GEOGRAPHY FOR TTCs

OPTION: SOCIAL STUDIES EDUCATION (SSE)

YEAR TWO

STUDENT'S BOOK

FOREWORD

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

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

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

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

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

Dr. MBARUSHIMANA Nelson

Director General, REB

ACKNOWLEDGEMENT

I wish to sincerely express my special appreciation to the people who played a major role in development of Geography Student's book for SSE Option, Year 2. It would not have been successful without the support from different education stakeholders.

I wish also to thank Rwanda Basic Education Board (REB) leadership who supervised the textbook writing process. I wish to extend my appreciation to REB staff, Lecturers, Tutors, Teachers from General Education, Experts from Local and International Organizations for their effort during the writing of this textbook.

MURUNGI Joan,

Head of Curriculum Teaching and Learning Resources Department/REB

TABLE OF CONTENT

ACRONYMS AND ABBREVIATIONS

DRC: Democratic Republic of Congo

HEP: High-Electrical Power

IOM: International Organization for Migration

UK: United Kingdom

USA: United States of America

GENERAL INTRODUCTION

This text book is part of the reform of the school curriculum in Rwanda: that is changes in what is taught in schools and how it is taught. It is hoped this will make what you learn in school useful to you when you leave school, whatever you do then.

In the past, the main thing in schooling has been to learn knowledge – that is facts and ideas about each subject. Now the main idea is that you should be able to use the knowledge you learn by developing competencies. These competencies include the ability to think for yourself, to be able to communicate with others and explain what you have learnt, and to be creative that is developing your own ideas, not just following those of the tutor and the text book. You should also be able to find out information and ideas for yourself, rather than just relying on what the tutor or text book tells you.

Activity-based learning

This means that this book has a variety of activities for you to do, as well as information for you to read. These activities present you with material or things to do which will help you to learn things and find out things for yourself. You already have a lot of knowledge and ideas based on the experiences you have had and your life within your own community. Some of the activities, therefore, ask you to think about the knowledge and ideas you already have.

In using this book, therefore, it is essential that you do all the activities. You will not learn properly unless you do these activities. They are the most important part of the book.

In some ways this makes learning more of a challenge. It is more difficult to think for yourself than to copy what the tutor tells you. But if you take up this challenge you will become a better person and become more successful in your life.

Group work

You can also learn a lot from other people in your class. If you have a problem, it can often be solved by discussing it with others. Many of the activities in this book, therefore, involve discussion. Your tutor will help to organize these groups and may arrange the classroom so you are always sitting in groups facing each other.

Research

One of the objectives of the new curriculum is to help you find things out for yourself. Some activities, therefore, ask you to do research using books in

the library, the internet if your school has it. This, or other sources such as newspapers and magazines. This means you will develop the skills of learning for yourself when you leave school.

Skills lab

Geography subject is practical than being theoretical only that is why it requires time of skills lab which is a regular time on normal time table when student-teachers are required to complete learning activities working in manageable groups.

During skills lab activity student-teachers are given an opportunity to talk more and get more involved in the lesson than tutors. Student-teachers receive constructive feedback on work done (Tutor gives quality feedback on student presentations).

The Skills Lab prepares student-teacher to complete portfolio assignments on their own after classes. So the classroom activity should connect directly to the portfolio assignment and the tutor during the skills lab makes sure that he/she links the unit with the students.

Icons

To guide you, each activity in the book is marked by a symbol or icon to show you what kind of activity it is. The icons are as follows:

 ***Thinking icon/Introductory activity***

This indicates thinking for yourself or groups discussion. You are expected to use your own knowledge or experience, or think about what you read in the book, and answer questions individually or as group activity.

 **Thinking icon/Learning activity**

This icon reminds you link your previous knowledge with the topic you are going to learn. As a student feel free to express what you already know about the topic. What is most important is not giving the right answer but the contribution you are making towards what you are going to learn.

 **Application activity**

Some activities require you to complete them in your exercise books or any other book. It is time for you show if you have understood the lesson by answering the questions provided.

Skills lab

This icon indicates a practical activity, such as a role play to resolve a conflict, participating in a debate and following instructions provided by the teacher. These activities will help you to obtain practical skills which you can use even after school.

End unit Assessment icon

This icon invites you to write down the results from activities including experiments, case studies and other activities which assess the attainment of the competences. Tutors are expected to observe the changes in you as student teacher.

UNIT 1

STATISTICAL GRAPHS AND DIAGRAMS

Key unit competence: The student-teacher should be able to interpret the statistical data, construct statistical graphs and diagrams.

Introductory activity

Read the extract below and use it to answer the questions that follow:

Rwanda exported over Rwf 250b Agricultural products in 2017. The National Agriculture Exports Development Board (NAEB) says that the country's agricultural exports generated revenues amounting to Rwf 304.6 million from January to September 2017 compared to 232.65 million earned in the same period in 2016. In the first quarter of 2017/18, agricultural exports generated Rwf 116 million against Rwf 82,809,581 in first quarter 2016/17. Agricultural crops locally produced and exported like coffee, tea, and pyrethrum generated frw 108 million from January to September of 2017, compared to 89 million in the same period in 2016. The volume of exported vegetables was frw 18.98 million kilograms from January to September 2017, compared to over 15.61 million kilograms in the same period of 2016, meaning that the quantity of exports increased by only 21.56%. The value of exported vegetables was frw 8 billion from January to September 2017, against frw4.2 billion in the same period of 2016, implying an increase of 98.65 percent, and a rise in price per unit of the vegetables.

Answer the following questions:

1) *Name the data which are represented in the passage*
2) *Using the past studies in both ordinary level, senior four and personal research,*
   - i) *Identify other methods to represent the data displayed in the passage.*
   - ii) *Discuss the importance of the geographical data identified in (i) above and make a class presentation, if possible using ICT tools, or flip charts or any other resource available.*
   - iii) *Comment on the Rwanda's exports between January 2017 to Oct 2017 and account for the variations in the trend of exports.*

1.1. Introduction to the statistics in Geography

Activity 1.1

Read the story below and use it to answer the questions that follow:

Micomyiza Jeanne and Habinshuti Gilbert made their field study on 'The effects of human activities on the physical environment in Rulindo village. They used various methods of data collection. Jeanne was interested in writing down every observed aspect in a descriptive manner while Gilbert filled his note book with tables and charts that he would interpret after the field trip. Some other students who had also attended the field work, used various methods of noting down data, such as line graphs, bar graphs with description foot notes. They could look at the graphs and drawn charts and easily understand the content contained therein. The collected numerical data revealed that 12 farmers were using poor methods of farming, 20 farmers had applied agro-forestry and tree planting, 2 farmers were engaged in charcoal burning, 7 people had large herds of cattle whose impact on the environment was so evident. All data collected were presented and recorded on a chart.

a) Explain why most of students were interested in using statistical way of data recording.

b) Does the passage above represent statistics? Explain your answer.

c) Using the example of Habinshuti, examine the importance of statistical graphs and diagrams in Geography.

1.1.1. Definition of statistical geography

Statistical geography is defined as the study and practice of collecting, analyzing and presenting data that has a geographic dimension. The statistics in geography is about social, economic, climatic, spatial or demographic characteristics. Data used in statistical analyses comes from various variables such as, population housing censuses, surveys, and administrative records.

In a broader sense, the ***term statistics*** refers to the science of collecting, analyzing, interpreting and presenting various data. It is a science of how data are collected, analyzed and interpreted.

Someone who collects, classifies, analyses, presents and interprets statistical data is called **statistician.**

1.1.2. Importance of statistical graphs and diagrams in geography

Statistical graphs and diagrams play a key role in geography for the following reasons:

1) Statistical graphs and diagrams help students to process and summarize huge data with accuracy.
2) The geographers can identify and interpret the relationship existing between various variables (e.g. the relationship between the increase of prices for commodities and increase in cost of fuel).
3) They clearly predict the trend and variations among others of production, trade.
4) Statistical diagrams and graphs enable make easy the presentation and interpretation of geographical data.
5) Statistical graphs and diagrams provide a good and attractive visual representation.
6) Statistical diagrams and graphs facilitate easier memory of the reader or students/geographers than data presented in a descriptive manner.

Application Activity 1.1

Using firsthand experiences and skills acquired in statistics explain how statistics is important in your daily life and show how it would help to understand geography.

1.2. Line and curve graphs

Line graph and **curve** graph are types of charts which display information as a series of data points called 'markers' connected by straight **line** segments.

The types of line and curve graphs the most used in statistical geography described in this section include:

i) Simple line and curve graph
ii) Group or comparative line graph
iii) Compound line graphs
iv) Divergence graphs.

1.2.1. Simple line and curve graphs

Activity 1.2.1

Land use in country X from 2015 to 2017

Year	*Activity per hectares of land ('000 ha)*
2015	*250*
2016	*350*
2017	*650*

Using the knowledge and skills acquired from Mathematics and the data provided in the table above, answer the following questions:

a) Draw a simple line graph to represent the above information.

b) Use the same data indicated in the table above, to construct a simple curve graph.

c) Using both the data and the graphs drawn, comment on the trend of land use in country X from 2015 to 2017.

d) Discuss the advantages and disadvantages of simple line graph.

i. Simple line graph

A **simple line graph** is one which shows points plotted connected by a series of short straight lines. This distinguishes it from the simple curve graph in which points plotted are joined by a single smooth line.

Construction of a simple line graph

The following are steps to be followed while constructing a simple line graph and curve graph.

1. The ***independent variables*** are indicated on horizontal axis. (Independent variables are items that are not affected by the changes in other values)
2. The ***dependent variables*** are represented on the vertical axis. (Dependent variables are items that are reliant on the independent variables. That is to say; are measurable responses from the reaction caused by a change in the independent variables).
3. The vertical axis should start from zero. While the top part be slightly greater than the maximum value to be indicated or recorded on it.

4. The length of the horizontal line is determined by the number of the independent values in relation to the scale.
5. Draw two vertical lines on both sides and exact numbers of values of constant relationship be recorded on the two axes. However, this is not a must be done condition.
6. When plotting points in correspondence to both independent variables and dependent variables, it is appropriate to put the dot in the middle of the two vertical lines.
7. Join the points with smooth curve using free hand.

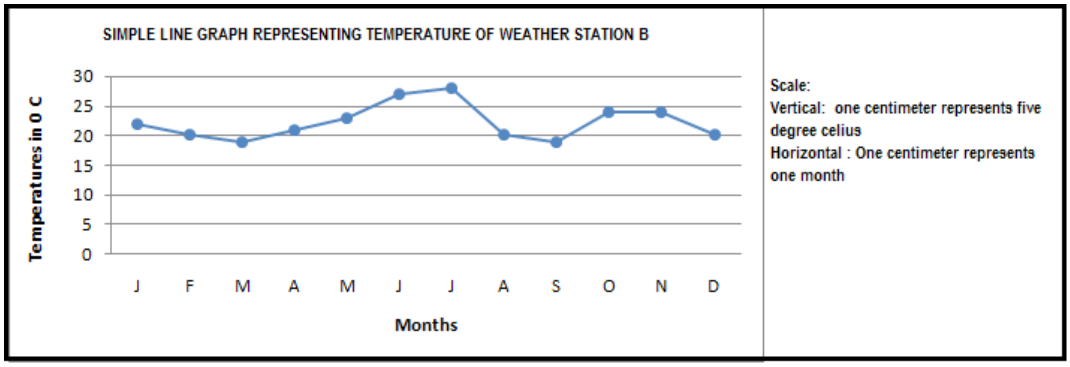
Worked example:

The following table presents mean temperature values recorded at weather station

Temperature recorded at weather station B

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. ^{0}C	22	20	19	21	23	27	28	20	19	24	24	20

Use the data presented in the table above to construct a simple line graph to portray the above statistical data.



Simple line graph of monthly mean temperature recorded at weather station B

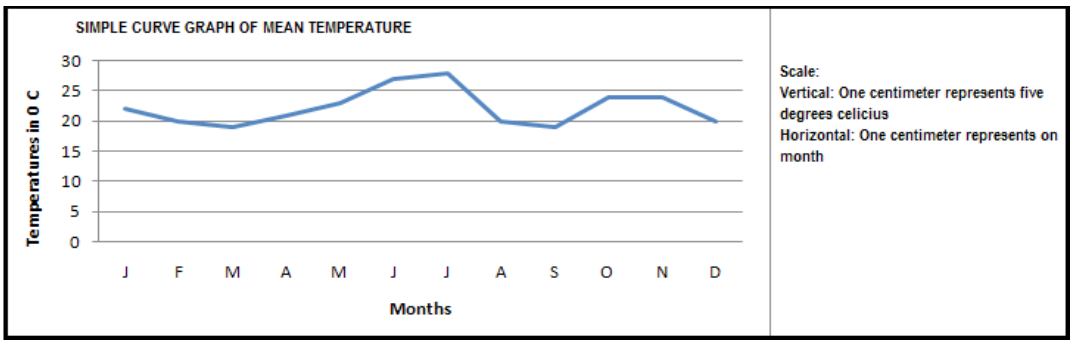
When making a simple line graph, the following must be considered:

- Choose a suitable scale to be used on vertical as well as horizontal axes.
- Write the scale as statement in the upper right corner of the graph.
- Write suitable title in capital letters, balancing it above the graph as appropriate.
- Do not attach the line to the vertical axes of the graph

ii. Simple curve line graph

The procedures for drawing a curve graph is similar to that of drawing a line graph except that while in constructing curve graphs the dots are joined using a straight line, in the case of simple line graphs; the dots are joined using a smooth line with free hands.

The data recorded at weather station B are used to construct the following simple curve graph



Simple curve graph of monthly mean temperature recorded at station B

Advantages and disadvantages of simple line and simple curve line graphs

In the following paragraphs are described advantages and disadvantages of both simple line graphs and simple curve graphs:

Advantages

1. They are simple to draw or construct.
2. When neatly drawn, they provide a good visual impression.
3. They are easy to interpret.
4. Less time is needed to construct them.
5. Simple errors or error free because of the simplicity nature of the methods.
6. Simple calculations are involved.
7. They can be used together with other statistical methods and diagrams such as dot maps, in a super-imposition manner.
8. They have a multi-purpose service. For example, they are used in representing several geographical aspects such as the trend of crop production, variation in temperature, minerals, etc.

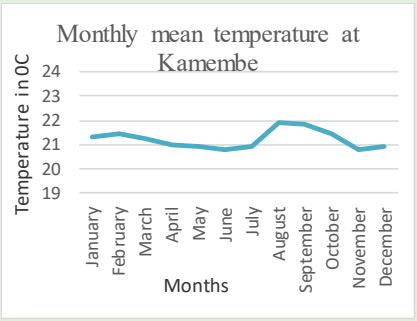
Disadvantages

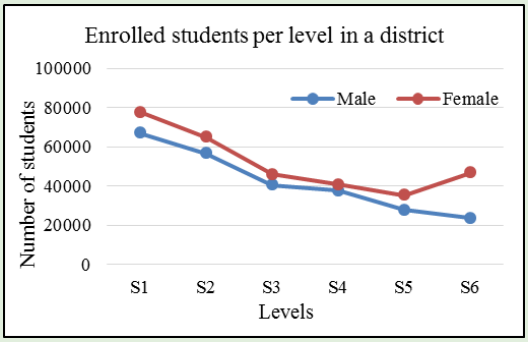
1. There is no accurate interpretation because of some points are plotted basing on estimation of values.
2. There are difficulties in determining the appropriate scale especially when large figures or values are used.
3. The curve graphs are less accurate in comparison to simple line graphs.
4. It is not easy to use the simple line and curve graphs to compare various categories of data.
5. Changing scale of either axes, can greatly change the visual impression of the graph.
6. They are only used while dealing with continuous data.

1.2.2. Group or comparative line graphs

Activity 1.2.2

The following are selected graphs





Refer to the above figures to answer the questions below:

a) Explain the differences existing between the two graphs shown above.

b) Describe the features represented on graph of enrolled students per class.

c) Explain the advantages and disadvantages of graph showing the enrolled students per class

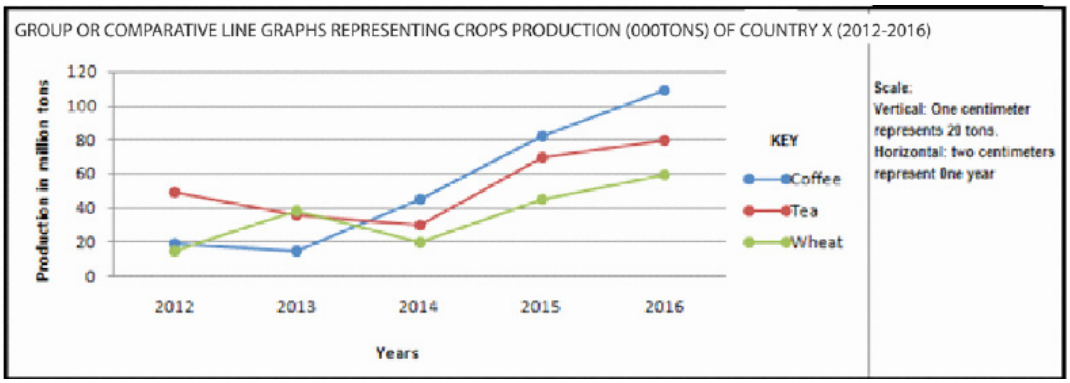
Group or comparative line graphs are also known as multiple line/curve graphs. This form of displaying statistical data is used to portray more than one dependent variable, whereby each line represents a given specific variable of individual item.

Crop production from 2012 to 2016 in Country X in '000 tons

Year / Crops	2012	2013	2014	2015	2016
Coffee	19	15	45	82	109
Tea	50	36	30	70	80
Wheat	15	38	19	45	59

The above table shows several dependent variables as well as the independent variables. There are 5 years and three crops which are coffee, tea and wheat. When critically analyzed, you find that for each independent variable in the left column (crops) can be represented by a single simple line graph.

As earlier said, a comparative line graph has more than one line as shown by the sample below:



Group/comparative line graph of selected crops in X province

Construction of group or comparative line/curve graph

Below are steps or guidelines to be followed while drawing a group or comparative/multiple line/curve graphs:

1. Several lines are constructed on the same graph.
2. The lines drawn representing individual variables or items should be easily distinguishable from one another. It is advised to use varying colors.
3. Avoid congesting the graph with many lines. The recommendable maximum number of lines is five.
4. The lines/curve should not cross each other unless the data given requires it. If it happens therefore, strictly varying colors or shading must be used.

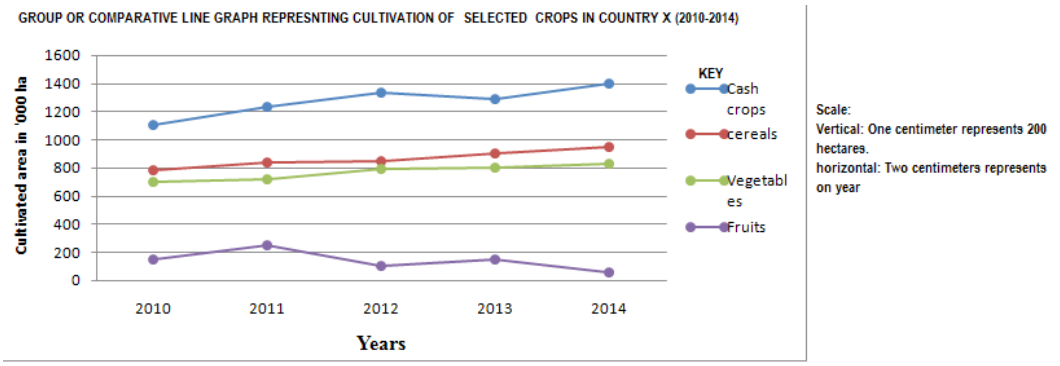
5. Lines should not touch the vertical axis.
6. Names of variables being represented should be written directly on each line.

Worked example:

Trends in the area cultivated ('000 ha) for selected crops in country X (2010-2014)

Crop / Year	Cash crops	Cereals	Vegetables	Fruits
2010	1110	786	700	150
2011	1230	840	720	250
2012	1330	850	790	100
2013	1290	900	800	150
2014	1396	950	830	56

Construction of a group or compound line graph using the statistical data presented above.



Group/comparative line graph of cultivated area for selected crops in country X

Advantages of group/comparative line graph

1. It is a simple method as it does not involve a lot of calculations.
2. It gives a clear impression of the different variables presented on one graph.
3. It can be used to show comparison of different items.

Disadvantages of group/comparative line graph

1. The presence of many variables on the same graph makes their interpretation more difficult.
2. The values for each period are not easy to determine.

1.2.3. Compound line graph

Activity 1.2.3

The table below shows the crop production from 2005 to 2010 in '000 tons in country Y:

Years / Crops	2005	2006	2007	2008	2009	2010
Sorghum	1158	1100	1027	1008	1192	1198
Maize	888	853	725	1151	1941	2487
Beans	637	823	924	916	944	1027

Using the previous knowledge and skills acquired in Mathematics and the data presented in the table above, answer the following questions:

a) Calculate the cumulative totals.
b) Construct a compound line and shade every component.
c) Research on the advantages and disadvantages of compound line graphs.

A compound line graph is also known as a cumulative line graph. It is the type of graph where a variety of variables are presented as subsequent lines. Therefore, a compound line graph displays cumulative totals. It is drawn in a way that lines are super-imposed above each other; creating several segments or components.

Construction of a compound line graph

The following steps must be followed while constructing a compound line graph:

1) Make a cumulative table representing progressive or cumulative totals of the provided variables.
2) Select the appropriate scale for both dependent and independent variables.

3) Follow the steps used when a simple line graph is being drawn. It should be the variables with large or biggest values to begin.

4) The lines constructed for each variable should connect onto the two vertical lines on both sides.

5) Super-impose other lines on top of the first line beginning from each segment or component. Indicate the name of the variable in each section shaded.

6) The lines drawn must begin from or attached to the vertical axis as earlier emphasized.

7) Since plotting of points is dependent on the calculated values in a cumulative manner, lines therefore, must not cross each other.

8) If the statistical data is in large numbers, it is very advisable to convert the value of each variable into percentage. Thereafter, calculate the cumulative totals. Such calculations should be indicated.

Worked example:

Table of total exports in million tons for country X's for 2015-2017

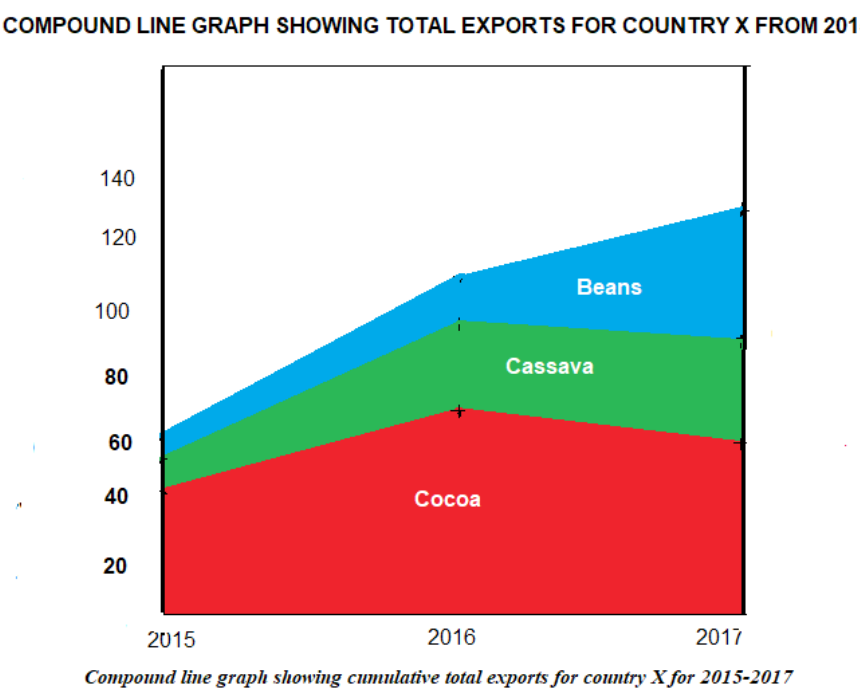
Years / Crops	2015	2016	2017
Cocoa	46.0	74.0	69
Cassava	11.0	24.5	27.7
Beans	13.0	11.5	33.3

Use the data presented in table above to construct a compound line graph

Table of cumulative total exports in million tons for country X's from 2015-2017

Years / Crops	2015	2016	2017
Cocoa	46.0	74.0	69
Cassava	57.0	98.5	96.7
Beans	70	110	130

The above cumulative totals can now be used to construct a compound line graph as shown below:



Compound line graph showing cumulative total exports for country X for 2015-2017

Advantages of compound line graph

1. They are easy to interpret.
2. They provide a good visual impression.
3. They are simple to draw.
4. Less space is used.
5. They can be used to present a variety of variables.
6. They are suitable for comparison purposes.

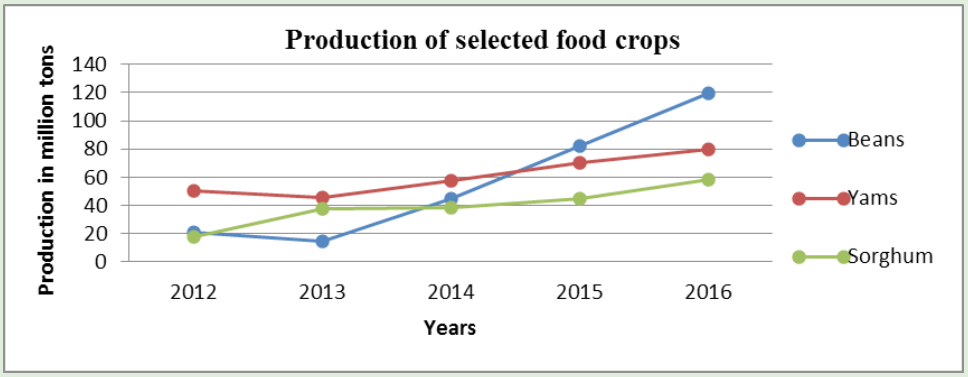
Disadvantages of compound line graph

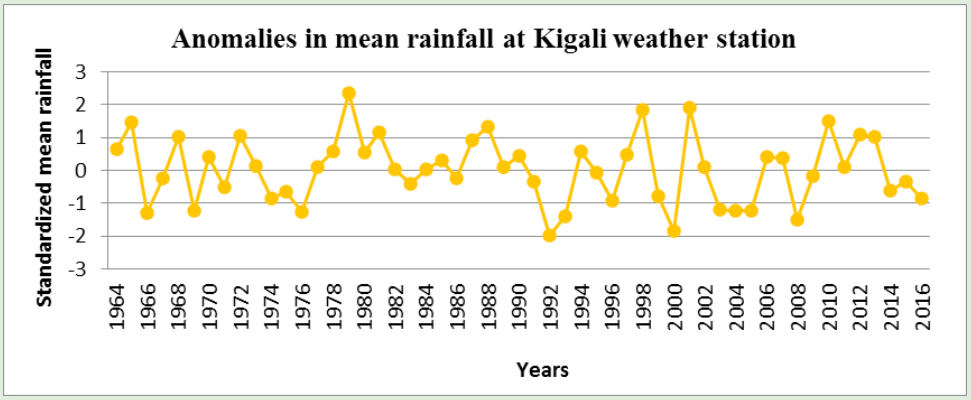
1. When large numbers are used, selecting a suitable scale becomes more challenging.
2. It or they involve calculations such as; converting the values into percentages and then determining the cumulative totals.
3. The use of cumulative totals while constructing the compound line graphs makes it difficult to find precisely the actual values of the variables.

1.2.4. Divergence line graphs

Activity 1.2.4

Below are two statistical graphs representing different statistical data:





Use the diagrams above to answer the following questions:

a) Identify the differences existing between the two graphs presented above.

b) Research on advantages and disadvantages of the graph showing the anomalies in mean rainfall at Kigali weather station.

Divergence line graphs are statistical graphs that directly portray variations in values. When there is an increase in values; a plus sign **(+)** is used in the figure while a fall or decrease in values is portrayed using a negative sign **(-)**. This type of graph is used while dealing with variables whose values are highly changing spatially and temporally.

Construction of a divergence line graph

The following steps must be considered when drawing a divergence line graph:

1. Draw two vertical lines (axis) and leave a reasonable space for the baseline; on which the independent variables are to be indicated.

2. Draw the average line commonly known as the zero line. This should join the center of the two-vertical axis.
3. Draw a basement line for independent variables; joining the bases of the two vertical lines. The length of the horizontal line is determined by the number of independent variables and the horizontal scale used.
4. Determine the average values of all the values indicated in the table. This is obtained using the following formula:

$$Average\ value = \frac{Total\ value}{Number\ of\ variables}$$

An example:

Production of cars in country X

Years	2013	2014	2015	2016	2017
No. of cars	6700	6800	7000	7500	4500

Therefore, the average value can be calculated as below:

$$Average\ value = \frac{6700 + 6800 + 7000 + 7500 + 4500}{5} = 6500\ cars$$

1. Deduct the average value from each value. The positive and negative signs should be indicated or shown.
2. The figures or values with positive sign (+) are plotted above the Zero line or average line. While the negative values are plotted below or beneath the zero or average line.
3. While determining the scale, the vertical scale should be determined basing on the calculated divergences. The horizontal scale is chosen normally depending on the independent variables provided.
4. Thicken or darken the zero line/average line.

Worked example:

The table of monthly pineapple production in different areas

Areas	**Monthly production in '000 tons**
A	10,527
B	10,038
C	3920
D	3770

E	2550
F	1833
G	884
H	825
I	744

The divergence values can be calculated as follows:

$$Average\ value = \frac{10527 + 10038 + 3920 + 3770 + 2550 + 1833 + 884 + 825 + 744}{9} = \frac{35091}{9}$$

$$= 3899$$

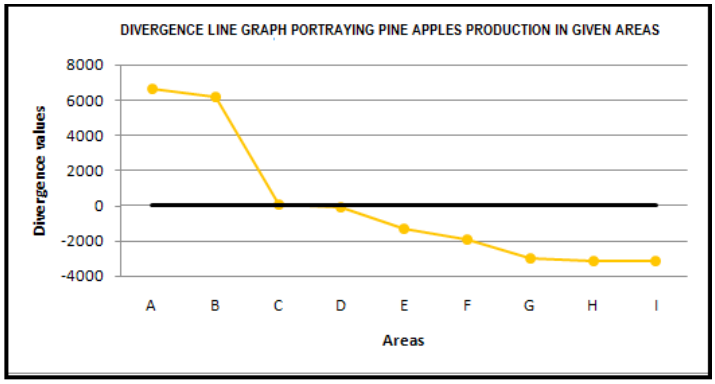
The average value = 3,899 (in 000 tons)

Therefore, the divergence table will be constructed below:

The table of monthly pineapple production in different areas

Area	Monthly production in '000 tons	Divergence values
A	10,527 -3,899	+6628
B	10,038 – 3,899	+6139
C	3920 - 3,899	+21
D	3770 - 3,899	-129
E	2550 - 3,899	-1349
F	1833 - 3,899	-2066
G	884 – 3,899	-3015
H	825 - 3,899	-3074
I	744 - 3,899	-3155

A divergence line graph showing monthly pineapple production in different areas



Divergence line graph of monthly pineapple production in different areas

Advantages of divergence line graph

Below is an outline of the main advantages of divergence line graph:

1. It is easy to construct.
2. It provides a good visual impression.
3. It is easy to interpret.
4. It is an appropriate method of representing items that need comparative analysis.
5. It requires limited space.

Disadvantages of divergence line graph

1. It involves several calculations for example the total value, getting average and finding divergences.
2. The actual figures are not shown. Only divergences are indicated instead.
3. There are some difficulties while determining the scale mostly when the divergences are composed of bigger values and very low ones.
4. Its construction is time consuming.
5. The method allows some inaccuracy while being drawn. This is because if large values are used, decimal points are neglected.
6. To be used, it requires the reader to have the original raw data or a table of values.

Application Activity 1.2

1. Collect data on the students' performance in any subject of your choice and use the scores to construct the following line graphs: simple and curve line graph, comparative, compound and divergence line graphs.
2. Comment on the distribution of statistical data displayed on the constructed graphs.

1.3. Bar graphs

Bar graphs are statistical methods whereby rectangular bars are used to portray data.

Bar graphs differ from line graphs because the lines used under bar graphs join to form single and individual rectangular bars.

Bar graphs described below include:

i) Simple bar graphs

ii) Compound bar graphs
iii) Divergence bar graphs
iv) Age-sex graphs
v) Dispersion graphs

1.3.1. Simple bar graphs

Activity 1.3.1

Table showing population of selected countries of the world ('000,000 people) in 2016

Country	*Population in Millions*
China	*1378.67*
India	*1299.00*
Euro Area	*341.01*
United States	*324.30*
Indonesia	*258.70*
Brazil	*206.08*
Russia	*146.80*
Japan	*126.86*

Use the data presented in table above to answer the following questions:

a) Draw a simple bar graph portraying the above data.
b) Describe the population distribution as portrayed on the graph and the table above.
c) Explain the impact of population on the physical environment in countries such as China and India.
d) Research on advantages and disadvantages of bar graphs.

A simple bar graph is created following the same procedures as a simple line graph. However, instead of using a line to represent the variables, parallel bars are used. The independent variables are indicated on the horizontal axis and dependent variables shown on the y-axis or vertical line.

Construction of a simple bar graph

The following are the main steps followed to construct a simple bar graph:

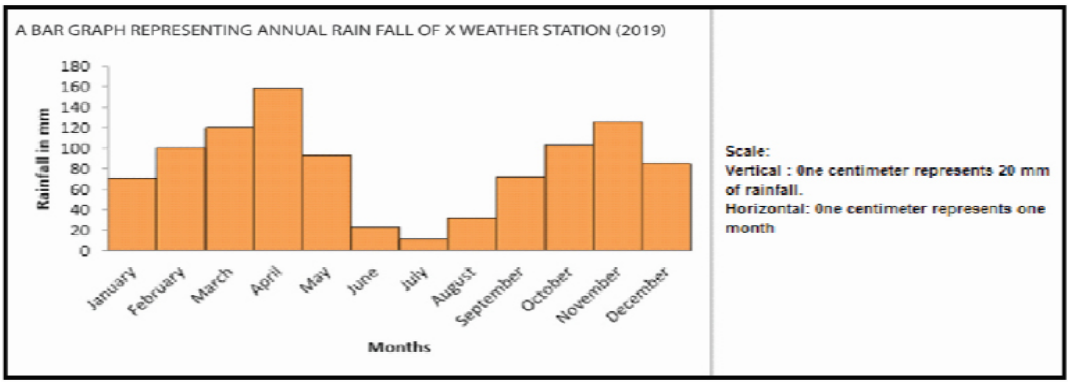
1) Create a frame of both vertical and horizontal axes. That is, drawing the X and Y axes. The length of these two lines will be determined by the scales used and the figures to be plotted.
2) Indicate the independent variables on the X axis and dependent variables on Y axis.
3) Select appropriate scale: Both vertical and horizontal scales. This is determined as studied while dealing with line graphs.
4) The horizontal scale will automatically determine the size of the bars. It is recommended that the size of each bar should not exceed 1 cm or go below 1cm in width. Too small and huge bars make the graph lose its primary appearance.
5) While plotting points, use tiny dots to mark the required points. This is because with bar graphs dots are not supposed to be seen.
6) The volume, percentage or value of the dependent variable is represented by the height of each independent bar.
7) A reasonable small space should be left to separate the bars from the vertical axis.
8) There should be uniformity in terms of the size of bars, separating space existing between bars.
9) The bars should be attached only when a single or similar dependent variable is being dealt with. But this is not a golden ruling. For example, Rainfall, production of coffee or any other variable.

Worked example:

Table of annual mean rainfall of X weather station in 2019

Months	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall mm	71	101	120	158	93	22	11	32	72	103	126	85

The data displayed in table above were used to construct the following simple bar graph:



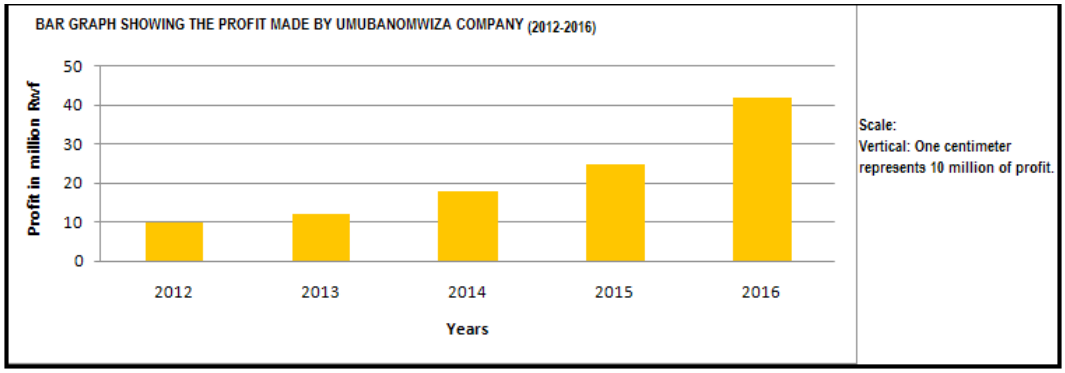
A simple bar graph showing annual mean rainfall (dependent variables) at Kanombe weather station

The data used to construct the above simple bar graph, deals with single dependent variables like rainfall and that is why the bars are attached to each other. However, the separated bars are used to represent independent variables as shown on the figure below.

Table showing the profits made in a period of 5 years by company Umubano mwiza

Years	2012	2013	2014	2015	2016
Profit in million Rwf	10	12	18	25	42

The above data are used to construct a simple bar graph for independent variables as shown below:



A simple bar graph showing profits made by Umubanomwiza Company (independent variables)

Advantages of simple bar graphs

The following are advantages of simple bar graphs:

1) They are easy to interpret.
2) Summarizes a large amount of data in a visual form.
3) They display trends easier to highlight or notice than simple line graphs.
4) They can be super-imposed on other statistical diagrams. That is, they can be used together with other methods.
5) They are easy to construct.
6) They do not involve complicated calculations.
7) They represent each data category in a frequency distribution.
8) The several bars constructed provide a chance of comparative analysis and expression of differences existing between variables. For example, rainfall received within 12 months.
9) They provide a compact way of presenting statistical data.
10) They are suitable for showing data with different units such as years, months among many others.

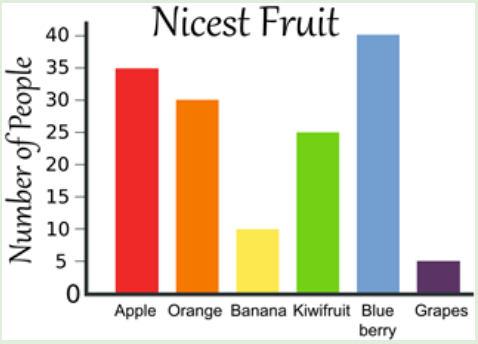
Disadvantages of simple bar graphs

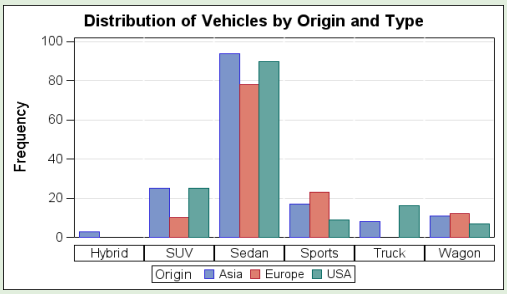
1) They can easily be manipulated to provide false impressions.
2) When large figures are used, determining a suitable scale is more challenging.
3) Time consuming especially when several variables are dealt with.
4) They do not provide adequate explanation. Therefore, for them to be rewardingly understandable, additional explanation is required.
5) Simple bar graphs do not show key assumptions, causes, impacts and patterns.

1.3.2. Group bar graph

Activity 1.3.2

The following are graphs representing different items





A ***B***

Examine the graphs provided above to answer the following questions:

a) Explain the differences and similarities existing between graph A and B.

b) Discuss on the advantages and disadvantages of graph B.

Group bar graphs also known as multiple bar graphs. Group or multiple bar graph is a statistical technique used to represent data that is made up of several dependent variables, that can hardly be shown using simple bar graph. A group of bars is constructed following the steps involved in drawing of a simple bar graph. The only difference is that group bar graph is constructed by attaching a set of bars representing individual variables.

Construction of a group bar graph

The following are main steps involved in construction of a group bar graph:

1) The way of constructing a group bar graph is the same as that of simple bar graph.
2) The bars are drawn in form of a set and touching each other for each independent variable. This implies that bars are grouped but separated from another group by a space.
3) Draw the bars in a vertical manner.
4) The independent variable that has the largest values should be started with and drawn on the left and continuing in a descending order towards the right.
5) The arrangement of the first group should be maintained throughout.

6) The width of all bars must be similar. That is, ensure that all bars display equal size.

7) Shade differently each individual bar and maintain the same shading or colouring up to the last group of bars.

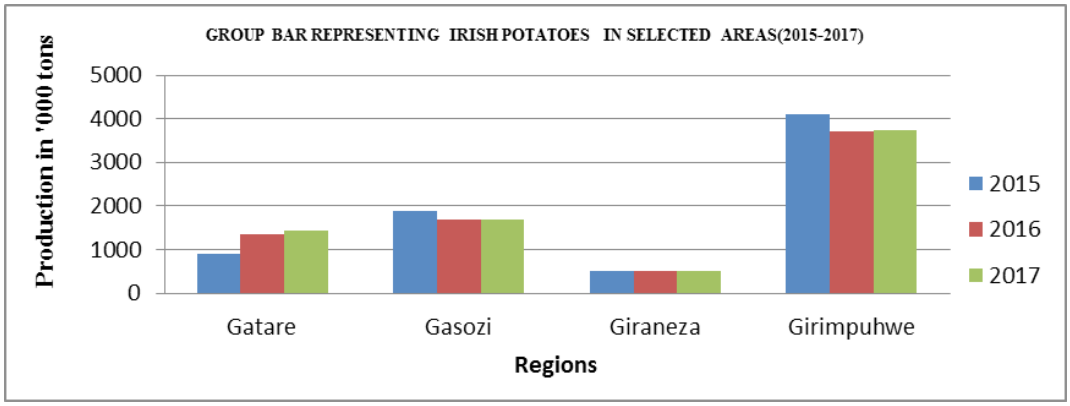
8) A suitable title as adapted from the title of the table used should be indicated on top part of the graph. In the title, the type of the statistical method used must be stated.

Worked example:

Table of Irish potatoes production in '000 tons in selected areas

Year / Regions	2015	2016	2017
Gatare	894	1360	1430
Gasozi	1900	1700	1700
Giraneza	520	500	500
Girimpuhwe	4110	3700	3750

The above data are used to construct a group bar graph as shown below:



Group bar graph of Irish potatoes production in '000 tons in selected areas

Advantages of group bar graph

1) Group bar graph is easy to interpret;

2) It favors comparative analysis of the statistical data being dealt with;

3) It is simple to draw;

4) The calculations involved are simple and easy;

5) It provides a wonderful visual impression when it is coloured;

6) It can be used together with other diagrams in a super-imposed way;

7) It is suitable for a wide range of variables.

Disadvantages of group bar graph

1) It requires a large space;

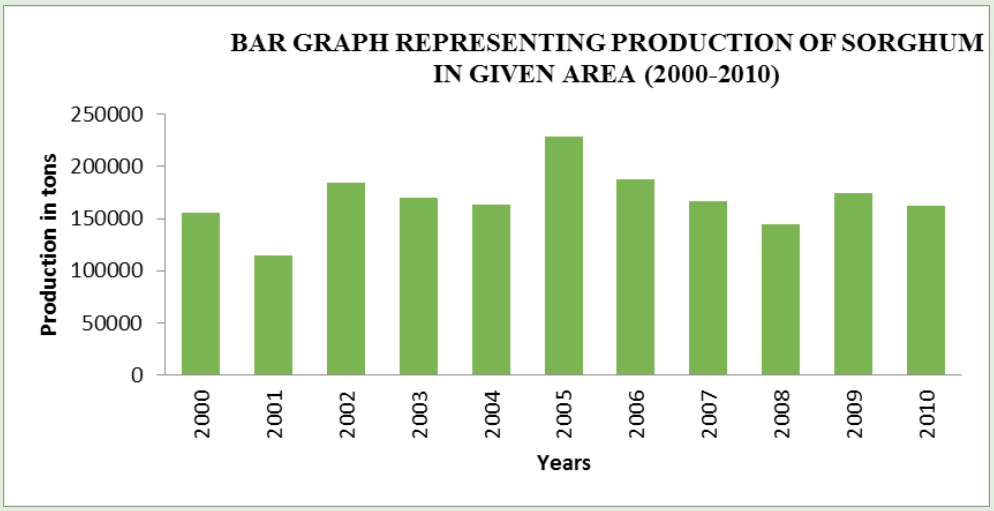
2) It is challenging while determining the scale;

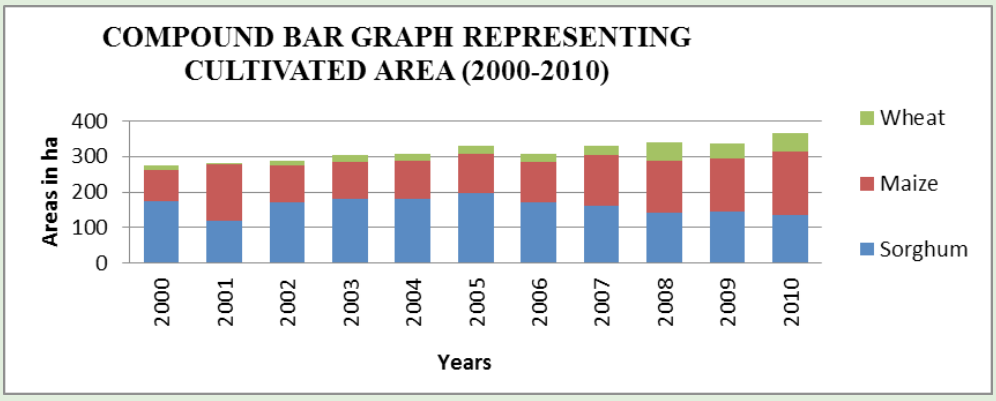
3) It may be difficult to interpret it when it is congested.

1.3.3. Compound bar graph

Activity 1.3.3

The following are graphs representing different items:





Examine the graphs provided above to answer the following questions:

1. *Explain the differences and similarities existing between graph showing production of Sorghum and that of cultivated areas of selected food crops in given area.*
2. *Research on the advantages and disadvantages of the graph showing cultivated areas of selected food crops in given area.*

Compound bar graphs are also called cumulative or divided bar graphs. This form of statistical graph is used to show how the total in any one bar is divided up between several subtotals basing on the calculated cumulative totals.

A compound bar graph used when there is more than one variable and a variety of the items are to be portrayed using one bar. Basing on cumulative totals as calculated depending on the raw data on the table provided, a given bar can be divided into segments. The size of each segment depends on the value of variable being represented.

Construction of a compound bar graph

The following are the main steps followed to construct compound bar graph:

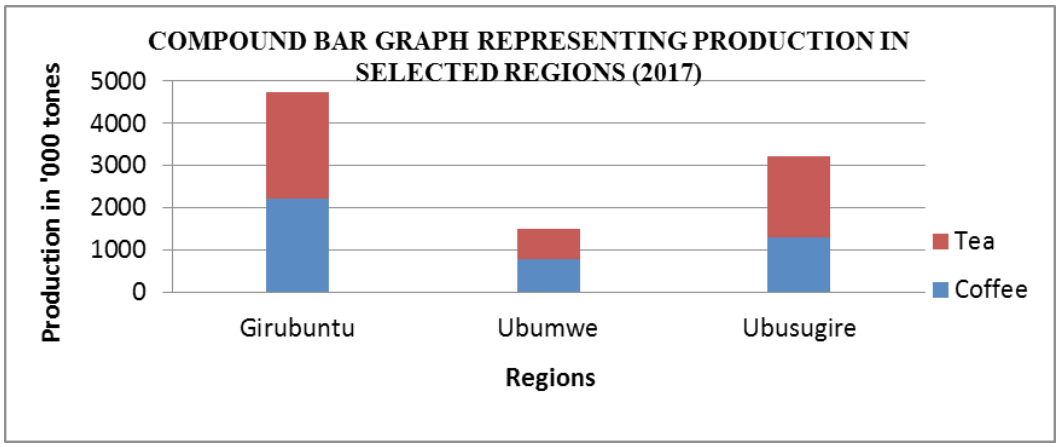
1) It is constructed by using cumulative progressive totals.
2) It requires selecting a suitable scale that enables the plotting of both big and small values.
3) The plotted data are displayed in percentages starting with the greatest value and ending with the smallest figure.
4) The width of each bar is determined basing on the scale used.
5) The number of bars will be determined by the number of variables to be represented in each set of bars.
6) The varying sheds or colors are used for each individual segment or component of every bar.

Worked example:

Coffee and tea production in '000 tones for selected regions in 2017

Cash crops / Regions	Coffee	Tea
Girubuntu	2206	2535
Ubumwe	786	708
Ubusugire	1295	1928

The above data are used to construct a compound bar graph as shown below:



Compound bar graph of coffee and tea production for selected regions

1.3.4. Divergence bar graphs

Activity 1.3.4

Table showing mineral exports of country Z from 2000-2008 in USA Dollars

Year	*Amount in (million $)*
2001	*790*
2002	*689*
2003	*900*
2004	*850*
2005	*680*
2006	*500*

Use the data presented in table above to answer the following questions:

a) *Draw a divergence bar graph.*

b) *Suppose you are asked to explain to your friend the steps involved in drawing a divergence bar graph, list down the main points you would tell her/him.*

The primary purpose of the divergence bar graph is to represent the way values of various variables deviate from the average/mean value. Therefore, this statistical method shows the fluctuation of the variables.

