and Yeongsan River in South Korea can be accessed using the following URL link: https://en.wikipedia.org/wiki/Four_Major_Rivers_Project

9. End unit assessment

1) Describe the benefits and challenges of multipurpose river projects and suggest ways to overcome those challenges. (Refer to lesson 14.2 of Learner's Book)

The multipurpose river projects for developing countries present many benefits:

- They provide hydro-electric power for both domestic and industrial purposes.

- They supply water for domestic use and irrigation which contribute in the development of agriculture and increased diversified food production.
- They contribute to the development of Tourism sector due to waterfalls and created beautiful features such as dams and lakes which help countries to earn foreign exchange.
- The generate government **revenue** through taxation of workers' incomes, people, industries, institutions which benefit from water and power supplies provided by the project.
- **The contribution to the development** of diversified industries is stimulated as there is ample power and water that are generated.
- **There is reduction of importation of number of products** such as fuel, manufactured products and foodstuffs since these are now produced locally.
- **infrastructures** such as rail way, roads, water transport routes or shipping routes (river navigation), development of towns, schools, hospital facilities, etc. within the area covered by the project.
- **Promotion of international relations**: there have been joint ventures in the development of river projects that have created co-operation among nations.
- Dams are used to control flooding in flood-prone areas by regulating the flow of water upstream and downstream.

10. Additional activities

a) Consolidation activities

1. The Teacher should recommend learners to revise the 4 steps undertaken by TVA to implement the multipurpose Tennessee Project (Lesson 14.4.1). The learner should be able to explain the outcome of each step. The steps include
    - Assignments tasked to the Tennessee Valley Authority.
    - Concrete actions taken to control soil erosion.
    - Construction of Dams and results.
    - Construction of important infrastructures and industries.
2. Considering the requirements of constructing a multipurpose river project, identify the factors that can favour or limit such project in Rwanda.
3. Based on the case studies studied in this unit, explain the economic advantages that Rwanda would benefit if it had constructed a multipurpose river project.

b) Remedial activities

1. Learners should be guided to read about problems resulted from the construction of multipurpose river projects in Volta basin and Nile basin and the possible solutions that have been suggested.

    - Problems associated with the Akasombo Dam and Aswan High Dam projects
    - Solutions to problems resulting from Akasombo Dam and Aswan High Dam projects

2. It will be important for learners to revise the importance of the project Huang He basin development and resulting challenges.

c) Extended activities

Learners should be guided to read about problems resulting from the multipurpose projects of developed countries.

UNIT 15: ENVIRONMENTAL CONSERVATION AND TOURISM

15

1. Key unit competence

The learner should be able to evaluate the impact of the conservation of natural resources and tourism on the sustainable development in the different countries of the world.

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

Unit 18 of senior 4 introduced the study on environmental conservation and tourism in Rwanda. They studied types of natural resources, environmental conservation, tourist attractions, factors, importance, problems and solutions to tourism industry in Rwanda. They also studied case studies related to tourism in Rwanda (Nyungwe, Akagera and Birunga National Parks).

In the learner's book there is an introductory activity, it is intended to identify the economic activity, show the importance of conserving wildlife and describe the vegetation shown in the photograph. This will help learners to understand appropriate measures to be taken in conserving the environment. Therefore, a teacher emphasizes the cross cutting issue of environmental sustainability.

3. Cross-cutting issues to be addressed

A citizen has to 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 environmental conservation based on knowledge previously acquired, the learners should know how to protect their environment therefore environmental sustainable as a cross-cutting issue should be put into account.

Financial education is another cross-cutting issue that is linked to the study of the economic importance of tourism. This economic activity has helped people to earn a living and government revenue for socio-economic development.

Peace and value is another cross-cutting issue that is linked to the study of tourism. For this industry to develop relative peace must be guaranteed in the country. It also promotes international relationship which encourages peace.

4. Guidance on introductory activity

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

i) Identify the economic activity taking place in the photograph.

ii) Describe the vegetation shown in the foreground of the photograph.

iii) Why is it important to conserve wildlife in national parks?