Construction of divergence bar graphs

The steps to be followed while constructing divergence bar graph are:

1) Construct the two vertical axis lines.
2) Join the two vertical lines with the horizontal line at the base line.
3) Draw the average line which is known as a zero line at the center of the two vertical lines. Write the average against this line at the end points where "0" is indicated.
4) Find the total of all the value of the variables and divide it by the number of the items to get the average. Subtract the average obtained from each value, to get the divergences or deviations.
5) Select the suitable scale basing on the divergences calculated.
6) Plot the negative values below the average line and the positive ones above the same line.

Worked example

Coffee production in '000 tons for country X from 2010 to 2017

Year	Coffee production in '000 tons
2010	500
2011	600
2012	900
2013	700
2014	800
2015	700
2016	560
2017	600

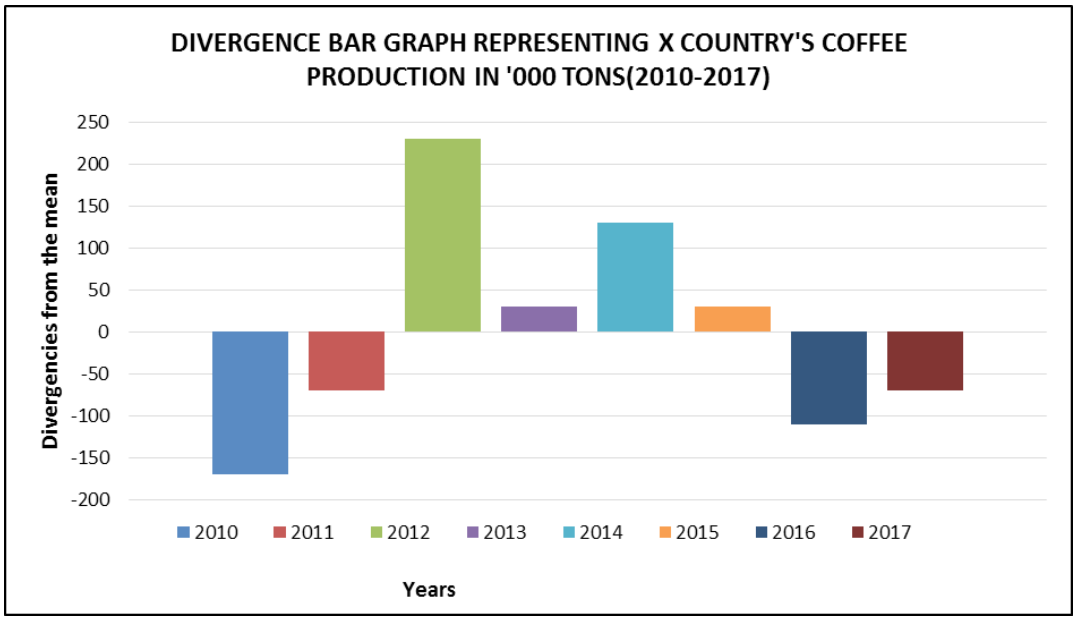
Calculate the average value

$$\frac{600+560+700+800+700+900+600+500}{8} = 670$$

Divergences from the mean

Year	Value	Average value	Divergences from the mean
2010	500	670	-170
2011	600	670	-70
2012	900	670	+230
2013	700	670	+30
2014	800	670	+130
2015	700	670	+30
2016	560	670	-110
2017	600	670	-70

The following divergence bar graph shows country's coffee production in 000 tons from 2000-2008



A divergence bar graph showing divergences in country's coffee production

Advantages of divergence bar graphs

The following are advantages associated with divergence bar graphs:

1) They provide a good visual impression.
2) They are appropriate for comparison purposes.
3) They are easy to construct.

4) They are less complex therefore, easy to interpret.

5) They use limited space.

Disadvantages of divergence bar graphs

1) There are several calculations involved.

2) The method is only limited to a single item or commodity.

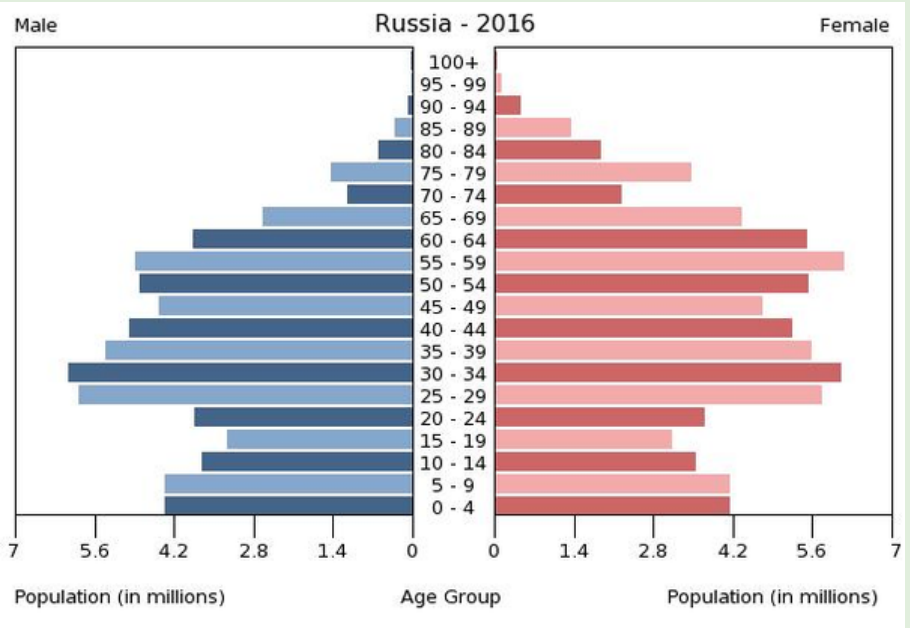
3) Determining the scale especially when the values have a wider amplitude is challenging.

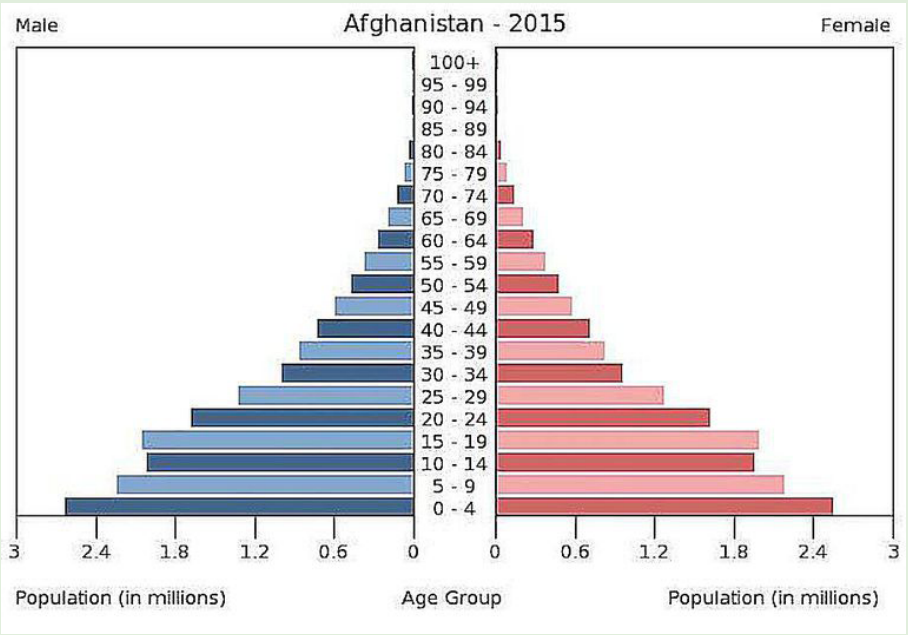
4) The plotting of values is only based on divergences. Therefore, the actual values are not seen.

1.3.5. Age and sex graphs

Activity 1.3.5

Statistical diagrams showing population structure in two different countries:





Refer to the figures presented above to answer the following questions:

a) *Name the diagrams indicated above.*

b) *Differentiate the two diagrams represented above based on their structure.*

c) *Research on the advantages and disadvantages of such diagrams.*

An age-sex graph is also known as a population pyramid. It is a type of bar graph that represents the structure of the population of a country or area basing on age and sex. An age-sex graph forms a structure of pyramid as the population grows.

It is a graphical drawing that displays the distribution of several age groups in each population of a country or part of the world, which makes the shape of a pyramid as the population grows. It is usually in age groups of five years for example 0 - 4 years; 5 - 9 years; 10 - 14 years and so on. The age groups are indicated or plotted in the middle.

The primary purpose of the population pyramid is to portray population structure and age groups. The number may be in a raw form or converted into percentages.

Construction of age-sex graph

When drawing an Age-sex pyramid, the following steps should be observed:

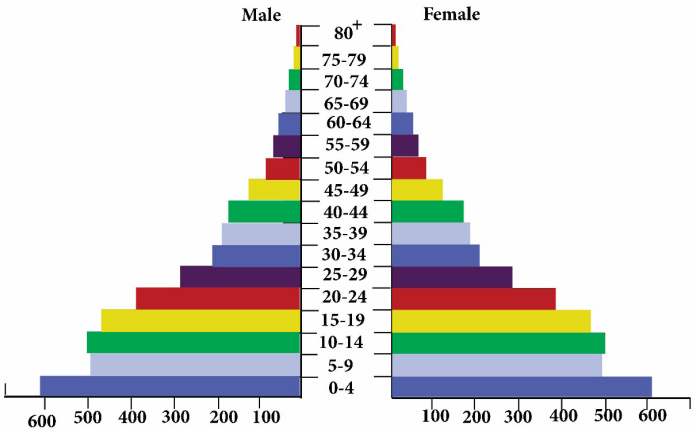
1) It is constructed on two X-axis; one to portray male and another for females.
2) Males are represented on the left and females on the right.
3) The bars representing each sex are separated by a space. It is in this space that age groups are indicated in a progressive manner.
4) The data provided should be grouped using the interval of 5 years as follows; 0 - 4; 5 – 9; 10 – 14; 15 – 19; 20 – 24; 25 – 29; 30 - 34 and so on.
5) After forming the age groups; the lowest group which forms the youngest is indicated on the base of the graph.

Worked example:

Table showing population structure (age-sex) of country X

Age	Male	Female
0-4	4500	4780
5-9	4280	4400
10-14	3980	3050
15-19	3400	3000
20-24	2540	2300
25-29	2050	1809
30-34	1940	1920
35-39	1800	1750
40-44	1500	1670
45-49	1200	1300
50-54	1050	1290
55-59	800	900
60-64	500	700
65-69	450	656
70-74	300	478
75-79	120	140
80-84	87	130
85+	40	80

The following age-sex bar graph of country X is drawn using the data presented in table above.



Age-sex graph of country X

Advantages of an age-sex graph

The following are the main advantages of an age-sex graph:

1) It provides instant display of the composition of female and male population being portrayed and their corresponding age ranges;
2) It shows the general shape of population structure. The features associated with the age-sex pyramid can indicate factors affecting a represented area or region;
3) It gives a good visual impression that captures the attention of the reader or interpreter;
4) It is easy to interpret;
5) It has limited or sometimes no calculations involved, therefore, it is easy to draw;
6) Age-sex pyramid is suitable for comparison purposes.

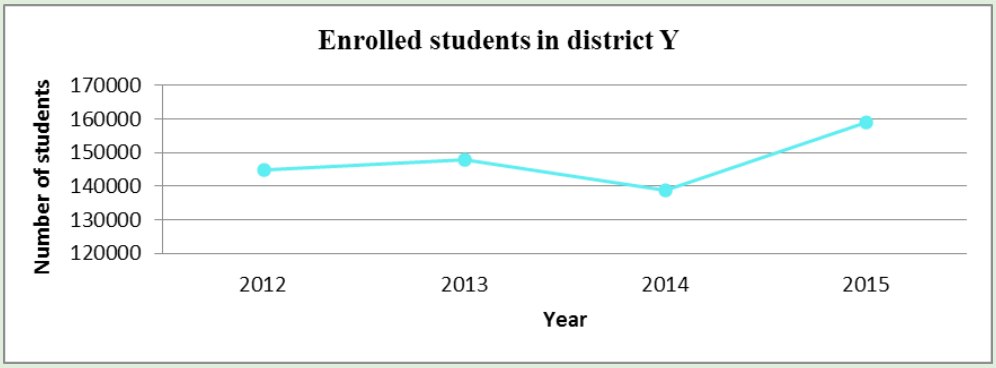
Disadvantages of an age-sex graph

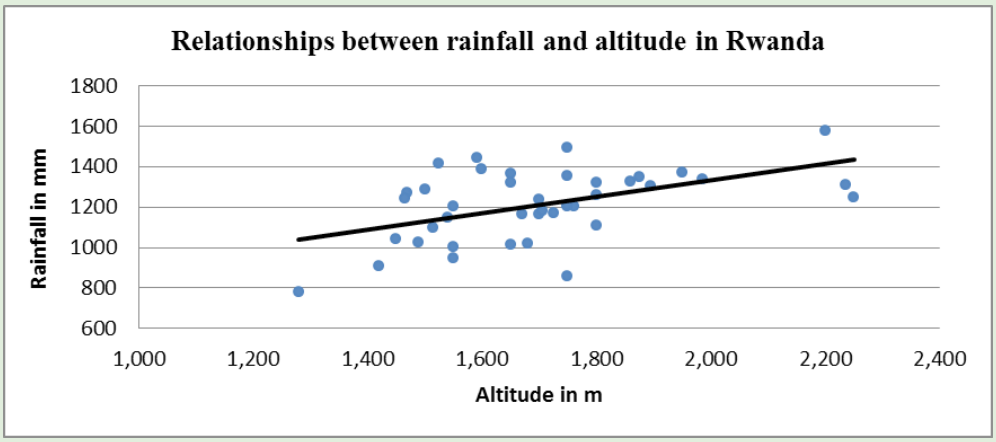
1) It is only used to represent population structure;
2) There is loss of important information due to the use of figures that are in age-cohorts;
3) It cannot show the population distribution (Do not describe or show the trend of population growth);
4) The actual figures may not be seen since in most cases percentages are used;
5) It is challenging to determine a suitable scale.

1.3.6. Dispersion graph

Activity 1.3.6

The following diagrams represent various items





Referring to the figures above answer the questions that follow:

a) Name and describe the above presented diagrams.

b) Research on the advantages and disadvantages of dispersion graphs using the internet and text books available.

The dispersion graphs are statistical representation method that displays the tendency of data scattered over a range. It is also called scatter graph. It is used to show the relationship existing between dependent and independent variables.

Construction of dispersion graph

Below are the main steps followed while constructing a dispersion graph:

1) Draw the vertical axis and horizontal axis.
2) Select the suitable scale for both axes.

3) Determine the variable that qualifies to be independent variable and the dependent variable.

4) Indicate the dependent variables along the vertical axis and the independent variables on the horizontal axis.

5) Plot the points using visible dots that are thickened.

Dispersion graphs can display positive correlation (e.g. previous figure) and negative correlation

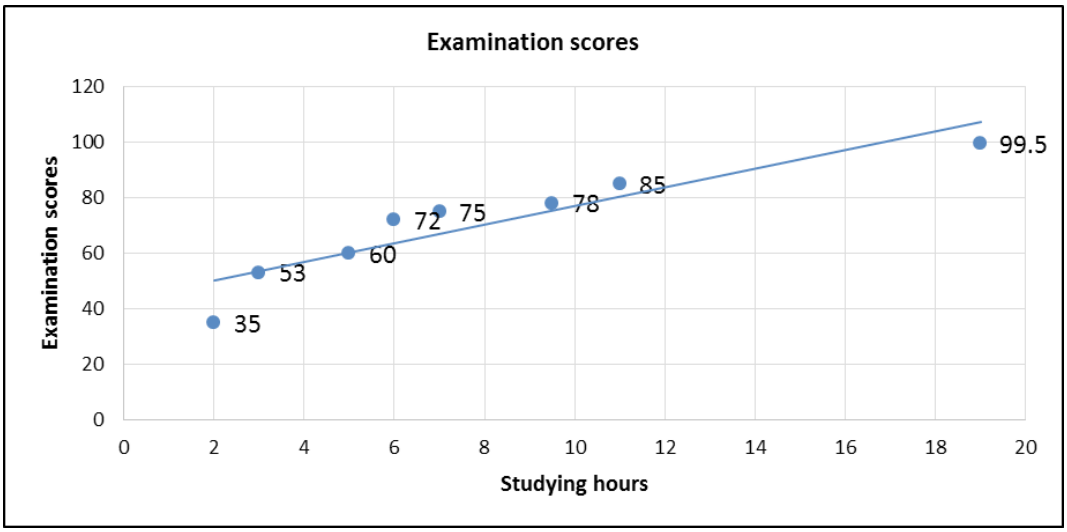
Worked example:

The table below shows the examination scores in G.S Dihiro in Bugesera District in relation to the hours assigned.

The table showing the examination scores in G.S Dihiro in Bugesera District

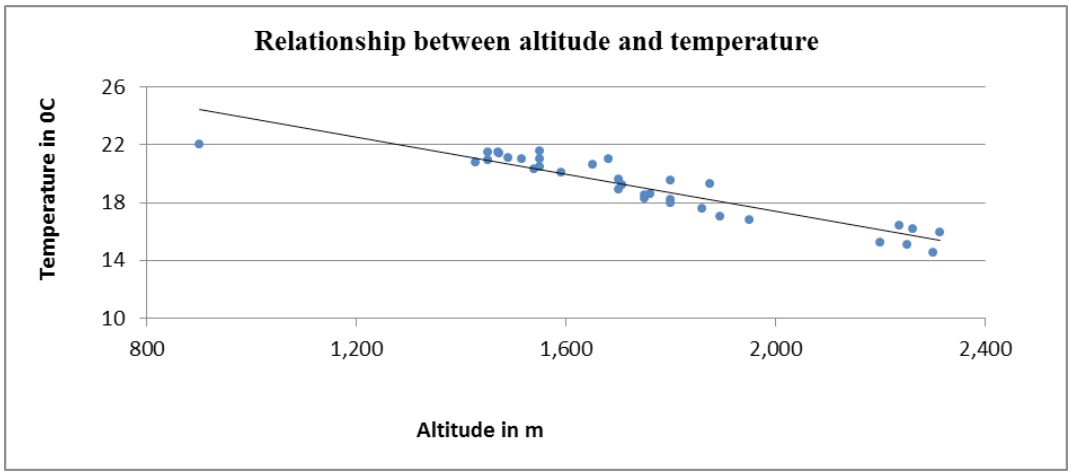
Hours of studying	2	5	6	7	3	19	9.5	11
Examination scores	35	60	72	75	53	99.5	78	85

The above data are used to construct a dispersion graph as shown below:



Dispersion graph showing the relationship between studying hours and examination scores

The graph above shows a positive correlation between studying hours and students' examination scores because the students' examination scores increase with increase in hours of study. The following graph shows negative correlation between altitude and temperature.



Dispersion graph showing the relationship between altitude and temperature

The figure above depicts that there is a negative correlation between altitude and temperature as far as the temperatures decrease with altitude.

Advantages of a dispersion graph

1) Dispersion graph displays the relationship between two variables;
2) It tests how reliable the data collected is;
3) It is easy to draw;
4) It provides a good **visual** impression;
5) It easily portrays the anomalies associated with data.

Disadvantages of a dispersion graph

1. Some information that may be important is not displayed.
2. It is more reliable when a wide data is used but when the data used is small, the conclusion may not logically be reliable.
3. Much time is required when huge information is used.
4. It is easily constructed by using ICT (Excel) and hard to construct it manually.

Application Activity 1.3

Study the table below showing annual copper production for selected countries between 1980 and 1995 (000'metric tons) and answer the following questions:

Table annual copper production levels

Year / Country	1980	1985	1990	1995
Chile	1063	1,360	1,628	2,488
United states of America	1,181	1,100	1,498	729
Zambia	596	453	445	329
China	115	185	375	370

a) *Choose suitable graph to portray the information given in the table.*

b) *Explain the merits and demerits of using the such statistical method*

c) *Identify the country with the: (i) least amount of copper produced in 1995, (ii) highest amount of copper produced in 1995.*

d) *Assess the contribution of the copper mining industry to the development of any one country given in the table.*

Skills lab

In your school, collect data of the number of students for the last five years and construct the appropriate statistical graph to portray the population of your school.

End unit Assessment

Landslides and floods hit several parts of Rwanda between 7 and 8 May 2016 after a period of heavy rainfall. Government officials say that at least 49 deaths have been recorded so far. Some of the victims drowned in flood water, others died after houses collapsed under the heavy rain and landslide.

The worst hit areas are the districts of Gakenke and Muhanga. As many as 34 people have died in Gakenke, 8 in Muhanga, 4 in Rubavu and 3 in Ngororero. Around 26 injuries have also been reported. Reports from the Ministry for Disaster Management and Refugee Affairs reported that over 500 houses have been destroyed. Therefore, use the statistical information presented above to do the following:

a) *Extract statistical raw data mentioned in the story.*

b) *Use appropriate statistical diagrams and graphs to display the portrayed data in (a) above.*

c) *Identify and describe the geographical phenomena that are highlighted in the news print.*

d) *Explain how you would use the data collected and statistical diagrams, graphs and charts constructed to advise the people and the government on the environmental challenges to be addressed.*

e) *Assess the environmental challenges to be addressed in the area and show measures of controlling them.*

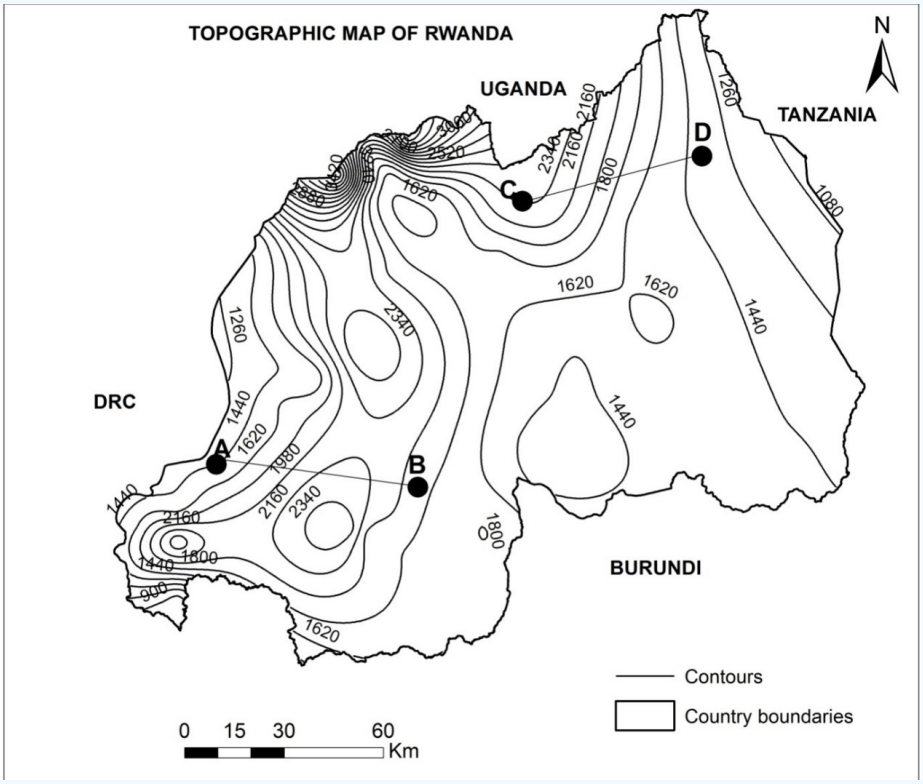
UNIT 2

BEARINGS, DIRECTIONS, DISTANCES AND AREAS ON A MAP

Key Unit competence : The student-teachers should be able to measure the bearings and the directions, calculate distances and areas on a map.

Introductory activity

Maps are very important in showing location of places. Study the topographical map of Rwanda provided below, and answer the questions that follow.



a) *How do we locate places on maps using grid references?*

b) *Determine the distance from point A to B and C to D?*

c) *Identify the steps to be followed to determine the bearing of B from A.*

2.1. Location of places using the grid references

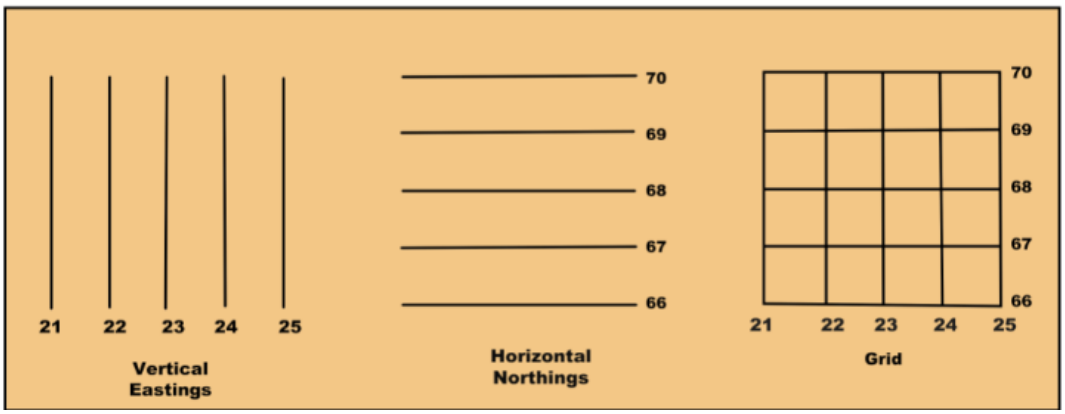
Activity 2.1

Map

a) A map has several printed lines on it. Show the vertical and horizontal lines printed on the map. Identify them.

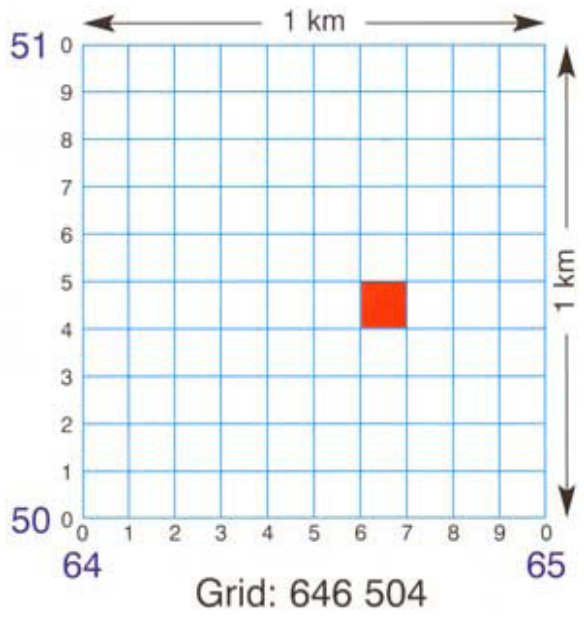
b) What does grid reference mean?

A grid is a series of straight lines drawn vertically and horizontally on a topographical map, where the lines cross each other and form squares of equal sizes. The lines running from north to south (vertical lines) are called Eastings. This is because their numbers increase towards the east from the south western corner. This is known as the grid origin and it is from it that all readings start. Lines drawn horizontally run from east to west and are called Northings. Their numbers increase towards the north.



A grid reference system

The lines shown on the illustration above intersect forming grid squares. These are formed by both vertical lines (Eastings) and horizontal lines (Northings). These are called grid references or geographical coordinates. They are the ones that are used to locate places and features indicated on the map. This is illustrated below:



Subdivision of Eastings and Northings into rows and Columns of little boxes

The value of the easting (vertical gridline) is read first, followed by the value of the northing (horizontal Gridline). The values of the Eastings and Northings are known as coordinates. The coordinates are expressed as a single continuous figure without decimal points or commas, for example, 646 504 and not 646,504. They are plain numbers, without units of measurements.

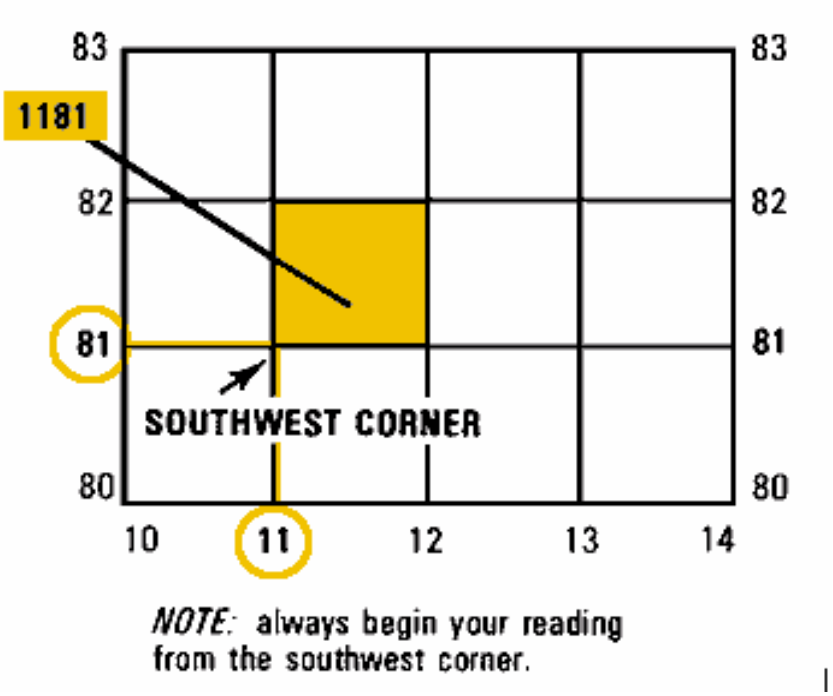
The coordinates are given in two ways:

- Four-figure grid reference
- Six-figure grid reference

2.1.1. The four-figure grid reference

The four-figure grid has four digits. It gives the grid reference in which a position is found. The four-figure grid references of the yellow square, in figure below, are found as follow:

- Read the easting first and record its value. In this case it is 11.
- Next read the northings and record its value. In this case it is 81.
- Put the two values together.
- The four-figure grid reference for the square is 1181.

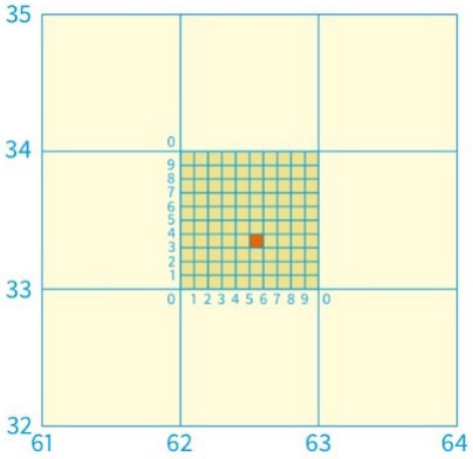


Four-figure grid reference

2.1.2. The six-figure grid reference

This reference has six digits. It is more exact than the four-figure grid reference. To find the six-figure grid reference for the red square in figure below is done in the following ways:

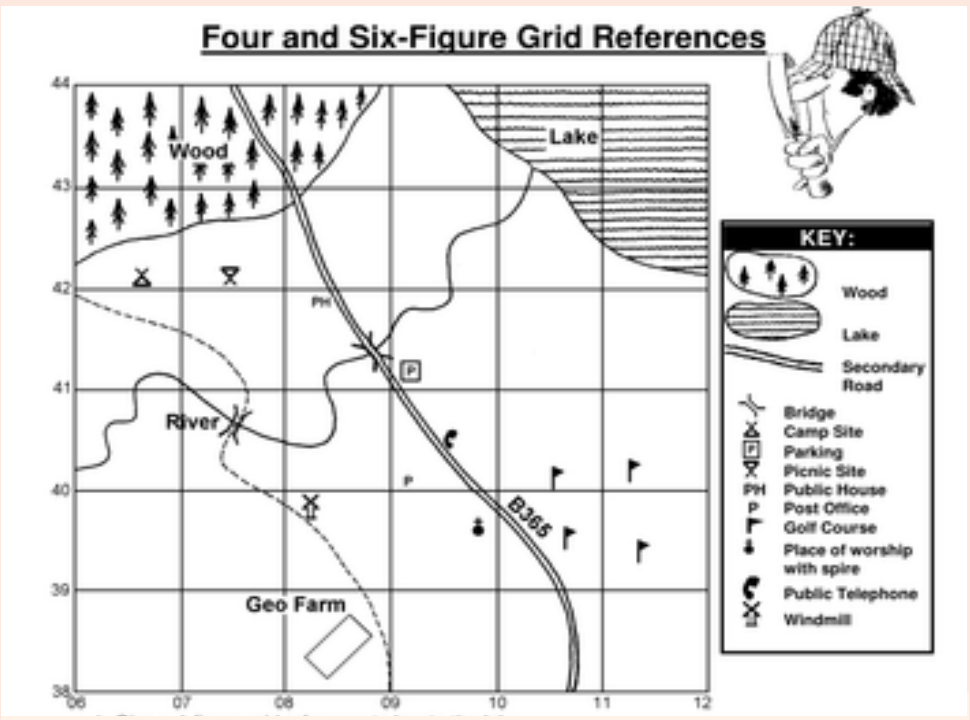
- Read the easting first and record its value. In this case it is 62;
- Subdivide the area between easting 62 and 63 into 10 equal parts;
- Record the value of red square out of 10 from easting 62. In this case, it is 5. This forms the third digit of the easting;
- The value of the easting for red square is therefore 625;
- Read and record the northing. In this case, it is 33;
- Subdivide the area between northing 33and 34 into 10 equal parts;
- Record the value of red square out of 10 from northing 33. In this case, it is 3. This forms the third digit of the northings;
- The value of the northing is therefore 333;
- The six-figure grid reference for red square is therefore 625333.



Six-figure grid references

Application Activity 2.1

Study the extracted map below and answer the questions that follow



1. *Give the four-grid reference of the Geo farm.*
2. *Identify the six-grid reference of two bridges shown on the map.*

2.2. Starting directions and bearings on topographic maps

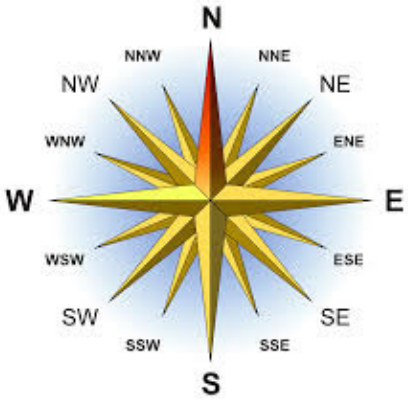
Activity 2.2

Look at the picture below and answer the following questions

1. *What do you understand by the term direction?*
2. *Explain the relationship between directions and bearing on the map.*

2.2.1. Direction

Direction or orientation is important for finding the position of a place and its relative. All directions are based on the cardinal points of the compass shown below:



Compass showing 16 cardinal points

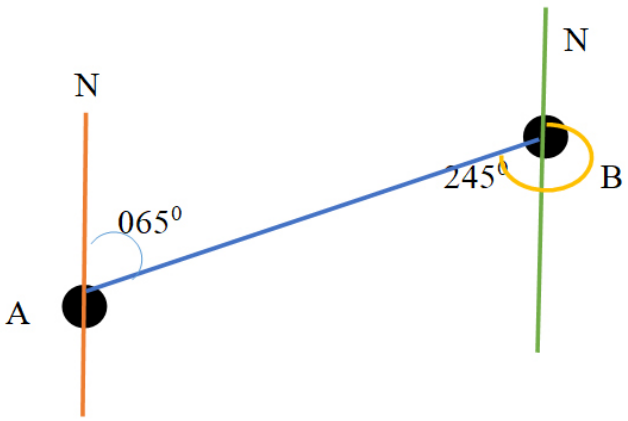
Direction is the relative position of a place from another using the points of the compass. The main cardinal points of a compass are north, east, south and west. The first letters of these directions are used in capital letter in place as this. These are N-North, E-East, S-South, W-west.

2.2.2. Bearing

Bearing is a way of giving the direction of one place in relation to another. It is more accurate than direction because it has 360 points compared to the16 points of a compass. Instead of saying, for example, that place A is located north east of place B, we use degrees. So, we could say that place B is situated at 45^0 from place A

The bearing of a point is the number of degrees in the angle measured in a clockwise direction, from the North line to the line joining the center of the compass with the point. It is used to represent the direction of one-point relative to another point.

For example, on the following diagram, the bearing of A from B is 245^0, the bearing of B from A is 65^0.



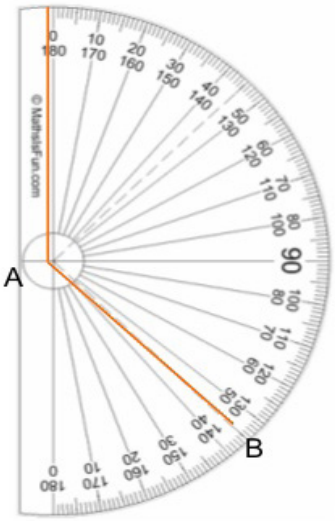
Bearing of point A and point B

Bearing is also the direction to something measured as an angle relative to the north. It increases towards the East, with North=0 degrees, East=90degrees, South=180 degrees, and West=270 degrees.

2.2.3. Measuring true bearing

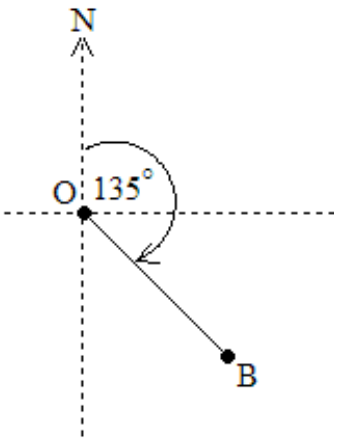
The true bearing (TB) is the bearing where the true-north line is taken as 0^0. It is the measurement between the true-north line and the line joining the two places concerned. It is measured by using a protractor from the true North, as the example below:

- Draw a north-south line through the starting point.
- Use a straight line to join the two places given.
- Draw an arrow from the true North line to the line joining the two places in a clockwise direction, and the angle is measured with a protractor.



B

Protractor (A)



A

Measuring bearing of point (B)

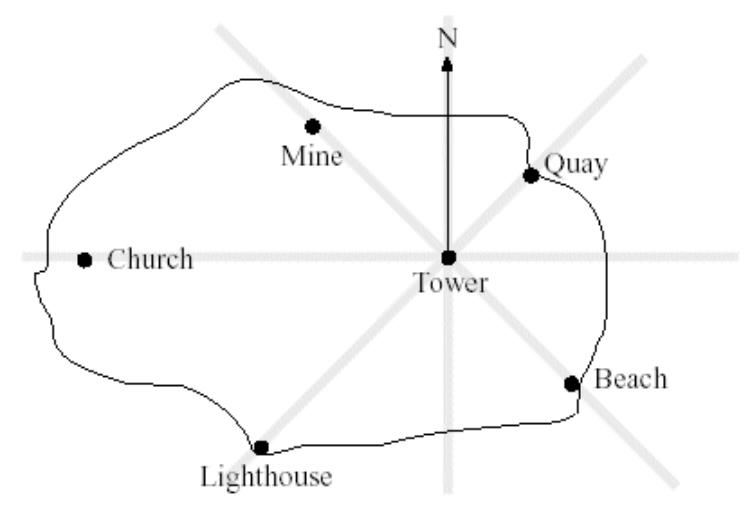
In this case, the bearing of B from A is therefore 135^0.

How to use a protractor?

- The centre of the protractor is over the starting point and orient 0 degree with the true north.
- Draw a line on the map from the starting point towards the destination,
- Read the bearing where the line intersects the protractor.

Application Activity 2.2

Study the illustration shown below and answer the questions that follow.



Determine the bearing of:

a) *The Beach from the Tower.*
b) *The Tower from the Church.*
c) *The Mine from the Tower.*
d) *What is the direction of the church from the Quay?*

2.3. Measure the distance on the maps: Straight line and curved line

Activity 2.3

Read the conversation between Eric and Sophie, students in S1B, and answer the questions:

Eric: I want to visit my uncle at Gasabo district.

Sophie: Can we walk from Kabuga market to Gasabo district?

Eric: I don't know, let us look at our map. It has a ratio scale of 1:50 000. On the map, it is 20cm from Kabuga to Gasabo district.

Using our map skills, that you have acquired in your previous studies:

- *Calculate the actual distance on the ground.*
- *Can Eric and Sophie walk in two hours from Kabuga market to Gasabo District? Support your answer.*

A map is a representation of actual ground on the paper. It is usually drawn using a scale.

Distance on the map is calculated between two points, and then it is converted into the actual distance on the ground. The distance can be either a Straight line or a curved line.

The most important is to know how to calculate the distance.

The following methods are used to measure the distance.

2.3.1. The Straight Line distance

The shortest distance between two points is sometimes known as "***the crow flies.***"

- use the ruler and measure the distance between two points in centimetres;
- convert the centimetre reading to kilometre by multiplying by 0.5km if the map scale is (1:50 000) to obtain the kilometres on the ground.

  Example, the distance of the crow flies from P and Q is 8.5cm on the map, therefore $\frac{8.5\text{cm} \times 0.5\text{km}}{1\text{ cm}}$ =4.25 km on the ground.

  A map scale refers to the relationship (or ratio) between distance on the map and the corresponding distance on the ground. The map scale shows you the comparative size of features and distances display on the map.

2.3.2. Curved distance

In map reading, there are sometimes curved or straight areas while determining the distance.

Below, there are some steps to follow to calculate curved Distance.

- place the straight edge of the paper along the features to be measured e.g. road, river;
- make a mark where the paper intersects the road;
- hold the paper steady with the point of a pencil;
- swivel paper;
- mark where paper intersect with the road;
- write down the reading after measuring the road or river;

- check the scale of the map,
- and convert the distance between the two points into the real distance on the ground.

The answer above should be converted to the unit for ground distances (km).

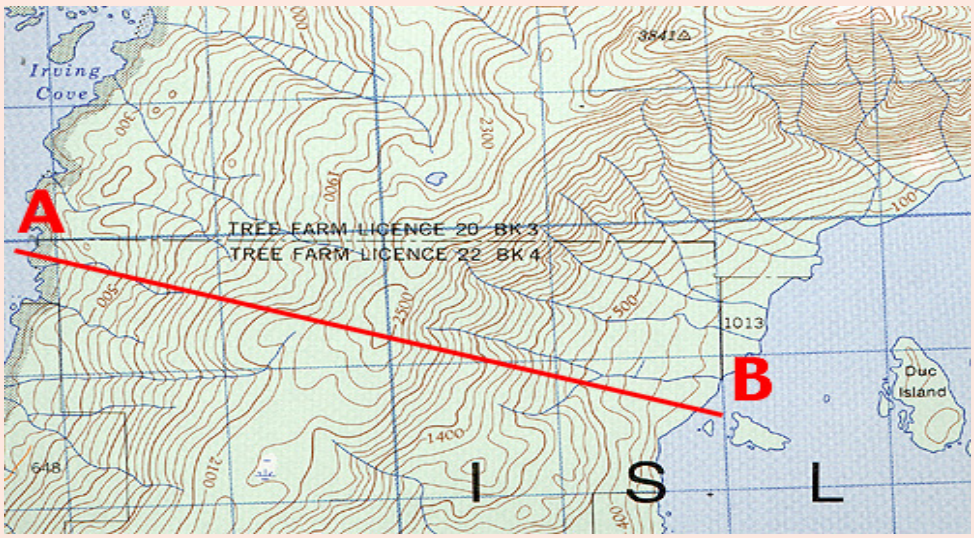
N.B. An alternative method is where a piece of string is used to measure the curved or winding line. Make sure that the string is not elastic.

Formula:

Actual distance = Map distance x Scale.

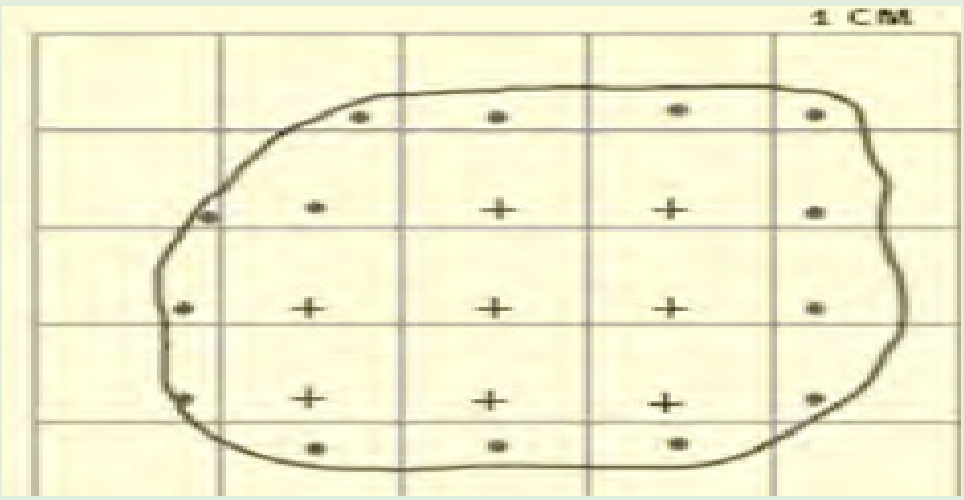
Application Activity 2.3

Observe carefully the map provided below and calculate the distance from A to B using the scale of 1:50 000



2.4. Calculate the area on topographic map: regular and irregular shape

Activity 2.4



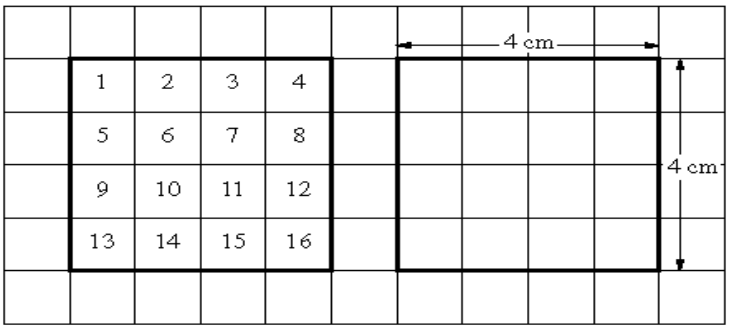
1. *Here is the area of a forest. Determine the total area covered by a forest*
2. *Identify methods used to calculate areas of regular shape on the map*

An area is calculated to determine the actual (size on the ground) of a feature/ region/ demarcated area. The area of a feature can be regular or irregular in shape.

2.4.1. Calculate areas of regular shapes

Getting the area of a regular body on the maps is simple. This is because the body may be a square, rectangle, triangle, or a circle. Once the distances obtained, the mathematical formula are used.

- Square and rectangle: multiply the length by the width
- Triangle: half base multiplied by height
- Circle: Pi multiply by square of radius.



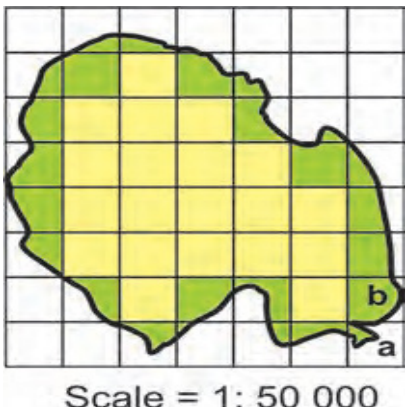
Squared figure measurement

2.4.2. Calculate areas of irregular shapes

The following methods are used to calculate the area of irregular shapes:

1. The use of grid squares

On topographical maps of the scale 1:50,000, there are grid squares measuring 2 cm by 2 cm.



On the ground, these measure 1 km by 1 km. It means that they have an area of 1 km^2.

To calculate the area of irregular shapes, we need to perform the following steps are performed:

- Count all the full squares inside the irregular body.
- Count all the half squares inside the irregular body and divide them by two.
- Add the total of the full squares and the half squares.

For example:

Formula:

Full squares= 20

Half Squares=26

Get 26 halves divide by 2 =13 full squares

20 +13=33 full squares X the area of one square

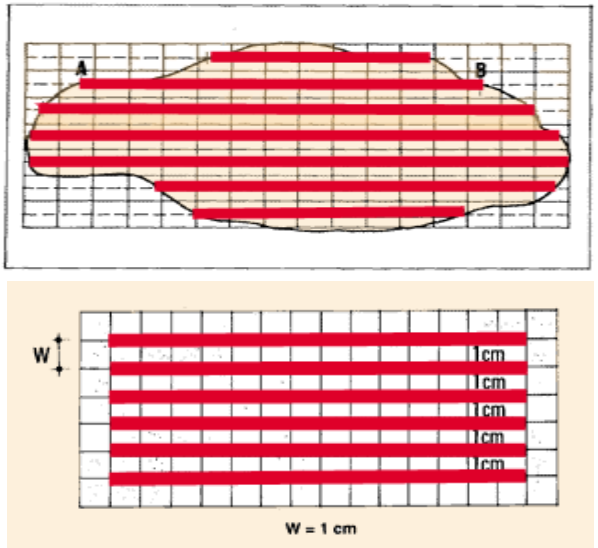
33 x1 square km

=33 km Squared.

2. The use of strip method

The strip of equal width is drawn on the irregular body. The length of the strips differs from strip to strip.

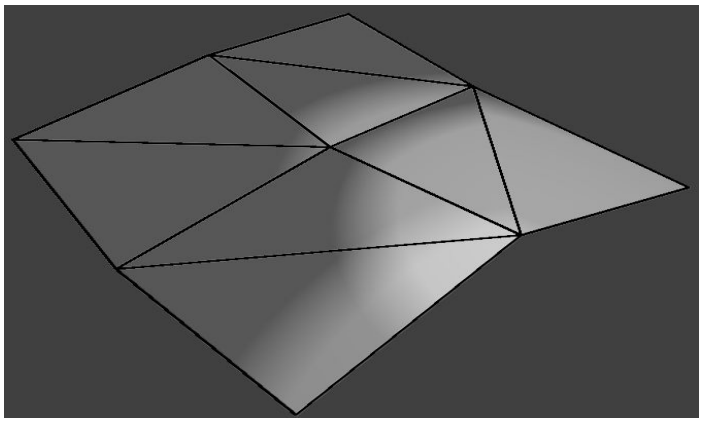
Follow the method used to find the area of regular shapes. Calculate the area of each strip. Add the areas of the various strips. This gives you the area of the irregular shape.



Calculating an area using the strip method

3. Use of rectangles and triangles

The irregular body is divided into a rectangle and triangles as shown below. Their measurements are recorded. The formula for finding the area is used (known). Then get the totals of these areas.