5. List of lessons (including assessment)

	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Definition, components and factors accountable for the environmental degradation	Identify component of environment. Explain the causes of environmental degradation.	2
2	Consequences of environmental degradation, methods of environmental conservation and importance of environmental conservation.	Identify and explain the consequences of environmental degradation and the methods for environmental conservation.	3
3	Pollution: definition, types ,causes ,effects and solutions	Identify and explain causes, effects and measures to pollution.	3
4	Catastrophes	Evaluate the causes and effects of the catastrophes and propose possible solutions	3

5	Definition, major tourist areas of the world and factors affecting the development of tourism in the world.	Identify major tourist areas in the world Explain factors affecting the development of tourism in the world.	4
6	Importance and impact of tourism	Appreciate the importance of tourism in the sustainable development Evaluate the impact of tourism on the environment and the development of a country	2
7	Problems affecting the tourism in the world and the prospects	Explain the problems of tourism and propose the possible solutions	2
8	Case studies on tourism	Appreciate the importance and challenges of tourism in different countries.	4
5	Assessment		1

6. Guidance on different lessons outlined above

Lesson 15.1: Definition, components and factors accountable for the environmental degradation

a) Prerequisites/ Revision /Introduction

This topic on environmental conservation was discussed in senior 4. It is important to link the content studied with what is going to be learnt in senior 6. In senior 4 learners learnt environmental conservation in Rwanda.

Help learners to review the senior 4 contents by asking them to explain the components and factors accountable for the environmental degradation in Rwanda. Later assist learners to discover the content that is going to be covered.

b) Teaching resources:

To achieve learning objectives, use the following resources:

- Text books
- Other geographical documents.
- Internet

c) Learning activities

Refer to the learning activities 15.1 in the learner's book

Help learners to work in groups, they will be able to identify physical features shown on the photograph, explain human and physical factors that accelerate environmental degradation. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.1 in the learner's book

Learners are asked to compare factors of environmental degradation between the city of Kigali and the northern province of Rwanda. They will use the content given in the learner's book on components and factors accountable for the environmental degradation.

Lesson 15.2: Consequences of environmental degradation, methods of environmental conservation and importance of environmental conservation.

a) Prerequisites/ Revision /Introduction.

Learners will briefly explain factors accountable for the environmental degradation, the teacher will introduce the new content to be studied. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activities 15.2 in the learner's book

In pairs, learners are asked to mention phenomena which took place on the photograph and explain the effect of human activity shown, on the environment. Guide them to get the answers in the learner's book. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.2 in the learner's book

Learners are asked to analyse the areas in Rwanda that experience environmental degradation, possible measures to conserve the environment and suggest the negative impacts of environmental destruction in any area. They will use the content given in the learner's book and internet on consequences of environmental degradation and methods on environmental conservation.

Lesson 15.3: Pollution

a) Prerequisites/ Revision /Introduction.

Briefly guide learners to review the previous work covered. Supplement their ideas and introduce a new lesson.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents
- Sample photographs

c) Learning activities

Refer to the leaning activities 15.3 in the learner's book

Put learners in groups; facilitate them in discussing about types and effects of pollution. Thereafter refer them to the learner's book on pollution. 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.3 in the learner's book

Learners are asked to describe how human activities have accelerated pollution in the environment and suggest ways adopted to reduce pollution. They will use the content given in the learner's book and other geographical documents to get the answers for these questions.

Lesson 15.4: Catastrophes

a) Pre-requisites/ Revision /Introduction

Help learners to review the previous content learnt. Through questioning, guide them to discover the content to be discussed.

b) Teaching resources:

To achieve learning objectives, use the following resources:

- Text books.
- Other geographical documents.
- Sample photographs.

b) Learning activities

Refer to the learning activities 15.4 in the learner's book

Engage learners in group discussion, they will be able to explain types and causes of catastrophes. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.4 in the learner's book

Learners are asked to analyse the areas affected by catastrophes in Rwanda, their effects and to suggest ways to mitigate them. Refers them to the learner's book on catastrophes for answers of the above questions.

Lesson 15.5: Definition of tourism, major tourist areas of the world and factors affecting the development of tourism in the world.

a) Prerequisites/ Revision /Introduction.

Learners will briefly explain the effects of catastrophes in general, the teacher will introduce the new content to be studied. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Internet
- Sample photographs
- Other geographical documents

b) Learning activities

Refer to the learning activities 15.5 in the learner's book
In pairs, learners are asked to identify and explain the physical features shown on the photograph and other tourist areas of the world. Help them to get the answers in the learner's book. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

b) Application activities

Refer to the application activities 15.5 in the learner's book

Learners are asked to analyse how physical factors have led to the development of tourism industry in the world and show how mountain gorillas, Rwandan culture and water bodies have contributed to the development of tourism industry in Rwanda. They will use the content given in the learner's book and internet to answer this question.

Lesson 15.6: Importance and impact of tourism

a) Prerequisites/ Revision /Introduction.