Calculating an area using rectangles and triangles

Application Activity 2.4

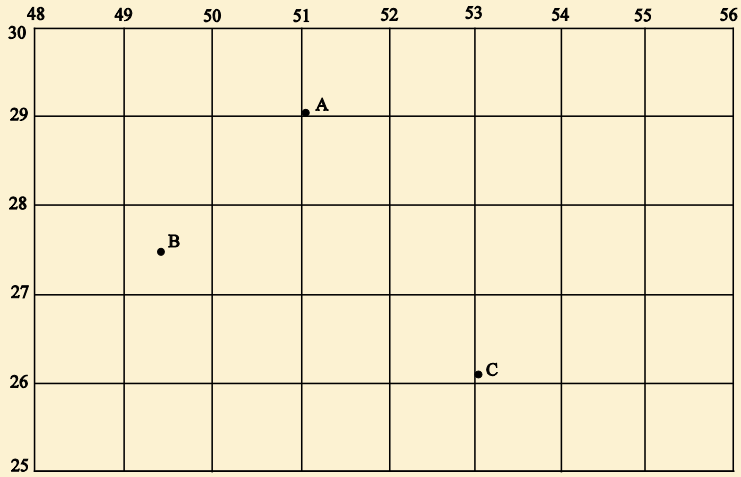
Using your knowledge, identify how you can calculate the area of a farm if the measurement got are 45 m length, and 34 m width.

Skills lab

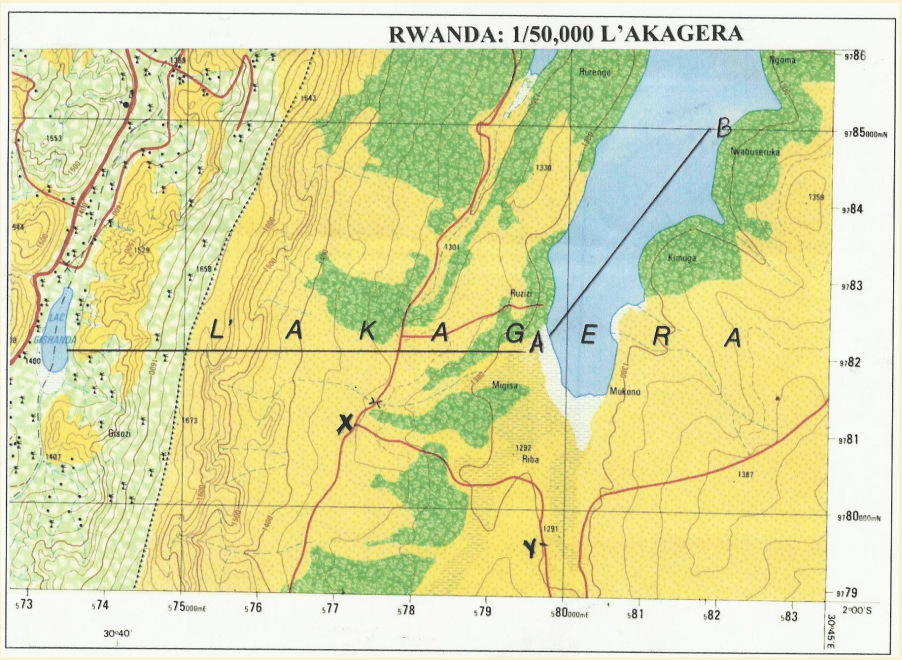
In your school environment, use the school plan to calculate the area of your school compound and submit it to your school leader, then compare the result obtained to the real area of the school.

End unit Assessment

1. Calculate the grid references for the points A, B and C on the figure:



2. Study the Topographical map below and calculate the actual distance on the ground between the point A and B; X and Y on the Map.

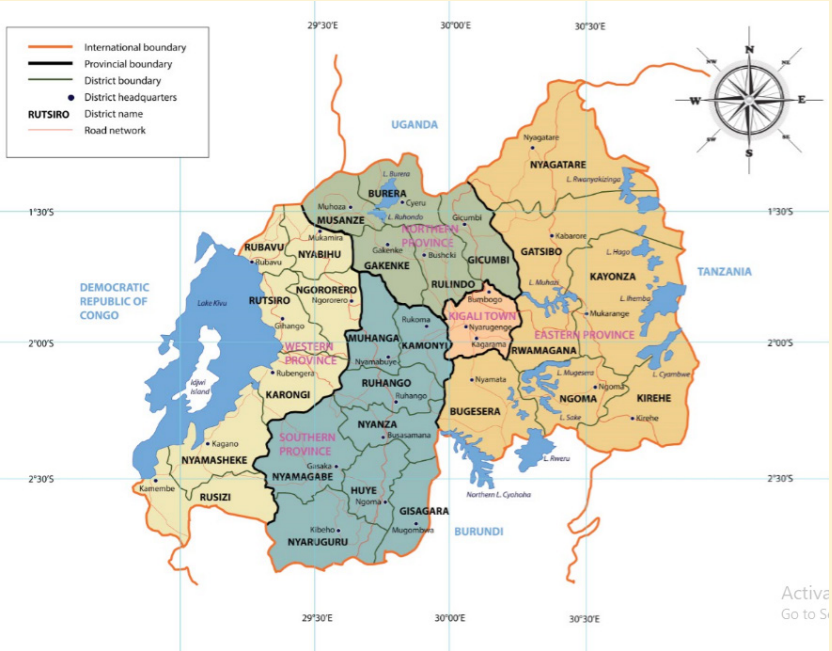


3. Mugisha and Mucyo are traders in Kigali and they export goods made in Rwanda and import some commodities that are not locally produced. Sometimes goods delay as they are being transported from Mombasa port. Suppose you want to travel with these traders, explain how you would use a map to find out the distance from Kigali to Mombasa.

4. Suppose someone comes from Europe to visit Rwanda, specifically Muhoza sector, in Musanze District (see the map below). At Kigali airport someone gives him a map with a scale of 1:50,000. He/ she needs to know the bearing of Muhoza from Kigali.

   — Show how you would find the bearing of Muhoza if this visitor asked for guidance.

   — What is the relative position of Muhoza from Kigali?

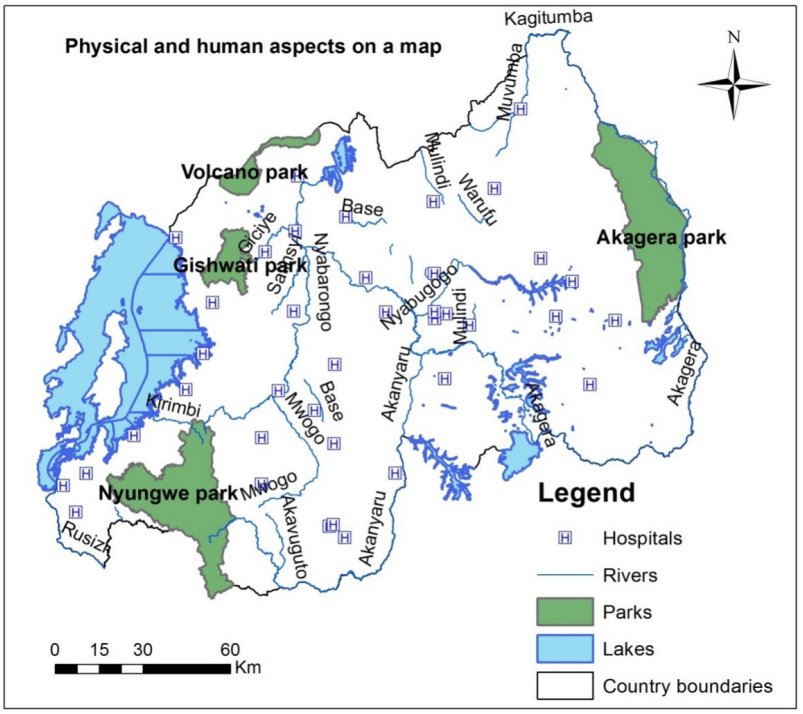


UNIT 3

MAP WORK INTERPRETATION

Key unit competence : The student-teacher should be able to explain the relationship between the physical and human activities on maps.

Introductory activity



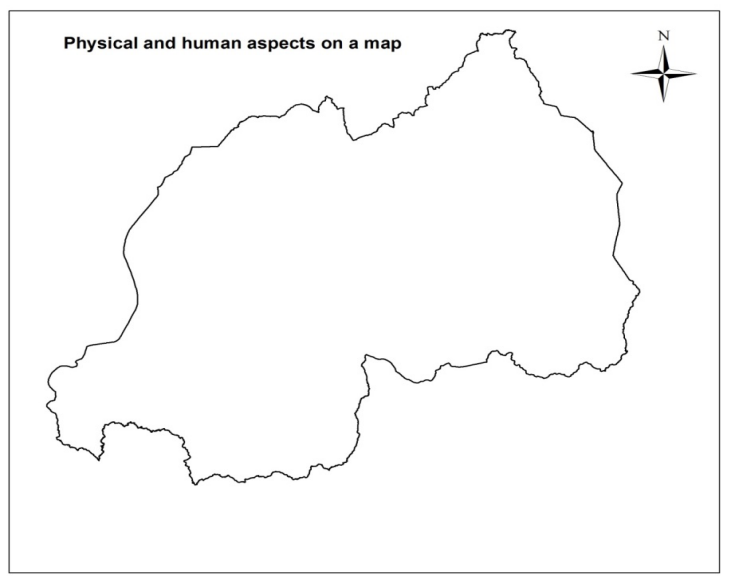
A map is a representation of all or part of existing things on the earth surface on a flat surface. A photograph is a picture of an object or environment taken by a camera at a particular time in a given place. Maps and photographs represent both physical and human features. The aspects represented on map/ photographs are shown using several types of signs and symbols. This helps map /photograph users to extract the needed information from a given map / photograph.

Referring to the map above and the definition above;

a) Identify the main physical features represented on the map.

b) Identify the human features represented on the map.

c) Use the following map to represent approximately the same features as those represented on the map above.



d) Take a photograph of the environment around your school and then identify all physical and human aspects taken on that photograph.

3.1. Interpretation of physical aspects from maps/photographs

Activity 3.1

Make a research on:

a) The major physical aspects which may be represented on a map/photograph.

b) The signs and symbols which may be used to represent physical features on a map/photograph.

Physical features are also called natural features. They include the following:

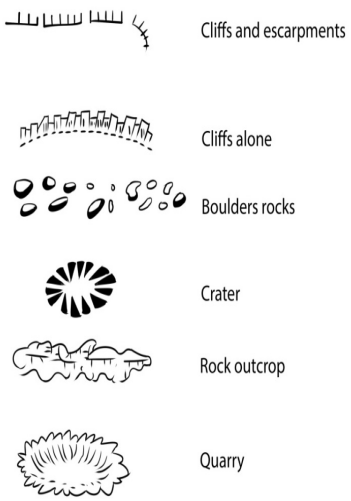
- Relief which comprises rocks, slopes, soils, valleys, plains, plateau, hills, and mountains.

- Drainage features like rivers, dams, lakes, seas and oceans.
- Vegetation cover like forests made of several types of trees, crops and ground vegetation, wetland vegetation.
- Climate which is defined through various parameters like rainfall, temperatures, relative humidity, cloud cover, wind speed and direction, atmospheric pressure, sun shine.

3.1.1. Interpretation of geological features

The main geological features commonly represented on a map/photography include rocks, cliffs and boulders.

- A rock is a solid matter which is found on the surface or in the interior of the earth.
- A cliff is a vertical or nearly vertical rock face in mountainous and hilly areas. Cliffs are found along the shores of lakes and seas. Cliffs and rocks are shown on topographical maps using contours that are close to each other. Boulders are large pieces of rocks that resisted weathering.
- A **crater** is a bowl-shaped depression, or hollowed-out area, produced by the impact of a meteorite, volcanic activity, or an explosion.
- A quarry is a place from which stones, rocks, construction aggregate, riprap, sand, gravel, or slate are excavated from the ground. A quarry appears like a place where open cast mining is practiced.



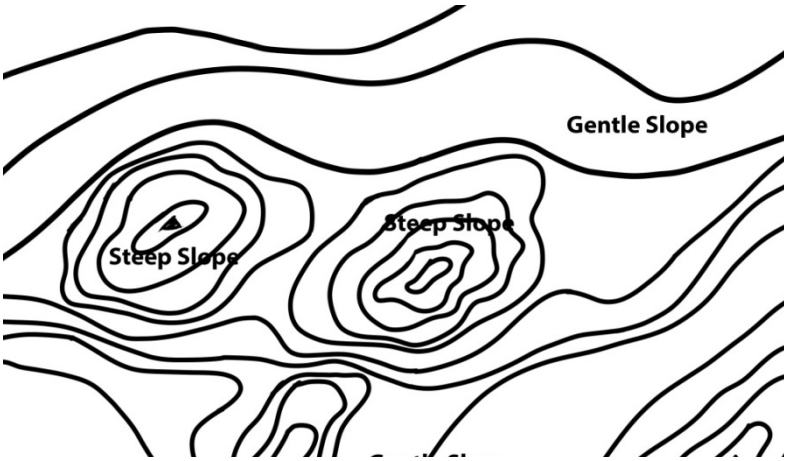
Cliff, rock and boulders

3.1.2. Interpretation of slopes from a map/photograph

The slopes are classified according to their inclination, constancy or shape. The slopes are represented on the map by help of contours. Contours are lines on a map linking places of the same height above the sea level. They are drawn at fixed intervals, known as vertical interval or VI.

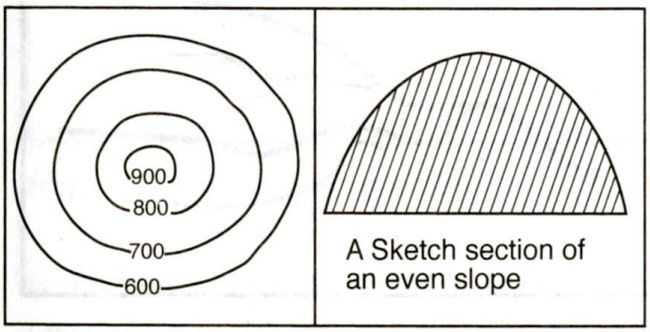
Contours are labeled from the lowest to the highest. Where they are too close to each other, the relief is steep. Where they are far apart, the land may be a plain or a plateau. The main types of slopes are: gentle, steep, regular, irregular, convex and concave slopes.

- **Gentle slopes:** Spaced contours are used to indicate gentle slopes. In that case the land may be a plain or plateau which is a flat elevated landform that rises sharply above the surrounding area.
- **Steep slopes:** Very close contours are used for steep slopes. The closer the contours, the steeper the slope. In that case the landform may be a mountain.



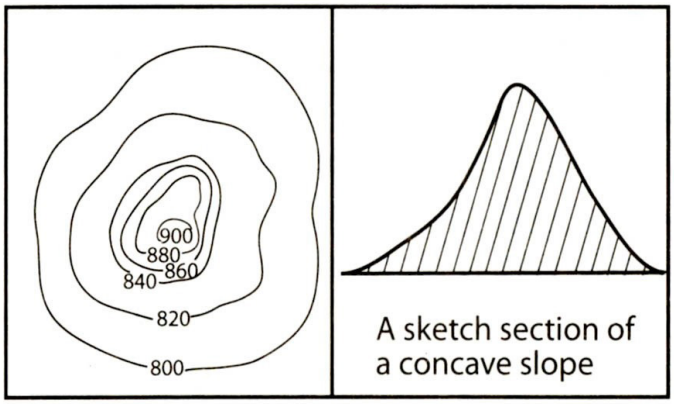
Contours representing gentle and steep slopes

- **Regular slopes**: Regular slopes are also called **constant** or **even slopes**. The contours have constant spaces. The slopes can be either gentle or steep slopes.
- **Irregular slopes**: These **are uneven** or **inconstant slopes**. They are represented by unequally spaced contours. They can be either gentle or steep slopes. These slopes are found mostly in rugged, mountainous or hilly areas.



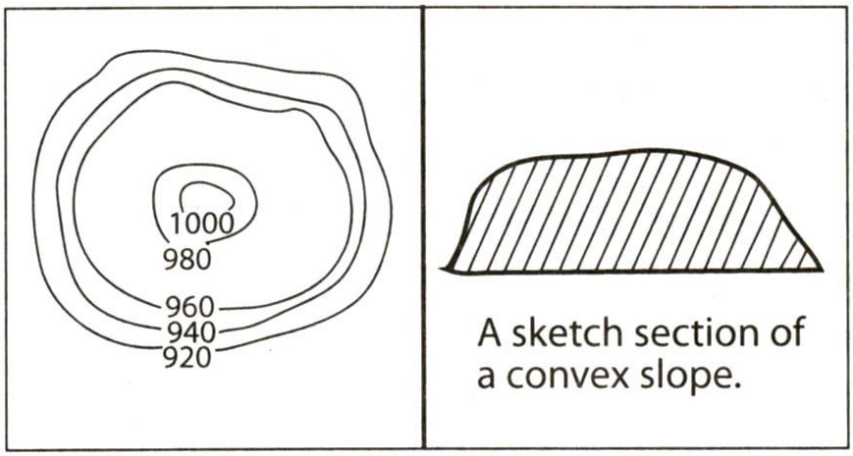
Contours representing by irregular and regular slopes on a sketch section

- **Concave slopes:** They indicate that the land is steeper on the upper part and gentler on the lower part. They are drawn using closely packed contours on the upper part of where the slope is steep. The contours are widely spaced on the lower part where the slope is gentle.



Contours representing a concave slope and a sketch of a concave slope

- **Convex slopes**: Convex slopes are gentle at the top and steep at the bottom of the hill or mountain. The contours are closely spaced at the bottom section (steep slopes) and widely spaced at the top section (gentle slopes).

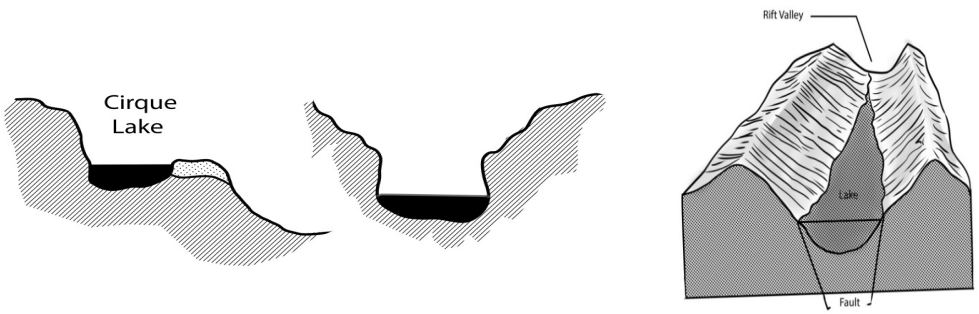


Contours representing convex slopes and sketch of a convex slope

3.1.3. Interpretation of drainage and landforms from a map/photo-graph

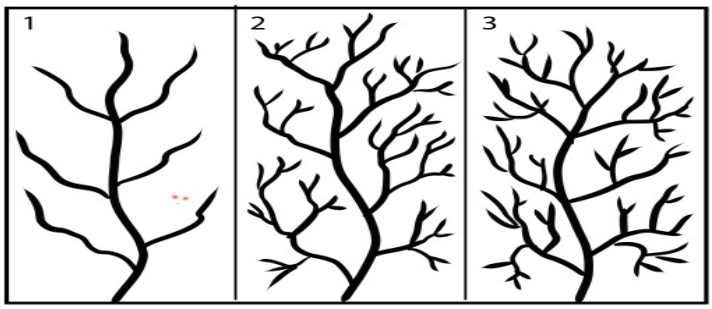
i. Interpretation of drainage features from a map/photograph

The lake, sea and ocean occupy a very large area. They are seen in blue color on a color photograph and in dark color on black and white photograph. However other conventional symbols may be applied on a map to represent a lake, sea and ocean; the most important thing is to put in legend/key the used symbols.



Examples of a representation of a lake

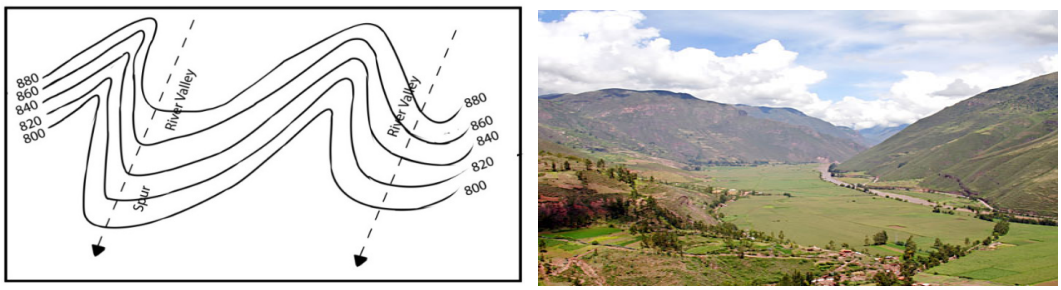
The rivers originate from mountains or hills and flows on steep slope to end in the depression that are usually found in valleys or low-lying areas. The streams and rivers are seen on a coloured photograph/map as blue lines and they have different patterns or arrangements which can be detected easily on a map or photograph.



Examples of river patterns

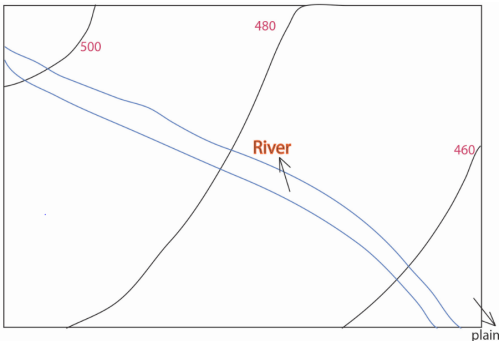
ii. Interpretation of landforms:

1. **Valley**: A valley is an elongated depression sloping towards a drainage basin like a sea, lake or swamp and which may contain water or not. The valley is normally represented on a topographic map by using the contours having "V shape".



A valley passed by a river on a topographic map and a photograph of a valley

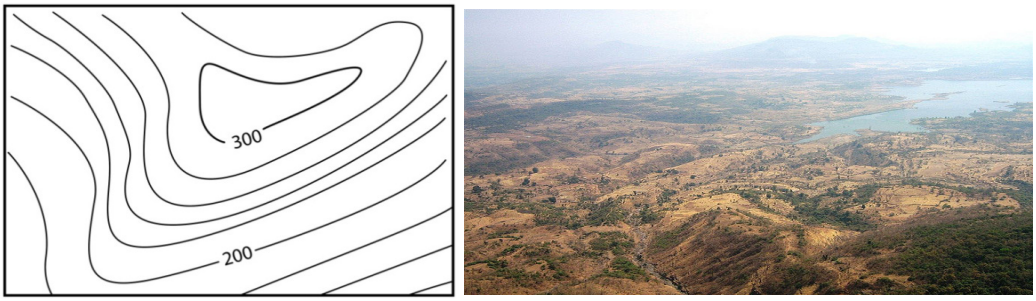
2. **Plain:** Most of the plains are in low-lying areas but some of them may be raised but the slopes remain gentle. On the topographical maps, a plain is represented by widely spaced contours. The river passing in plain areas may also be shown on the map.



A plain on a topographic map

A photograph of a plain

3. **Plateau:** A plateau is an extended landform which is bordered by steep slopes. On the map, a plateau is shown as a wide area surrounded by one or two contours having the same height on both sides.



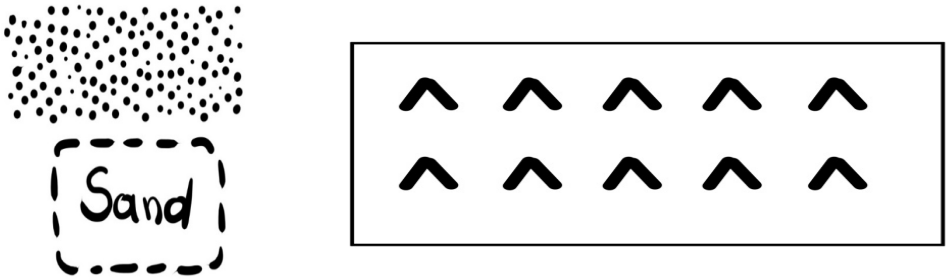
Contours showing a plateau and a photograph of a plateau

4. **Mountain:** A mountain is an extended landform with steep slopes. On the map, a mountain is shown as a wide area with very close contours surrounded by one or two wider contours showing the depression areas surrounding the mountain.

Contours showing a mountain and a photograph of a mountain

3.1.4. Interpretation of soils on the map

Assorted colors or symbols are used to show several types of soils on a topographic map. Tiny brown dots called stipples are used to represent a surface covered by sand or mud. The types of soil can be also shown by help of dots having varied sizes according to the texture of the soil. The types of soils can be differentiated on a photograph based on their texture (sizes) and color. Surfaces covered by lava flows are shown by symbols that look like inverted V'S.



Sand or shifting sand and Symbols showing lava surfaces

Application Activity 3.1

a) Identify the physical features in area where you live and describe how they are represented on a topographic map.

b) Draw a sketch of your home area, on it, name and mark the physical features identified in (a) above.

c) Suggest ways through which the above features can be protected and conserved.

3.2. Interpretation of human aspects on maps

Activity 3.2

Make a research on:

a) The major human aspects which may be represented on a map/ photograph.

b) The signs and symbols which may be used to represent human features on a map/photograph.

Human aspects on a map reflect human activities of a given area represented on a map. These include agricultural development, mining, industry, settlement, etc.

3.2.1. Agricultural activities

Crop plantations are drawn on a topographical map by using light-green shading. A letter may be used over the shade to indicate the name of the crop growing in each area. For example, **C** for coffee, **T** for tea.

Symbol for Coffee (CC) and Tea (TT) plantation

Several types of crops may be taken on a photograph and be identified based on their shapes, sizes and colors.

Crops in the field

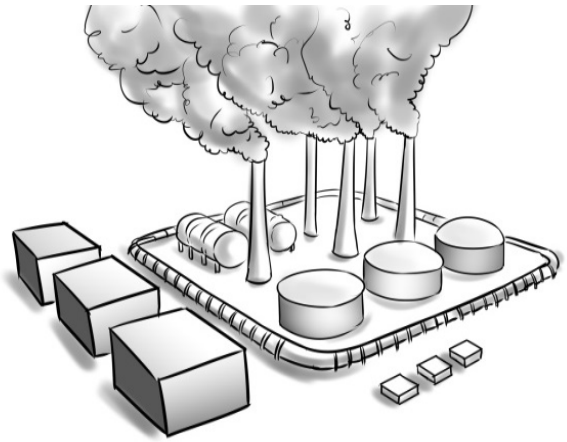
3.2.2. Mining and quarrying activities from a map

Mining refers to all the processes by which minerals are obtained from the earth's crust. Minerals may be in gaseous, liquid or solid form. Quarrying is the digging of stones, sand or soil from the ground. Mining and quarrying activities on a map are shown by symbols as represented on the figure below. The mining activities may be taken on a photograph and different types of minerals/ quarries may be differentiated based on their colors.

Mining area, quarrying and machine in mining activities

3.2.3. Industrial areas

An industrial area is a geographically localized set of specific industries. Such areas are subject to important production, marketing and other interrelationships.



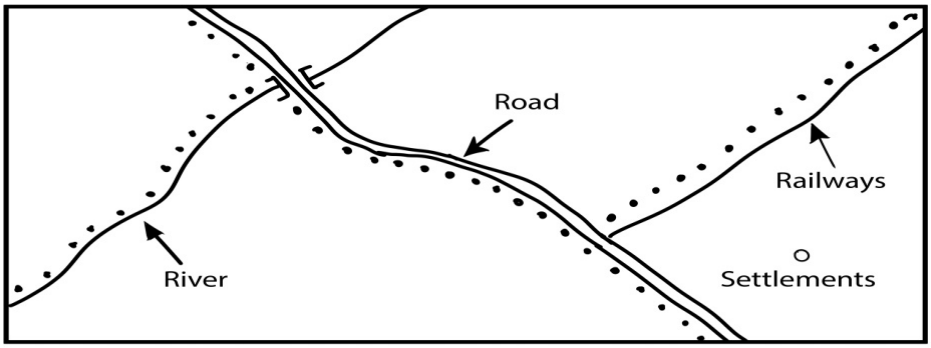
Industrial areas

3.2.4. Settlements

Settlement refers to a place where people live. It also means the process of settling in such a place. Settlement on the map can be shown by dots or rectangles which may be black or grey in colour. Dots indicate rural semi-permanent settlements while rectangles show permanent buildings like those built of stone or bricks, with iron or tile roofing.

The dots or rectangles are spaced in relation to the concentration of settlement. Nucleated settlements are represented by the dots and rectangles close to one another while they are much spaced for scattered settlement.

The settlement is also represented according to its shape, for example ring or linear. The shapes of settlement may be influenced by communication networks like roads, railways, landforms like valley, plain, plateau, mountain among others.



Linear settlement

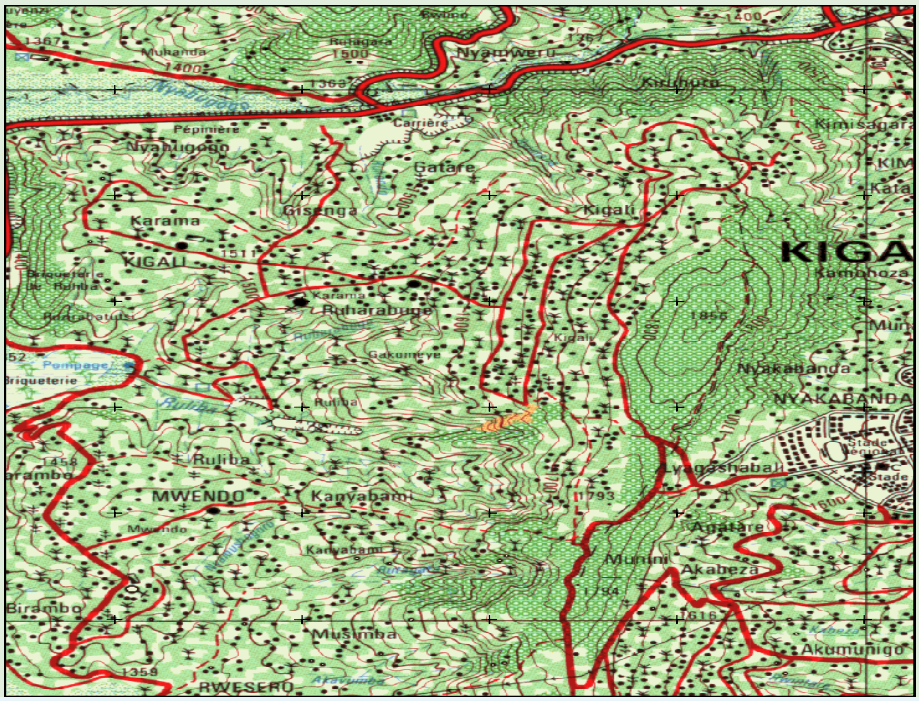
Application Activity 3.2

1. *Use a photograph/map to identify and describe mining/quarrying areas.*
2. *Visit the nearest mining/quarrying areas and represent them on sketch map using appropriate signs and symbols.*

3.3. Relationship between physical and human aspects on maps/photographs

Learning activity 3.3

The following map represents both physical and human aspects which are interrelated.



In reference to the map above from Kigali Suburbs and the knowledge acquired from the influence of relief on the human activities; answer the following questions:

a) Identify the existing relationships between main physical and human features represented on the map.

b) Discuss the existing relationships between main physical and human features available in the environment around your school and your village.

Physical aspect of an area plays a key role in the activities people do. It also has an influence on the number of people who settle in an area. For instance, the relief affects human activities in the following ways:

- Mountainous places are less populated because of steep slopes being unfavorable for settlement and for mechanized agriculture. Such landscape makes the establishment of social facilities (hospitals, schools, shopping centers) in such places to be difficult.
- Places that are poorly drained like swamps and marshes are also not suitable for settlement because they do not favour activities like agriculture, transport etc. that most people rely on for survival.
- Some plains and plateaus have good soils. These allow growing of crops and keeping of livestock. It is also possible to use machines in farming. Therefore, more food is produced, and more people live there.
- The depressions or valleys areas are also suitable for agriculture since they contain fertility brought by depositions from the surrounding high altitude areas.
- Fishing is developed in areas that have seas, oceans and lakes.

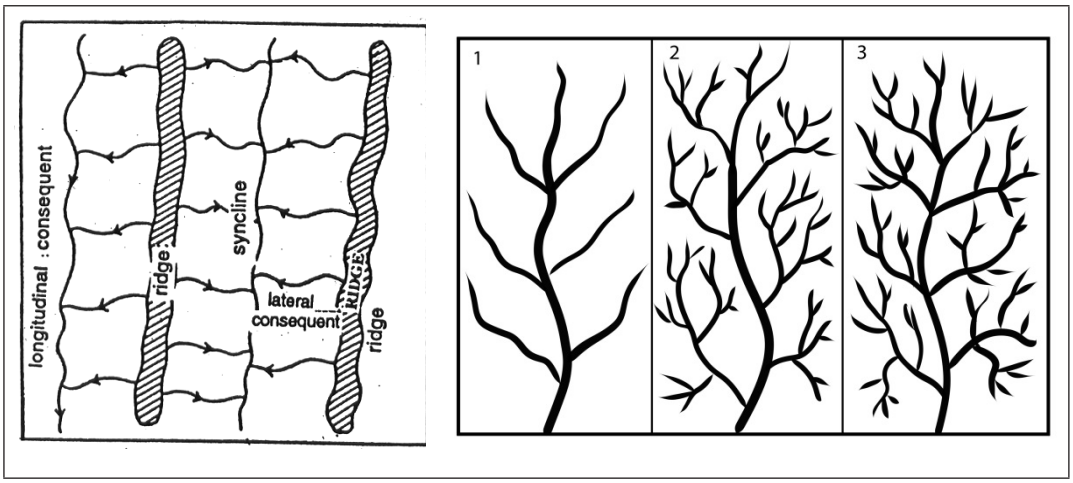
3.3.1. Drainage patterns

A drainage pattern is a network formed by rivers and their tributaries on the landscape. The development of the drainage patterns is influenced by the gradient of the slope, nature of the bedrock in terms of hardness, structure of the basement rock. The drainage pattern can also result from human activities which may change the original patterns.

The some examples of drainage patterns which can be seen on a topographic map/photograph are as follows:

- **Trellised drainage pattern**: Such patterns are developed in simple folds characterized by parallel anticlinal ridges alternated by parallel synclinal valleys.

– **Dendritic drainage pattern**: The dendritic pattern is associated with the areas of similar lithology, horizontal or very gently dipping strata, and rolling extensive topographic surface having extremely low reliefs.

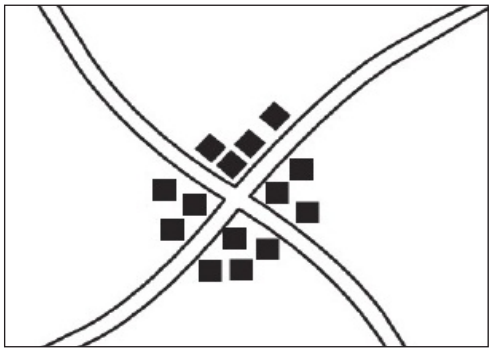


Trellised drainage pattern (left) and dendritic drainage pattern (right)

3.3.2. Settlement patterns

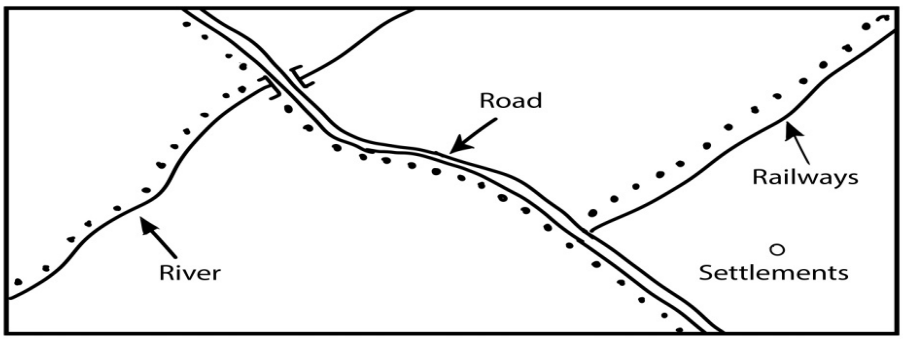
Settlement refers to a place where people live. It also means the process of settling in such a place. The settlement patterns of a given area are influenced by both physical and human factors like topography, road network, community services, cultural and economic factors, etc. This results into several types of settlement patterns as follows:

- **Nucleated settlement:** This refers to the grouping of many houses around a center called nucleus; often around a central feature like a church or a pub. Houses are built close to each other. This type of settlement is mainly influenced by cultural and social factors. For example, the houses in "imidugudu" settlements may have such pattern.



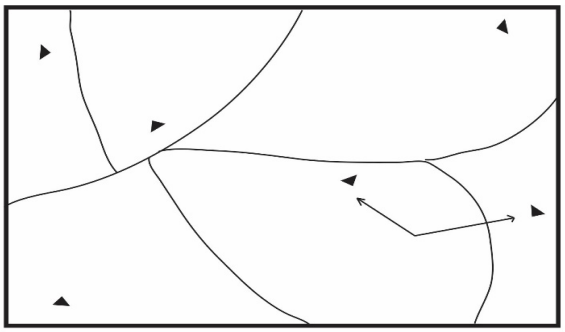
Nucleated/Clustered settlements

- **Linear settlement:** This is where houses are well planned. They are built along the road, railway and river or along the coast.



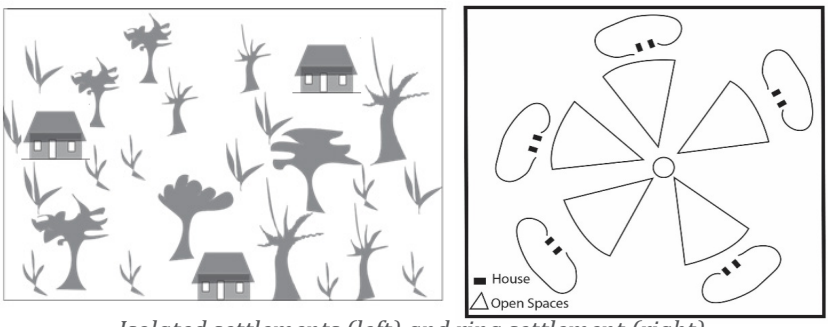
Linear settlement

- **Sparse or scattered or dispersed settlements:** The settlement associated with houses which spread out over a wide area (houses are built far from each other). They are often the homes of farmers and can be found in rural and mountainous areas.



Scattered settlements

- **Isolated settlement:** This is where a few people live away from other people. These people could be hunters in a forest.
- **Ring settlement:** In this type of settlement, houses make a circle. There is an open ground at the center.



Isolated settlements (left) and ring settlement (right)

- **Planned settlement:** This type of settlement is well organized and planned in specific ways as directed for instance by the government.

Planned Settlements

3.3.3. Vegetation

Human activities are related to vegetation. The distribution of vegetation on a photograph/map in each area is linked with human activities taking place in that part/dwelling. Below are some of the examples that show the interrelationship between man and vegetation:

- **In areas with dense forests:** The main activities are timber harvesting. The timber is used to make furniture and paper.

Timber harvesting in evergreen forest

- **In savannah grasslands:** The main activities are livestock keeping and agriculture. This is because in these areas soils are fertile.

Livestock keeping and agriculture in savannah grasslands

- **Desert vegetation:** Agriculture is only possible in oases. Very few animals can survive in the dry areas like the camels, goats and sheep and reared under nomadic pastoralism.

Livestock keeping in desert area

- **In tundra and taiga forests:** The low rainfall and temperature affect human activities. Only hunting, fishing and mining are the main activities done in these regions.

Hunting activities in tundra/taiga forest

3.3.4. Communication networks

Communication networks facilitate the movement of people and commodities from one place to another over a given distance. Communication networks may also refer to the physical facilities which help the transmission of information in the form of news and messages. The communication networks represented on map/photograph are most of time influenced by both physical and human factors. Some of them are discussed below:

- ***Relief:*** Steep slopes make the construction of roads and railway lines expensive. On the other hand, valleys have swamps; they contain water logged soils that are too soft to allow the movement of heavy objects like trailers, lorries and trains.

Construction of roads in swampy and sloppy areas

- **Climate:** Too much rainfall results into floods and landslides and these disturb land transport. On the other hand, accumulation of fog and clouds reduce visibility hence affecting air transport.


Landslides blocking the roads and airplane in cloudy sky

- **Vegetation:** Thick vegetation cover makes construction of road and rail networks difficult because it requires uprooting big trunks of trees. Areas with thick vegetation are invested with wild animals that pose danger to the people.


Construction of road in dense forest (left)and on a flat area (right)

- **Drainage:** Navigable rivers, lakes, seas and oceans provide natural route-ways used for transportation.

A boat in Kivu Lake

- **Topography:** Mask towers for communication are usually placed on the top of mountain.

Mast tower on the top of mountain

- **Economic activities:** The economic activities (mining, agriculture, industries, etc) taking place in given areas influence the construct of communication networks.

Road networks in mining areas

Application Activity 3.3

1. *Identify several types of communication networks on any map/ photograph.*
2. *Explain how the identified communication networks are related to physical and human features.*
3. *Move around your village and identify the existing communication networks and explain their relationships with physical and human features.*

Skills lab

Map interpretation is an important skill needed in different areas of life like military, land mapping, tourism etc. Use the knowledge you have acquired in this unit to draw a sketch map of your school, calculate its area and present your findings to the class.

End unit Assessment

1. *"As it is difficult and costly to reach all parts of the world; the photographs and maps help people most especially geographers to explore different physical and human features of the earth."*
   a) *Identify physical features on topographic map of Rwanda.*
   b) *Identify the human features on thematic maps of Rwanda.*
2. *Show different signs and symbols to be used in representing physical and human features on maps/photography.*
3. *Examine the relationships existing between settlement patterns and physical features in your district and present them on a sketch map using signs and symbols.*
4. *Take photographs from different places in Rwanda, and prepare a sketch map of captured physical and human features by using conventional signs and symbols.*

UNIT 4

THE UNIVERSE AND THE SOLAR SYSTEM

Key unit competency: The student-teacher should be able to establish the difference between the universe and the solar system and their respective components.

Introductory activity

One of the students in senior one moved outside one evening and all of sudden saw a running star that disappeared. The moon was fading, being covered by dark clouds. He wondered whether there are moons elsewhere and went back to bed. In the morning, the sunrise with golden rays replaced the dark and starry night.

a) Identify the heavenly bodies mentioned in the passage.

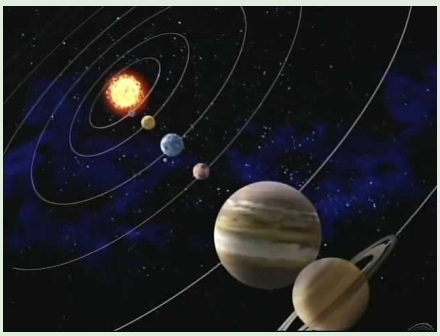
b) Using your experience and the passage above, identify other components of the universe not mentioned in (a) above.

4.1. Definition and components of the Universe

4.1.1. Definition

Activity 4.1

Study the photograph provided below and use it to answer the questions that follow:



a) Explain what the above photograph represents.

b) Using the above photograph, explain the meaning of Universe.

c) Identify the components of the universe.

The universe refers to all space and everything in it. It contains everything that exists, from the smallest particles to the largest structures known. The exact size of the universe is not known. Astronomers estimate that it contains about 100 billion galaxies. Astronomers are people who study bodies in the sky or outer space and their behaviours.

4.1.2. The components of the Universe

The Universe contains many heavenly bodies, which vary considerably in size from the smallest particles like dust to the largest particles like rocks, comets, asteroids, moons, dwarf planets, planets, solar systems, stars and galaxies.

Galaxy: a galaxy is a group of billions of stars, with gas and dust held together by the same gravitational force. The name of the galaxy in which our planet is found is **Milk way**.

Cluster: This is a group of stars which are bound together due to gravitation.

A star: A star is luminous (gives out light) heavenly body that emits its own light. Stars have high temperature. The sun is also a star.

A planet: a planet is a heavenly body that revolves around a star with a constant speed and a specific time. E.g. Earth

Application Activity 4.1

Study the simple illustration provided below and use it to answer the questions that follow:

a) Explain why we should love our universe.

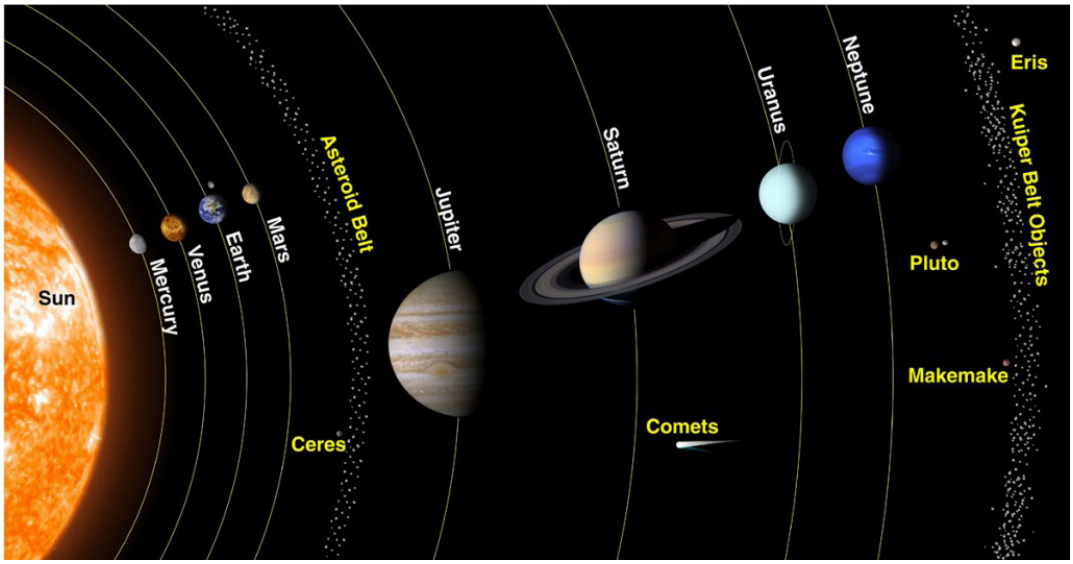
b) Suppose you are asked by your friend, to describe and relate the above illustration with the earth, explain what your answers would be.

4.2. Solar system: sun and planets

Activity 4.1

1. *Using the knowledge that you have in Geography, explain the meaning of solar system and identify the elements or components that form it, and share your finding in class.*
2. *Using internet, text books and other sources of geographical information, research on the characteristics of sun and planets.*

The term **solar system** is defined as the gravitational bound of the sun and the objects that revolve around it. The solar system is therefore made up of the following: the sun, planets and their satellites and other heavenly bodies such as asteroids, comets, meteorites, meteors, etc.as it can be observed on the figure below.



Solar system

4.2. Characteristics of different planets and their positions

The term **planet** comes from Greek word ”planets” which means “wanderer” and it refers to a round celestial (heavenly) body that revolves around the sun. Planets are grouped into categories as discussed below:

Inner (terrestrial) planets of the solar system share the common characteristics with the planet Earth, They are rocky and nearer to the sun. The inner planets of the solar system are therefore Mercury, Venus, Earth and Mars.

Outer (Jovian) planets of the solar system have similar characteristic with Jupiter, they contain small amount of rocky materials but much of their mass is occupied by gases. The outer planets of the solar system are thus, Jupiter, Saturn, Uranus and Neptune.

Pluto was also known as the ninth planet, but it was demoted to a dwarf planet in 2006 and removed from the list of planets because it never developed fully. The following are reasons why Pluto was disqualified:

i) Its size is too small to be classified as a planet.

ii) It has no uniform revolution around the sun.

iii) Its revolution is not circular but spherical in nature.

iv) Its movement is too slow when compared with the rest of the planets of our solar system.

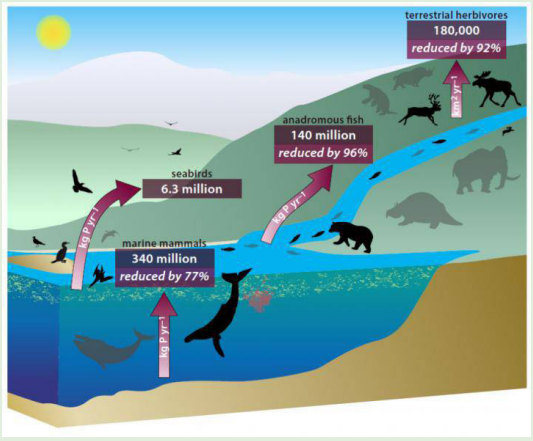
Application Activity 4.2

1. *You are asked to address the geography students from other schools, explain what you would tell them about characteristics of the planets found in our solar system.*
2. *"The earth is the only planet that supports life" Explain why it is so and show how you would ensure that it continues supporting flora and fauna.*

4.3. Earth: Peculiar elements of the earth

Activity 4.3

Examine the illustration below and use it to answer the questions that follow:



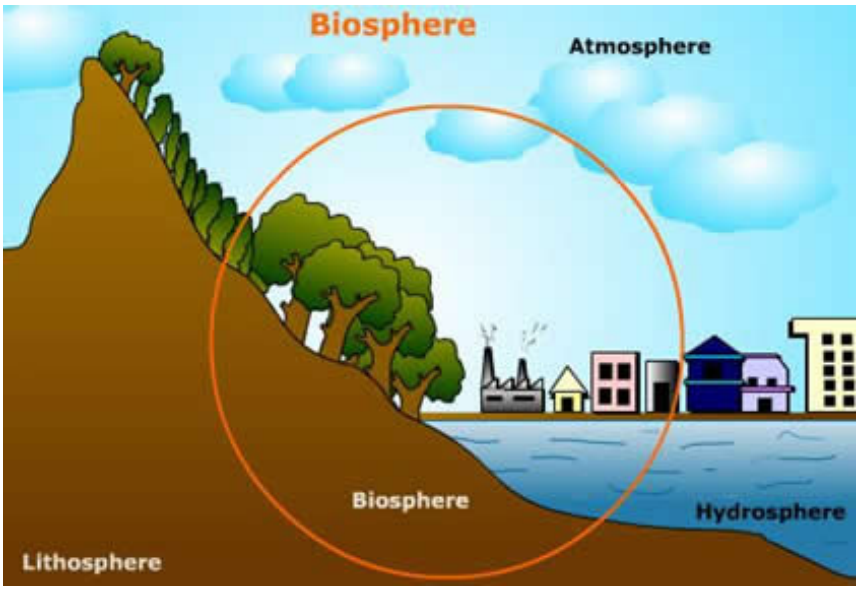
a) *Using the illustration shown above, explain to your friend the meaning of Peculiar elements of the earth.*

b) *Identify the componets of the earth that form its exterior part shown in the illustration.*

c) *Discuss ways through which man can protect and conserve the peculiar elements of our planet earth.*

The **peculiar elements** of the earth are outer parts of the earth. They include the following:

1) Hydrosphere or water bodies
2) Lithosphere or Land and rocks
3) Atmosphere or Gases
4) Biosphere or flora and fauna



Peculiar elements of the earth

- **Hydrosphere:** This stands for all the waters found on the earth surface. It covers 71% of the earth's surface.
- **Biosphere:** This is a part of the earth that includes the totality of life on the earth (Animals,Plants and Man).
- **Lithosphere:** This is the rocky part of the earth.
- **Atmosphere:** It is the gaseous part of the earth. It comprises all gases that can be found on the earth.

Application Activity 4.3

Study the table below and match the statements with the appropriate peculiar elements of the earth.

Peculiar elements of the earth	***Description***
Biosphere	*Stands for water bodies*
Lithosphere	*Gases or air that surrounds our earth*
Atmosphere	*A set of flora and fauna*
Hydrosphere	*Rocks and land*

a) *Explain why it is very important to conserve the peculiar elements of planet earth.*

b) *Suppose you are appointed the minister of environment and natural resources, list and describe the programs or ways you would emphasize to ensure that the planet Earth remains habitable.*

4.4. Earth's movements

Activity 4.4

Read the following passage and answer the questions provided.

Every day the sun rises in the east and sets in the west. This process led many people in the past to think that the sun is moving, and the earth is fixed. The sun moves around the earth. But with the advancement of science and technology, it has been proved that the sun itself is moving and the earth is in a continuous motion. Later it has been revealed that the sun does not move around the earth, rather the earth moves around the sun.

Using the knowledge and skills acquired in previous studies answer the following questions?

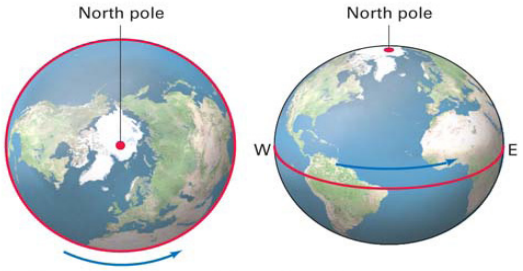
a) *How many movements does the earth make?*

b) *Identify proof for the earth rotation and revolution.*

c) *Describe effects caused by the above movements.*

4.4.1. Rotation of the Earth and Associated Effects

Rotation of the Earth is defined as the movement of the Earth spinning on its own axis. This movement of the Earth on its own axis is in an anticlockwise direction. The earth takes 24 hours to complete its rotation.



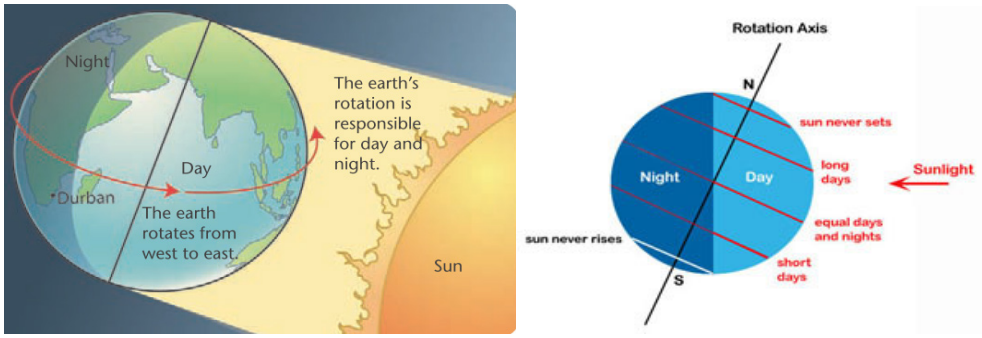
Rotation of the earth in anti-clockwise

The effects of rotation of the earth

As the Earth turns around its axis, it affects some processes on the earth's surface. Some effects of the earth rotation are:

i) Rotation causes day and night.

Earth's rotation on its axis creates day and night. The one half of the Earth that faces the sun has **day time**, while the opposite half facing away from the Sun has **night time.**



Day and Night

ii) Rising and falling of ocean water (tides)

During the rotation of the earth, gravitational force of the sun and the moon acts on the ocean water to produce tides which may be high or low tides.

iii) Deflection of wind and ocean current (Coriolis Effect)

Rotation causes winds to be deflected to the right in the Northern or to the left in southern whenever they cross the Equator. This deflection is called the **Coriolis Effect**.

iv) Time difference between longitudes

One round of the Earth is completed after turning 360°.

This implies that, the earth takes 24 hours to complete its rotation.

Therefore, in one hour the earth covers 15^0. This is calculated by:

$$\frac{360\ degrees}{24} = 15\ degrees$$

If it takes the earth to cover its 15 degrees in 60 minutes, then, 1^0 is completed within 4 minutes. This is obtained by getting:

$$\frac{60\ \text{min}\ x\ 1^0}{15^0} = 4\ min$$

For example, supposing the local time at Greenwich Meridian is 12:00. What is the local time at Kigali which is on longitude 30° East?

Solution

- Find the difference in degrees between the two longitudes: (30° - 0°) = **30°**
- Determine the time that is equivalent to 30 degrees. This is obtained by: 30^0 x 4 minutes=120 minutes.
- Change the 120 minutes into hours. This is done by: = $\frac{120\ \text{min}}{60\ \text{min}/hour} = 2hours$
- Finally add 2 hours to the original time experienced at the Prime meridian/ Greenwich:

  12:00+2hours=14:00. The time at Kigali is: **14:00 PM**

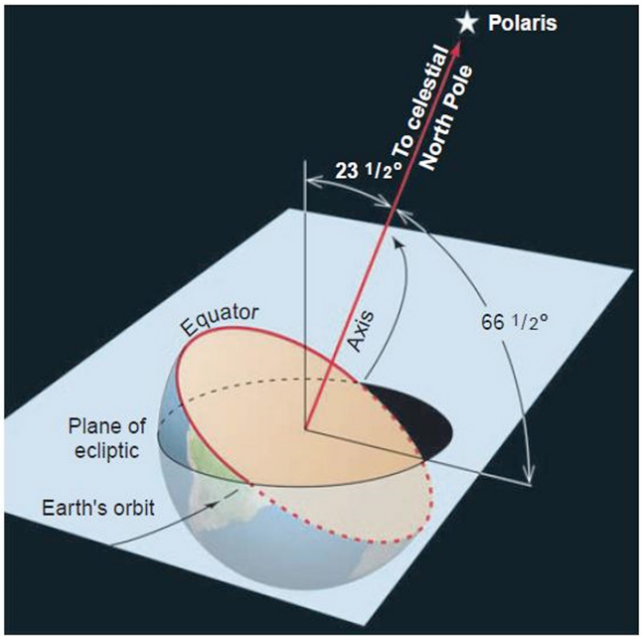
  To find the local time of an area which is positioned in the west of the given longitude, **subtraction** is used while when the local time to be found is positioned east of the given longitude **addition** is used.

v) Temperature difference

Due to the spherical shape of the earth and the position of the sun, the parts of the Earth located in the tropical areas between 23.5˚ North and South of Equator, get direct sunlight all the year round. Regions located in higher latitudes get less rays during the year.

4.4.2. Revolution of the Earth and Associated Effects

The revolution is the movement of the earth around the sun. Earth revolves around the Sun along an oval-shaped path called an orbit. The earth takes 365 days and 6 hours to complete one revolution.



Earth's ecliptic plane

The Leap year is the year with 366 days which comes every after four years. This results from adding 6 hours rotation of each year to make one day after 4 ordinary years.

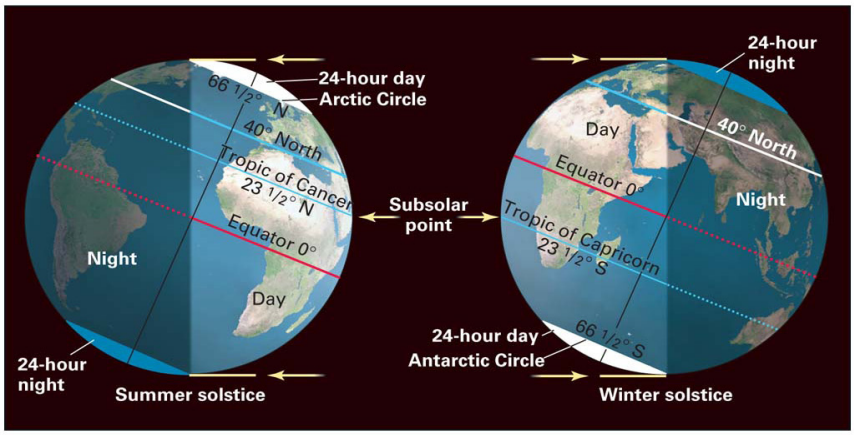
The consequences of the revolution

i) Determination of seasonal variation

The earth's revolution around the sun causes difference in seasons because different parts experience differences in temperatures which lead to difference in rainfall distribution. Summer is usually associated with much heat and brightness and winter with coldness and rain.

ii) Varying length of day and night at different times of the year

The revolution of the earth around the sun causes variations in the length day and night time over different latitudes. On 21st June when the sun is overhead at the tropic of cancer, day time is longer than night time in the northern hemisphere and the reverse takes place in the southern hemisphere. On 22ndDecember when the sun is overhead at the tropic of Capricorn night time is shorter than day time in the southern hemisphere and in the northern hemisphere night time is longer than day time.



Variation of lengths of hours in different time based on hemisphere and seasons

iii) The beginning and end of the year

The earth revolves around the sun in a continuous way. When the earth completes one revolution, it is referred to as one year. And the end of one revolution marks the beginning of another revolution; hence the beginning and end of the year.

iv) Changes in altitude of the midday sun

Earth's revolution exposes different parts of the earth to the overhead sun differently because of the inclination of the earth's axis. For instance parts of the earth beyond the tropics never experience the overhead sun while the equator and the tropics experience the overhead sun alternatively during the equinoxes and solstices.

4.5. Other heavenly bodies

Apart from the celestial bodies discussed above, other bodies include Asteroids, Meteorites, Meteoroids, Meteors, Constellations, Comets and UFOs (unidentified flying objects).

Application Activity 4.4

1. Rusizi is 28 E and the time is 6:00 am. What is the time in a place which is located at 60°W?
2. What is the longitude of a place X whose local time is 11:00 a.m. if the local time at longitude 30 E is 2:00 pm?
3. Explain why some parts of the earth's surface are getting hotter than others while others are becoming cool and cold.

End unit Assessment

1. *Study the two photographs shown below.*

a) *Identify the heavenly bodies shown in the two photographs.*

b) *Mention and describe the heavenly bodies found in the universe that are not shown in the two photographs.*

c) *Explain why the areas shown in the two photographs are all found on planet earth yet having different habitable conditions.*

d) *Draw a program that can enable man to live in harmony with the universe and the earth.*

2. *Read the story below and use it to answer the questions that follow:*

Recently John and Mary went to visit their uncle in Rubavu. In the afternoon of their second day, they were taken by their cousins to visit the lake shores. Evening came, and the moonlight was so intense that one could pick the smallest thing at that time. Suddenly, they saw water extending in a rhythmic manner to the place they had made a camp fire."

a) *How could you use your knowledge to convince John and her sister Mary that what happened was connected to the moon, sun and earth's rotation.*

b) *Suppose you want to build near the coastline, explain how the knowledge and t*he skills acquired from the lesson on tides can guide you.

UNIT 5

THE ORIGIN OF THE EARTH

Key unit competence: The student teacher should be able to discuss the theories of the origin of the Earth.

Introductory activity

Using previous knowledge gained in Geography and other disciplines:

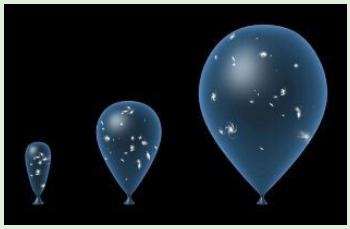
a) *Explain how the Earth came into existence.*
b) *Identify the major characteristics of the earth.*
c) *Describe the internal structure of the Earth.*
d) *Find out and describe the various geological eras and periods recorded in history.*

5.1. Theories of the origin of the earth: Big bang theory and creation theory

Activity 5.1

Do the exercise shown below:

a) *Collect the balloons provided and blow air in each of them.*
b) *Make sure the balloons are inflated to their maximum sizes.*
c) *Tie the ends of the balloons containing air to prevent it from escaping.*
d) *Press hard on the balloons to make sure that they burst.*
e) *Discuss most generally accepted hypothesis for the formation of the universe related to the practical exercise performed in (a-d) above.*



In order to understand how the earth came into existence, we need to first be aware of how the entire universe was formed since the earth is part of the universe.

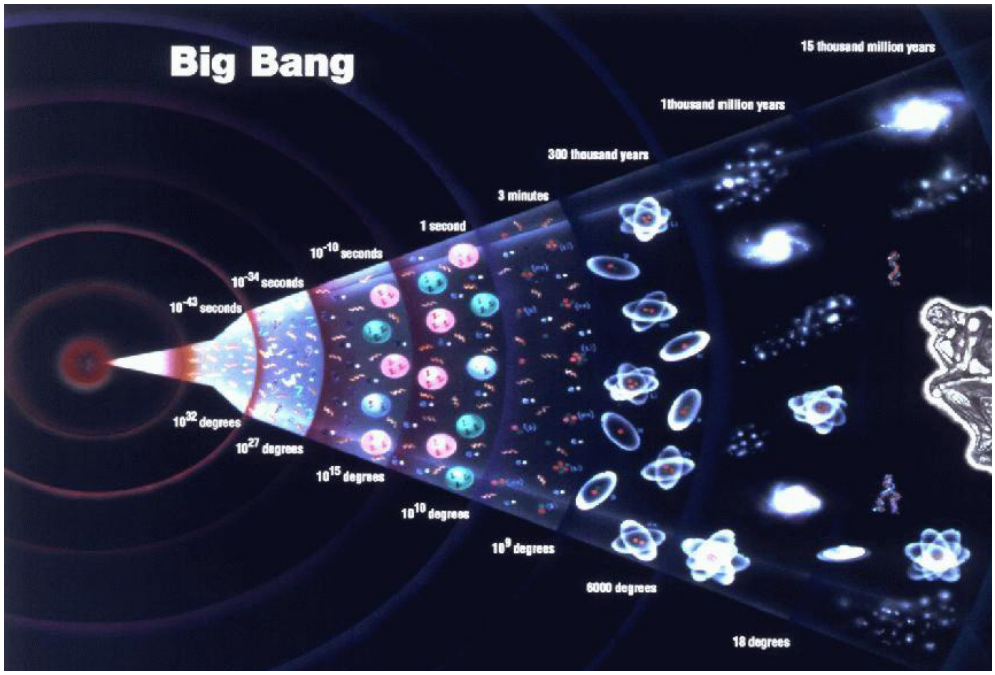
Scientists have tried to explain the origin of the earth. It is believed that the earth and the universe were formed about 15 billion years ago. Some believe that the earth was formed in a massive explosion known as the **big bang** and others believe that the earth and the entire universe were created by God.

There are several theories advanced to explain the origin of the earth. However, only two theories are going to be discussed: Big Bang theory and Creation theory because they seem to be the most accepted.

5.1.1. The Big Bang Theory

According to this theory, the entire universe was at one time confined to a heavy, hot, massive ball that disastrously exploded about 15 billion years ago. The explosion propelled the materials in all directions away from the centre of the explosion. This explosion was called the **big bang** and marked the beginning of the universe.

The masses of gas from the explosion cooled and condensed to form the stellar systems like galaxies that are always moving away from the centre of the explosion in a centrifugal motion.



A simplified diagram of the expansion of the universe by George Le maître

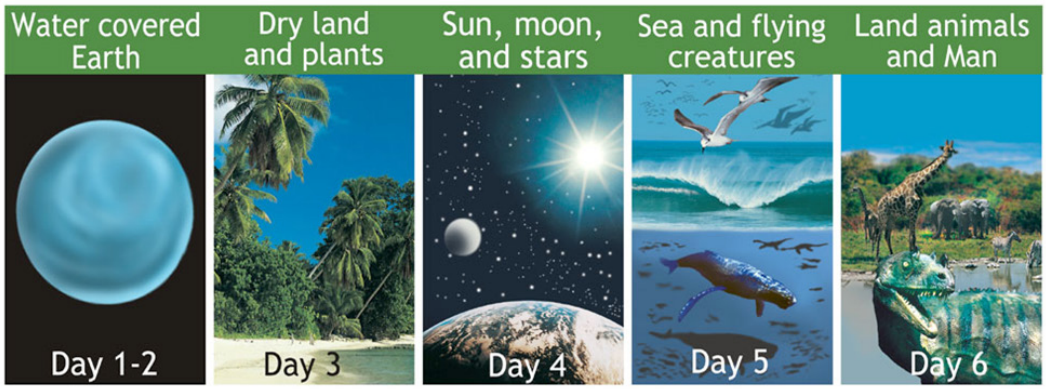
5.1.2. The Biblical or creation theory

The biblical theory is based on the God's creation story that is found in the first chapter of the bible (Genesis). This chapter states that the earth was created by God and draws the calendar of the whole creation process. The creation process took place in six days.

On the first day, God created the day and the night.

- On the second day, He created the sky.
- On the third day, He created the land, water and the plants.
- On the fourth day, He created the sun, moon and stars.
- On the fifth day, He created the sea creatures and the birds.
- On the sixth day, He created animals of all kinds and human beings.

Therefore, according to this theory, the Earth and universe were all together created by God.



A summary of the six days' creation

Application Activity 5.1

From the theories that you have learnt above;

a) Explain the difference between the Big bang theory and the Biblical theory about the origin of the earth.

b) Make a research on other theories of the origin of the earth.

5.2. Characteristics of the Earth

Activity 5.2

Read the passage below and answer the questions asked

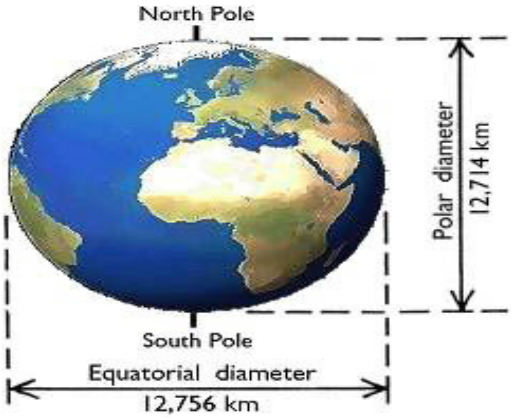
Far back in ancient times, everybody thought the earth was flat. If you are in a boat way out in the middle of the ocean, the top of the water looks flat in every direction and the sky seems to fit over it like an upside-down bowl. The line where the sky and water meet is called the "horizon". The horizon looks like a circle with yourself at the center. If you are on land, the land stretches out to a horizon also. The horizon on land, however, is not even. It goes up and down because of houses, trees, hills, and other things. Some ancient people suspected that the earth went on forever. They thought it might be a huge flat piece of land and sea with no end at all.

a) *What does the story above talk about?*
b) *How do you find the shape of the earth?*
c) *Find out the evidences advanced to support the most agreed shape of our planet.*
d) *How big is the planet Earth?*

5.2.1. The shape of the earth is spherical

1) The shape of the earth

Studies based on modern technology have proved that though the earth is a sphere, it is not a perfect sphere but a **geoid.** This is because the observation of the polar areas reveals that they have a flat landscape, at the same point the equatorial areas have a bulging appearance as shown below:

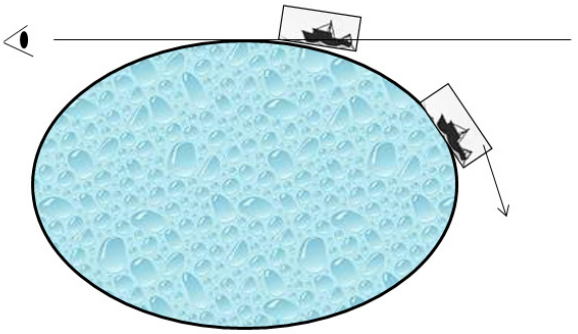


An oblate spheroid form of the earth

2) Evidences showing that the earth is spherical

There are several evidences to prove the spherical form of the earth:

- ***The circumnavigation***: If one travelled across the world along the straight path without stopping would come back to the point of origin where the journey started from.
- ***Images from the space:*** Photographs taken from space by satellites show that the earth's surface is curved (spherical shape).
- ***The view of other planets****:* All observations from telescopes reveal that the planetary bodies are spherical from whichever angle. Therefore, since the earth is one of them, its shape is also spherical in nature.
- ***The shadow of the earth during eclipses*****:** The shadow resulting from the eclipse of the moon (Lunar eclipse) shows that the earth is round and only spherical objects can cast a round image.
- ***Day-night and seasonal change*****:** The earth's tilted axis produces seasonal climatic conditions and gives days and nights of varying length. If the earth was at right angles to the sun, the day and the night would always be of equal length, and there would only be one season throughout the year.
- ***The size and diameter of the earth*****:** The earth's equatorial diameter and circumference are much bigger than those of the polar areas.
- ***The sun rise and sun set*****:** If the earth was flat, the sun would rise and set at the same time in all countries. But, the sun rises and sets at different times in different places.
- ***The ship sailing away from the coast*****:** The lower parts of a ship that is moving away from the coast disappears before the upper parts. The figure below helps to understand this evidence:

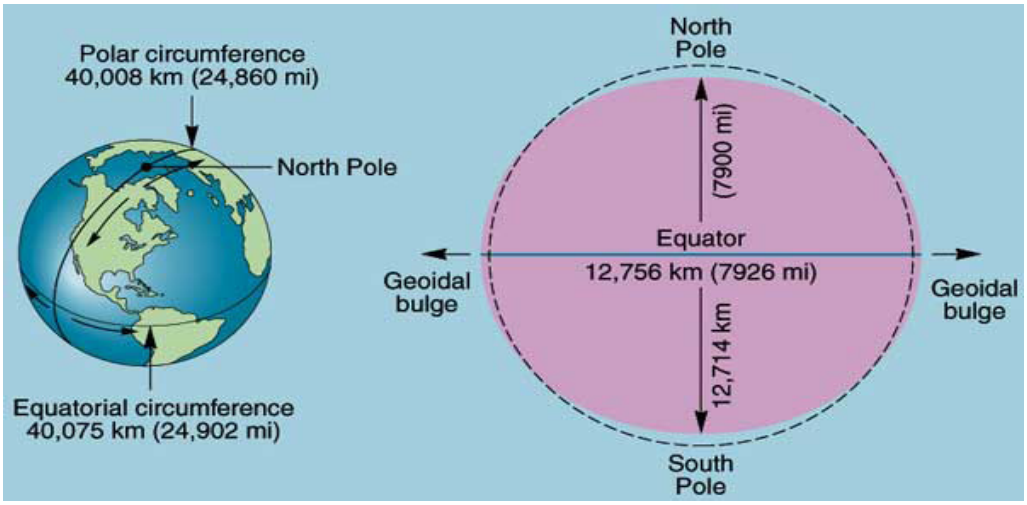


View of an approaching ship

– ***The view of circular horizon*:** The distant horizon viewed from the top of a hill or deck of a ship at a sea is always circular in shape.

5.2.2. The Earth's size: radius, diameter, circumference, volume and mass

- The average **radius** of the earth is 6,371 km.
- The Earth's equatorial **diameter** is 12,756 km while the polar diameter is 12,714 km.
- The Earth's **circumference** at the equator is 40,075 km. From pole to pole, its circumference is 40,008 km.



The size of the Earth

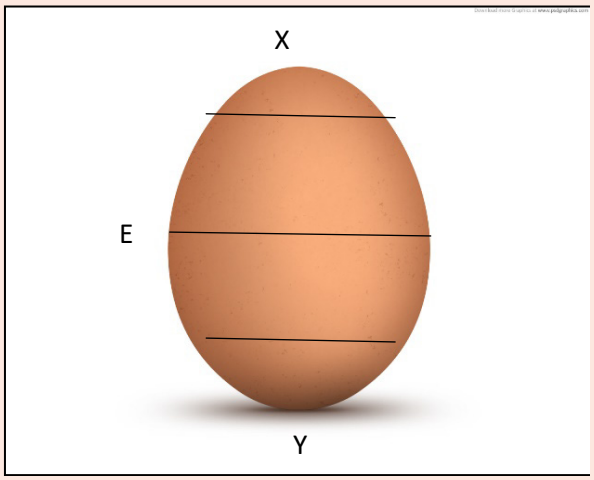
- The Earth's volume is 1.08321×10^{12} km^3
- The Earth's mass is **5.9736** x 10^{24} kg.
- The Earth's density is 5.52 g/cm^3.
- Gravity of the earth is approximately 9.8 m/s^2

Application Activity 5.2

Study the illustration provided below and use it to answer the questions that follow:

– *Use an egg, a piece of thread, a ruler and markers.*

– *Mark that egg following the marks in the illustration below.*



a) *With reference to the divisional lines drawn on the illustration above, use the egg provided to measure the diameter and the circumference.*

b) *From your findings above, describe the shape of the earth.*

c) *Assume the above illustration stands for our planet earth, name X, E and Y, and indicate the size of E:*

i) *X: ……*

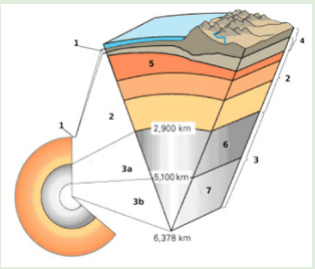
ii) *E: ……*

iii) *Y: ……*

5.3. The internal structure and mineral composition of the earth

Activity 5.3

1. *The study of the earth's environment cannot be complete without understanding the nature of the earth's interior structure. What do you know about the interior of the earth?*
2. *Using the knowledge acquired so far, study the illustration given below and give names of layers represented by figures.*



a) Name the parts of the earth corresponding to numbers, 1,2, 3a, 3b,4,5,6 and 7.

b) Describe the characteristics of the parts you have named.

3. *Carry out a research to find the main mineralogical composition of the earth.*

5.3.1. The internal structure of the earth

The layers of the Earth's interior include the crust, mantle, liquid outer core, and solid inner core. The interior structure of the earth is layered in concentric shells:

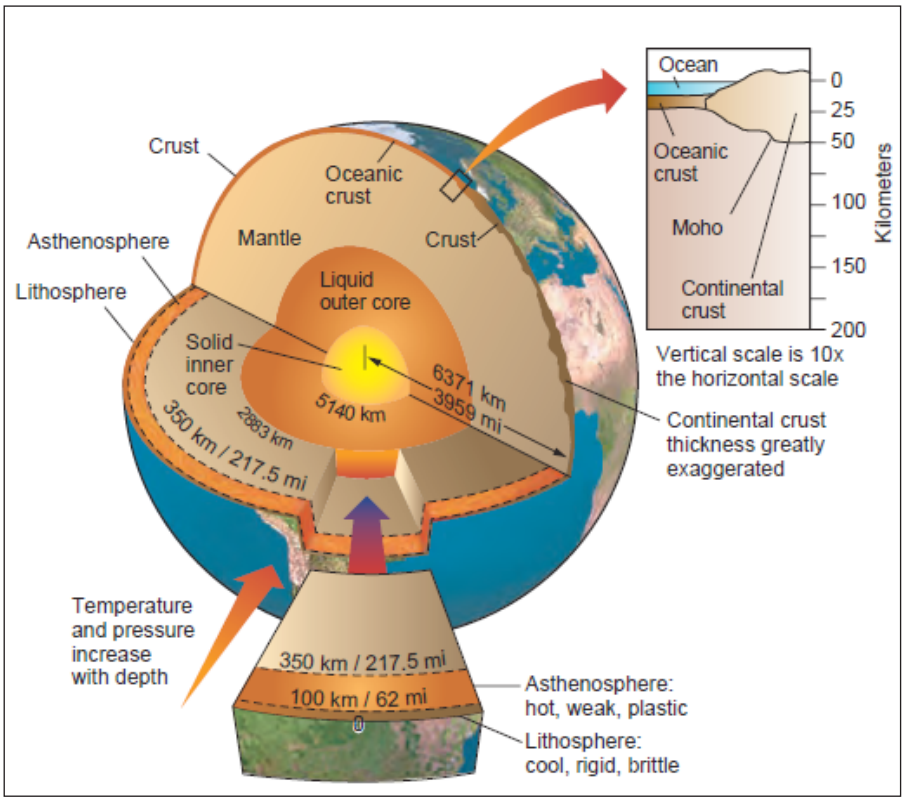
i) An outer silicate solid crust,

ii) A highly viscous mantle,

iii) A viscous outer core,

iv) A solid inner core.

The figure below depicts the main layers of the Earth's interior part and their respective properties.



The interior parts of the Earth

1) The crust

The crust is the outermost layer of the Earth. It is also referred to as the lithosphere. The crust is divided into two types, the oceanic crust and the continental crust:

- *Oceanic crust (SIMA)* is a layer consisting mainly of basalt, averaging 6-10 km. in thickness.
- *Continental crust (SIAL)* is layer consisting mainly of granite; it can be up to 70 km thick. The crust is separated from the mantle by *the* ***Mohorovicic discontinuity***.

2) The Mantle

The mantle is composed mainly of silicate rocks, rich in iron and magnesium. The mantle is under the crust. It is composed of rocks that are in a semi-molten state. They are mainly composed of Ferro magnesium silicate (iron, magnesium) minerals.

The mantle is divided into two main parts, namely the upper mantle and the lower mantle:

- The **upper mantle:** It is a layer of less rigid and more plastic rocks. It extends from ***Repeti discontinuity*** to the depth of 1,000 km.
- The **lower mantle:** It goes from 1,000 km to 2,900 km in depth. At this depth the lower mantle is separated from the outer core by ***Gutenberg discontinuity***.

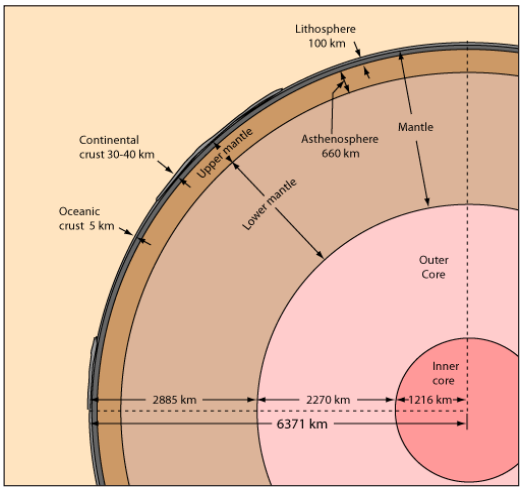
3) The core

The core is composed of outer core and inner core.

- The **outer core** is liquid and kept in a semi-molten state
- The **inner core** is solid and made mostly of nickel iron and with some (NIFE).

The figure below shows the relative depth of different internal layers of the earth. Inner core and outer core are separated by ***Lehman discontinuity.***

In geology, the term "**discontinuity**" is used for a **surface** at which seismic waves change velocity in interior of the earth.



Relative depth of internal structure of the earth

5.3.2. Chemical composition of the Earth

Earth's crust

The most common **chemical** elements in the **crust** are oxygen (gas) (46.6%), with mineral such as **silicon** (27.7 %), **aluminum** (8.1 %), iron (5.0 %), **calcium** (3.6 %), **potassium** (2.8 %), sodium (2.6 %), and **magnesium** (2.1%). Continental crust is dominated by Silicon and Aluminum minerals (SIAL), whereas the oceanic crust has Silicon and Magnesium is large proportion.

Earth's mantle

In terms of its constituent elements, the **mantle** is made up of 44.8% **oxygen**, 21.5% **silicon**, and 22.8% **magnesium**. There's also iron, aluminum, calcium, sodium, and potassium. These elements are all bound together in the form of silicate rocks, all of which take the form of oxides.

Earth's core

The Inner core has 20 % Nickel and 80 % Iron whereas proportions of minerals in the o**uter core** amount, for Nickel: 2 %, Iron: 86 %, Sulfur: 12 %

Application Activity 5.3

Apply the knowledge you have acquired in this lesson to answer the following questions:

1) *Suppose you are asked to describe how Mount Muhabura is related to the internal structure of the earth, what would be your response?*

2) *The earth's crust is composed of many minerals. Indicate its most common chemical elements.*

Skills lab

Visit one of the neighbouring schools in your area and discuss with the students around about the shape of the earth using the knowledge gained from this unit.

End unit Assessment

1. *Read the following discussion between two students and answer the questions asked:*

Two students Mugisha and Uwamahoro were discussing about the origin of the earth. Mugisha said that the earth and other celestial bodies came into existence in different ways: some were formed due to the collision of stars, others by explosion. With confidence, Uwamahoro said that everything in the universe was created by God.

   a) *Who is right, who is wrong?*

   b) *Explain the biblical theory of the origin of the earth.*

2. *The physical features of the earth are changing day by day due to natural reasons and human activities. Suggest ways which people can use to conserve the nature for its sustainability.*

3. *Geologists and archaeologist are directly involved in carrying out excavations (digging) that make their research successful in discovering new fossils in different places on the Earth. Suggest the ways in which humans should protect the environment for the sake of promoting such archaeological research.*

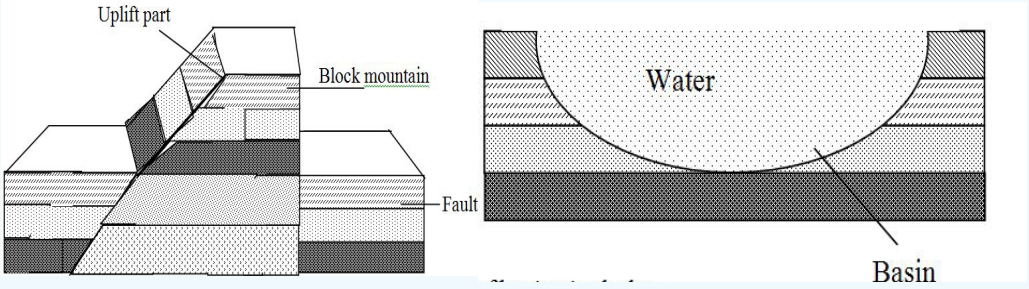
UNIT 6

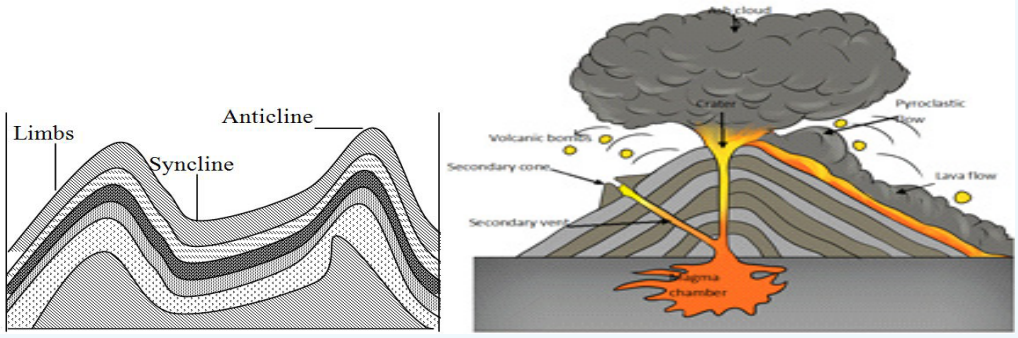
INTERNAL LANDFORM PROCESSES

Key unit Competence: The student-teachers should be able to examine the internal processes responsible for the evolution of different relief landforms.

Introductory activity

Observe critically the diagrams below and answer the questions that follow:





In reference to the diagrams above showing the internal landforms' processes; answer the following questions:

a) *Identify the internal processes associated with each diagram illustrated above.*
b) *Describe how the internal processes lead to the formation of various relief features.*
c) *Identify the effects of the features resulting from internal processes on human activities.*

6.1. Faulting

6.1.1. Faulted landforms and forming processes

Activity 6.1

Using textbooks, internet, and other resources of geographical information research on:

1. *Meaning of the faulting and fault*
2. *The processes responsible for the formation of different faulted landforms*

(i) Meaning of faulting and fault

- **Faulting** is the process through which the rocks of the earth's crust crack or fracture due to tectonic forces as accompanied by displacement of blocks. The direct effects of faulting include the formation of rift valley, block mountains, fault scarps,
- **A fault** is a fracture in the crustal rocks where the rocks are displaced along a plane called a fault plane. A fault is also considered as a rupture or fracture of rock strata due to strain, in which displacement is observable.

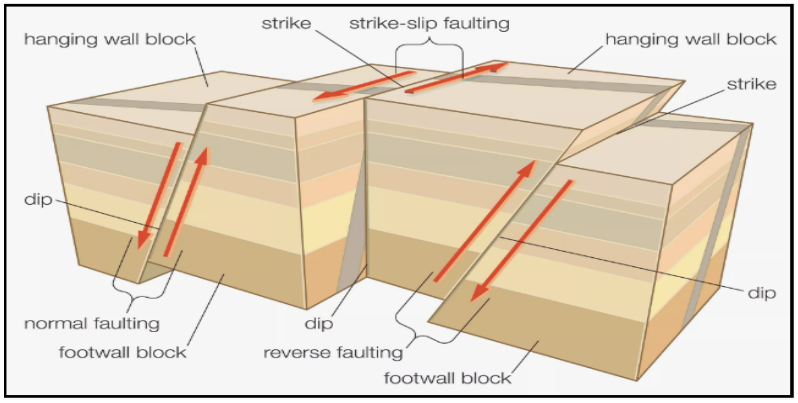
ii) Forces causing faulting

Faulting is the fracturing of the crustal rocks due to the influence of endogenic forces or processes. Endogenic forces are responsible for various types of vertical irregularities that give birth to numerous relief features including mountains, plateaus, plains, lakes, faults and folds. The endogenic forces include faulting, folding, warping, vulcanicity and earthquake.

iii) Main parts of a fault

The process of faulting is caused by tensional and compressional forces. When these forces act on crustal rocks of the earth's crust, they develop stress in them and break along the zone of maximum tension. The rocks are then removed from their original position either upwards, downwards or horizontally.

When a rock is displaced upward it is called **up throw**, and the downward displacement is called **down throw**.



A diagram outlining the basics of faulting. Encyclopaedia Britannica/Universal Images Group/Getty Images

Main parts of fault

The main parts of a fault are (1) the fault plane, (2) the fault trace, (3) the hanging wall, and (4) the footwall. The fault plane is where the action is taking place. It is a flat surface that may be vertical or sloping. The line it makes on the earth›s surface is the fault trace. Where the fault plane is sloping, as with normal and reverse faults, the upper side is the hanging wall and the lower side is the footwall. A strike is the direction of the fault trace on the earth›s surface. The dip is the measurement of how steeply the fault plane slopes.

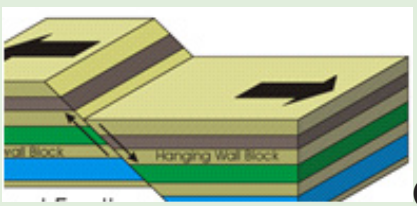
Application Activity 6.1

Basing on the knowledge and skills acquired from the above lesson, describe the area where the faulting process occurred.

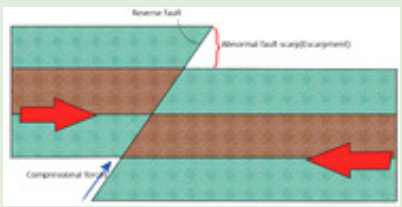
6.1.2. Types of faults

Activity 6.2

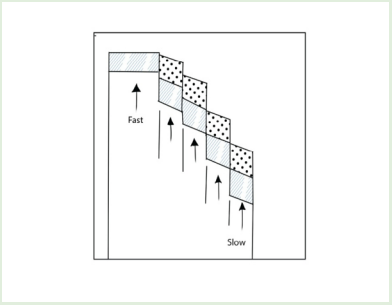
Observe the diagrams below and use other geographical resources to answer the questions that follow:



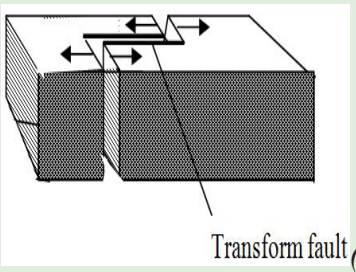
(A)



(B)



(C)

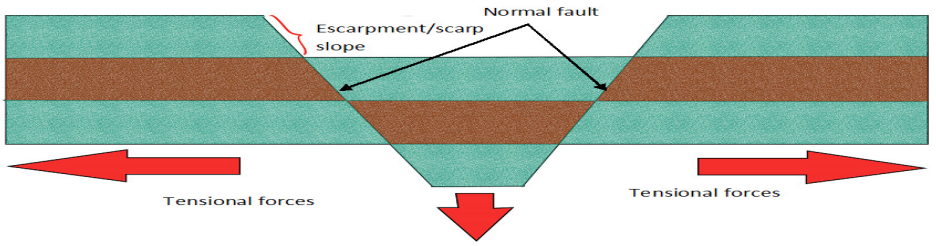


(D)

1. *Identify the types of faults labelled by letters A, B, C and D*
2. *Compare and contrast the illustrated faults.*

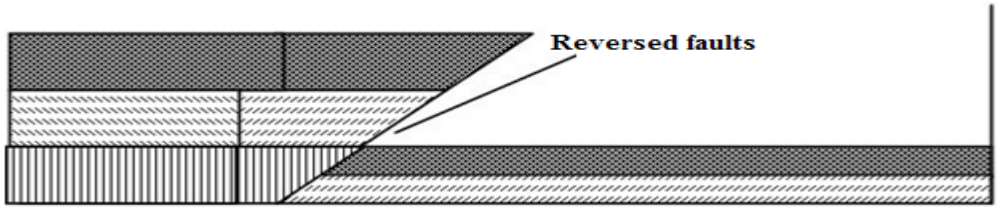
Faulting results into numerous types of faults briefly described in the following:

i) **Normal faults/consequent fault lines** are formed due to the tensional forces that lead to opposite displacement of the rock blocks. The steep scarp resulting from normal faults is called fault-scarp or fault-line scarp.



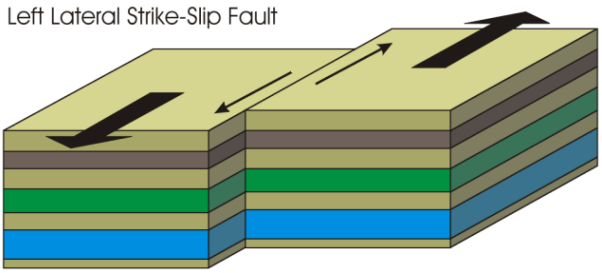
Normal faults

ii) **Reverse faults/ obsequent fault lines** are formed due to compression forces that lead to the movement **o**f the fracture rock blocks towards each other. The fault plane in a reverse fault is usually inclined.



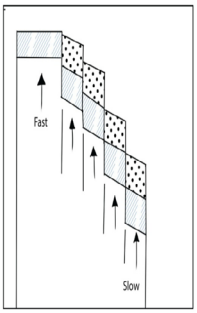
Reverse faults

iii) **Lateral or strike-slip faults** are formed when the rock blocks are displaced horizontally along the fault plane. They are called *left-lateral* or *sinistral faults* when the displacement of the rock blocks occurs to the left on the other side of the fault, they are called *right-lateral or dextral faults.*



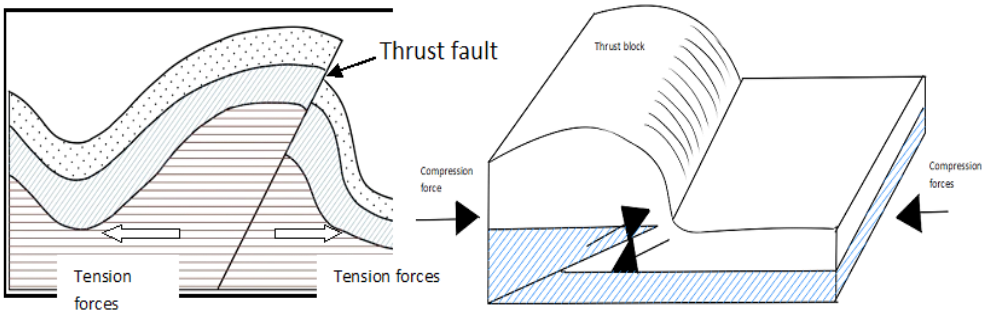
Lateral faults

iv) **Step faults** are formed when a series of parallel faults occurring in an area in such a way that the slope of the entire fault planes of the faults are in the same direction.



Step faults

v) **A thrust fault** refers to a reverse fault in which the dip of the fault plane is at a small angle to the horizontal and it is caused by strong crustal compressional forces.



Thrust fault

Application Activity 6.2

Basing on the knowledge and skills acquired from the above lesson, describe the area where the faulting process has occurred in Rwanda.

6.1.3. Influence of faulting on landscape and drainage

Activity 6.3

Kwigira and Mahoro are students from GS Terambere. They visited Lake Kivu and its surrounding area in western part of Rwanda. Back to school they were told to make description of the area visited. In the description they included: Lake Kivu and other different relief features around. They said that their teacher called Bumwe who accompanied them explained how Lake Kivu was formed. He said that Lake Kivu was formed in the same way as Lake Tanganyika, Eduard, George, Manyara and Turkana in East Africa. Furthermore, the teacher told them that there are other landforms which resulted from faulting in Africa and the World. Based on this story to answer the following questions:

1. *Describe the impact of faulting on landscape of the area visited by Kwigira and Mahoro.*
2. *Examine other landforms produced because of faulting not mentioned in the passage above.*
3. *Assess the impact of faulting on drainage system.*

i. Influence of faulting on landscape

There are several landforms produced by faulting. They include rift valleys, fault scarp, escarpments, block or Horst Mountains, fault guided valleys, titled block/landscape and Grabens which host rift valley lakes.

Rift Valley

Rift valley is a trough or hollow/depression (Graben) which may result from both tensional and compressional forces. It is formed when two faults are developed parallel to each other.

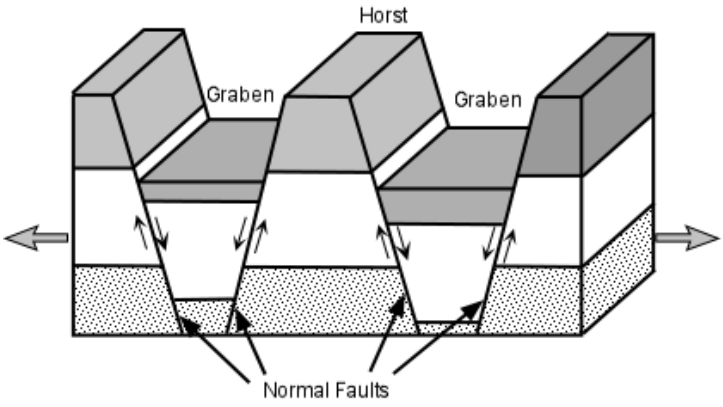


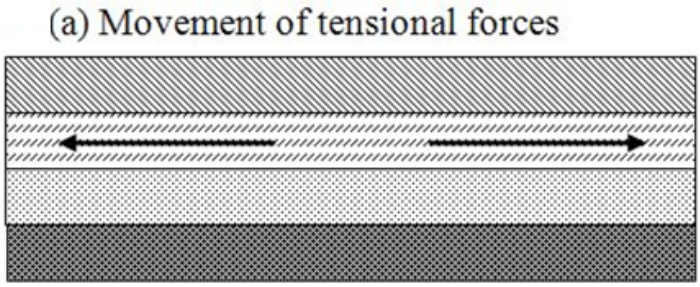
Figure: A Graben and horst

Various theories have been put forward to explain the formation of a rift valley. They include tensional theory, compressional theory and differential up-lift theory. They description is briefly described in the following

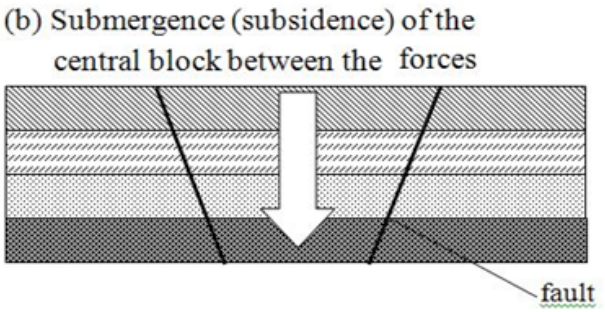
Formation of the rift valley by tensional forces (Tensional theory by J. W. Gregory)

Rift valley is formed when tensional forces move away from each other. These tensional forces produce faults and the block (part of the crustal block) between two parallel faults subsides to form a rift valley, while the outer blocks remain standing to form escarpments.