Briefly guide learners to review the previous work covered. Supplement their ideas and introduce a new lesson of the day.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

b) Learning activities

Refer to the learning activities 15.6 in the learner's book

Put learners in groups; facilitate them in discussing the contribution of the tourism industry in economic development and negative effects of tourism. 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 learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

c) Application activities

Refer to the application activities 15.6 in the learner's book

Learners are asked to make a field trip and discuss the impacts of tourism industry on the environment and show how tourism has benefited people around national parks as well as the country. They will use the content given in the learner's book and internet to get the answers for this question.

Lesson 15.7: Problems affecting the tourism in the world and the prospects

a) Prerequisites/ Revision /Introduction

Teacher will review the previous lesson on the importance of tourism and introduce the new content to be studied. Briefly supplement the answers given by learners.

b) Teaching resources:

- Text books
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activities 15.7 in the learner's book

In pairs, learners are asked to explain the problems faced by tourism industry in developing countries and analyse other human activities that affect tourism industry. Help them to get the answers in the learner's book. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.7 in the learner's book

Learners are asked to show how shortage of land and poor means of transport are barriers to the development of tourism in developing countries. They will use the content given in the learner's book and internet.

Lesson 15.8: Case studies on tourism.

a) Prerequisites/ Revision /Introduction

Allow learners to brainstorm on the previous content studied. Then put learners in groups and guide them to make research on the case studies related to tourism.

b) Teaching resources:

Use the following resources to achieve learning objectives:

- Text books
- World map
- Internet
- Other geographical documents

c) Learning activities

Refer to the learning activities 15.8 in the learner's book

Guide the learners to work in groups, they will be able to draw the world map and locate the major tourist attractions in Switzerland, EAC and USA. Their answers should involve the integration of generic competences such as critical thinking, cooperation, communication, research and problem-solving skills.

Engage learners in activities like discussion, asking and answering questions and for more answers they are referred to the learner's book.

d) Application activities

Refer to the application activities 15.8 in the learner's book

In groups learners are asked to compare the tourist attraction in Rwanda and those of Switzerland, analyse factors influencing tourism in EAC in relation to those of USA. They will use the content given in the learner's book on tourism industry.

7. Summary of the unit

This unit covers environmental degradation and conservation, pollution, catastrophes, major tourist areas of the world, factors, importance, problems and prospects for tourism industry. Various case studies related to tourism (East Africa, Florida and Switzerland) are also discussed in this unit.

8. Additional Information

This unit is linked to unit 18 in senior 4 on Environmental conservation and tourism in Rwanda. It is very important for learners to link the prior knowledge acquired in senior 4 to what is contained in this unit. When you are teaching this unit, you should use local examples of tourist attractions in Rwanda. Make comparison between different regions in relation to tourism industry.

The learner's book has some activities where group discussion is emphasized. It is therefore important that where possible teaching methods can be changed and activities adjusted to achieve learning objectives.

9. End unit assessment

Questions

i) ccount for the persistent famine in many parts of Africa.

ii) Discuss the impact of tourism on sustainable development of Africa.

iii) Famine is one of threatening calamities in Africa. Suggest measures most governments can take to reduce famine in developing countries.

iv) The world is currently facing the problem of environmental degradation. Suggest measures to protect the environment.

Guidance to answers:

i) Account for the persistent famine in many parts of Africa.

Help learners to share the answers by using experience from many areas and refers them to learner' book.

ii) Discuss the impact of tourism on sustainable development of Africa.

Allow learners to brainstorm on the impacts of tourism especially in developing countries and giving specific examples.

iii) Famine is one of threatening calamities in Africa. Suggest measures most governments can take to reduce famine in developing countries.

Put learners in groups, they discuss the strategies to reduce famine in developing countries and make class presentation.

iv) The world is currently facing the problem of environmental degradation. Suggest measures to protect the environment.

Let learners use dialogue by referring to local examples in Rwanda and supplement their ideas.

10. Additional activities

a) Consolidation activities:

i) Account for the development of tourism in the developed countries

ii) Why is it important to conserve the environment?

Help learners to answer the above questions using local examples. For example, factors for tourism development are: a variety of tourist attractions, enough capital, government policy, good accommodation facilities etc. We conserve the environment in order to protect wildlife, conservation of natural beauty, avoid climate changes, etc.

b) Remedial activities (for slow learners)

i) Define tourism.

i) Outline five examples of tourist attractions in Rwanda.

iii) Identify four types of pollution.

Guidance to answers:

1) Tourism involves movement from one's home for leisure, research and study

2) Five tourist attractions in Rwanda are: museums, national parks, rivers, lakes, mountains.

3) Types of pollution include: land, air, water and noise pollution.

c) Extended activities (for gifted and talented learners)

With reference to one developing country, assess the effect of pollution on the environment

Guidance to answer:

Facilitate the learners to make research on the effects of pollution in any developing country. Their findings should be presented in class.

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