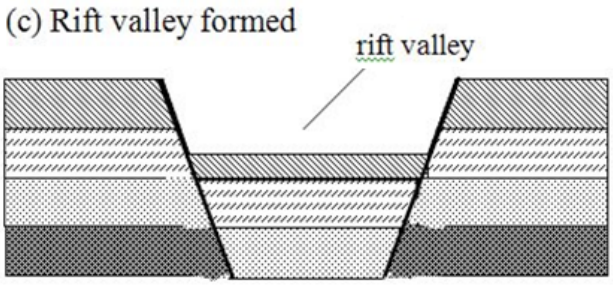
Phase 1: Before faulting



Phase 2: During faulting /creation of normal faults



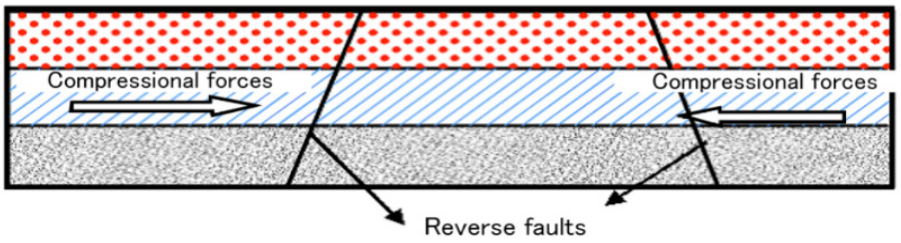
Phase 3: Rift valley formed



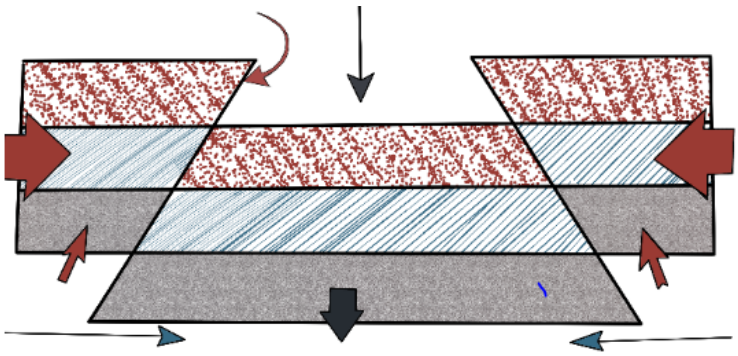
Rift valley formation by tensional forces

Formation of the rift valley by compressional forces (Compressional theory by E.J. Wayland)

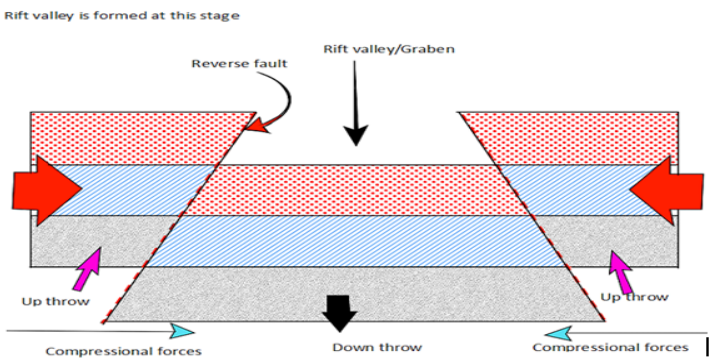
Rift valley is formed when horizontal forces act towards each other. These forces push the crustal rocks or layers towards the center from all sides. These forces of compression produce two parallel faults and the pieces of land on either side are lifted above the general level of the ground to form a rift valley. How the affected rocks respond to compressional forces depends on how brittle (breakable) the rocks are and the speed with which the forces are applied. Brittle (rigid) rocks will break down and result in formation of faults. This process is known as **faulting**. **Folding,** which is a bending or wrinkling of rock layers, occurs when compressional forces are applied to rocks that are ductile (bendable), as opposed to brittle.



Rift valley is formed at this stage



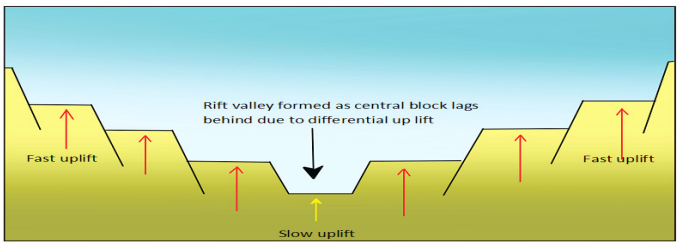
Formation of the rift valley by compressional forces



Formation of the rift valley by compressional forces

Theory of differential uplift (by Dixey and Troup)

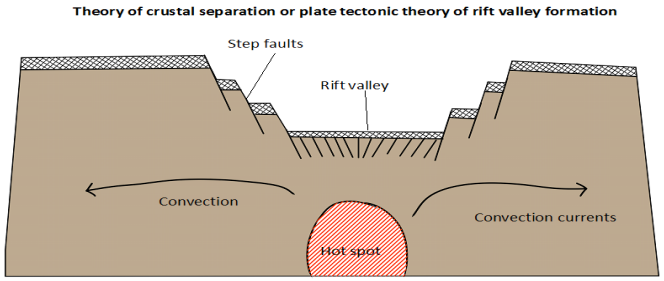
Rift valley is formed when normal faulting produces several normal fault lines followed by gradual up lift of the faulted area with several step faults. Typical example is Kedong in the part of Nairobi.



Rift valley formed as central block lags behind

Theory of crustal separation/Plate tectonics theory

This is formed in manner of sea-floor spreading or tectonic movement, where convectional currents within the mantle rise vertically and then divert from each other horizontally. This results to the dragging of oceanic or continental plates. Such results into breaking of crustal layers that are dragged apart together with continental rafts. As movement continued the central block was forced to subside. For example, the separation of Arabian block from East African block show the closeness of continental drifting that seems to be taking place in East African Rift valley.



Rift valley formed in manner of sea-floor spreading or tectonic

ii. Influence of faulting on drainage

The following is the influence of faulting on drainage system:

- There is development of specific types of drainage patterns in a given area. These include rectangular, parallel and trellised drainage patterns.
- Formation of fault guided valleys. In this case, rivers flow following the layout of the fault guided valley. A good example is River Rusizi in western Rwanda.

- River reversal (change of direction). Example is River Katonga and Kafu in western Uganda that were joining the Congo River basin and reversed towards Victoria basin.
- Rift valley lakes are formed when graben or rift valleys are filled by water. Typical examples include: Lake Kivu, Eduard, Albert, George, Tanganyika in western arm/branch of East African rift valley, Turkana, Manyara, Nyasa, Magadi in Eastern arm/branch of East African rift valley.
- Waterfalls in faulted areas such as Rusizi, Mururu in Rwanda and Mubuku water falls in South Western part of Uganda.
- Rising of the underground water table along fault planes. Typical examples are Mwiyanike, Nyamyumba in Rwanda.

Application Activity 6.3

Explain the influence of faulting on landscape and drainage system in the context of Rwanda.

6.2. Folding and warping

Activity 6.4

Read the passage below and provide answers to the question that follow:

The relief of Rwanda is characterized by six topograhic units that include Bugarama plain and Lake Kivu Banks, Congo-Nile crest, Central plateaus, Eastern low lands, Buberuka region and the Volcanic region. Some of these topographic units were formed through faulting process as it was explained in the previous lesson. Those topographic units formed as result of faulting include Bugarama plain and Kivu banks. On the other hand volcanicity has been responsible for formation of volcanic relief in Northern, while the Eastern lowlands resulted from warping. Some landforms of Rwanda were formed through folding process.

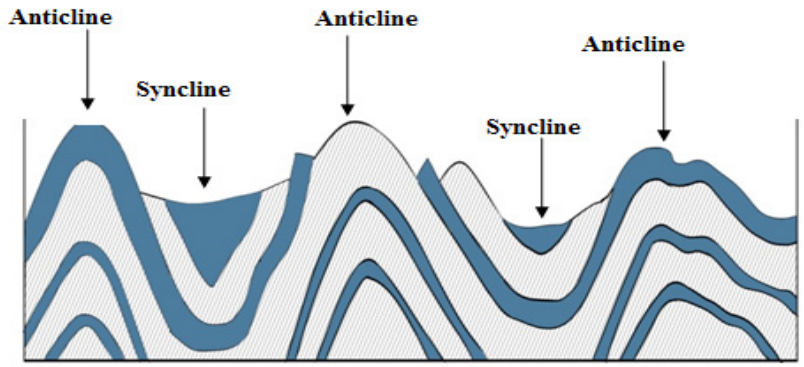
1. *Refer to the above presented passage to answer the following questions:*
   a) *Explain the folding processes*
   b) *Differentiate the folding processes from other internal processes in the passage.*
2. *Suggest the impact of folding process on any landscape you have observed.*

6.2.1. Folding and its process

(i) Meaning of folding and folds

Folding is a process by which crustal rocks bend due to compression forces. This results from horizontal movement caused by the endogenic forces originating deep within the earth.

Folds are the wave-like bends resulting from folding processes. The up-folded rock strata in arch-like forms are called **anticlines** while the down folded structure forming trough-like feature is called **syncline**. The sides of a fold are called **limbs** of the fold.



Anticline and syncline

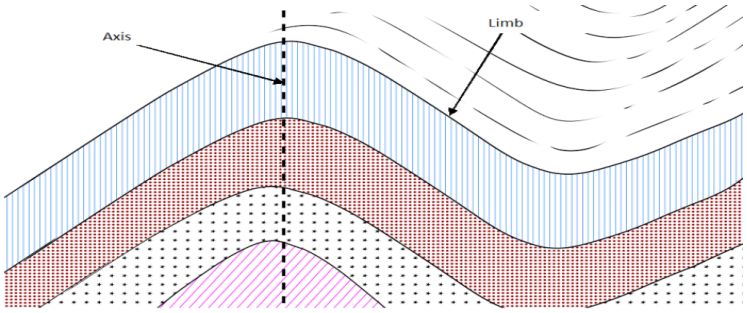
(ii) Processes of folding

The processes of folding are mainly engineered by the presence of compressional forces that push intensely the crustal layers towards a common centre. It occurs in areas with soft and young rocks and instead of fracturing due to internal forces or convectional currents that lead to formation of compressional forces the crustal layers start to bend.

(iii) Types of folds

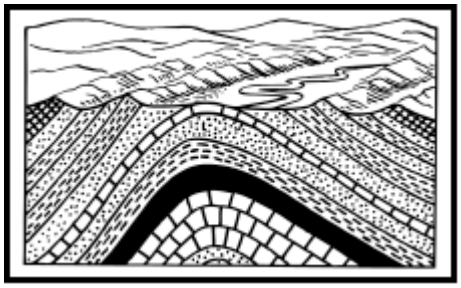
Based on the inclination of the limbs, folds are divided into the following categories:

a) **Symmetrical folds** are formed when compressional forces work regularly but with moderate equal intensity. Symmetrical folds are very rare.



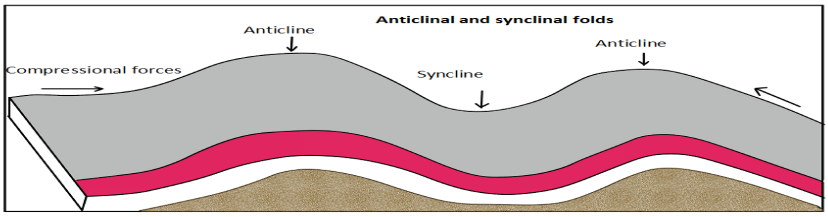
Symmetrical folds

b) Anticlinal fold: This is a fold that has the convex appearance and has its oldest beds at its core.



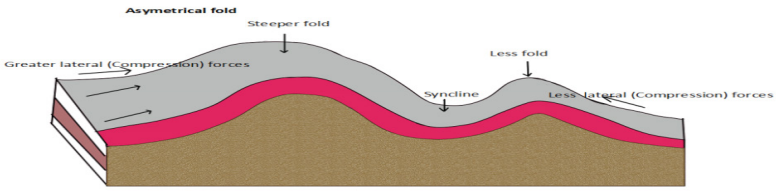
Anticlinal fold

c) A syncline fold: This is a fold with younger layers closer to the center of the folded structure. Synclines are typically a downward fold, termed as syncline (i.e. a trough) but synclines that point upwards can be found when strata have been overturned and folded.



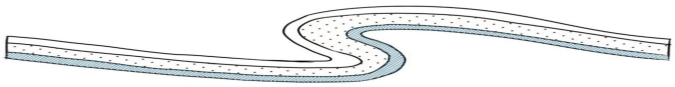
Syncline fold

d) Asymmetrical folds: These are formed when there the compressional forces acting upon the crustal young layers are unequal. One side is intensely pushed while the other is moderately compressed.



Asymmetrical folds

e) Over fold: This is a type of fold formed where the compressional forces push with great intensity one limb to the extent of the land folding so much that the anticlinal part or crest is pushed over the would-be syncline.



Overfold

(iv) Influence of folding on drainage and landscape

a) Influence of folding on drainage

The following are ways through which folding has influenced drainage:

- Formation of various water falls in Rwanda and elsewhere in the World. Some of the waterfalls are located on the upward folded areas. A good example is Rusumo water fall.
- Fold Mountains are good catchment areas. A typical example in Rwanda is in Gicumbi District.

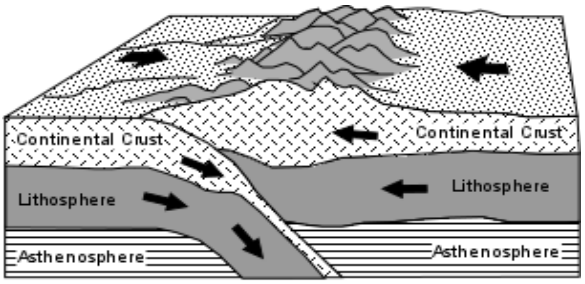
b) Impact of folding on landscape

There are various landforms resulting from folding. These include the following:

i) Rolling plains: These types of landforms result from down warping movement caused by the folding processes. They have gently sloping anticlines with very wide synclines.

ii) Ridge and valley landscape: The strong compressional forces create a series of asymmetrical folds. The anticlines form the uplands (ridges) while the synclines form the valleys.

iii) Fold Mountains: The mountains rise to different heights depending on the velocity and intensity of compressional forces.



Fold Mountains

6.2.2. Warping

i) Meaning of warping

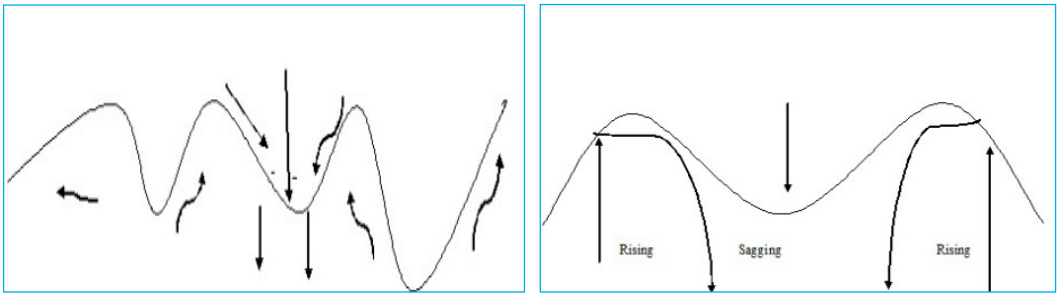
Warping is the downward movement of crustal rocks caused by sinking convectional currents within the interior part of the earth. This results into formation of a saucer-shaped basin. A typical example where warping took place in East Africa is Lake Victoria basin.

ii) Types of warping

There are two types of warping:

a) Down warping: This is formed when the sinking convectional currents drag down wards the lower part of the crust. Therefore, the crustal layers bend inwardly to form basins. This created East African major basins i.e. the depressions occupied by Lake Victoria, lake Kyoga in Uganda and Lake Muhazi in Rwanda are good examples.

b) Up warping: During the down warping the outer parts of the crustal layers tend to move upwards. This is commonly caused by isostatic movement associated with upward movement. This produced up land regions like East African plateaus and other uplands elsewhere in the world.



Up and down warping

c) Broad warping

When the process of up warping and down warping affects larger areas, the resultant mechanism is called broad warping.

iii) Causes of warping

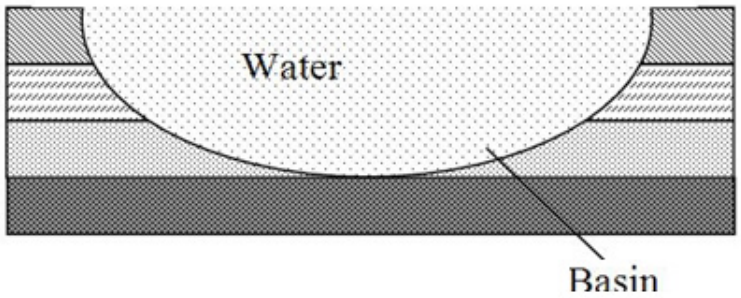
Warping is mainly caused by convectional currents that result into lateral compressional forces of low intensity. Typical examples are common in East Africa where few areas escaped the down warping and up warping process. The resultant impact on the landscape of Africa is evidenced by: African Basins, crustal warped lakes, extensive swamps around the lakes, extensive plateaus, reversal of some rivers, etc.

(iv) Landforms associated with warping

The process of warping led to formation of numerous landforms which include the following:

a) Plateau: It is a large, extensive uplifted part of the earth's crust which is almost flat at the top. The top of the plateau is mostly plain. Examples include: Eastern plateaus of Rwanda, Guinea highlands, Jos plateau (Nigeria), Ahaggar (north centre of Sahara), etc.

b) Basin: It is a large and extensive depression on the earth's surface. Most basins are formed due to vertical downward movement of the earth's crust.



Basin

Examples of basins include: Congo basin, Chad basin, and Amazon basin. When a basin is filled by water; it forms basin lakes like Lake Muhazi and Mugesera in Rwanda, Lake Victoria, etc.

c) Plains: These are flat areas that are in lowland areas. Typical examples are generally in coastal regions that were greatly affected by warping process.

(v) Influence of warping on drainage

The following is the influence of warping on drainage:

- Some rivers change their courses due to warping in a given area. A good example is the case of hydrography of East Africa where some rivers changed direction and other filled depressions to form lakes.
- Formation of many lakes in East Africa. Good examples include: Lake Victoria and Lake Kyoga in Uganda, Lake Muhazi and Mugesera in Rwanda.
- Presence of waterfalls which are located on the upward warped areas.
- The drainage of Rwanda flows from west to east from the up warped features of Rwanda.

Application Activity 6.4

1. *"Some parts of East Africa have been affected by up warping and down warping." With relevant examples support this statement.*
2. *Draw a sketch map of Rwanda, on it label and name the major landforms which resulted from warping.*

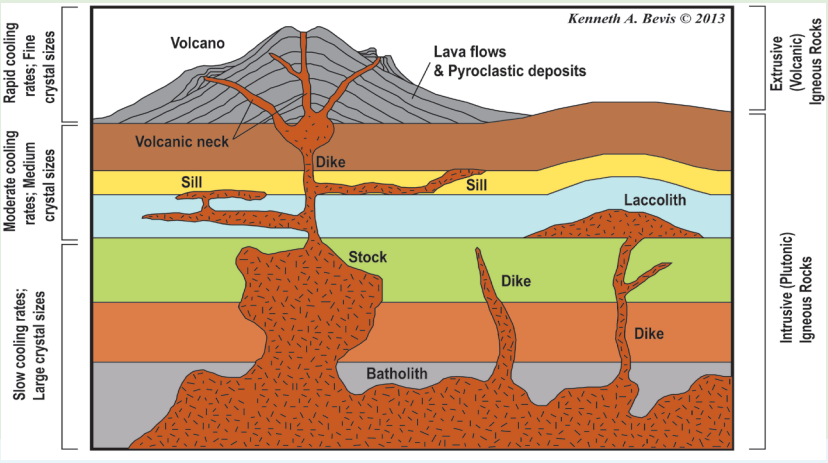
6. 3. Vulcanicity and earthquakes

6.3.1. Vulcanicity

(i) Processes of vulcanicity and volcanicity and associated materials

Activity 6.5

Study the figure below and answer the questions that follow:



1. *Identify and explain the process illustrated in the above figure.*
2. *Suggest the materials which are ejected out associated with the process identified in (1) above.*

Terms used in vulcanicity

The following are the key terms used in vulcanicity studies:

- **Vulcanicity** refers to the processes from which the molten materials are either ejected on the surface of the earth or remain in the earth's crust.
- **Volcanicity** refers to the process by which lava through volcanic eruption is ejected to the earth's crust.
- A **volcano** is a mountain that opens downward to a reservoir of molten rock below the surface of the earth.

(ii) Materials of vulcanicity

Volcanic materials of various types are ejected through the volcanic pipe known as a vent. This is situated in the part of fault line that assisted the escape of magma. Volcanic materials include the following:

- **Vapour and gases:** Stream and vapour include phreatic vapour and magmatic vapour. Volcanic gases include carbon dioxide, nitrogen oxides, sulphur dioxide, hydrogen and carbon monoxide.
- **Magma and lava:** Molten rock materials are called magma when they are still below the earth's surface. When they reach the earth's surface, they are known as lava. Lava and magma are grouped into two classes. These include the following:
  i. Based on silica percentage; lava and magma are divided into two groups: *acidic magma* (high percentage of silica) and *basic lava* (low percentage of silica).
  ii. Based on light and dark coloured minerals; lava and magma are also classified into Felsic and Mafic lava.
  iii. Based on size of pyroclastic materials: These are grouped into four kinds:
    - Volcanic dust (finest particles)
    - Volcanic ash (2 mm in size)
    - Lapilli (of the size of peas), and
    - Volcanic bombs (6 cm or more in size).

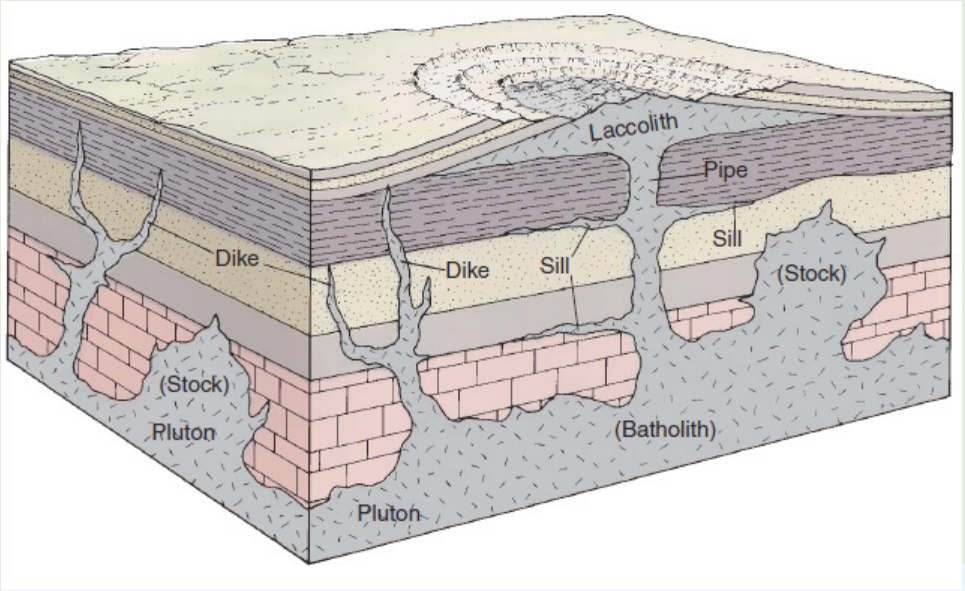
Application Activity 6.5

1. *Describe the main materials derived from vulcanicity.*
2. *Name and locate the volcanoes available in Rwanda.*

(iii) Intrusive and extrusive features

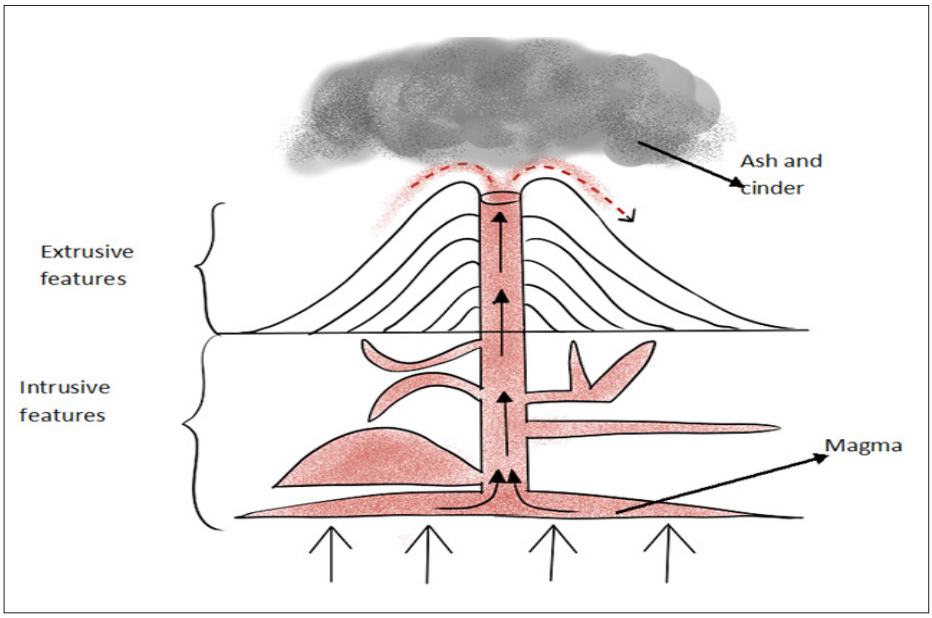
Activity 6.6

Critically observe the photograph shown below and use it to find answers to the questions that follow:



Basing on your observation of the above photograph and the previous lessons on relief features of Rwanda studied in year one, describe the landforms of volcanic region of Rwanda.

Magma found inside the crust may sometimes reach the surface of the crust through fracture, fissures and consolidate from there. In this case the features formed are ***extrusive features***. But when magma fails to reach the earth's surface and consolidate inside the crust before reaching the surface; the features formed will be called ***intrusive features***.



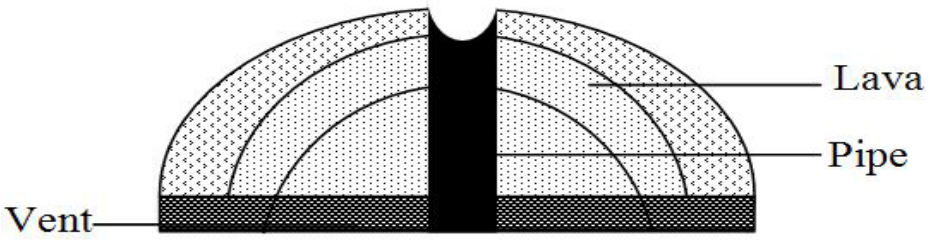
Intrusive features

i. Extrusive volcanic features

These features include the following:

a) Volcano: This is a mountain that opens downward to a reservoir of molten rock below the surface of the earth. Unlike most mountains which are pushed up from below, **volcanoes** are formed when molten rock escapes to the earth›s surface. This solidifies to form highland known as volcanoes.

b) Acidic lava cone: This refers to a cone made of viscous lava normally that is ejected out of the earth's crust and solidifying faster as soon as it reaches the Earth's surface. It always cools faster than basic lava because it is viscous in nature.



Vent, pipe and lava

c) Basic lava cone: This is a cone of basic fluid/lava spread over a long distance. Basic lava cone is characterized by gentle slope. Basic lava cone

is also known as shield or basalt volcanoes. Typical examples include Nyamuragira in DRC and Muhabura volcanoes in Rwanda.

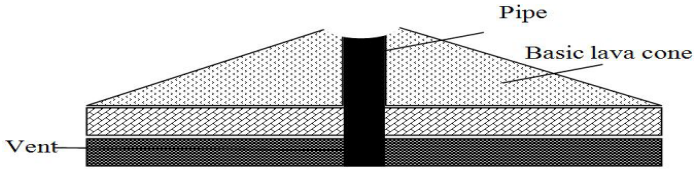
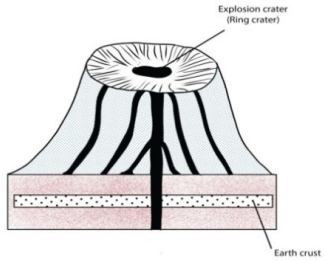


Figure: Basic lava cone

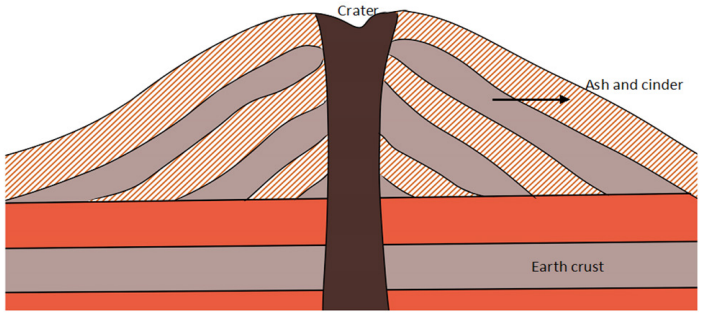
d) Crater: This is a volcanic depression on top of the volcano. When a crater is filled by water, it forms Crater Lake. Examples of crater lakes in Rwanda are found on Kalisimbi, Muhabura and Bisoke volcanoes.



A crater lake on the top of volcano

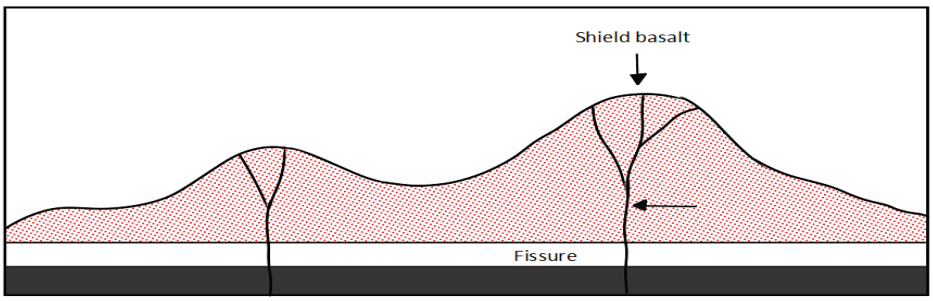
e) A caldera: This is a wide depression that forms on top of a volcanic mountain due to explosive eruption or secondary eruption. When a caldera is filled with water, a Caldera Lake is formed. Typical example of dry caldera is Ngorongoro Caldera in Tanzania.

f) Ash and cinder cone: These are formed when lava is ejected into the air violently, breaks into small particles known as Ash and cinder. These fall back and pile up to form alternating layers of ash and cinder. These have slopes that are importantly concave and asymmetrical in nature.



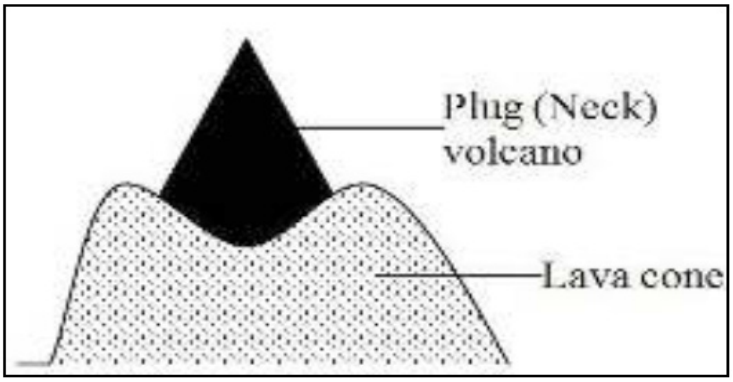
Ash and cinder cone

g) Volcanic plateaus: These are formed when there are various fissures or vents and basic lava flows out spreading to a wide area. This results into the formation of a flat-topped highland known as volcanic plateau. Typical examples of lava plateaus are found in Musanze, Nyabihu, Rubavu, Burera (North Western part of Rwanda), Ethiopian highlands, Deccan plateau in India and Bui plateau in Nigeria, Shirasu-Daichi in Japan and the North Island Volcanic plateau in New Zealand.



Lava plateau

h) Volcanic plug: This is also called a volcanic neck or lava neck, is a volcanic feature created when magma solidifies within a vent and later the soft layers of rocks surrounding it are eroded away.

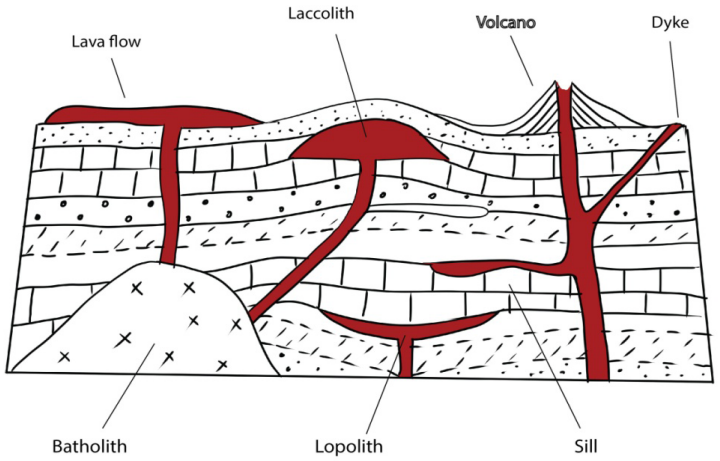


Volcanic plateau

(ii) Intrusive vulcanic features

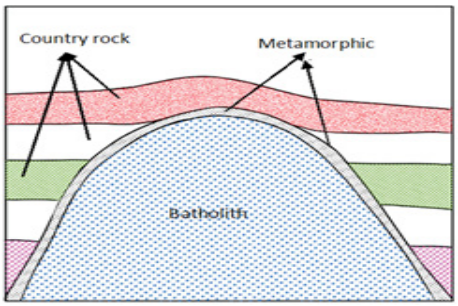
This is a type of vulcanicity where magma does not reach the earth's surface but cools and solidifies within the crustal rocks.

They include the following, Lava flow, laccolith, Volcano, Dyke, Lapolith, sill, etc.



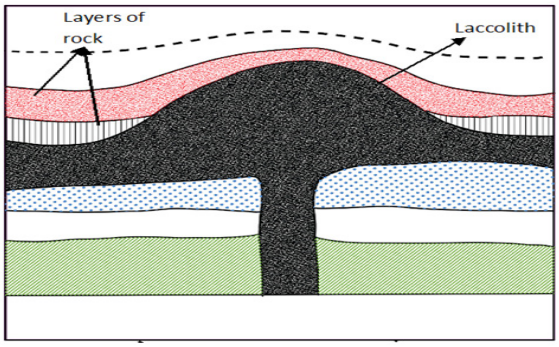
Intrusive vulcanic features

a) Batholith: This refers to large dome-shaped intrusion of magma extending to great depth within the earth's crust. Batholiths are formed deep below the surface when large masses of magma cool and solidify. These may later be exposed because of erosion to form in inselbergs.



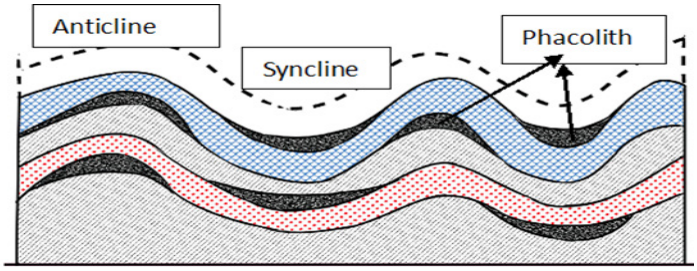
Batholith

i) Laccolith: It is a dome-shaped intrusion of magma formed when the magma cools and solidifies in anticline bedding plane.



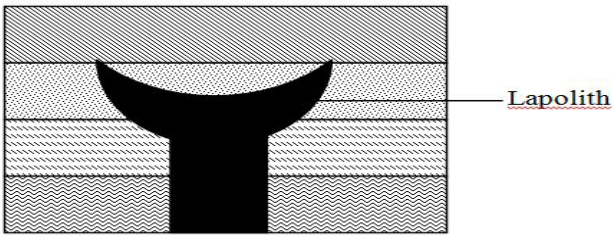
Laccolith

ii) Phacolith: This islens-shaped mass of igneous rock formed when magma cools and solidifies at anticline and syncline in folded rocks. Phacolith is much shallower.



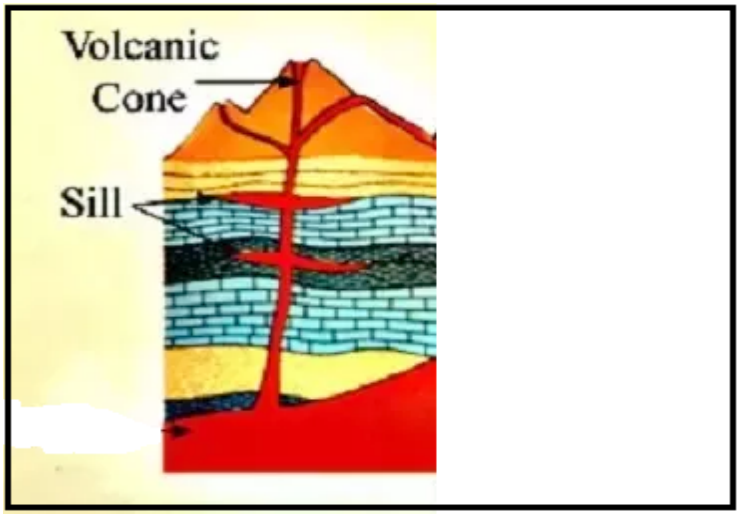
Phacolith

iii) Lapolith: It is a large saucer-shaped intrusion formed when magma (molten rocks) cools and solidifies in a syncline bedding plane. Lapoliths form shallow basins along the rock bedding plane.



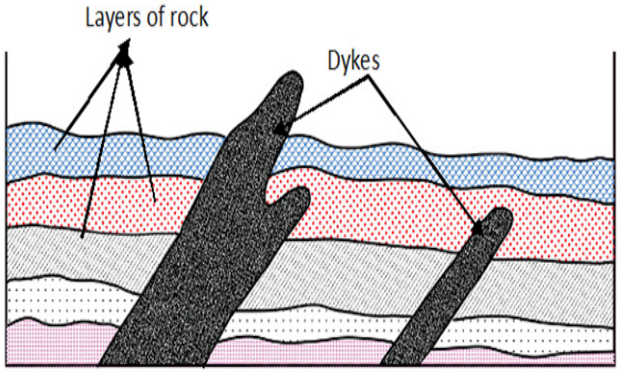
Lapolith

iv) Sills are horizontal intrusions of magma which have solidified along the lines of bedding planes.



Sills

v) **Dykes:** These are vertical intrusions formed when magma solidifies in a vertical manner or within the vent and subsidiary vents.They cut across the bedding planes of the crustal rocks into which they have been intruded. Dykes often occur in groups where they are known as dyke swarms.



Dykes

Application Activity 6.6

With the help of diagrams, differentiate intrusive and extrusive volcanic landforms.

i. Types of volcanoes and their characteristics

Activity 6.7

In the previous lesson you learnt that vulcanicity leads to formation of various landforms including volcanoes.

a) Describe volcanoes according to their period of activity.

b) Make a classification of the volcanoes according to their nature of volcanic eruptions.

(a) Classification based on periodicity/activity of eruptions

The following are types of volcanoes based on periodicity or activity of eruptions:

- **Active volcanoes:** These are volcanoes which constantly eject volcanic lavas, gases, ashes and fragmental materials. These are erupted very recently or are engaged in eruption. Examples are Nyiragongo and Nyamuragira in DRC, Ol Doinyo in Tanzania, Lengai and Etna, Stromboli (in Mediterranean Sea).

- **Dormant volcanoes**: These are volcanoes which have taken long without erupting but still show signs of eruption. That is, theyare quiet after their eruption for sometime. However, they suddenly erupt violently and cause huge damage to human, animal and plant life around them. An example is Muhabura, Karisimbi, Gahinga andBisoke in Rwanda, Vesuvious near Naples in Italy.
- **Extinct volcanoes**: These are volcanoes that have taken a long time without erupting and show no signs of erupting in future. A good example is Mount Sabyinyo in Rwanda.

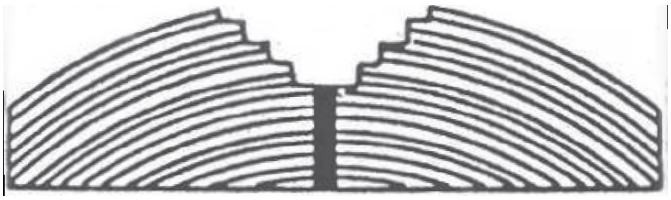
(b) Classification of volcanoes basing on the nature of eruptions

Based on the nature of eruptions volcanoes are classified into the following:

i) Explosive volcanoes: These are volcanic eruptions whereby the magma is violently ejected out of the Earth's crust through a central pipe (vent).

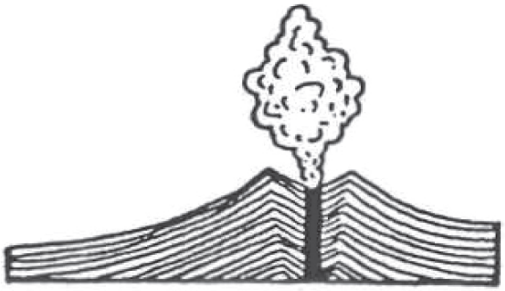
Explosive type of volcanoes are classified into the following:

- **Hawain type of volcanoes**: Such volcanoes erupt quietly due to less viscous lava and non-violent gas. A good example is Nyiragongo of DRC, Mihara in Japan, Etna of Italy, Kilauea of the southern Hawaii island.



Hawain volcano

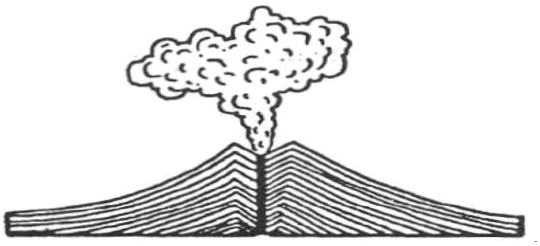
- **Strombolian type:** Such volcanoes erupt with moderate intensity. Besides lava, other volcanic materials like pumice, scoria and bombs are also ejected into the sky. e.g: Stromboli in Italy.



Strombolian volcano

- **Vulcanian type of volcanoes**: Such volcanoes erupt with great force and intensity. The lava is so viscous and pasty that quickly solidifies

and hardens. E.g:Lipari in the Mediterranean Sea, Sakurajima in Japan etc.

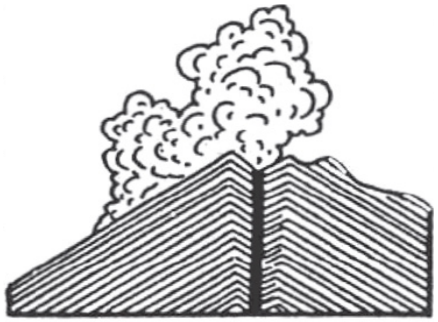


Vulcanian volcano

- **Peleean type of volcanoes:** They are the most violent and explosive types of volcanoes. The ejected lava is extremely viscous (a large amount of gas, dust, ash,and lava fragments are blown out of the volcano crater. e.g: Pellee Volcano of Martinique Island in the Caribbean Sea.

Peleean volcano

- **Visuvious type of volcanoes**: There is a violent expulsion of magma due to enormous volume of explosive gases. A good example is the Plini volcano in Italy.



Visuvious volcano

ii) Fissure eruption type or quit eruption type: These occur along fracture, fault and fissure and there is slow upwelling of magma from below and the resultant lavas spread over the ground surface. An example is Laki fissure eruption in Iceland.

Application Activity 6.7

With specific examples from East Africa,

a) Identify and describe the extrusive volcanic landforms.

b) Categorize the volcanoes according to their period of activity.

ii. Influence of volcanicity

Activity 6.8

Observe the photograph of Bisoke crater provided below and answer the questions that follow:

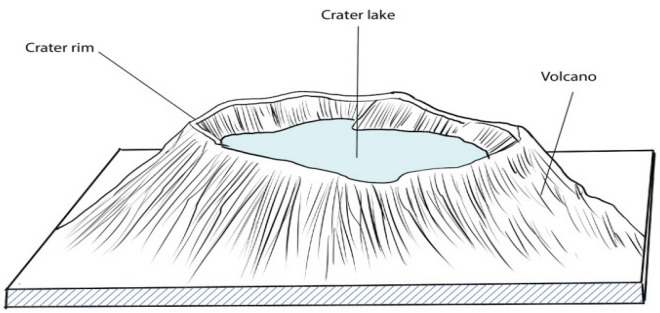
1. *How did the volcanicity influence the formation of the mentioned drainage feature?*
2. *Using your own experience, textbooks and internet, research on the impact of volcanicity to the social economic development of a country.*
3. *Locate the volcanic regions on the east Africa map.*

In this section, we highlight some of impacts produced by volcanicity on ***drainage systems***, and ***humans***, and we briefly describe the ***distribution of volcanoes*** in the world.

(a) Influence of volcanicity on drainage

The volcanicity influences the drainage system in a given area in different ways as follows:

- Some seasonal rivers originate from the crater lakes and flow down slope. The good example includes Susa River in Rwanda.
- Crater or caldera of volcanoes may be filled with water to form lakes. Good examples in Rwanda are the lakes located on Bisoke, Muhabura and Kalisimbi.



Crater Lake on the top of a volcano

- Some rivers may change their courses due to volcanicity. For example, before the Rwandan volcanoes came into existence, Nyabarongo River was flowing northward and then when volcanoes came in place, the river changed its course which is southward.
- It leads to formation of lava dammed lakes. E.g. Burera and Ruhondo.

(b) Impact of volcanicity to the human

Volcanicity has both negative and positive impacts to human life, as briefly described in the following paragraphs:

Positive impacts

The following are some examples of positive impacts of volcanicity:

- Volcanicity is associated with rich (fertile) volcanic soils that stimulate agriculture;
- It leads to production of geothermal heat and geothermal energy;
- It stimulates mining of metal ore deposits (including gold, silver, copper, tin, iron, lead, wolfram and zinc);
- Volcanicity is associated with the formation of crater and lava dammed lakes that stimulate fishing and water transport. A typical example is in Burera and Ruhondo lakes in Northern Rwanda;
- Industrial materials like building stone, pumice and clay are provided by volcanic features;
- Volcanicity leads to formation of waterfalls that facilitate the generation

of electricity (HEP). A good example is at Ntaruka and Mukungwa Hydro-power plants in Northern Rwanda.

- Volcanoes play a great role in modification of climate which supports various human activities such as agriculture.

The hot springs are used for medicinal purposes, for example therapeutic water.

Negative impacts

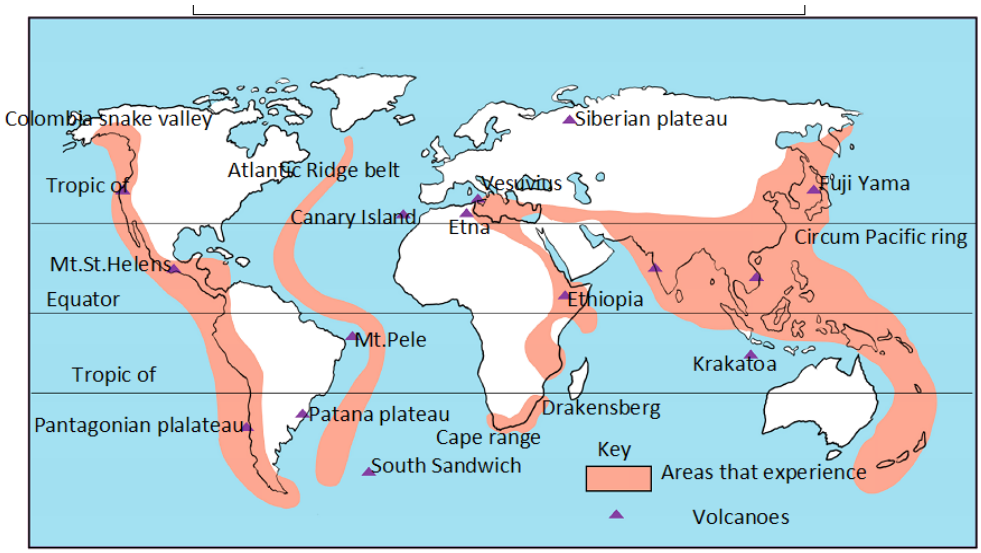
The following are some examples of negative impacts of volcanicity:

- Volcanic eruptions cause heavy damage to human lives and property through outpouring of lava, fallout of volcanic materials; speeding lava flows.
- Too much volcanic materials also lead to diversion and blocking of drainage systems and floods.
- The poisonous gases produced during the eruptions cause acid rain.
- Sometimes volcanic eruptions are followed by heavy rainfall. The heavy rain mixes with falling volcanic dusts and gases to cause mudflows or lahar;
- Volcanic eruptions may generate tsunamis and seismic waves causing death to human beings.

(c) World distribution of volcanoes

There are three major belts or zones of volcanoes in the world. These are:

- **Circum-Pacific belt:** volcanic zones of the convergent oceanic plate margins, including the volcanoes of the Eastern and Western coastal areas of the Pacific Ocean. This includes island arcs and festoons off the East coast of Asia and of the volcanic islands scattered over the Pacific Ocean. This volcanic belt is also called "The fire girdle of the Pacific or the Fire ring of the Pacific".
- **Mid-continental belt,** also known as 'the volcanic zones of convergent continental plate margins'. This belt includes the volcanoes of Alpine mountain chains and the Mediterranean Sea, and the volcanoes of the faulted zone of Eastern Africa.
- **Mid-Atlantic belt:** This includes the volcanoes along the Mid-Atlantic ridge which represents the splitting zone of plates. In other words, two plates diverge in opposite directions from the mid-oceanic ridge. Thus, volcanoes of fissure eruption type occur along the constructive or divergent plate margins.



Volcanic region of the world

Application Activity 6.8

1. *Examine the significance of volcanicity to the economic development of the areas found in volcanic regions.*
2. *Assess the role played by volcanicity in the development of the following economic activities in Rwanda:*
   a) *Tourism industry*
   b) *Agriculture*
   c) *Power and energy*
3. *Locate and describe the major volcanoes of the world on world sketch map.*

6.3.2. Earthquake

i. Meaning and causes of earthquakes

Activity 6.9

Read the passage about earthquakes occurrence and provide answers to the questions that follow.

Earthquakes *occur when masses of rock in Earth's crust slip and slide against one another. This kind of movement is most common along a fault, a break in a body of crustal rocks that can extend for kilometers or even hundreds of kilometers. When pieces of crustal rock suddenly slip and move, they release enormous amounts of energy, which then propagates through the crust as seismic waves.*

At the Earth's surface, these waves cause the ground to shake and vibrate, sometimes violently.

Geologists classify seismic waves into two broad categories: body and surface waves.

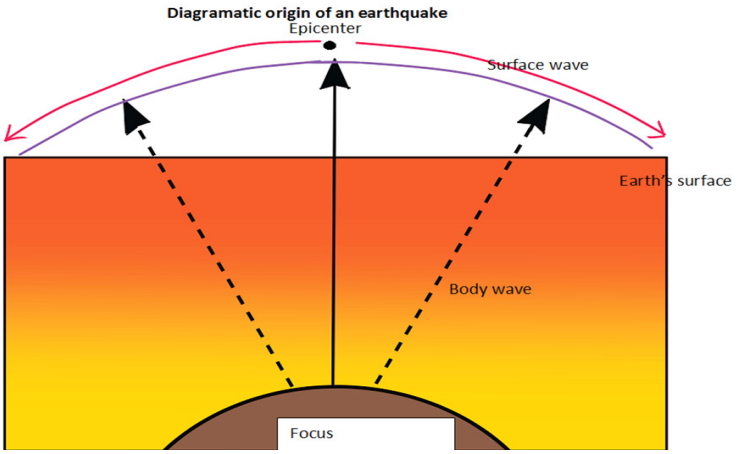
Body waves*, which include Primary and Secondary waves, travel through the Earth's interior.*

Primary waves *resemble sound waves which mean they compress and expand material as they pass.* ***Secondary waves*** *resemble water waves which mean they move material up and down. Primary waves travel through both solids and liquids, while Secondary waves only travel through solids.*

1. *Identify the internal process explained in the above passage*
2. *Explain how that process occurs.*
3. *Conduct a research and find the meaning of the following terminologies:*
   - *i. Hypocentre*
   - *ii. Epicentre*
   - *iii. Focus*
   - *iv. Tremor*

a) Meaning of earthquake and associated terminologies

An earthquake is a sudden tremble or shaking of the ground caused by abrupt release of energy from crustal rocks; a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings and causing gaping fissures in the ground.



Focus and epicentre

- **Focus or hypocentre:** It is the place of origin of the earthquake and is always hidden inside the earth. It is also considered as the place of the occurrence of earthquake.
- **Epicentre:** It is a place on the ground surface which is perpendicular to the focus. That place is the first to experience seismic event.
- **Magnitude**: It is a measure of the amount of energy released during an earthquake.
- **Tremors** or **temblor** is the perceptible shaking of the surface of the Earth, resulting from the sudden release of energy in the earth's crust that creates seismic waves.

b) Causes of earthquakes

Earthquakes are caused by both natural and human factors as follows:

Natural causes of earthquakes

Natural causes of Earthquakes are associated with endogenic forces resulting from convectional currents.

- Volcanic eruptions of explosive and fissure types. Generally, volcanic earthquakes are confined to volcanic areas.
- Dislocation of crustal rock blocks during faulting. Such earthquakes are severe and disastrous.

- Disturbance in the isostatic balance at regional level due to imbalance in geological processes. Generally, earthquakes occurring in the active zones of mountains fall in this category.

Human causes of earthquakes

The earthquakes may also result from human activities such as:

- Pumping of water from underground aquifers, oil reserves; deep underground mining;
- Blasting of rocks by dynamites for purposes of construction (of dams and reservoirs, roads);
- Nuclear explosions;
- Storage of huge volumes of water in big reservoirs.

Application Activity 6.9

Through internet, journals, textbooks and magazines search on the earthquakes which affected Western Rwanda in past years. Then answer the following:

1. *Name the epicentre of earthquake which took place in Rwanda in February, 2007 and August, 2015.*
2. *Suggest why the western part of Rwanda experiences high level of earthquake.*

Activity 6.10

1. *Describe what you observe on the picture above.*
2. *Propose measures that can be taken to curb the effects of the hazard/disaster presented in the picture above.*

ii. Consequences and measures to alleviate earthquake effects

a) **Consequences of earthquakes**

The following are consequences earthquakes:

- Loss of life and destruction of property happens when violent shaking of the land causes cracks on walls and making the buildings to collapse.
- Outbreaks of fires occur where the earthquake destroys oil and gas pipelines.
- Occurrence of Tsunamis which are huge sea waves and are very destructive
- Landslides occur when; sudden movements of large masses of rock and soil downhill.
- Displacement of crustal rocks. This is takes place vertically and laterally, leading to damaged transport and communication lines such as roads and railways.

b) Measures to alleviate earthquake effects

The measures for alleviating the earthquakes include the following:

- Building houses in a way that they are more resistant to earthquakes.
- When one is outside, should stay move away from buildings and streetlights.
- If trapped under a collapsed structure tap on a pipe or wall so that rescuers are able to locate you.
- When the shaking stops, look around to make sure it is safe to move. Then leave the building.

Application Activity 6.10

It has been noticed that Western part of Rwanda experiences earthquakes at great extent compared to other regions of Rwanda.

a) Suggest why that part of Rwanda experiences such phenomenon.

b) What do you think are the effects of such catastrophe/disaster in any region where it occurs?

c) Assume that you are in charge of disasters management; propose measures that should be taken to control earthquakes.

Skills lab

The landform evolution and processes have a great impact on landform. Examine the internal landform susceptible to change the surface of your local area.

End unit Assessment

1. *Discuss the impact of faulted landforms on the East African landscape and drainage*
2. *Explain the significance of folded relief features in the socio-economic development of East Africa.*
3. *With specific examples, explain the importance of warping on drainage system of Africa.*
4. *Critically examine the effects of either Tsunami in Japan or earthquake in Haiti on the World economic development.*
5. *Assume that you are appointed as Director General of Rwanda Environmental Management Authority (REMA), what are measures that you should reinforce for conserving the basin lakes and wetlands found in Eastern province.*

UNIT 7

SOILS

Key Unit Competence: The student-teachers should be able to investigate the different constituents and morphological properties of the soil.

Introductory activity

Observe carefully the figure below and answer the questions that follow:

i. Identify the major components of the soil.

ii. Using the experiences gathered from previous classes on soils, explain the contents of each components of the soil.

iii. Describe the morphological properties of soil.

iv. Explain what makes soil to be more productive.

7.1. Soil constituents

Activity 7.1

Using previous knowledge learnt in Geography textbooks and other sources of geographical information;

a) Define soil.

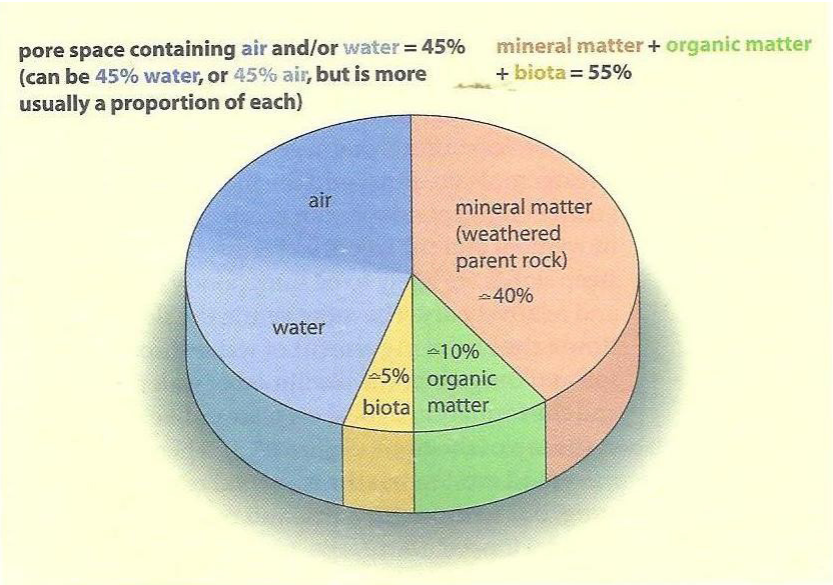
b) Differentiate the constituents/components of soil.

7.1.1. Definition of the soil

Soil is a dynamic natural material composed of fine particles in which plants grow. It is defined as a natural body consisting of layers (**soil** horizons) that are composed of mineral materials, organic material, air and water. Mineral materials originate from weathered rocks whereas organic materials are products of decayed plants and animals.

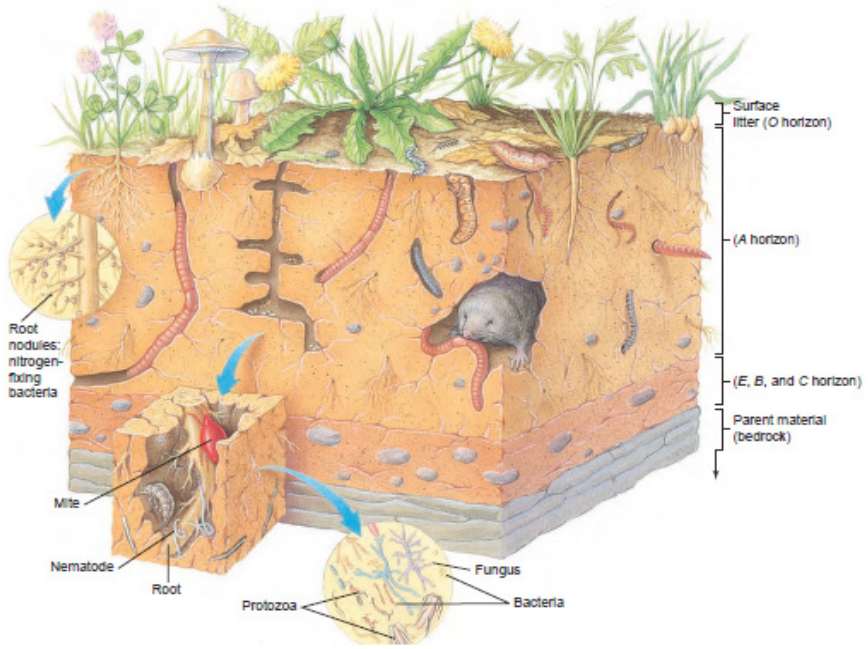
7.1.2. Soil constituents

The figure below shows the five major constituents of the soil with their proportions, as described in the following paragraphs:



Soil constituents and their approximate percentages

Soil is not merely a group of mineral particles. It also has a biological system of living organisms and some other components.



Micro fauna as part of soil dynamics

A brief description of each of the five constituents of the soil is given in the following paragraphs:

i) Inorganic materials, also called **mineral matter** is matrix of mineral particles derived from varying degrees of breakdown of the parent-rocks through weathering. These particles vary in shape and size. ***Sand***, ***silt*** and ***clay*** are the three major contents of mineral matter. They include the following. ***Oxides*** which are products of metal rust and mineral oxidation (e.g. iron oxides), are also important constituents of the soil.

Inorganic matter provides important plant nutrients; determine soil aeration, soil texture and drainage. It also gives support to the plants. Inorganic matter makes up *45%* of the soil.

ii) Organic matter is made up of decayed plants and decomposed animal products. Some living animals and plants are also important part of the soil. The decayed remains of plant and animal materials, partially transformed by bacterial action, are collectively called **humus,** which provides the soil with brown or dark color. Organic matter makes up 5% of the soil.

Organic matter has among other the following benefits:

- Humus helps in soil aeration, enhances the soil's ability to hold and store water and improves the soil structure
- It helps plants to extract soil nutrients.

- Humus reduces eluviation of soluble minerals from the top soil and supplies nutrients and minerals to the soil.
- Soils that contain humus are quite workable and have a good capacity to retain water. Humus is also an important source of food for microscopic soil organisms.

iii) **Soil water and moisture** refers to all the water contained in the soil together with its dissolved solids, liquids and gases. Soil water is a dilute solution of many organic and inorganic compounds, which is the source of plant nutrients. The water in the soil moves by **gravity** (downward) or by ***capillarity*** (upward) movement. **Gravitational water** is the water that passes through the soil under the influence of gravitation, whereas **capillary water** is soil water that clings to soil particles as a result of surface tension. Capillary water moves in all directions through the soil from areas of surplus water to areas of water deficit. The movement of water and dissolved minerals is called *leaching*, and the water is called *gravity water.* The soil water makes up 25% of the soil and it occupies the pore spaces in the soil.

Soil water has among others the following benefit:

- It dissolves various minerals and organic substances that derive from plant or animal remains forming solutions;
- The soil water helps plant to absorb minerals from the soils;
- The soil water removes highly soluble minerals from the upper layers to the lower layers, and this process is known as ***leaching***;
- The soil water brings soluble minerals from the lower to the upper horizons of soil through ***capillarity***;
- The soil water is very important in the sense that it provides a medium within which most of the chemical processes of the soil formation take place;
- The soil water provides a medium through which living organisms and soil bacteria operate during the decomposition of organic matter.

iv) **The soil air** occupies the pore space between soil particles which is not filled with water. The soil is normally lower in oxygen and higher in carbon dioxide content. The soil air includes gases from biological activity and chemical reactions. The air or gases make up 25% of the soil. The air in the soil is important in the following ways:

- It facilitates plant growth by supplying oxygen to the root hairs;
- It supports micro-organisms which are found in the soil;

- It helps in the process of weathering known as oxidation which is responsible for breaking down rocks to form soils.

v) Biological system or living organisms and bacteria: The living organisms and bacteria help to decompose the organic matter into humus. This is sometimes classified together with organic matter/humus.

Application Activity 7.1

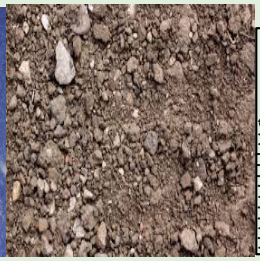
Carry out a tour around your school. Observe critically the nature of the soil constituents and make a their description

7.2. Morphological properties, profile and catena and fertility of the soil

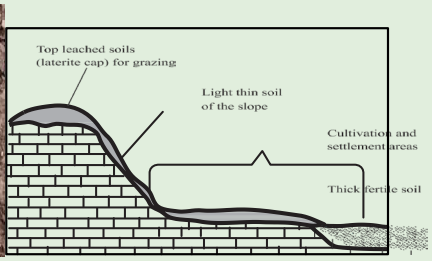
Activity 7.2

Observe the illustration provided below and answer the questions that follow:

A



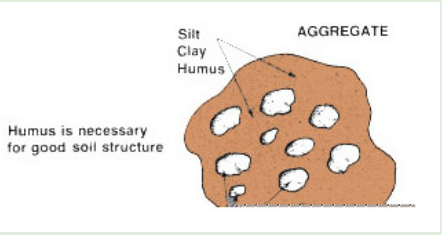
B



C

D

E



F

1. *From your observation of the above illustrations, which picture represents: (i) Soil structure, (ii) Soil texture (iii) Soil colour (iv) Soil profile (v) Soil catena (vi) Soil porosity.*
2. *Differentiate soil structure from soil texture.*

Soil properties refer to the chemical and physical characteristics of the soil and these include mainly: structure, texture, colour, porosity, pH and consistency.

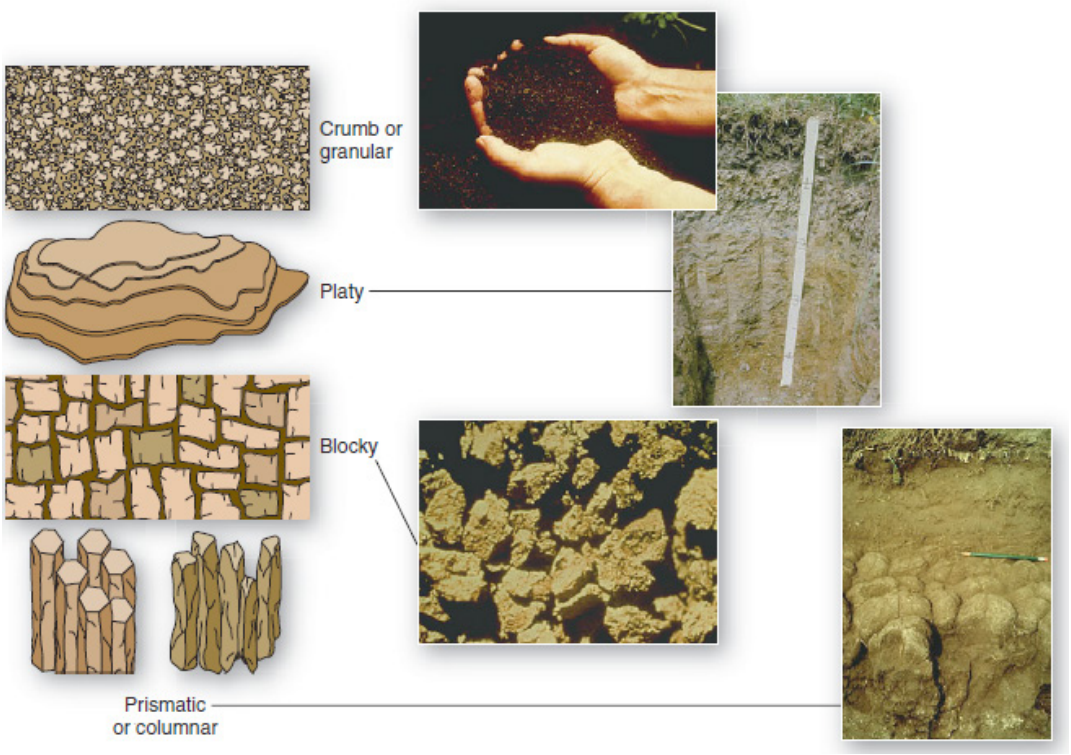
7.2.1. Soil properties

The main properties of the soil include the following:

i. Soil structure

The soil structure is the arrangement of the individual soil particles. Soil structure varies in size and shape. Based on the shape, the following types of soil structure exist: granular, prismatic, platy, columnar and blocky**.**

- ***Granular and crumb****:* They are individual particles of sand, silt and clay grouped together in small, nearly spherical grains. Water circulates very easily through such soils. They are commonly found in the A-horizon of the soil profile.
- ***Platy*****:** It is made up of soil particles aggregated in thin plates or sheets piled horizontally on one another. It is commonly found in forest soils, in part of the A- horizon.
- ***Prismatic****:* The soil particles are formed into vertical prism-like particles. Water circulates with greater difficulty and drainage is poor. They are commonly found in the B-horizon where clay has accumulated.
- ***Columnar*****:** It is similar to prismatic, but the particles are rounded at the top.
- ***Blocky***: These are soil particles that bound together in irregular square or angular blocks having more or less sharp edges. Relatively large blocks indicate that the soil resists penetration and movement of water. They are commonly found in the B-horizon where clay has accumulated.



Types of soil structure

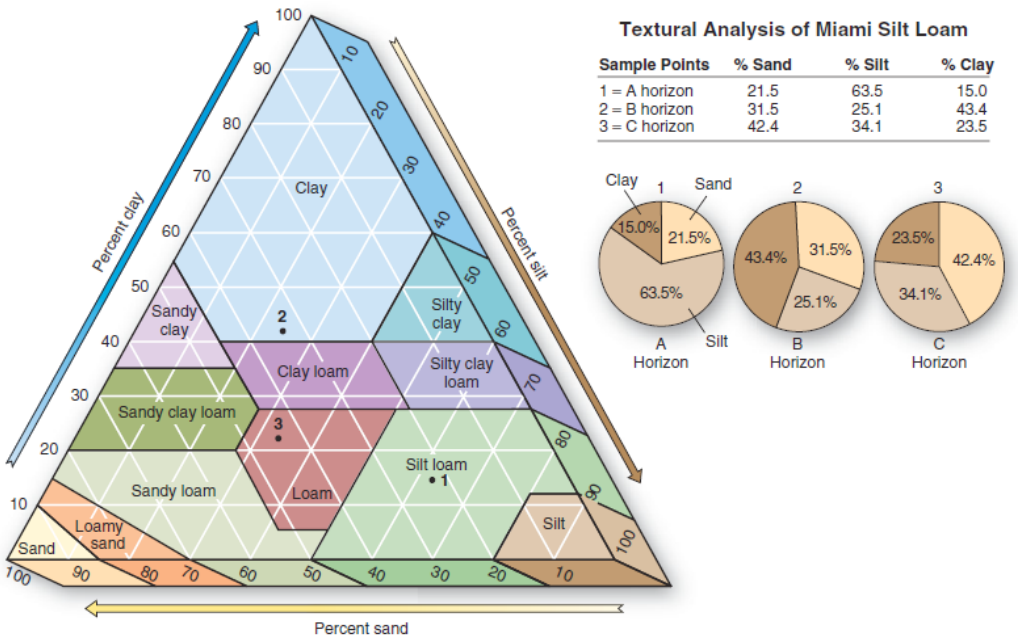
Structure is important because it controls drainage, rooting of plants, and how well the soil delivers nutrients to plants. The shape of individual peds, shown here, controls a soil's structure.

ii. Soil texture

Soil texture refers to the mixture of sizes of its particles and the proportion of different sizes, namely sand, silt and clay within a soil. Particles that are larger than sand are grouped as stones.

Soil texture is important due to the following reasons:

- It influences the amount of air and water available within the soil. Silt and clay soils have a high water holding capacity. Sandy soils have a low water holding capacity.
- It also influences the amount of water and the ability of the roots to pass through it.
- It determines the plant roots penetration and growth in the soil.
- It determines the soil's ability to retain humus from being washed away.
- It influences the aeration of the soil.



Soil textural triangle

Measures of the ratio of clay, silt, and sand determine soil texture. ***As an example***, points 1 (horizon A), 2 (horizon B), and 3 (horizon C) (***see figure above***) designate samples taken at three different horizons in the Miami silt loam in Indiana. Note the ratio of sand to silt to clay shown in the three pie diagrams and table.

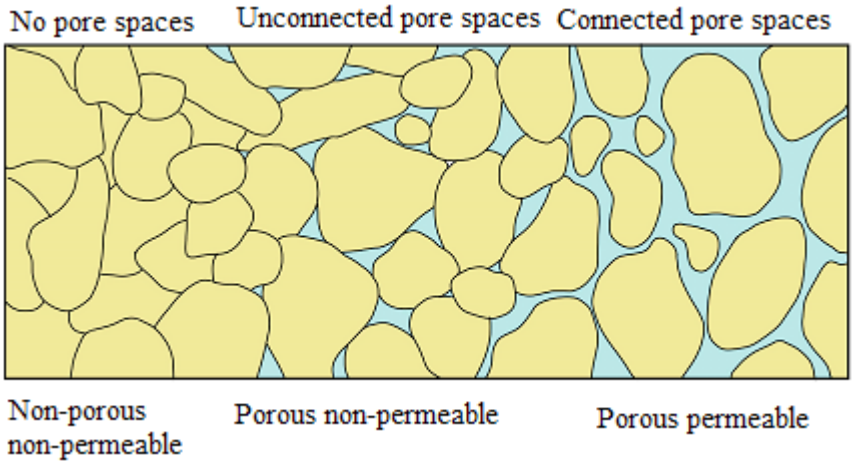
iii. Soil colour

Soil color is important, because it sometimes suggests its composition and chemical makeup. It is influenced by the parent rock, organic matter, moisture content and minerals. Soils have a variety of colours. They include red, yellow, black, grey, white and brown. A soil that is dark brown has high organic matter content. Soils that are reddish brown are well drained whereas grey soils are infertile.

iv. Soil porosity/permeability

This refers to the number of pore spaces in the soil. The pore spaces relate to the portion of the soil space occupied by air and water. This is determined by the arrangement of the soil particles.

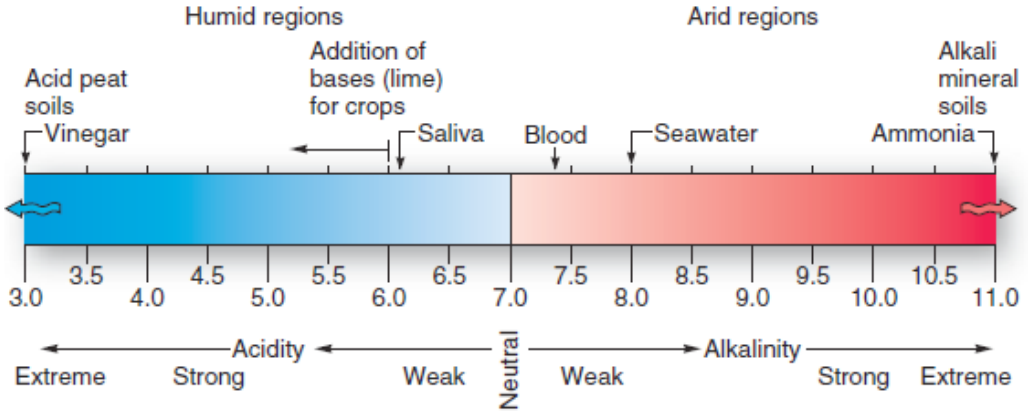
Soils vary in porosity. Soils with large pores, for example sand are porous while clay is non–porous.



Porosity and Permeability of soil

v. Soil pH (potential for Hydrogen)

Soil pH is an indicator of the acidity or alkalinity of soil. It is also known as soil reaction. The pH scale measures acidity (lower pH) and alkalinity (higher pH). The complete pH scale ranges between 0 and 14. Numbers from **1** to **6.9** indicate acidity; number **7** indicates neutral state, while 8 to 14 indicate alkalinity.



The pH scale

The pH scale measures acidity (lower pH) and alkalinity (higher pH). The complete pH scale ranges between 0 and 14.

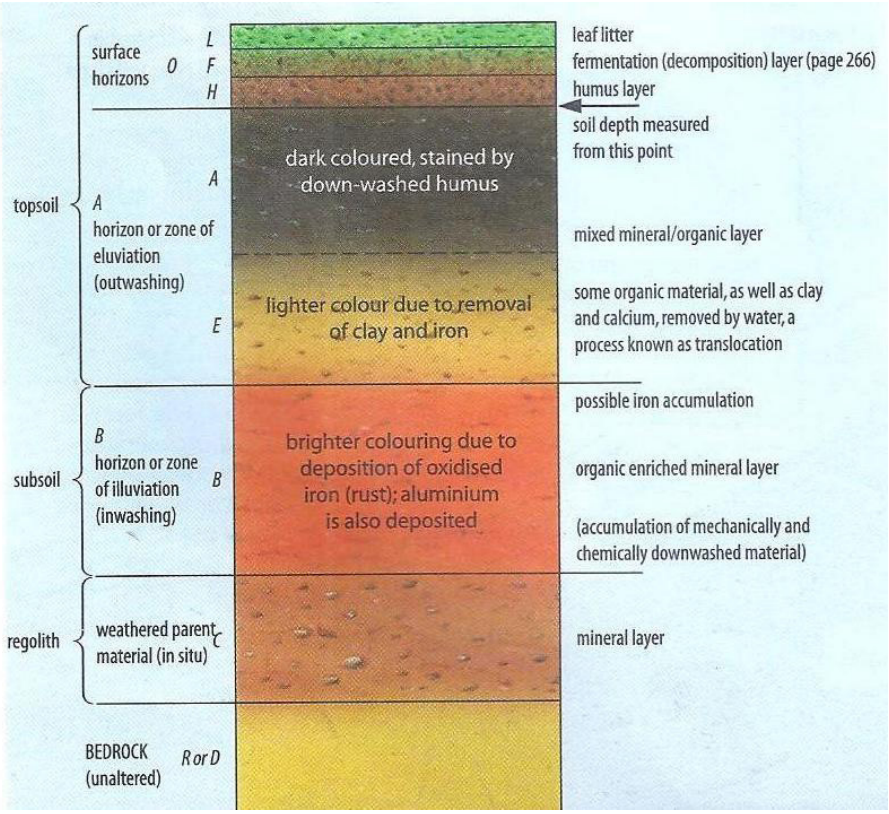
vi. Soil consistency

Soil consistency is the strength with which soil materials are held together or the resistance of soils to deformation and rupture. It also refers to the ability with which individual soil particles of soil can be eroded. The consistency of the soil can be tested on the field using cultivation tool or fingers, or through laboratory tests.

7.2.2. Soil profile and catena

i. Soil profile

Soil profile refers to the vertical arrangement of the soil in layers from the ground/surface to the parent rock/bedrock or mother rock. It can be as little as 10 cm thick in some places or as deep as several meters in others. The layers are known as soil horizons. They are marked using letters A, B, C and D.



Soil profile

i) **Surface horizon O**: This layer is also known as the superficial layer. This layer includes organic litter, such as fallen leaves and twigs. These are fresh or partially decomposed organic matter. This zone has two sub-layers:

O_L: This is the uppermost layer consisting of freshly fallen dead organic matter such as leaves, branches, flowers, fruits and dead parts of animals.

O_F: Called fermentation layer, it lies just below the O_L layer. Here, organic matter is found under different stages of decomposition.

O_H: Lies beneath O_F layer and is made mostly by humus

ii) Horizon A: This layer is also known as the top soil horizon. It refers to the upper layer of soil, nearest the surface (Horizon O). In this layer biological activities and humus content are at their maximum. Called eluvial or outwash horizon, the zone is the the most affected by the leaching of soluble mineral and removal of finest solid material downwards. This horizon is divided into two sub-layers:

A_A : Is dark and rich in organic matter 'humus'. It is characterized by abundant proportion of organic matter compared to other sub-horizons, mixed with mineral matter.

A_E: Layer is of light colour, with more sand particles and little organic matter. In regions of heavy rainfall, the mineral elements are rapidly washed downwards in this region. This is also known as podzolic or eluvial (E); referred to as zone of leaching.

iii) Horizon B, also called the sub-soil horizon, or zone of illuviation is the layer below the top soil, characterized by clay and oxides iron deposits, which is why it is also called zone of inwashing, or illuvial horizon.

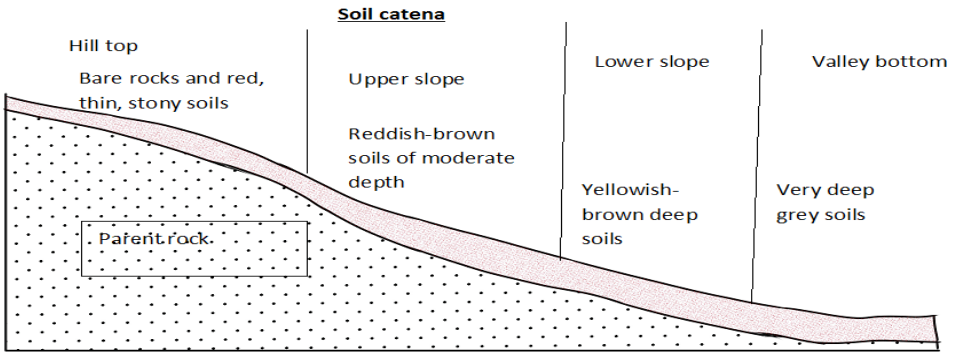
iv) Horizon C: This is the mineral layer made of recently weathered parent materials, with little organic matter content.

v) Horizon D is the half-weathered or unaltered parent rock.

ii. Soil catena

A soil *catena* is a series of distinct but co-evolving *soils* arrayed down a slope. It shows the changes that take place in the soil from the top to the bottom of the slope, but the term is also used to describe the lateral variation in soils over a hillslope.

The development of soil catena is influenced by climate and angle of slope. Along the slopes, the soil horizons are thin as the slope angle increases, but they become thicker in gentle sloping topographies.



Soil catena

A soil catena consists of three main divisions called complexes namely: *Elluvial* complex, the *colluvial* complex and the *illuvial* complex.

- ***The elluvial complex****:* This is the upper convex slope where weathered materials are washed out downwards. It includes the summit and free face of the hill. Erosion predominates the free face hence; the soils are skeletal and with shallow soil profile**.**
- ***The colluvial complex****:* This is the lower concave slope where there is gradual deposition of eroded material at footslope areas or in their nearby. The soil of the colluvial complex is thus moderately drained and retains certain moisture hence, supports agriculture and grazing.
- ***The illuvial complex****:* This occupies the valley bottoms where fine materials are inwashed through seepage.

Soil catena is important in the following ways:

- The soil catena (elluvial complex) is used for settlement;
- The soil catena is used for rock quarrying for construction especially on free face which has no vegetation;
- The valley bottoms are used for brick lying (e.g. Ruliba Clay Works along River Nyabarongo in Rwanda);
- The illuvial complex is used for agriculture due to the deep soil profile derived from deposition;
- The valley bottoms are used for rice growing and growth of vegetables and yams, etc.

7.2.3. Soil fertility

Soil fertility is the ability of the soil to support plant growth. Fertile soil is the soil that is rich in nutrients needed for the growth of plants: the most important nutrients include: Nitrogen, Phosphorus and Potassium and Magnesium.

Factors affecting soil fertility

The following are the major factors affecting soil fertility:

- *Mineral matter:* A matrix of mineral particles derived from varying levels of breakdown of the parent-rocks.
- *Organic matter or humus:* a fertility of soil depends on the amount of organic matter or humus available in soil. The higher amount of organic matter reflects the higher level of soil fertility.
- *Soil water or soil solution:* The required optimum amount of water depends on the type of crops to be grown in specific area. Some crops such as rice require much water while the crops like sweet potatoes, cassava required low quantity of water.

- *Soil nutrients* are chemical elements found in the soil. They help in plant growth and ensure the soil remains fertile.
- *Thickness (depth):* Thick soils (above 1 m of depth) are good for agriculture whereas thin soils are not good, because they don't allow the development of root system.
- *Soil permeability:* This is the ability of the soil to allow water to pass through it. Permeable soils are much more fertile than non-permeable soils.
- *Soil texture* refers to the size of soil particles. Clay loam soil are much fertile than other soil.
- *Soil acidity and alkalinity:* The basic soils are much more fertile than acidic soils.

Application Activity 7.2

1. *Basing on the knowledge and skills acquired from the above lesson, differentiate soil porosity in Eastern Rwanda from soil porosity of volcanic soils in the Northern Rwanda.*
2. *With the help of diagrams differentiate soil profile from soil catena.*
3. *Identify the factors influencing soil fertility.*

Skills lab

Make a field study on your local area, and select the best type of soil suitable for increasing production in agriculture.

End unit Assessment

1. *Conduct a field trip around your school, collect soil samples and study them to identify their constituents.*
2. *Explain the importance of soil catena*
3. *Establish the difference between:The soil structure and the soil texture, the soil colour and the soil pH*

UNIT 8

WEATHER AND CLIMATE OF THE WORLD

Key unit competence: The student-teacher should be able to appreciate the importance of the atmosphere, weather and the impact of climate on the environment and human activities in the world.

Introductory activity

Read the following passage and answer the questions that follow:

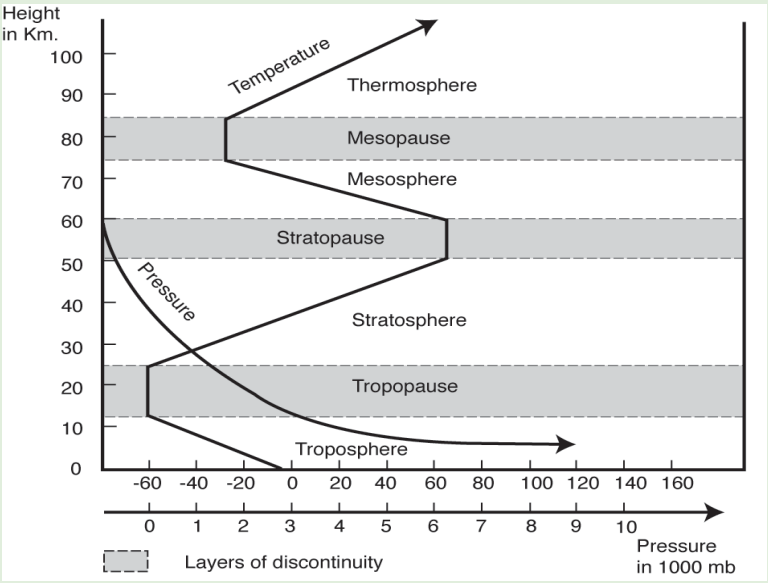
The climate is defined as the average weather conditions of an area in terms of temperature, atmospheric pressure, wind direction and wind speed, moisture, cloudiness, precipitation, and sunshine for a standard period of 30 years. Due to its high altitude, Rwanda enjoys a tropical temperate climate. The average annual temperature ranges between 16 and 20° C, without significant variations. Rainfall is abundant although it has some irregularities. Winds are blowing with a speed of 1-3 m/s. With an economy that is dominantly supported by agriculture.

1. *Referring to the passage above, establish the difference between the climate and the weather.*
2. *Establish the relationship between weather, climate and atmosphere on Earth's surface.*
3. *Examine the influence of climate on the environment and socio-economic development of Rwanda.*

8.1. The atmosphere: definition and structure of the atmosphere

Activity 8.1

Observe the figure provided below and give answers to the questions that follow:



1. *Identify on the illustration the major atmospheric structures*
2. *Describe different layers shown in the figure above.*
3. *Examine the relevance of atmosphere to human?*

8.1.1. Meaning of the atmosphere

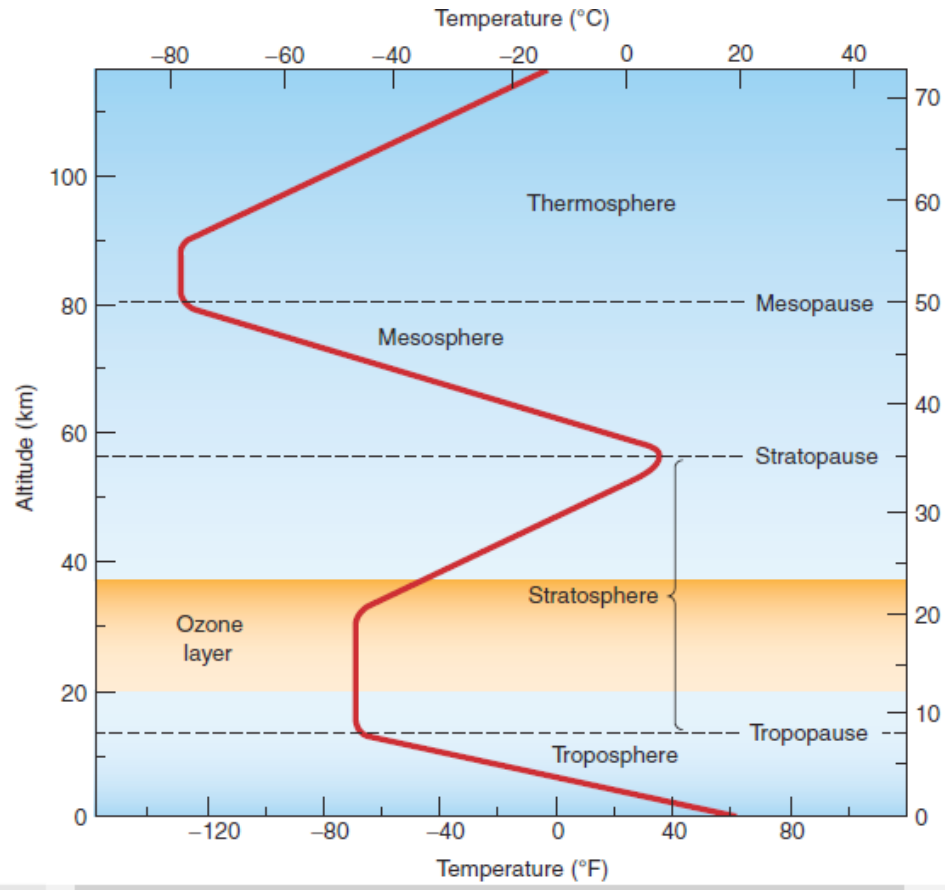
The atmosphere is the envelope of gases surrounding the earth. It contains all gases including those that support all forms of life on earth. This envelope of air is dense at the sea level and becomes thin with the increase in altitude.

8.1.2. The structure of the atmosphere

The atmosphere is made up of four vertical layers namely the troposphere, the stratosphere, the mesosphere and the thermosphere.

(i) Thermal characteristics of the atmosphere

Based on temperature variation, the four layers of the atmosphere (troposphere, stratosphere, mesosphere and thermosphere) represented on the following graph, are briefly described in the next paragraphs.



The structure of the Atmosphere

(i) Troposphere

The troposphere is the lowest layer of the atmosphere; it lies between 10 and 20 kilometres above the sea level. The upper limit of the troposphere is the **Tropopause**. The temperature decreases with increased altitude at a rate of 6.5^0c per 1000 m. Most of weather phenomena occur in this layer, which makes the troposphere vital to the survival of both fauna and flora.

(ii) Stratosphere

The stratosphere extends from 16 to 50 km above the sea level. There is an increase of temperature in this layer due to absorption of ultraviolet solar radiation by the **ozone** layer. There is nearly the absence of weather

phenomena because of dry air and rare occurrence of clouds. The upper limit of the stratosphere is called **Stratopause**.

(iii) Mesosphere

The mesosphere extends between 50 km and 80 km above the sea level. Temperature decreases with increased altitude reaching nearly - 100^0 C at the upper limit of this layer; the **Mesopause**.

(iv) Thermosphere

This atmospheric layer extends from 80 km to 640 km. It is composed of Ionosphere and Exosphere.

a) **The ionosphere** is moistless and dustless. It consists of several ionized layers which transmit radio and television waves.

b) **The exosphere** represents the uppermost layer of the atmosphere. The density of the air becomes extremely low. The temperature reaches more than 1700° C at its outer limit. The atmosphere above the ionosphere is called the outer atmosphere and it is made of exosphere and the magnetosphere.

8.1.3. Composition of atmosphere

Basically, the atmosphere is composed of ***Nitrogen*** which is the most abundant gas with 78.1% of the totality of the Atmosphere followed by ***Oxygen*** 20.9%, ***Argon*** 0.93%, ***Carbon dioxide*** 0.03% and others occupy the remaining portion of the atmosphere.

8.1.4. Importance of the atmosphere

The atmosphere is important for the following reasons:

- It protects living things from harmful ultraviolet rays of the sun. This role is played by the ozone layer.
- It helps to regulate the heat during the day and night. On earth, however, molecules in the atmosphere absorb the sun's energy as it arrives, spreading that warmth across the planet.
- The atmosphere protects and sustains the Earth planet's inhabitants by providing warmth and absorbing harmful solar rays.
- It provides the various gases that are useful to living things, such as among others, oxygen carbon dioxide.
- It provides precipitation that helps to sustain life on earth.
- The atmosphere is a crucial part of the water cycle and is an important reservoir for water and the source of precipitation.

- The atmosphere moderates Earth's temperature because greenhouse gases absorb heat.

Application Activity 8.1

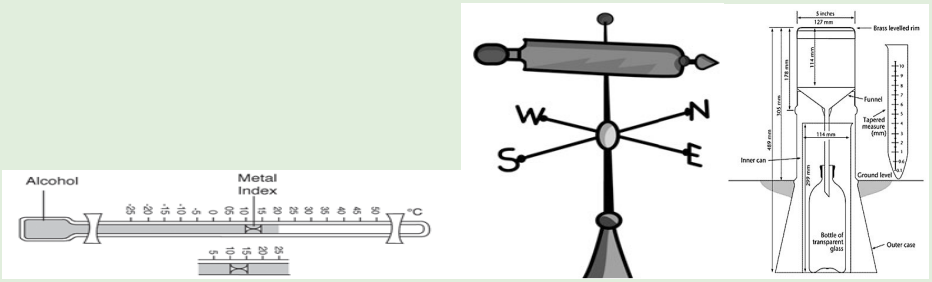
1. *(a) Explain why the atmosphere should be conserved.*

   (b) Describe how atmosphere should be conserved.

8.2. Elements of weather and climate

Activity 8.2

Observe the pictures provided below and answer the questions that follow:



A *B* *C*

D *E* *F*

1. *Identify the instruments marked by letters A, B, C, D, E and F above*
2. *Describe their roles.*

Definition of weather and climate

Weather is defined as the state of the atmosphere at any given time. Weather keeps changing all the time. The change is from hour to hour and day to day.

Climate is an average weather conditions of atmosphere of a given place over long period of time (about 30 years).

The elements of weather and climate: Weather and climate are observed from their elements. The main elements are temperature, precipitation, wind, atmospheric humidity, clouds, sunshine and atmospheric pressure.

8.2.1. Temperature

Activity 8.2.1

Read the context below and answer the questions that follow:

When people migrate from Bugesera to Musanze they are required to change clothing style. Some of them say that it is necessary to put on jackets due to climatic conditions of that area.

1. *Why is there constant change of clothing style from Bugesera to Musanze?*
2. *Identify the weather condition that lead people to put on jackets in Musanze while in Bugesera they put on T-shirts.*
3. *What may be the possible causes or factors responsible for that constant change of the weather?*

Temperature is the degree of heating and cooling of the atmosphere at a given area and time.

(i) Factors influencing temperature variation

Temperatures change from place to place. These changes are caused by different factors which include the following:

1) **Latitude:** The amount of sunshine received decreases as one moves away from the Equator since the equator and the nearby places receive the overhead sun whereas areas beyond tropics never experience the overhead sun.

2) **Altitude:** Temperatures decrease with increasing altitude from the earth's surface towards troposphere, at the normal rate of 6.5°C per 1000 metres ascent.

3) **Distance from the sea:** Places nearby large water bodies usually receive cooler temperatures than places far away from the coast due to the effect of land and sea breezes.

4) **Prevailing winds:** Winds blowing from low latitudes to high latitudes raise the temperature of the regions where they reach. Winds blowing from high latitudes to low latitudes lower the temperature.

5) **Nature of land and water:** Land becomes warm and cold more quickly than the water body; this is because water has the capacity of absorbing and storing sun energy which is transformed into heat.

6) **Nature of ground surface:** The nature of ground surface in terms of colour, vegetation, and land use practices determines the reflection or absorption of sun energy and affects distribution of temperature. Areas under vegetation absorb more heat from the sun than those without vegetation.

7) **Nature of ground slope:** The slopes facing the sun receive more heat from the sun because its rays reach the surface more or less straight.

8) **Cloud cover:** Cloudy nights and days are warmer than cloudless nights and days because cloud does not allow heat to escape from the atmosphere.

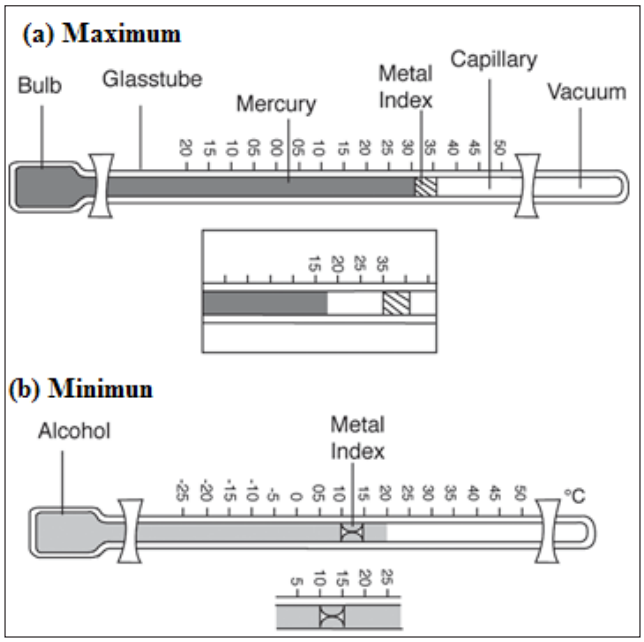
9) **Ocean currents:** The warm Ocean currents flowing from tropical areas to temperate and cold zones raise the average temperature in the affected areas.

(ii) Measurement and recording of temperature

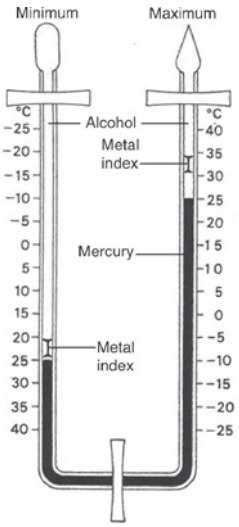
The instrument used for recording temperature is called a **thermometer**. Temperature is measured in degrees Celsius (°C). The line on the map joining places with the same temperature is called **isotherm**.

The three common types of thermometers the most include:

- Maximum thermometer (records the highest temperature of the day)
- Minimum thermometer (records the lowest temperature of the day).
- Six's thermometer (records both maximum and minimum temperature of the day).



Maximum and minimum thermometers



Sixth's thermometer

(iii) Terms related to temperature

- **Mean temperature**

The following are types of average temperature:

Diurnal average temperature represents the average temperature within 24 hours of the day.

It is obtained by adding the hourly temperatures and dividing the total by 24 (hours).

The highest temperature recorded within 24 hours is called the ***daily maximum temperature***.

The lowest temperature recorded within 24 hours is called the ***daily minimum temperature***.

- **Monthly mean temperature**: This is the sum of mean daily temperatures for a given month divided by the number of days of that month.
- **Annual mean temperature**: This is the sum of the monthly mean temperatures divide by 12.
- **Temperature range**
  - The difference between the maximum and minimum temperatures of the day is called ***diurnal temperature range*** **(DTR)**.

DTR= maximum T^0- minimum T^0.

– The difference between maximum and minimum temperatures of the year is called ***annual range of temperature*** **(ATR)**.

ATR= maximum monthly T^0- minimum monthly T^0

(iv) Impact of temperature on the environment

The following are the major impacts of temperature on the environment:

- A rise in global temperatures leads to an increase of evapo-transpiration. This could eventually lead to the rise in amount of rainfall which impact on environment.
- A rise of temperature leads to melting of glaciers in polar and mountainous regions or ice-capped highlands.
- An increase in temperature leads to global warming which impacts negatively on the environment.
- As the earth gets warmer, plants and animals that need to live in cold places like on mountain tops or in the Arctic, might not have a suitable place to live.
- The sea level has been rising more quickly over the last century as a result of temperature change.
- Precipitation (rain and snowfall) has increased across the globe; on average as a result of temperature change.

8.2.2. Precipitation

Activity 8.2.2

Observe the illustration provided below and answer the following questions:

1. *Identify the types of precipitation shown on the above picture.*
2. *Distinguish the formation of rain from that of snow.*

i) Meaning and forms of precipitation

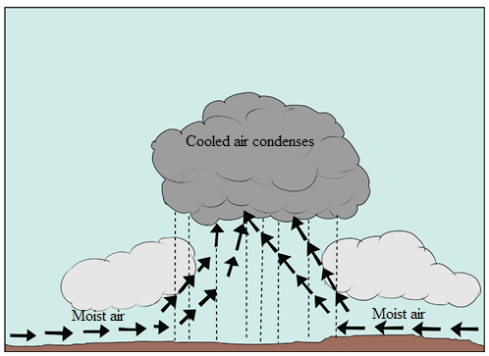
Precipitation is any form of liquid or solid water particles that fall from the atmosphere and reach the earth surface. The following are main forms of precipitations:

- **Rainfall** is the most widespread and important form of precipitation. Rain refers to liquid water droplets falling from the atmosphere under the influence of gravity.
- **Hail**: It consists of large pellets or spheres (balls) of ice falling from the atmosphere.
- **Sleet:** It refers to mixture of snow and rain.
- **Snow:** snow appears as very small crystals of ice suspended in the earth's atmosphere. Snow occurs when condensation occur below 0^0C.
- **Fog**: This is a cloud layer lying in contact and very close to the surface of the earth or sea.
- **Frost:** It is defined as transformation of water vapour directly into solid form at the ground surface due to condensation occurring below freezing point.
- **Dew**: These are droplets of water that are deposited on the ground. They are mostly present on plant's leaves in the morning.
- **Rime:** It is an opaque thin, white layer of ice that forms when the air temperature is below the freezing point of water, especially outside at night.

(iii) Types of rainfall

Rainfall is precipitation in form of droplets. The following are the major forms of rainfall.

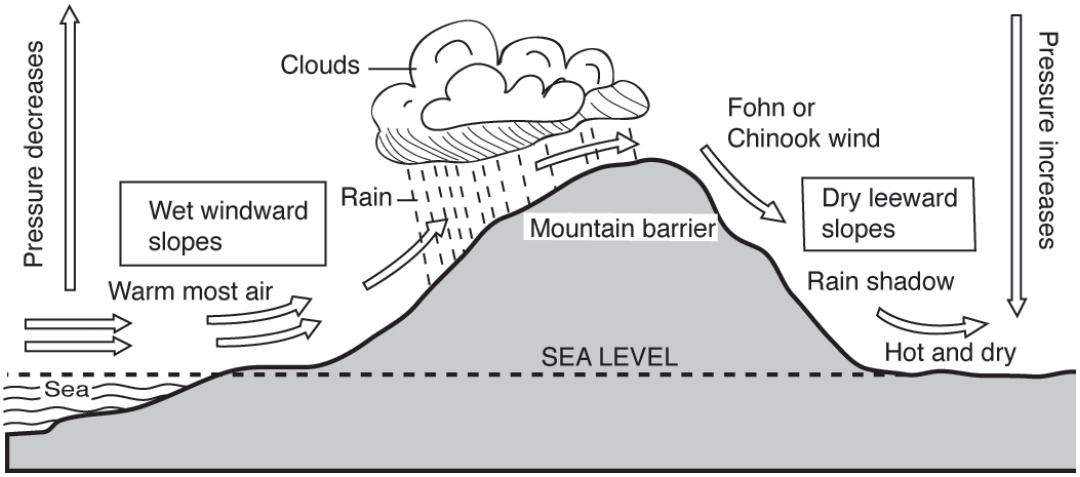
1. **Convectional rainfall:** It occurs when the earth's surface is heated by the sun. The warm air rises, and it is replaced by the cold air. As the air rises, the pressure on it decreases, expands and cools. Further cooling makes the moisture in it to condense and form clouds. It later falls as rain.



Convectional rainfall

2. Orographic rainfall

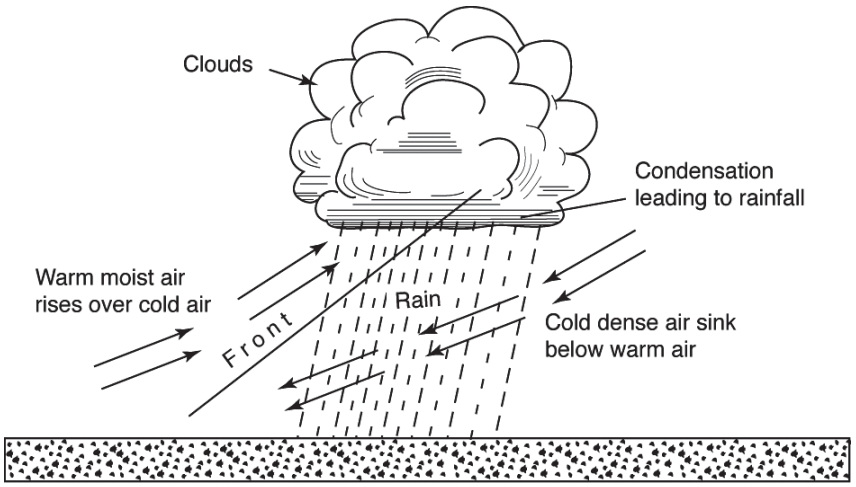
This type of rainfall occurs when a water body is heated by the sun. The heating causes evaporation. Moist air from the sea blows over a hill or mountain side. The rising causes it to expand and cool. It condenses and forms clouds. Rainfall occurs on the wind ward side of the mountain. This is the side facing the moist wind. The opposite side known as leeward side is dry.



Orographic rainfall

3. Cyclonic or frontal rainfall

Cyclonic or frontal rainfall occurs when air masses of different temperatures meet. One is warm and the other is cold. The warm air is forced over the cool air. As the warm air rises, the moisture in it is cooled. It condenses and falls as rain.



Cyclonic or frontal rainfall

i) Factors influencing rainfall formation

Precipitation of different areas of the globe is influenced by different factors which include the following:

- **Moisture content of the air:** The atmospheric moisture depends on evaporation of water, regions having high temperature and abundance of surface water, and wide-open Oceanic surfaces for evaporation, receive higher amount of annual rainfall.
- **The convergent or divergent air circulation:** The convergence of two contrasting air masses creates frontal activity and result into cyclonic rainfall.
- **Topographic conditions:** Topographic conditions present favourable conditions for precipitation. Moist air is forced by mountains to ascend and condense hence yielding precipitation.
- **Distance from the sea:** Distance from the source of moisture determines the amount of rainfall in different areas. Places near the water bodies receive increased precipitation compared to areas far away from the sources.

ii) Measurement and recording of rainfall

Rainfall is measured using a rain gauge. Most consist of a circular collector and a funnel that channels the collected rain into a measuring mechanism or into a cylinder where it may be measured later. The entrance to the gauge through the funnel is narrow to avoid debris clogging the mechanism and undesirable evaporation in hot weather. To make the rainfall measurement, the observer empties the collected rain into a graduated glass rain measure. Lines on the map joining areas with the same precipitation are called **isohyets**.

iii) Terms related to rainfall

The data obtained from the weather station can be used to calculate the following:

- ***Monthly rainfall total:*** This is the total amount of rainfall received in a month. It is obtained by calculating the sum of daily rainfall totals in the month.
- ***The annual rainfall total:*** This is the total amount of rainfall received in a year. It is obtained by finding the sum of all the monthly rainfall totals for 12 months.
- ***Mean annual rainfall:*** it is calculated by adding the monthly totals.

8.2.3. Winds

Activity 8.2.3

Observe carefully the picture provided below:

1. *Explain the phenomenon occurring on the above picture.*
2. *Describe the factors causing the mentioned phenomenon in (1).*
3. *Suggest the instrument used to record the direction and speed of wind.*

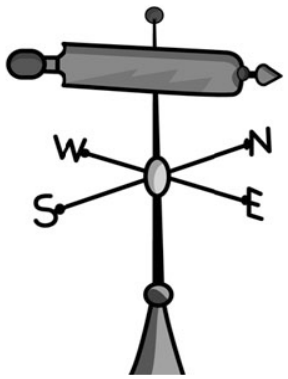
(i) Meaning of wind

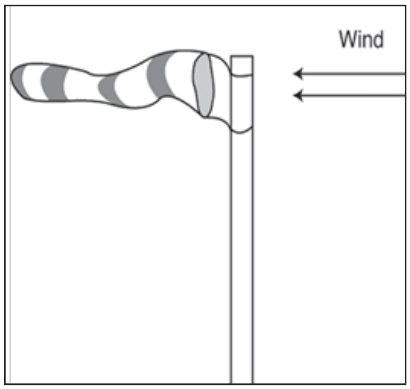
Wind is air in motion above the surface of the earth. It is caused by differences in atmospheric pressure. Air moves from areas of high atmospheric pressure to areas of low pressure.

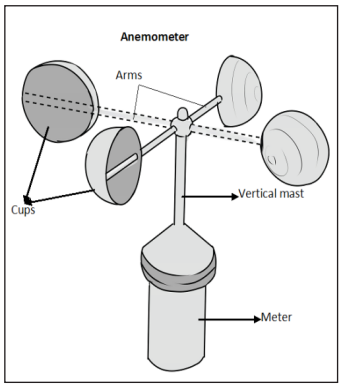
(ii) Measurement and recoding of wind direction and speed

The wind direction is measured with help of a *wind vane* and ***wind sock,*** while the ***anemometer*** serves to measure the speed of the wind. These instruments are represented in Figure

Wind vane: It consists of a horizontal rotating arm pivoted on a vertical shaft. The rotating arm has a tail at one end and a pointer at the other. When the wind blows, the arm swings and points to the direction the wind is blowing from. The wind is named after this direction.







a) Wind vane *b) Wind sock* *c) Anemometer*

Wind sock: It is common in airstrips. It consists of a cylindrical cloth bag tied to a mast. It always points towards the direction at which the wind is blowing.

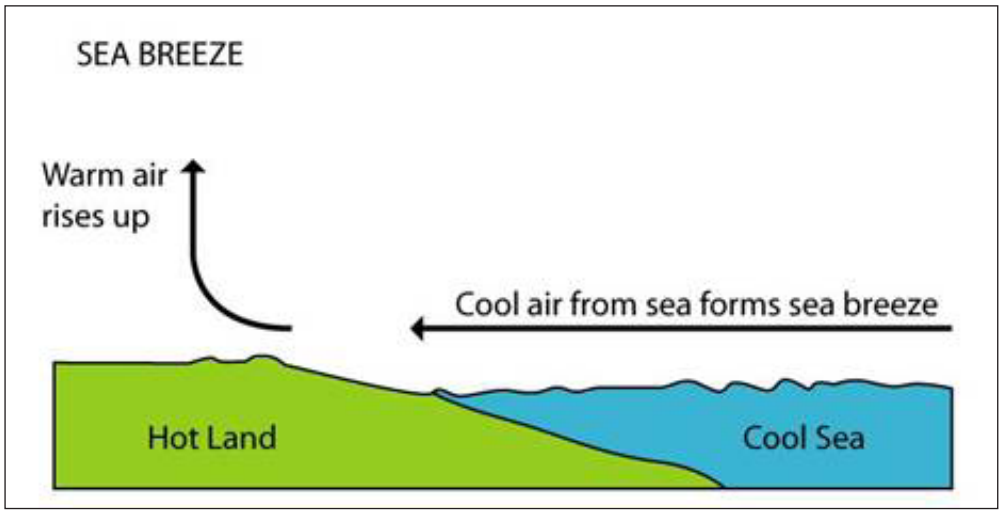
Anemometer is used to measure the speed of wind. This instrument consists of three or four metal cups fixed to metal arms that rotate freely on a vertical shaft. When there is wind, the cups rotate. The stronger the wind, the faster the rotation will be. The speed of rotation is recorded on a meter. Wind speed is measured in kilometres per hour (km/hr). The regions with the same wind speed are called isotaches.

(iii) Types of winds

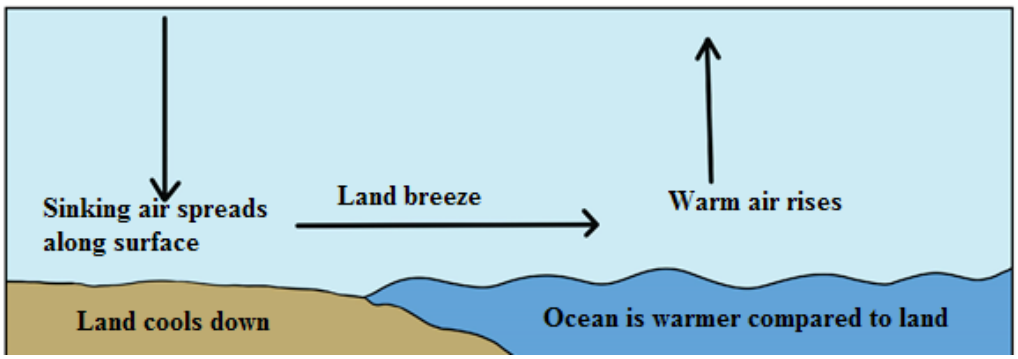
Winds are classified into 3 major categories namely local winds, prevailing wind and air masses.

a) Local winds are winds that blow over a small geographical area and normally for a short period of time. The examples of these include land and sea breezes, valley and mountain breezes and etc.

- **Sea breezes:** Land heats up faster than the sea during the day. Air over the land, therefore, becomes warmer than over the sea. The lighter and warmer air rises. The cooler and heavier air from the sea moves over the land to replace the rising air. This movement of air causes a sea breeze.
- **Land breezes:** At night, the land cools faster than the sea. The air over the land becomes cooler and heavier than the air above the sea. The warmer air over the sea is lighter. It rises while the cooler heavier air over the land moves to replace it. This creates an air current called a land breeze.



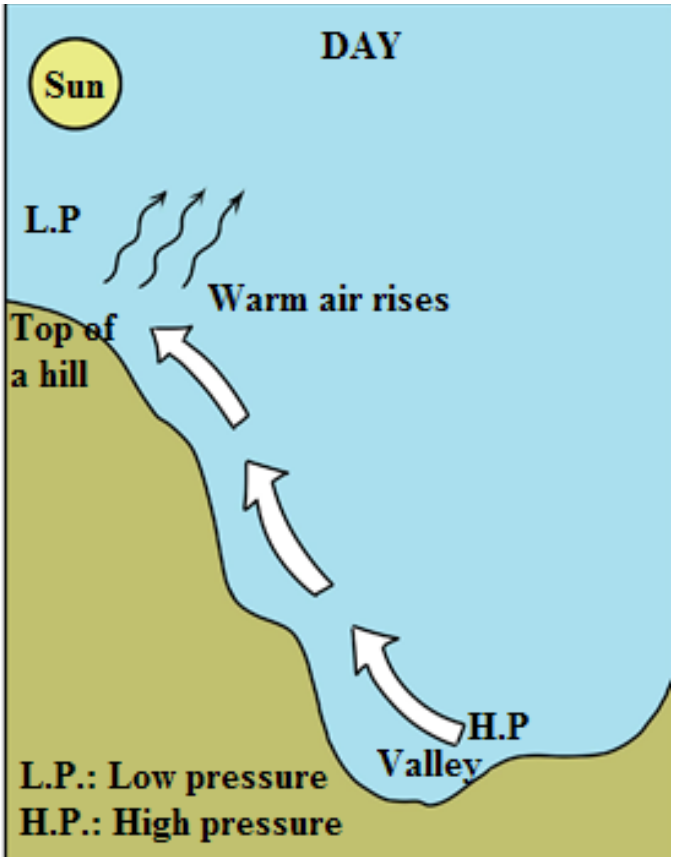
Sea breeze



Land breezes

- **Valley breezes:** The slopes and floors of valleys are heated more at daytime. The warm air moves up the slope or upwards. This movement creates what is called a valley breeze or **anabatic wind**.
- **Mountain breezes:** During the night, the hill slopes lose heat faster. The valleys remain warmer. A low-pressure gradient is created in the valley. Air current moves down the valley to form what is known as a mountain breeze. It is also called **katabatic wind.**

There are many other examples of local winds like Chinook, Sirocco, Harmattan which affect different parts of the world.



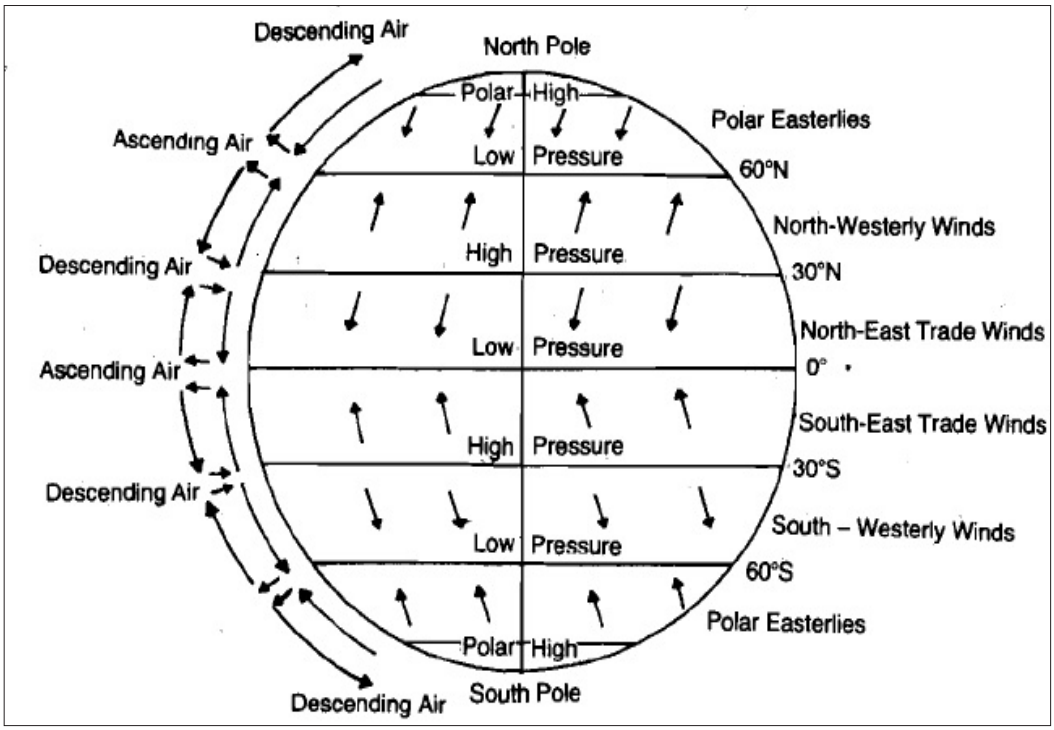
Valley breezes

b) Permanent winds, also called **prevailing** or **planetary winds** are those that flow from a known high pressure area to low pressure area throughout the year. Prevailing winds are large masses of air having fairly uniform humidity and temperature.

Permanent winds include:

- ***Easterlies*:** There are winds which blow from East to West. These are found in both inter-tropical zone and polar zone. The winds blowing in inter-tropical zone are also called ***trade winds***.
- ***Westerlies*:** These types of winds blow from West to East. They are found in the temperate zone between tropics and sub-polar zone.

The locations of planetary winds are illustrated on the following figure:



Planetary winds

c) Air masses

Air mass may be defined as a large body of air whose physical properties, especially ***temperature and moisture content*** are uniform horizontally for hundreds of kilometres. Air masses originate mainly from large areas with uniform properties like desert, seas and oceans. There are therefore two broad categories of air masses which are **continental air masses** and **maritime air masses.**

iv) Influence of winds on weather conditions and human activities

Influence of winds on weather conditions

- The movements of the air affect the weather of surrounding zones. Winds transfer heat and cold temperatures from one place to another
- Wind and ocean currents are the vehicles of water vapour which lead to cloud formation which yield rainfall.
- The wind direction will have an important influence on the expected weather. Wind direction changes often accompany changes in the weather.
- The wind speed and direction can give the clues to the expected weather conditions.

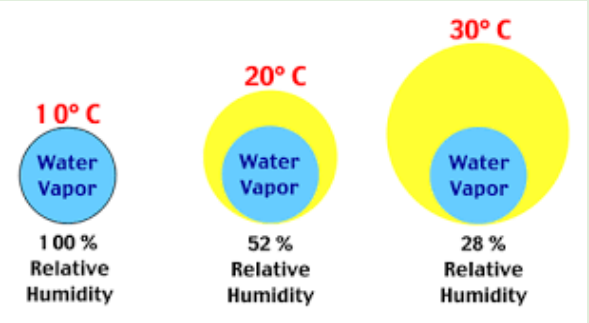
Influence of winds on human activities

- The winds with high speed cause the destructions of physical and human-made environment (e.g. Hurricanes, tornadoes, typhoon, etc.).
- Trees are bent under the wind effects and, sometimes this causes accidents on the neighboring buildings and electric poles.
- Exposure of growing plants to warm wind results in dwarfing due to dryness of plant tissue
- Wind increases evapotranspiration due to removal of accumulated humid air near the leaves crop water requirements by.
- Moderate wind aids effective pollination. Strong wind during flowering reduces pollination causes flower shed, increases sterility and reduces fruit set in all crops.
- Wind speed more than 50 km per hour leads to destruction of crops leading to heavy loss.
- Soil and sand particles blown by wind strike the leaves making punctures, abrasions, scratches and tear the leaves into pieces and strips.
- The coastal area affected by strong winds faces the challenge of high salinity due to salt particles drawn and deposited on the mainland. This makes the soil unsuitable for growing plants.
- The crops on the windward slopes yield more because the constant supply of moisture by warm winds from water bodies.

8.2.4. Atmospheric humidity

Activity 8.2.4

Observe the diagram below and give answer to the questions that follow:



1. *With reference to the knowledge and skills acquired from previous lessons; differentiate the above types of atmospheric humidity.*
2. *Explain the significance of atmospheric humidity to the environment.*

(i) Meaning of atmospheric humidity

Atmospheric humidity is the amount of water vapour in the atmosphere. The water comes as a result of hydrological cycle.

(ii) Measurement and recording of humidity

Atmospheric humidity is measured using a **hygrometer**. This instrument consists of a system of levers connected to a pen and record chart or graph paper. Within the hygrometer system there are threads of human hair. When humidity rises, the threads stretch and absorb moisture, whereas when humidity falls, threads dry and thin.

Hygrometer

(iii) Types of atmospheric humidity

The following are the main types of the atmospheric humidity:

- ***Absolute humidity*** is defined as amount of water vapour per unit volume of air at a given temperature. It changes with changing temperature, and is expressed in gram per cubic meter volume of air (gr/m^3).
- **Relative humidity** refers to a ratio of the air's actual water vapour content and the total amount of water vapour air can hold at that temperature and pressure. Relative humidity is generally expressed as percentage. Relative humidity is calculated as follows:

$$\text{Relative humidity} = \frac{\textit{Absolute humidity}}{\textit{Maximum humidity}} \; \textit{X 100}$$

The most common units for vapour density are gm/m^3. For example, if the actual vapour density is 10 g/m^3 at 20°C, compared to the saturation vapour density at that temperature of 17.3 g/m^3, then the relative humidity is:

$$R.H. = \frac{10g/m^3}{17.3g/m^3} x100\% = 57.8\%$$

(iv) Factors influencing atmospheric humidity

The following factors affect humidity:

- ***Temperature:*** An increase in the temperature of the air increases its ability to hold moisture.
- ***Amount of water available:*** There is more evaporation over the Ocean than the land. Therefore, there is more moisture over the Ocean than the land.
- ***Wind-speed:*** Evaporation depends on the speed of wind. When the winds are light, a thin layer of air just above the surface gets almost full of moisture. When the wind speed is high, the air has less moisture.
- ***Area of the evaporating surface:*** Larger areas where evaporation occurs increase the rate of evaporation.
- ***Mineral composition of water:*** The rate of evaporation is always greater over fresh water than over salty water.

(v) The importance of humidity to environment

- It facilitates the weather fore casting. It is not possible to forecast the weather exactly without precise knowledge of humidity in all the layers of the atmosphere.
- Correct relative humidity is important for our well-being and health.
- It enables the hydrological cycle to operate normally. It enables much water in form of vapour to be kept or stored in the atmosphere. Such is condensed later to form precipitation.
- Water vapour is a key agent in both weather and climate, and it is an important atmospheric greenhouse gas. This plays part in regulating the Earth's temperature.
- Humidity measurements contribute both to achieving correct environmental conditions that sustain various ecosystems.
- Humidity drives most of the observable weather phenomena starting with clouds, fog, rain, storms and finally to such dramatic weather conditions such as hurricanes.

8.2.5. Cloud cover

Activity 8.2.5

Read critically the text below and answer the questions that follow:

Daniella always wakes up and observes the horizon of the sky. One day, she observed the sky and found out that it was clear with white colour. She continues to take note of the daily occurrences of the nature of the sky. The next day she observed black colour in the sky, another day she found sky approaching the tops of hills and the last day of her last observation; she observed the sky being dark and reaching the ground. Now Daniella is asking herself what is happening in the sky.

Help Daniella to be satisfied with clear explanations to her question through answering the following questions:

1. *Explain what causes the different colours that arise in the horizon of the sky.*
2. *Describe the effects of the last observation of Daniella to the environment.*

(i) Meaning of cloud

A cloud is an aggregation or grouping of moisture droplets and ice crystals that are suspended in the air.

(ii) Types of clouds and their characteristics

Clouds are classified according to altitude and form. With regard to form, there are:

- ***Stratus clouds***: These are layered clouds. They look like blankets and cover large areas. They can give large amounts of rain or snow.
- ***Cumulus clouds***: These have bubble-like bodies. They give rain over a small area.
- ***Cirrus clouds***: these are composed of small ice crystal which are white, fibrous and feather like.

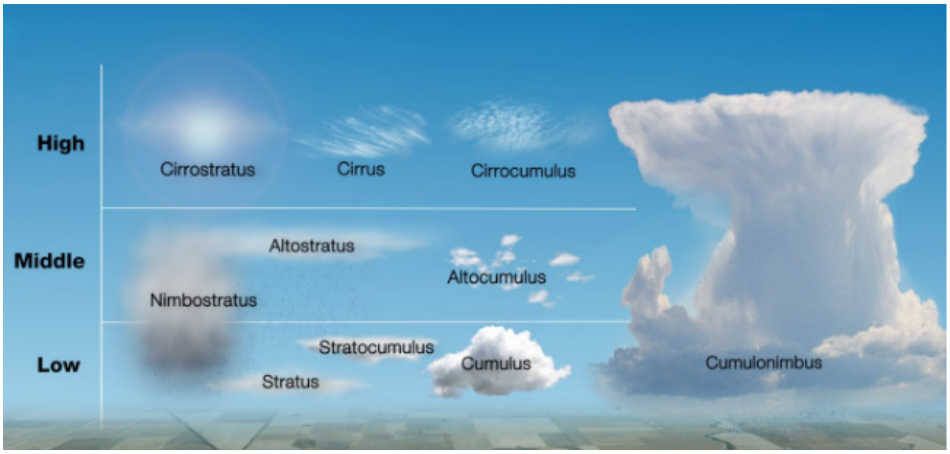
With regard to altitude, clouds are classified as:

- ***High clouds*** (form 6,000 m above the sea level). They look like feathers and appear in separate groups in fair weather. In bad weather, they are concentrated. Examples include:
  - Cirrus
  - Cirrostratus
  - Cirro-cumulus

- ***Middle clouds*** (between 4,000 and 6,000 metres of altitude). They are thick clouds. Examples include:
  - Alto-stratus
  - Alto-cumulus

They are mostly distributed over the whole sky. They appear white or grey.

- ***Low clouds*** (Below 2,000 metres). They are usually shallow. Examples include:
  - *Stratus*: They are dense, low-lying fog-like clouds of dark grey colour. They are composed of several uniform layers.
  - *Strato-cumulus*: They are generally associated with fair or clear weather but occasional rain or snow.
  - *Nimbo-stratus* (Ns): They are middle and low clouds of dark colour. They are associated with rain.
- **Clouds with great vertical extent**: They are found between 2,000 and 10,000 metres. They are white but may appear grey or black. They give heavy rainfall. The following are examples:
  - *Cumulus* (Cu) which are very dense, widespread and dome-shaped clouds. They also have flat bases and are associated with fair weather. These sometimes are characterised by thunder.
  - *Cumulo-nimbus* (Cb) are thunder-storm clouds and produce heavy rain, snow or hailstorm accompanied by lightning, thunder and gusty winds. They exhibit a well-developed vertical extent. They appear like mountains or huge towers.



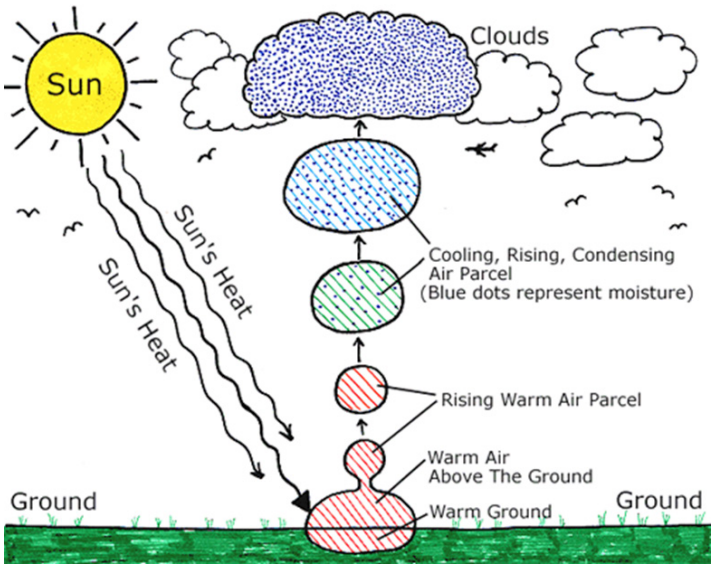
Types of clouds

Source: © Copyright *Commonwealth of Australia 2012, Bureau of Meteorology (ABN 92 637 533 532)*

(iii) Factors influencing the formation and the shape of clouds

The sun plays a major role in formation of clouds. The first step of cloud formation is related to the rising of the air into the atmosphere. Such air must be moist or carrying water vapour that is later condensed to form clouds. The following are the major factors influencing the rise of air into the atmosphere:

- *Sun:* The sun heats the earth and thus the air rises, expands, and cools.
- *Topography:* Clouds are also formed when air encounters mountains or other raised topography. The air rises and cools, condensing to form clouds.
- Clouds can be formed when air rises along the slope of a mountain. This aids the moist air to reach the atmosphere where it cools down, condensing and as a result, clouds are formed.
- *Warm and cold fronts*: Weather fronts cause the rise of the air. Specifically, warm fronts make the air to condense because the warm air rises above the cold air. This results into the formation of clouds.



Process of clouds formation

(iv) Effects of clouds on weather

The clouds are much important on weather conditions prevailing in a given area as it is explained below:

- During the day, the earth is heated by the sun. If skies are clear, more heat reaches the earth's surface. This leads to warmer temperatures.
- If sky is cloudy, some of the sun's rays are reflected back into space. Little sun's energy manages reaches the earth's surface which causes the earth to heat up more slowly.

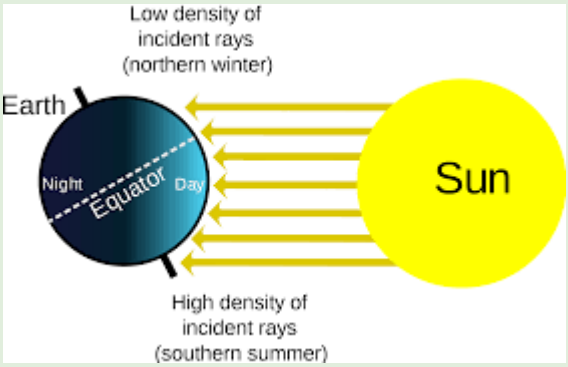
– The clear sky during day, leads to increase in temperature. At night, cloud cover has the opposite effect. If skies are clear, heat emitted from the earth's surface freely escapes into space, resulting in colder temperatures.

During a cloudy time, some of the heat emitted from the earth's surface is trapped by the clouds. This heat is reemitted back towards the earth. As a result, temperatures decrease more slowly than if the skies were clear.

8.2.6. Sunshine

Activity 8.2.6

Observe the following illustration and give answers to the questions that follow:



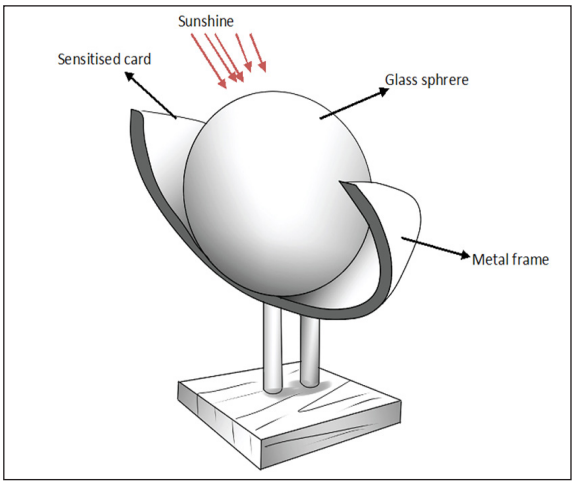
1. *Describe what is presented on the above illustration?*
2. *Arrows on the illustration show solar radiation reaching the earth surface, explain the factors influencing the amount of solar radiation in an area.*
3. *Explain the negative effects of solar radiation on the environment.*

(i) Meaning of sunshine

Sunshine refers to the energy emitted by the sun in form of rays. The sunshine is observed and recorded during the day time.

(ii) Measurement and recording of sunshine

This is done using a Campbell-stokes sunshine recorder. The instrument records the duration and intensity of sunshine. A line on the map joining places with equal sunshine is called **isohel**.

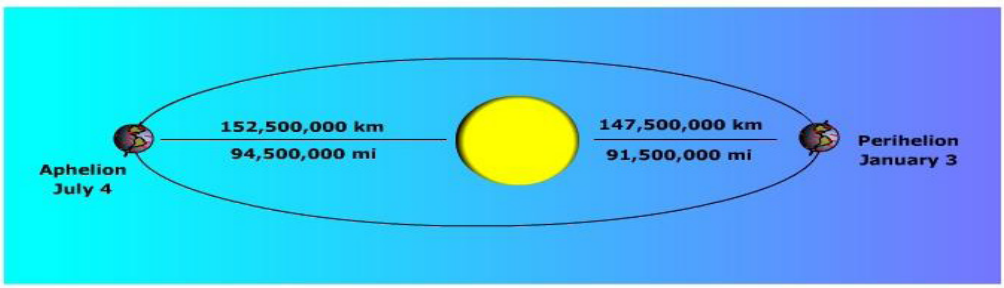


Sunshine recorder

(iii) Factors influencing the amount of solar radiation

Solar radiation is not equal distributed all over the zones of the Earth due to the following factors:

- **Angle of the sun's rays:** The angle of the sun's rays decreases as one moves towards the poles, and vertical rays are associated with more solar radiation,
- **Length of the day:** The shorter the duration of sunshine, longer the period of night. This results into lesser amount of solar radiation received at the earth's surface and vice versa.
- **Distance between the Earth and the Sun:** The distance between the sun and the earth changes during the course of a year. This is because the Earth revolves around the sun in an elliptical orbit. At the time of perihelion (on January 3) the earth is nearest to the sun while at the time of aphelion it is farthest from the sun. At the time of perihelion, the earth should receive maximum insolation while at the time of aphelion it should receive minimum insolation.



Relative distance between the sun and the earth

- **Effects of the atmosphere**: As solar radiation travels a long distance from the sun to the earth's surface; there are some portions of the solar energy which are lost through the processes of reflection, diffusion, absorption and scattering.

(iv) Influence of sunshine on the environment

The sunshine has both positive and negative effects on the environment, as briefly described in the following paragraphs:

Positive effects

- ***Health benefits:*** Humans require between 1,000 and 2,000 units of vitamin D daily for optimum health. The skin creates vitamin D naturally when exposed to solar radiation.
- ***Needed for photosynthesis:*** Sunshine is needed in photosynthesis processes for autotrophic green plants and algae to produce the compounds necessary for their survival.
- ***Disinfection:*** Exposing bottled water to sunlight for six hours or more can kill many harmful pathogens.
- ***Production of energy***: Sunshine can produce the energy which may be used for different purposes.

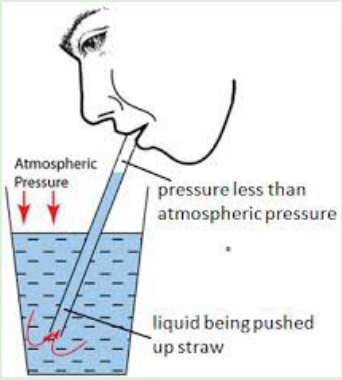
Negative effects

- ***Skin Cancer*****:** The ultraviolet radiation present in sunlight can also cause damage to the human and animal skins.
- **Eye Damage:** Solar radiation can also prove harmful to the human and animal eyes.
- ***Damaging the crops and other vegetation*****:** The excess of daily sunshine without rain for long-term, becomes harmful to crops and other vegetation because all water which would support the crops/ vegetation evaporates.

8.2.7. Atmospheric pressure

Activity 8.2.7

Critically observe the following picture and answer the questions that follow:



1. *With your observation what is taking place in experiment above?*
2. *Compare and contrast the pressure from the straw and pressure from atmosphere.*
3. *Explain the factors that can influence the distribution of atmospheric pressure at a given surface.*

i) Meaning of atmospheric pressure

Atmospheric pressure is the force per unit area that is exerted against the Earth's surface by the weight of air above it.

ii) Measurement and recording of atmospheric pressure

The **barometer** is the instrument used to measure atmospheric pressure. There are two types of barometers: Mercury barometer and Aneroid barometer. The line on the map joining places with the same atmospheric pressure is called **isobar.**

iii) Factors influencing the distribution of atmospheric pressure

The following factors influence atmospheric pressure:

- **Altitude:** The pressure at the ground level is higher than that at the top of high mountains. This is because air at the ground level has to support the weight of the air above it.
- **Temperature:** When air is heated, it expands. When this happens, the outward pressure of its molecules is spread over a large area.

This means the pressure of the air decreases. The pressure of the air therefore rises when its temperature falls.

- **Latitude:** The earth is not a perfect sphere and therefore force of gravity varies according to latitude. This is at maximum at the poles and a minimum at the equator. Atmospheric pressure is therefore lower at the equator and higher at the poles.
- **Season of the year:** Atmospheric pressure changes with seasons of the year being high over the cold continental interiors in winter and conversely low over the heated continents in summer.
- **The nature of earth's surface:** During the day, land heats up more than the water and hence air pressure is lower over land than the sea.

Application Activity 8.2

Observe carefully the table below showing rainfall and temperature data of Weather Station K in country R.

Months	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	30	45	196	240	200	10	4	6	20	80	210	60
Temperature (°C)	24	26	22	21	23	24	28	27	25	22	22	24

Answer the following questions:

1. *i)* What is the driest month of the year?
   ii) What is the wettest month of the year?
   iii) Calculate the total annual rainfall.
   iv) Calculate the mean annual temperature.
   v) Draw the graph portraying the data in the above table.
2. *Briefly explain the factors that influence weather and climate.*
3. *Walk around the school and observe the way the wind is blowing by movement of tree branches. Then describe the direction in which the wind is blowing.*

8.3. Factors that influence world climate

Activity 8.3

Explain how the following influence climate of any region:

(a)Latitude; (b) Altitude; (c) Water bodies

The following are the main factors influencing world climates:

i) **Latitude:** The equatorial zone experiences high temperature and precipitation, while they are low at the polar zone. This is due to the effect of convergence of tropical trade winds that converges at equatorial region. Their convergence causes the ascendance of air masses and the formation clouds which generate much rainfall.

ii) **Altitude:** Temperature decreases with increasing altitudes from the earth's surface. Precipitation, called orographic precipitation, on the other hand increases with the altitude.

iii) **Presence or absence of water bodies:** the temperature of regions near lakes or seas are influenced by the proximity of these large water bodies. When the continent is cool it can be warmed by the heat emanating from water bodies.

iv) **Vegetation:** Vegetation influences precipitation and moderate temperatures. Through transpiration, clouds form near the forests and precipitation occurs.

v) **Human activities**: Pollution from industries affects the climate. Chemicals and gases that are released into the atmosphere cause acid rain.

vi) **Ocean currents:** The warm ocean currents from tropical areas to cold zones raise the temperature in these areas. For example, the Gulf Stream increases the temperature of the coastal areas of North-Western Europe. While Kuroshio warm currents raise the temperature of the coasts of Japan.

vii) **Monsoons winds:** These are seasonal winds which reverse their direction at least twice a year. This results in the air blowing from the land to the Ocean in winter and from Ocean (water) to the land in summer. This situation makes the summer to be hot and wet and winter to be cold and dry in the affected areas.

Application Activity 8.3

Read the following context and give feedback to the questions that follow:

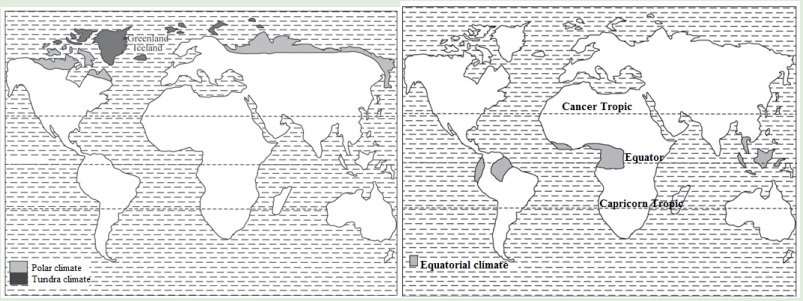
Generally, climate of any region or area is influenced by both physical factors (Latitude, altitude, water bodies, vegetation, ocean currents and aspect in relation to location) and human factors (pollution from industries, Chemicals released into the atmosphere, cutting down of forests /deforestation, over cultivation, overgrazing, land reclamation and construction).

Illustrate these geographical factors in Rwandan context.

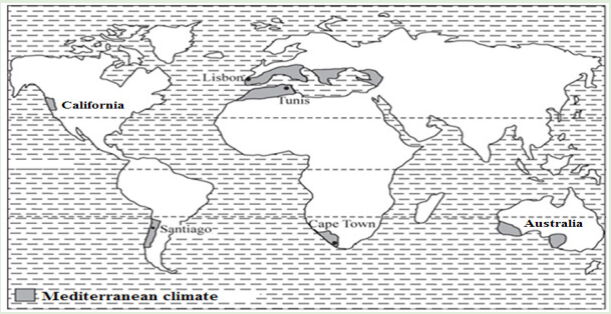
8.4. Types of climate and their characteristics

Activity 8.4

Observe the maps provided below and answer the questions that follow:



Q *P*



X

Identify the types of climate shown by the maps Q, P and X and identify their characteristics

The classification of climatic zones is based on temperature and rainfall. There are three world climatic zones. These are: Tropical, Temperate and Cold zones.

8.4.1. Tropical zones

i) Equatorial climate and characteristics of equatorial region

Equatorial climate is also called **tropical wet climate or tropical rainforest climate.** It is found along the equator extending from 5° to 10° South and North latitudes. Along the Eastern margin of continents, it spreads to 15° - 25° of latitudes. This type of climate is found specifically in the amazon basin in South America, the Congo basin in Africa, Malaysia, Indonesia in the south East Asia and etc.

The following are the major characteristics of equatorial region:

- This climatic region is located within 5° to 10° south and north of the Equator.
- The average monthly temperatures are over 18°c. However, many places record average monthly temperatures of 24° to 27°c.
- The Equatorial regions lie in a belt where the winds are light. It is a low-pressure belt.
- The annual range of temperature varies from 5°to 8°c.
- The annual average rainfall in the equatorial climate is nearly 2500 mm.
- There is a large amount of cloud.
- Conventional rainfall is received, and it is usually accompanied by thunderstorms.
- High temperatures and heavy rainfall encourage growth of natural vegetation. There are evergreen dense forests.

Below is an example of Singapore weather station in x year:

Singapore weather station

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual mean
T°C	26.4	26.9	27.5	27.5	27.8	27.5	27.5	27.2	27.2	26.9	26.9	26.9	27
P(mm)	399	221	157	139	112	95	100	187	167	206	120	235	2038 (total)

(ii) Tropical marine climate

It is found on the East coasts of regions lying between 10° N and 25° N and 10° S and 25° S of the equator. These areas come under the influence of on-shore Trade Winds. Examples are East coast of Brazil, the Eastern coastlands of Madagascar, Mexico, Nicaragua, Guatemala, Venezuela, the lowlands of Central America, West Indies, the coast of Queensland (Australia) and the southern islands of the Philippines.

Climatic characteristics of Tropical maritime/maritime climate

- The annual temperature range is about 8°c.
- Temperatures reach 29°c during the hot season while it is about 21°c during the cold season,
- Annual rainfall varies from 1000 mm to 2000 mm.
- Rainfall received is both convection and orographic brought by onshore Trade Winds.
- Humidity is high throughout the year.
- Sea breezes lessen the effects of the heat.
- Tropical maritime climate is good for tree growth. The lowlands have tall and evergreen trees.

Cameroon weather station (data for x year)

Month	J	F	M	A	M	J	J	A	S	O	N	D
T°C	24	24.5	25	24	23.5	23	22	22.5	22.5	22.5	22.5	23
P(mm)	9	40	50	207	187	120	150	78	282	264	160	5

(iii) Tropical continental climate

This climate occurs between 5° N and 15° N and 5° S and 15° S. It is in West, East and Central Africa, South America, parts of the Deccan plateau (India) and the areas to the north and east of the Australian Desert.

Climatic characteristics of Tropical continental climate

- Heavy convectional rainfall is mainly in the summer.
- Annual rainfall is about 765 mm.
- In some regions, the offshore winds are strong and hot. An example is the Harmattan of West Africa.
- Humidity is high during the hot, wet season.
- Summers are hot (32° C) and winters are cool (21° C).
- The annual temperature range is about 11°C. The highest temperatures occur just before the rainy season begins. This is in April in the northern hemisphere and October in the southern hemisphere.

iv) Savannah climate (Tropical wet-and-dry climate)

This is located between 5° and 20° latitudes on either side of the Equator. It is found in Latin America. These are the Llanos of the Orinoco Valley including Colombia and Venezuela, the Guyana Highlands and the Campos of Brazil.

In Africa, it is found in the South of the Congo basin, the Southern part of Democratic of Republic of Congo, Angola, Zambia, Mozambique, Tanzania, Uganda, Botswana, South-Western Madagascar, Central Nigeria, Southern Kenya, Togo, Ghana and Ivory Coast.

Climatic characteristics of Savannah Tropical climate

- High temperature of around 20°c.
- The annual range of temperature is greater than in the equatorial regions. It is over 3° but not more than 8°c.
- Total annual average precipitation varies from 1000 mm to 1500 mm. Much of the rain falls during the summer.
- The vegetation is grasslands with scattered trees and bushes.

(v) Tropical desert climate

Most of these deserts lie between 15° to 35° N and S of the equator. The hot desert climate is found in the following deserts: Atacama (the coastal deserts of Peru and Chile in South America), the Namib and Kalahari deserts of coastal Angola and South West Africa, interior part of Botswana and South Africa, the great Australian desert, the Sahara and the Arabian deserts, the Iranian desert, the Thar desert of Pakistan and India, California (USA) and the deserts of Northern Mexico.

Climatic characteristics of Tropical desert climate

- Hot deserts have the high temperatures throughout the year.
- They have cloudless skies and little or no humidity.
- The daily ranges of temperature vary between 22° to 28° C. In rare cases, the diurnal range may be as high as 41.7° C.
- The annual average precipitation is less than 250 mm.
- Relative humidity is high.
- There is little plant cover.

Below is an example of Khartoum (Sudan) weather station:

Khartoum (Sudan) weather station (for X year)

Month	J	F	M	A	M	J	J	A	S	O	N	D
T°C	22.5	23.5	27.5	30.7	33.1	33.3	30.8	29.4	30.9	31.4	27.5	23.7
Pmm	0	0	0	1	5	7	48	72	27	4	0	0

vi) Tropical Monsoon Climate

This is found in areas with seasonal land and sea winds. On-shore summer winds blowing from over tropical warm Oceans bring about heavy precipitation. Off-shore winds from over the land make the weather dry during winter.

Monsoon climate is found in the coastal areas of Eastern and Southern Asia. These places include India, Burma, Bangladesh, Indo-china, Southern China, and Philippines, Taiwan, Japan and Korea.

In tropical Africa, it is found along the South-West coast of West Africa. These areas include the coasts of Guinea, Sierra Leone, Liberia, and Ivory Coast.

Other areas are the Northeast coast of Latin America from the mouth of Orinoco River in Eastern Venezuela through Guyana, Surinam and French Guyana to the North-Eastern part of Brazil. The North coasts of Puerto Rico and the Dominican Republic in the Caribbean Islands which have a mild monsoon climate.

Characteristics of Tropical monsoon climate

- High temperatures (32°c) in the hot season (summer) and low temperatures (15°c) in the cold season (winter).
- High annual range of temperatures of about 17°c.
- Summers receive high rainfall of up to 2500 mm.
- The winters are dry.
- There is a reversal of winds. In one season they blow from sea to land (onshore). These bring heavy rainfall. In the other season, they blow away from the sea (offshore), such come along with little rain.

Cherrapundji (India) weather station for X year

Month	J	F	M	A	M	J	J	A	S	O	N	D	Annual
T°C	12	13	17	19	19	20	20	20	20	19	16	13	17
R (mm)	20	41	179	605	1705	2875	2455	1827	1231	447	47	05	11437

8.4.2. Temperate zone

i) Mediterranean Climate

Mediterranean climate is found between 30°and 40°N and S of the equator. This is on the western sides of the continents. This climate is found in five regions of the world:

- North of the Mediterranean Sea from Portugal to Turkey and beyond in the Iranian Highlands, Morocco, Northern Algeria, and Tunisia, and North of Bengasi in Libya.

- The central and Southern California coast in the United States of America.
- Central Chile.
- The Cape Town area of South Africa, and
- Southern Western coasts of Australia.

Characteristics of Mediterranean climate

- The average temperature of the coldest month is between 4.4°C and 10°c. That of the hottest month is between 21° C and 27°c.
- The mean annual temperature ranges are between 11°and 17°c.
- The average annual precipitation is between 350 and 750 mm.
- There is rain in winter while the summers are dry.

Below is an example of Algiers (Algeria) weather station:

Algiers (Algeria) weather station for X year

Month	J	F	M	A	M	J	J	A	S	O	N	D
T°C	11.9	13	14.2	16.1	18.8	21.9	25	25.3	23.8	20.3	16.9	13.1
R (mm)	107	90	89	59	33	15	2	7	29	80	117	137

ii) Temperate Maritime Climate

This type of climate is found between 40° and 65° N and S of the equator. These are regions to the West of continents.

It is mainly found in Western Europe including Great Britain, North Western France, Germany, Denmark, Holland, Belgium and Norway.

In North America, it is found along the West coast up to 60° N of the equator. It borders the Sub-Arctic climate of Canada and Alaska. In Europe, it extends along the west coast of Norway to 68° N.

In the Southern Hemisphere, it is found to the Southwest coast of Chile, Southeast coast of Australia, the islands of Tasmania and New Zealand.

Below is an example of Brest (France) weather station:

Brest (France) weather station for X year

Month	J	F	M	A	M	J	J	A	S	O	N	D
T°C	6.7	7.2	8.3	10.9	13.3	16.2	17.9	18.1	16.3	12.8	9.3	7.2
R (mm)	84	75	57	54	49	49	51	53	54	78	91	96

Characteristics of Temperate Maritime climate

- Temperatures are influenced by the warm Ocean currents.
- This climate has cool summers and mild winters.
- The annual range of temperature is about 7° C.
- Average temperatures in summer are between 15° C and 18° C. Winter temperatures range between 11° and 17° C.
- In Europe, the lowlands receive an average precipitation of 500 mm to 850 mm. On the windward side, it is between 2500 mm and 3750 mm.

iii) Continental Temperate climate

This type of climate occupies a large part of the United States of America. In Europe, it is found in Romania and Bulgaria. It occupies the lower Danube Valley.

In Eastern Asia, it is found in North China bordering the yellow Sea, North and South Korea, and Northern Honshu in Japan.

Characteristics of continental temperate climate

- Temperate continental climates are found on continents in the Northern Hemisphere between 40^{o}-70^{o}
- Climate in these areas is controlled by the fact that they are not located near Oceans where temperatures are moderate.
- Temperate continental climates are also called micro thermal climates, because they are located away from the Oceans. These climatic zones experience the extremes of temperatures.
- Summers are warm and can be very humid while winters are cold with snowstorms and blustery winds.
- The annual average temperatures are around 10^{0} C.

8.4.3. Cold zone

i) Polar and Tundra climate

The Tundra climate is found in the northern hemisphere beyond 60° N of the equator. These are areas to the North of Asia and Canada. It also occurs on the coast lands of Greenland. Polar climate is found in Greenland, interior of Iceland and in the Antarctica.

Characteristics of Tundra climate

- The average annual rainfall is 250 mm.
- Precipitation is in the form of snow in winter and rainfall in summer.
- Humidity is low because of low temperatures.

- Winter temperatures are low. They range from - 29°c to 4°c. Summer temperatures average about 10°c.
- Vegetation consists of mosses, lichens and dwarf trees and shrubs. It is called tundra vegetation.

Characteristics of Polar climate

- Temperatures are always low. They are below 0°c, which leads to snow.
- Precipitation mainly occurs in summer. It averages between 100 mm and 250 mm.
- Winters are associated with one continuous night. Summers are one continuous day.
- Blizzards are common. These are snowstorms with high winds. Visibility is low.
- There is hardly any vegetation. This is because of snow and ice cover.

Below is an example of ours weather station for X year:

Rwanda X station

Month	J	F	M	A	M	J	J	A	S	O	N	D
T°C	-9,5	-11	-11	-7.5	-1,5	1.5	4.5	4.5	1,5	-1.5	-6	-7.5
R (mm)	28	36	30	18	20	20	18	23	41	36	25	30

ii) Mountain climate

This type of climate is found in the mountain ranges of the world. These include Mt. Kenya, the Ethiopian Highlands and the Alpine ranges of Europe. Others are the North Western part of Rwanda, especially over volcanic region, the Andes of South America and the Rockies of North America.

Characteristics of Mountain climate

- High rainfall on the windward slopes. It is less on the leeward slopes.
- Orographic rainfall is received.
- Pressure and temperature decrease with altitude.
- But if the mountains are high enough, there is a height at which maximum precipitation occurs and above which it decreases.
- It is also characterized by strong local winds (mountain and valley breezes).

Application Activity 8.4

a) Draw a world sketch map and on it mark and label the world climatic zones.

b) Describe the characteristics of each climatic zone shown on that world sketched map.

8.5. Influence of climate on human activities

Activity 8.5

"People in North Western part of Rwanda grow Irish potatoes, while people in Southern Rwanda grow cassava and those of Eastern Rwanda grow bananas. Again, in some regions of Rwanda tea is grown as a cash crop while other does not".

Hence explain how those crops grown are influenced by climatic conditions in each part.

Climate influences the distribution of population. This is because of temperature conditions, amount of precipitation and length of crop growing season.

The relationship between climate and human activities is summarized below:

i) **Human activities in equatorial regions:** Heavy rainfall and high temperatures support growth of forests. The main human activities are lumbering and agriculture. Crops such as coffee do well in this type of climate.

ii) **Human activities in savanna climate:** This type of climate is good for agriculture and dairy farming. There is enough grass for the animals. Growing of vegetables is done in this type of climate.

iii) **Human activities in desert climate:** The high temperatures and low rainfall are not supportive for agriculture. Animal keeping is also not well developed only camels, goats and sheep are kept in such type of climate. Furthermore, it is only around the oases that some farming is done.

iv) **Human activities in temperate climate**: This type of climate is suitable for agriculture and livestock keeping. Most developed countries are in this type of climate. These zones have high population.

v) **Human activities in polar climate:** The main activities in this zone are the fishing and hunting. Few people are found here.

Application Activity 8.5

"Most of entrepreneurs look for climatologists and meteorologists to advise them when locating their firms", Discuss the statement.

Skills lab

Good and favourable climate is a key factor to the development of all human activities. With the help of your local leaders organise a seminar on how conservation of the natural environment can lead to a good climate and hence leading to the economic growth of the country.

End unit Assessment

1. *With aid of diagram describe the structure of atmosphere.*
2. *To what extent atmosphere plays a considerable role in regulating/ control negative effects of solar radiation?*
3. *Visit a weather station near your school to identify instruments used to measure and record weather conditions.*
4. *(a) Briefly describe the characteristics of Rwandan climate,*

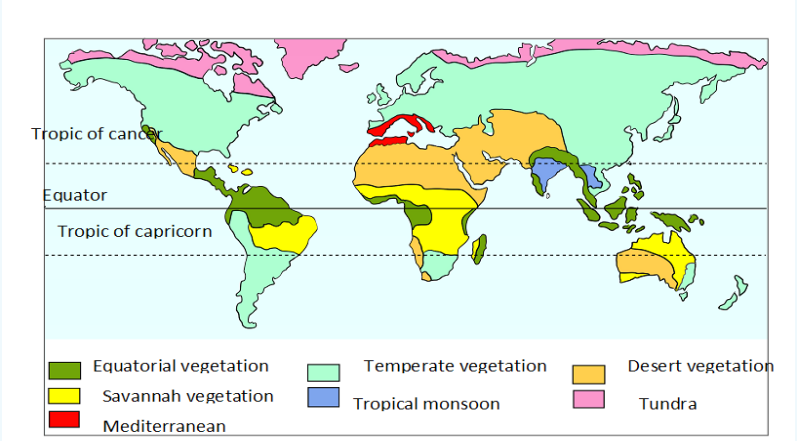
   (b) Explain the factors influencing the climate of Rwanda.
5. *"Human activities depend upon climate and weather conditions of an area" with relevant examples in Africa, support this statement.*

UNIT 9

NATURAL VEGETATION OF THE WORLD

Key unit competence: The student-teachers should be able to appreciate the distribution of different types of vegetation in the world.

Introductory activity



Vegetation is important to man in various ways and it acts as habitat place for wild animals. There is need to conserve it due to its significance. The different countries have come up with environmental campaigns aimed at protecting natural vegetation for environment and sustainability.

1. *Identify the different types of natural vegetation shown on the map provided above.*
2. *Describe the factors influencing the distribution of world vegetation.*
3. *Why is it important to conserve natural vegetation and how can we preserve our natural vegetation?*

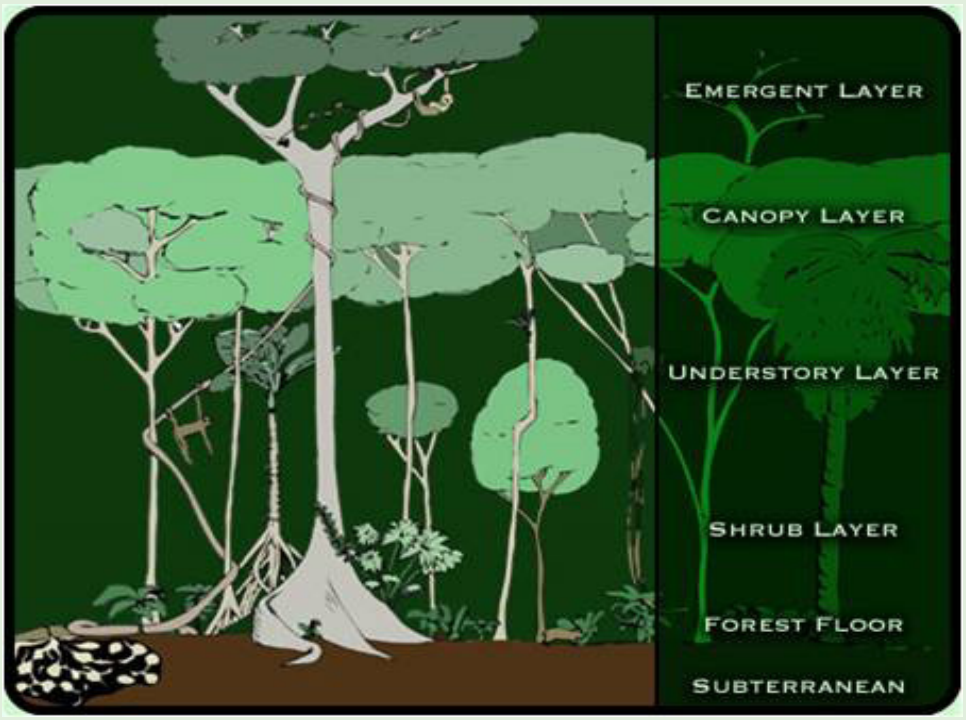
Vegetation refers to a community of plants which grow in an area and which gives it distinct character. Vegetation in biological terms is known as "flora", that is, all vegetation types growing on land and in water.

The world vegetation communities are into categories: forests and grasslands. They are distributed according to the vegetation zones and they include tropical, temperate, tundra, desert, mountain and aquatic/marsh or mangrove vegetation.

9.1. Tropical forests and their characteristics

Activity 9.1

Observe the photograph provided below and answer the questions that follow:

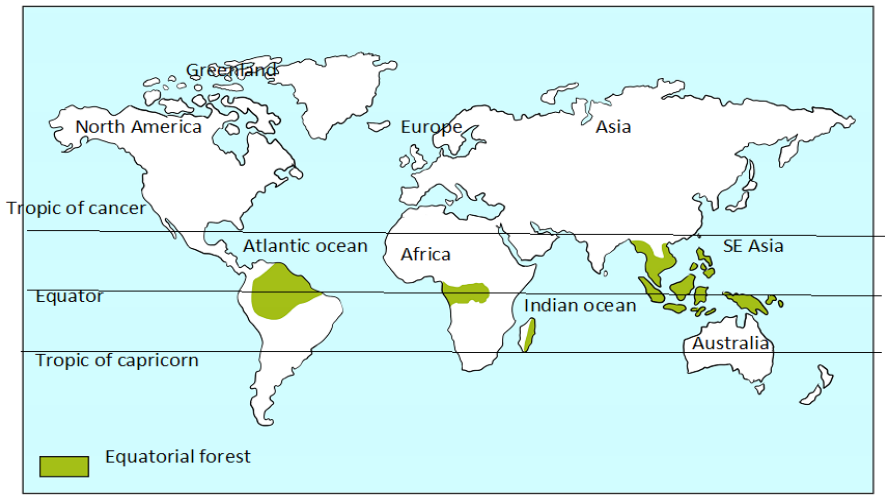


1. *Describe the characteristics of the vegetation presented in the illustration above.*
2. *What type of vegetation shown in the illustration above basing on the characteristics described in (1) above?*
3. *Identify and describe different types of tropical forests.*

Tropical vegetation develops within the tropics. Tropical vegetation can be sub-divided into three but related groups. These include equatorial rainforests, tropical monsoon forests and tropical mountain forests.

9.1.1. Equatorial forests

The equatorial rainforests grow within the tropics between 10 °N and 10 °S of the equator. Equatorial rainforests are sometimes called "**rainforests".** Equatorial rain forests cover only a small part of the earth's surface, which is about 6% of the earth's surface. They are situated in Amazon basin in South and Central America, Congo basin in Central Africa, Malaysia, Burma, and West African coastal belt (Nigeria, Ghana, Ivory Coast, Liberia and Central Africa Republic).



Location of equatorial rainforests

The conditions necessary for the growth of equatorial rainforests:

- Equatorial rainforests receive rainfall throughout the year about 2000 mm per year.
- The equatorial rainforests grow in areas with good fertile soils and well-drained soil.
- The equatorial rainforests require much sunshine to support their dense growth.
- The equatorial rainforests require temperature about 23-24^{0}c.

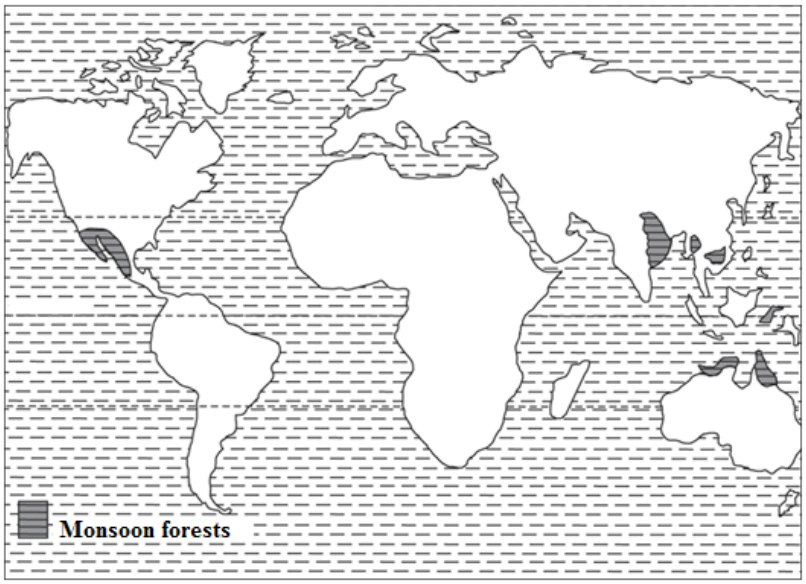
Equatorial rainforests are characterized by the following:

- Equatorial rainforests are evergreen, since the forests receive heavy rainfall throughout the year with no clear distinct seasons.
- Equatorial rainforests grow buttress roots in order to support their enormous sizes.
- The major tree species in equatorial are characterized by a long gestation period.
- The Equatorial rainforests receive rainfall throughout the year with no distinctive seasons.
- Vegetation in equatorial regions is comprised of four vertical layers starting from the canopy of tree to the ferns on ground.
- Equatorial rainforests are dominated with valuable tree species such as mahogany, ebony, green heart and redwood.
- The forest floor receives low quantity of the sunlight. This has led to the existence of little undergrowth.
- The trees are very tall (35 m - 40 m) with a very dense and thick canopy**.** The result is that the canopy blocks most of the sunlight falling on them depriving the plants under them of sunlight Most of the trees in Equatorial rainforests become tall in search of light.
- There are broad-leaved evergreen forests of dense and prolific growth of flora as well as fauna.
- The major tree species do not grow in pure stands. Trees of pure stands are scattered all over the forest.
- Beneath the tree canopy exists a well-developed layering of understory vegetation, which is so dense and this limits light to reach the floor of the forested area.

The Equatorial rainforests are associated with various economic activities. These include lumbering as a major activity, provision of local materials which are used in craft industry, provision of fuel, research and study, provide herbal medicine, support agriculture, etc.

9.1.2. Tropical Monsoon forests

The Tropical Monsoon Forests found beyond the equatorial region between 10 ^{0} and 25^{0} Northand South of the equator. This type of vegetation is found in areas such as; Burma, Thailand, the Indo-China region, parts of India, East Java, parts of Northern Australia, small parts along the South Western coastal areas of West Africa.



Location of tropical monsoon forests

The conditions necessary for the growth of tropical monsoon forests:

- The tropical monsoon forests receive heavy rainfall, which is around 2000 mm per year. This is received mostly in summer.
- In cooler seasons such as winter, very little rainfall is received. This is because these regions lie under the offshore trade winds.
- The tropical monsoon forest requires temperatures of about 27^0c. This temperature is moderately enough to support the growth of various plants.

Tropical monsoon forests are characterized by the following:

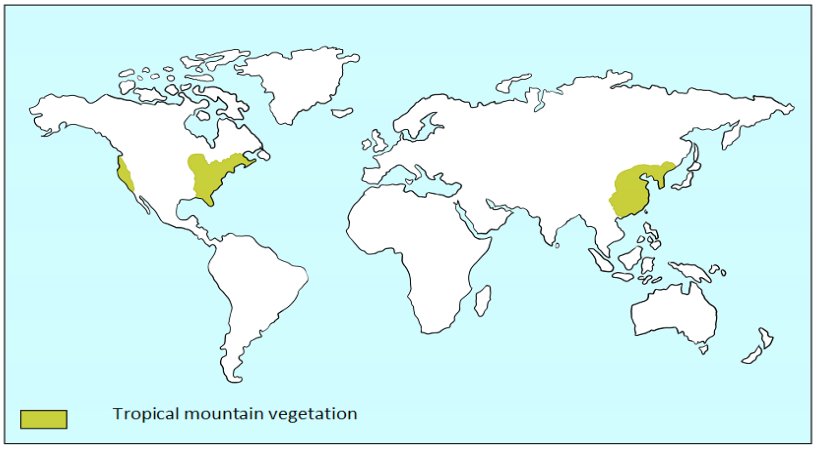
- The trees possess trunks that they use to store water during the dry seasons.
- The tropical monsoon forests can grow up to 30 meters in height.
- Trees possess long tap roots that penetrate into the ground to access groundwater. In order to sustain plants growth, especially during the dry winter season when there is unreliable rainfall.
- Tropical monsoon forests shade off their leaves during the dry seasons in order to minimize water loss.
- Trees have broad leaves due to sufficient rainfall (2000 mm) received during wet season.
- Tropical Monsoon forests experience temperatures that reach 28^0c especially in Summer.

- Tropical monsoon forests contain valuable hard wood tree species such as the teak and sandalwood.

The tropical monsoon forests are associated with various economic activities such as lumbering on the wider area, agriculture, craft industry, settlement pattern and provide herbal medicine.

9.1.3. Mountain tropical forests

The tropical mountain forests are mainly located at a high altitude in the mountains. These usually vary largely along the slopes of Himalayas Mountain ranges and East African Mountain peaks of Rwenzori, Mt. Kenya and other good examples include; Cameroon Mountains, and Ethiopia Highlands. The trees grow in plenty between the altitude 1,500 meters to 3,500 meters. This explains why such areas are dominated by mountain forests. These have evergreen trees like Teak, Bamboo, and other tree species such as Pine, Fir, Oak, Maple, Deodar, Laurel Spruce, Cedar, cedar pod carp and camphor. All these grow abundantly and dominate the natural vegetation in the area.



Tropical mountain forests

The conditions necessary for the growth of mountain forests:

- Mountain forests require much and reliable rainfall;
- Mountain forests require adequate temperature for the growth of tress;
- Mountain forests need deep fertile soil for the growth of forests;

Mountain forests have the following characteristics:

- Mountain forests grow broad leaves and they are evergreen;
- Mountain forests grow thick under growth;

- The forests contain giant evergreen trees that grow on the windward slopes of the mountain;
- The main tree species are characterized by long gestation period;

The mountain forests are associated with various economic activities such as lumbering on the wider area, provision of local materials, hunting of animals and provide herbal medicine.

Application Activity 9.1

1. *Briefly explain the geographical conditions that determine the location of equatorial forests.*
2. *It has been noted that environment is composed of varieties of natural resources that support socio-economic development of any country. Forests fall under such natural resources. Explain the influence of different categories of tropical forests to the development of Africa.*

9.2. Temperate forests and their characteristics

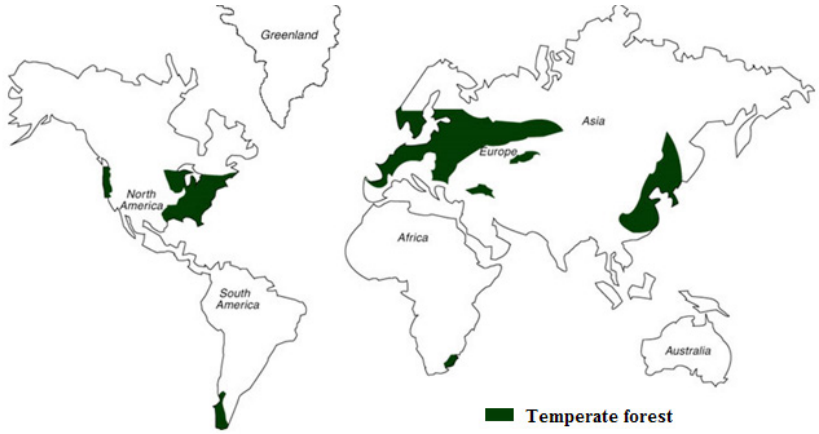
Activity 9.2

Read the passage provided below and give feedback to the questions that follow:

Temperate forests occur in Eastern North America, North Eastern Asia, Western and central Europe. Temperate forests are those, which grow outside the tropics. They are divided into three categories namely deciduous forests, Mediterranean forests and coniferous forests. Temperate forests are located between 30^0 and 70^0 North and 30^0 and 70^o South of the equator.

1. *Identify the types of forests mentioned in the passage above.*
2. *Compare and contrast the types of forest indicated in the passage above.*

The temperate forests are categorized into 3 categories that include: deciduous forests, Mediterranean forests and coniferous forests.



Temperate forests

The conditions necessary for the growth of temperate forests:

- Temperate forests need little supply of sunshine for the successful growth.
- Temperate forests require enough fertile soil and availability of water for growth.
- Temperate forests require amount of rainfall about to 750 mm in dry period.

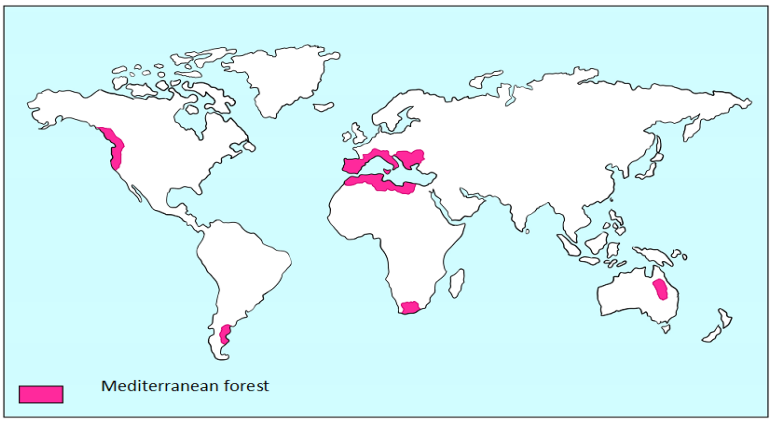
The characteristics of temperate forests

- With high levels of precipitation, humidity, temperate forests have a variety of deciduous trees.
- Trees shed their leaves in fall in winter and bud new leaves in spring when warmer temperatures and longer hours of daylight return.
- Temperate forests have tall evergreen trees dominating the regions.
- They have Redwood trees which are the tallest in the world, the most prominent tree type in temperate forest is Douglas.
- Temperate forests have epiphytes species such as mosses and ferns that live on the branches and trunks of trees, especially the broad-leafed maples.

The temperate forests are associated with various economic activities. These include tourism which is supported by the presence of many different species of birds such as like broad-winged hawks, cardinals, snowy owls, and pileated wood peckers that attract very many people from different parts of the world. There is also hunting due to different types of animals such as white-tailed deer, raccoons, opossums, porcupines and red foxes.

9.2.1. Mediterranean forests

The Mediterranean forests are located mainly in South West America, Spain, Italy, France, Australia, Algeria, Morocco, Tunisia, and Central Chile. Mediterranean forests grow also well in South Africa near Cape Town.



Mediterranean forests

- Mediterranean vegetation is characterized by open and evergreen woodlands.
- Mediterranean vegetation has deciduous tree species with long gestation period and thicket with thin and waxy leaves.
- They are composed of broadleaf trees, such as the oak and mixed sclerophyllforests.
- Mediterranean vegetation has dense foliage composed of broad-leaved evergreen shrubs, bushes, and small trees. There is inadequate undergrowth.

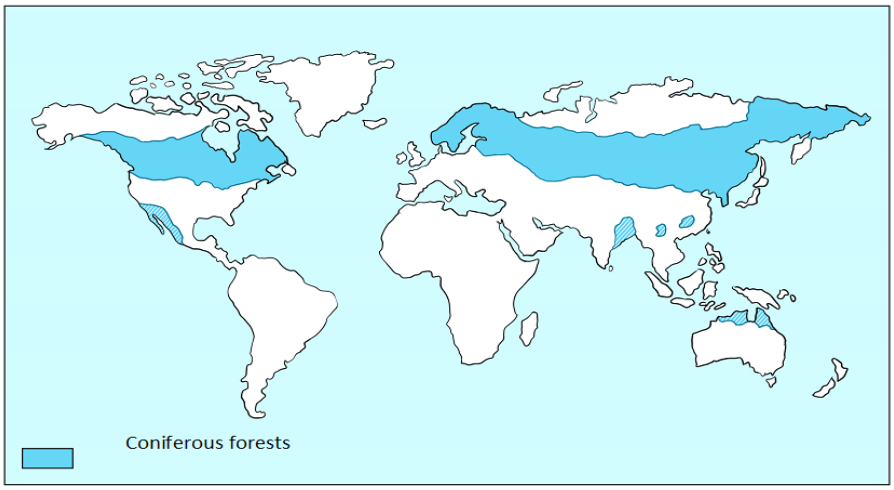
Tall trees grow in regions lying between 30° and 40° North and South latitudes

- There are woody, evergreen shrubs or small trees that have developed various strategies of growth and usage of available water during the dry period.
- Mediterranean plants have long taproots to reach underground water, called “Xerophytic Plants”.
- Mediterranean trees adapt themselves to dry summers with the help of their thick barks and wax coated leaves. These reduce the rate of transpiration.

The Mediterranean forests are associated with various economic activities such as mining of oil, tourism, and very limited population settlement. There is also rearing of sheep and growing of crops such as wheat, oats and cultivation of chestnuts.

9.2.2. Coniferous forests / Taiga Forest

The coniferous forests are located across North America, Europe, and Asia. These forests are found within the extent of 50˚ to 60˚N. The coniferous forest is the largest terrestrial vegetation covering about 17% of Earth's land area. Countries such as Canada, Russia, and Scandinavia are almost entirely covered by these coniferous forests. The vegetation is identified by its climate, which occurs almost exclusively in the high latitudes of the Northern hemisphere.



Coniferous forests

Coniferous forests are favoured by the following environmental conditions:

- The coniferous forests require inadequate supply of sunlight.
- The coniferous forests need medium fertile soil with availability of water.
- The coniferous forests grow well with an average temperature of below 43^0 F during the winter season.

The characteristics of coniferous forests are:

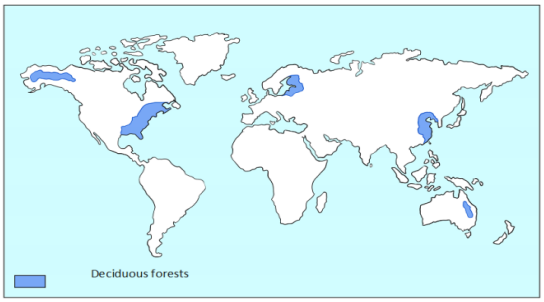
- The coniferous forests consist of tall, straight and softwood evergreen trees with few branches.
- There are limited species of trees. The existing trees are evergreen and grow apart.
- The type of trees in these coniferous forests grow in pure stands, to a height of over 30m.
- Trees are conical shaped with needle-like leaves. These include firs, pine and cedar which are important variety of trees in these forest.

- Coniferous tree species grow shallow roots and can collect enough water from top soil;
- They have shallow roots used to absorb the nutrients and water from the top soil;
- The coniferous vegetation has adapted to harsh conditions associated with winter season.
- Leaves are small, narrow with the capacity of reducing transpiration.

The coniferous forests are associated with various economic activities which include lumbering, tourism, apiculture (bee keeping), hunting, herbal medicines, fruit gathering and Research and study.

9.2.3. Deciduous forests

Deciduous forests grow well within the latitude of 40° N and 60°N and 30° S and 50°S of the equator. Deciduous forests can be found in the Eastern half of North America, and the middle of Europe. There are many deciduous forests in Asia. Some of the major areas having deciduous forests include, Southwest Russia, Japan, and Eastern China. South America has two big areas of deciduous forests in Southern Chile and Middle East coast of Paraguay. These are also located in New Zealand and South Eastern Australia also.



Deciduous forests

The conditions necessary for growth of deciduous forests:

- Deciduous forests require moderately distributed rainfall**.**
- Deciduous forests need low sunshine supply.

The characteristics of deciduous forests:

- Trees shed their leaves in the dry season to conserve water.
- Deciduous forests are characterized by existence of epiphytes, which include mosses.
- They contain hard wood trees like sandalwood, maple, oak, beech,

teak, ebony, bamboo, etc. which are the common trees found here. They require low sunshine supply.

- Deciduous forests grow in pure stands, have a short growing gestation.

The deciduous forests are associated with various economic activities which include lumbering, tourism activity, hunting, herbal medicines and fruit gathering.

Application Activity 6.2

Identify the characteristics of Mediterranean forests.

9.3. Grasslands in tropical zone and their characteristics

Activity 9.3

Observe the photograph provided below and answer the questions that follow:

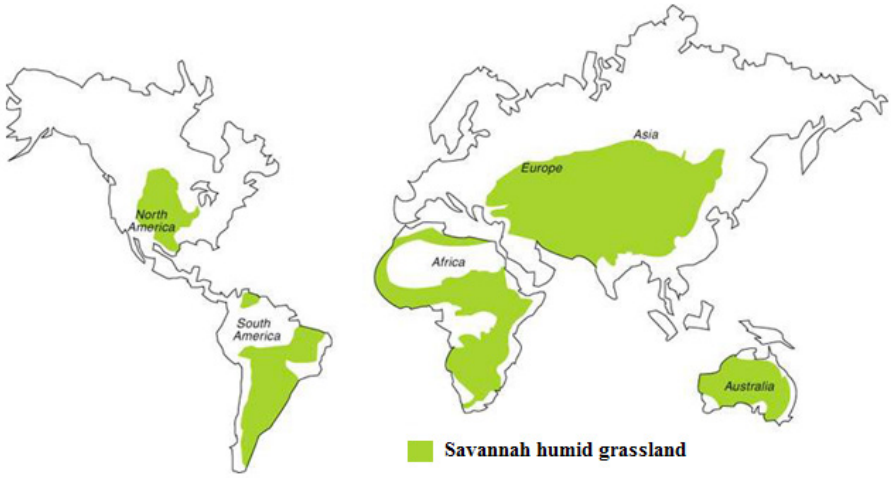
1. *Referring to your observation, describe the characteristics of the grassland shown above.*
2. *Suggest two world areas where such presented vegetation is found.*
3. *Distinguish savannah humid from savannah dry grasslands.*

Tropical grasslands are commonly known as savannah vegetation. Tropical grasslands grow well within altitude of 5^0 N and 15^o N and 5^0 S and 15^o S of the equator. Tropical grasslands grow well in Africa, South America specifically

in Campos in Brazil". They can also be found in Guyana, Australia, Eastern Madagascar and India. Tropical grassland is divided into two groups: Savannah and steppe.

9.3.1. Savannah humid vegetation

Savannah humid forests grow well in regions experiencing the average total rainfall of 1000 mm per year. Miambo woodlands of central Tanzania is one of the examples of savannah woodlands in East Africa. Other examples of savannah humid are found in Madagascar, Indian subcontinent, South East Asia and New Guinea.



Location of Savannah humid vegetation

The conditions necessary for the growth of Savannah humid vegetation:

- The savannah humid can grow well in regions experiencing temperatures ranging between 25^0C to 32^0C.
- Savannah humid vegetation grows well in areas which experience rainfall about 750 mm to 1000 mm per annual.
- Savannah humid needs maximum sunshine and light necessary for the plants to make chlorophyll.

The characteristics include the following:

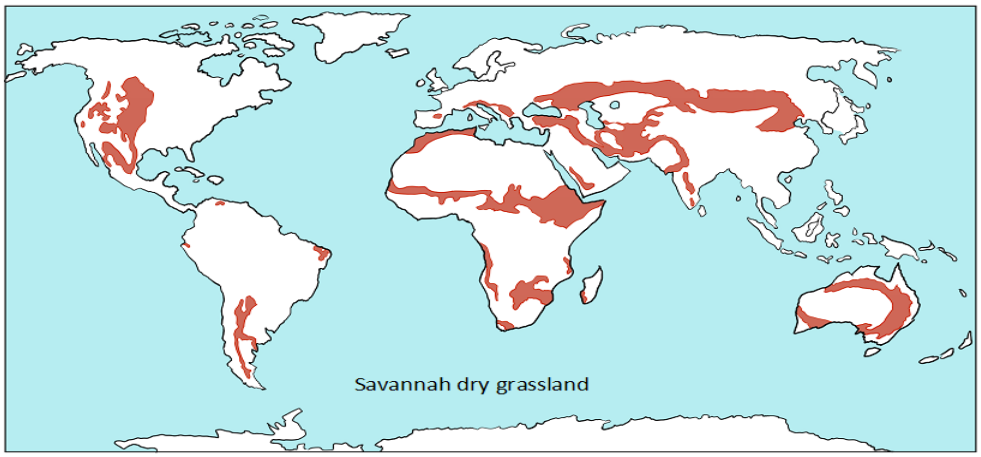
- The tree species are deciduous, and shade leaves during the dry periods.
- The Savannah vegetation is mostly characterized by undergrowth dominated by shrub and short grasses.
- The species of trees such as baobab and acacia are mostly common in area.
- The grass can grow very tall, about 3 to 4 meters in height. The common type of grass is known as "elephant Grass.

- Most tree species in the savannah woodlands form small umbrella.
- The non-thorny trees such as baobab, candelabra, and the Jackal berry are found in savannah grasslands

The Savannah humid vegetation is associated with various economic activities such as; hunting, herbal medicine collection, fruit gathering, rearing of animals and subsistence farming, settlement, mining and gazetting of national park and game reserves.

9.3.2. Steppe/ Savannah dry vegetation

Savannah dry covers almost half the surface of Africa (central Africa) and large areas of Australia, South America, and India. Climate is the most important factor in creating a savannah dry vegetation. Savannahs are always found in warm or hot climates where the annual rainfall is from about 508 to 1270 mm per year. These regions receive rainfall for about 6 to 8 months. This is followed by prolonged dry period that is usually affected by fire out-breaks.



Location of steppe vegetation / Savannah dry vegetation

The conditions necessary for growth of Savannah dry/steppe vegetation:

- The soil which is dry and porous, with rapid infiltration of water.
- Dry climatic conditions that support the growth of different grasses due to disparities in rainfall and soil conditions.
- Availability of average annual rainfall of 762-1016 mm.
- Presence of soils that are too thin. Trees require the existence of termite mounds where they grow.

The main characteristics of Savannah dry vegetation are:

- The trees and grass grow through direct competition for water, light and nutrients.

- The open canopy allows sufficient light to reach the ground to support an unbroken herbaceous layer consisting primarily of grasses.
- Annual herbaceous plants die completely at the end of the growing season or when they have flowered and fruited. These grow again from seed when the wet season sets in.
- The vegetation consists of tall grasses of two high or more and scattered trees.
- The trees lose their leaves in dry season and are mainly found near watercourses. The main types of tree species are acacia.
- Some plants have thick barks and thorny leaves to reduce water loss.

The Savannah dry /steppe vegetation is associated with various economic activities including hunting, fruit gathering, rearing of animals, settlement, agriculture and gazetting of national park and game reserves.

Application Activity 9.3

1. *Describe savannah grasslands with reference to South Africa.*
2. *With reference to Rwandan context, explain the importance of savannah grasslands in the economic development.*

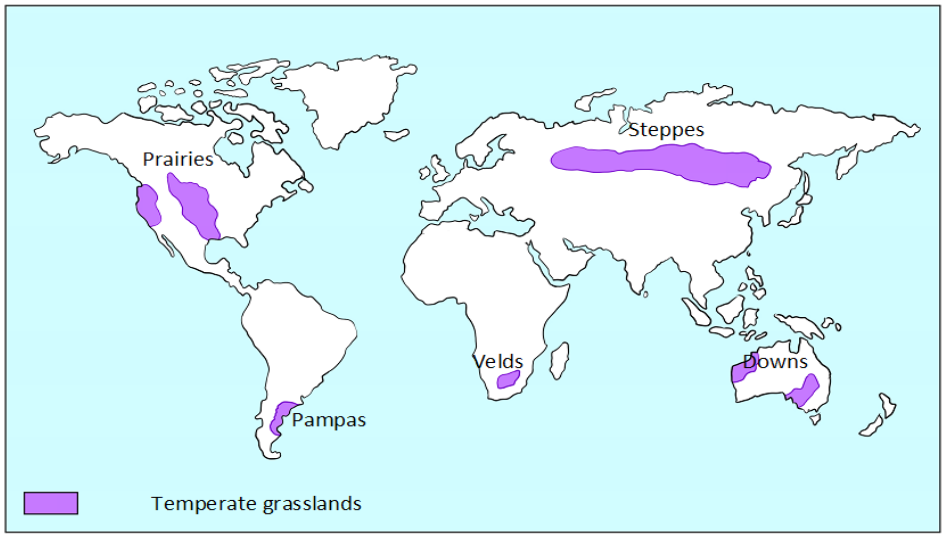
9.4. Temperate grasslands and their characteristics

Activity 9.4

Study the picture provided below and answer the questions that follow:

1. *Observe the picture provided and explain the conditions necessary for the growth of the vegetation shown above.*
2. *Suggest any two-world areas where the vegetation presented above is found.*

Temperate grasslands are known by different names in various regions. "***Prairies"*** in North America; ***"Pampas"*** in South America (Argentina), "***Downs***" in Australia ***"Velds"*** in South Africa and ***"Steppes***" in Europe. These are found in the mid- latitudinal zones and in the interior part of the continents. The Temperate grasslands are found in Central Asia from Black Sea to Central Russia, North Central USA and Southern Canada, South-East Australia, Southern Africa and Argentina.



Location of grasslands in temperate zone

The conditions necessary for growth of temperate grasslands:

- Temperate grasslands require minimum light for the plants to make their own food.
- The temperate grasslands require moderate fertile, fine drained and humid soil.
- Temperate grasslands need average sunshine in dry and cool winter time.
- Temperate grasslands require moderate rainfall of about 500 mm - 750 mm for best growth of grasslands.

The characteristics of temperate grasslands are:

- Grasslands found here are short and juicy which is suitable for cattle feed.
- The region is known of growth of maize and wheat in large amount. This explains why, the area is known as "bread basket" of the world.
- The perennial temperate grasses mostly belong to the family of "Gramineae."

- The steppes form the largest segment of the temperate grassland biome. Steppes are divided into: Forest steppes, Meadow steppes and grasses.

The temperate grasslands are associated with various economic activities which include: hunting, fruit gathering, rearing of animals, settlement, agriculture and gazetting of national park and game reserves.

Application Activity 9.4

Assess the contribution of Temperate grasslands to the economy of the countries where they are found.

9.5. Desert vegetation and its characteristics

Activity 9.5

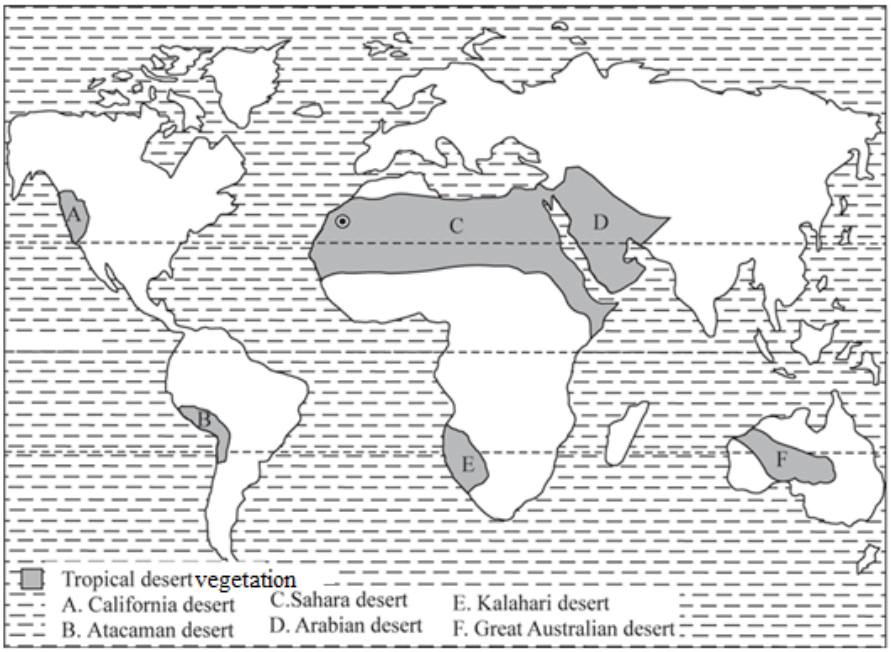
Observe critically the photographs provided below and answer the questions that follow:

1. *Identify the nature of the types of vegetation in these two figures above.*
2. *Compare and contrast the geographical conditions shown on both figures.*

Desert vegetation grows in the Western margins of the continents between 15° – 30° North and South of Equator. Biggest deserts are: Sahara and Kalahari in Africa, Thar in India, Arabia desert covering the countries of Saudi Arabia, Iraq, Iran, Syria and Israel, Atacama Desert (Peru and Chile), Southern California in USA, Sonora in Mexico and Victoria in Australia. Desert Vegetation is divided into two types, namely hot desert and cold desert vegetation or Tundra.

9.5.1. Hot desert vegetation

Hot deserts are located between the latitudinal belts of 15°-30° North and South of the equator. These deserts can be found in North America, South Asia, South and Central America, Africa and Australia. Hot desert vegetation experiences hot climatic conditions throughout the year. The rainfall is unreliable. This is caused by the dry winds that blow over the area, leading to arid conditions. Such conditions leave behind very poor vegetation in the desert region.



Hot desert vegetation

The conditions necessary for growth of hot desert vegetation:

- The presence of poor quality and infertile soils.
- Availability of rainfall total of about 250mm or less per year.
- The prevailing of high temperatures ranging between 29^0c and 31^0c to support the growth of plants associated with arid areas like deserts.

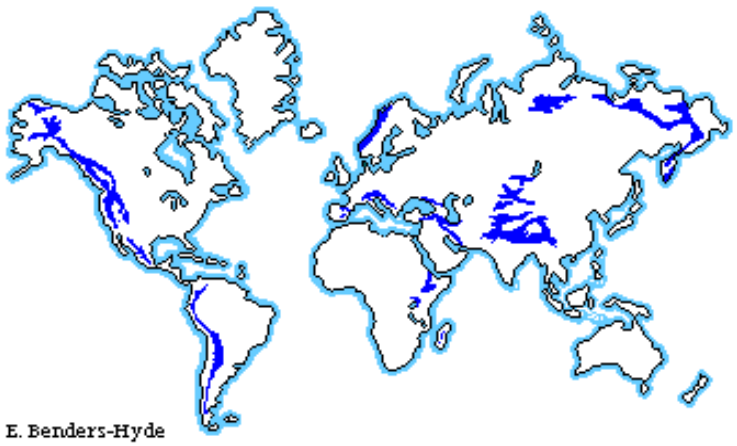
Hot desert vegetation is characterized by the following:

- There are a few plants with succulent stems, long roots and leaves.
- The desert trees shed off their leaves occasionally primarily to minimize on water loss from the excessive temperature.
- Desert vegetation types especially the tree species grow long tap roots to have access to water that is found deep in the underground water table.

- The main vegetation growing here is mainly thorny acacia, bushes, euphorbia and turfed coarse grasses.
- Some desert vegetation types grow no leaves in order to avoid excessive water loss through evapotranspiration.

9.5.2. Cold desert vegetation

The cold vegetation is located in high flat areas called plateaus. It is also common in mountainous areas in temperate regions of the world. Temperate regions lie between the Polar Regions and the tropics. Like other types of deserts, cold deserts get very little rain or snow and are mainly in the Northern part of Canada, North Russia, North Sweden and Finland islands in Arctic Ocean.



Location of cold desert vegetation

The conditions necessary for growth of cold desert vegetation:

- Cold desert vegetation needs low sunshine for its successful growth.
- It requires a combination of freezing temperatures, poor soil quality, lack of moisture and sunlight.
- This vegetation requires soils associated with relatively high soil salinity.
- Cold desert vegetation needs very little rain fall of about 250 mm during the summer season and snowfall during the winter.
- It requires areas characterized by frost conditions.

The major characteristics of cold desert vegetation include the following.

- The main plants are deciduous widely scattered and most having spiny leaves.
- The cold desert vegetation grows in areas with large amount of snowfall in winter (and sometimes in summer).

- The cold desert vegetation experiences short and wet moderately warm summers.
- This vegetation receives a mean annual precipitation that ranges from 90 mm to 260 mm, and the mean average winter temperature ranges from -2 to 4 degrees.
- The cold desert vegetation does well in areas with good drainage that facilitates leaching of most of the salts.

The cold desert vegetation is associated with various economic activities that include tourism, mining and agriculture on small scale and establishment of national park and game reserves.

Application Activity 9.5

Referring to Sahara Desert, describe the impact of desert vegetation and climatic conditions on the population settlement in any country around it.

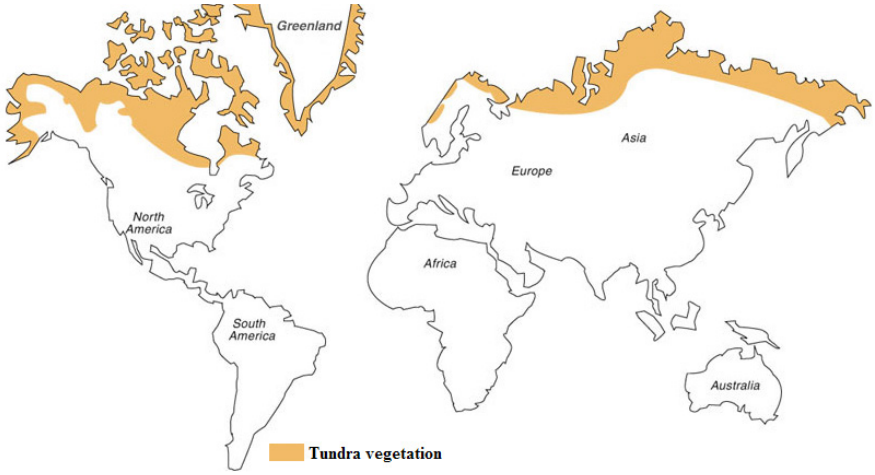
9.6. Tundra vegetation

Activity 9.6

Observe the provided picture below and answer the following questions

1. *Identify the type of vegetation shown on the photograph above.*
2. *Explain the characteristics of the vegetation identified in (1) above.*

Tundra vegetation is found in coldest regions of the world. The term tundra is derived from the word "***tunturi***" (from Finnish language) which means *"treeless plain."* This vegetation is found in the arctic region on top of mountains where climate is cold, windy and with limited rainfall. The tundra vegetation is found in regions that cover the areas of Alaska, parts of Russia, Northern Scandinavian countries and some parts of Canada.



Location of tundra vegetation

The following are conditions necessary for the growth of tundra vegetation:

- The Tundra vegetation requires winters that are cold, long and dark.
- It does well in regions that experience about 6 to 10 months with monthly temperatures below 32° F or 0° c.
- This vegetation needs limited precipitation and existence of strong and dry winds.
- It requires snowfall conditions that support the survival of plants and animal life. At the sometimes, acts as a protection layer on the surface of the ground.

The characteristics of tundra vegetation are the following.

- The vegetation arrangement is simple and there is limited variety of trees.
- The season of growth and reproduction is short.
- The drainage system is nearly limited.
- The nutrients and energy here is in form of dead and organic material.

The tundra vegetation is associated with various economic activities that include tourism which is associated with the following tourist attractions: Birds like ravens, falcons, snowy owls and snow geese and animals such as foxes, wolves and some smaller mammals like the lemmings and snowshoe rabbits. These areas also, support hunting, oil exploitation and research and study.

Application Activity 9.6

For either Russia or Canada, describe the necessary geographical conditions for the growth of tundra vegetation in that country.

9.7. Mountain vegetation and its characteristics

Activity 9.7

Using your previous knowledge and geographical sources, answer the following questions:

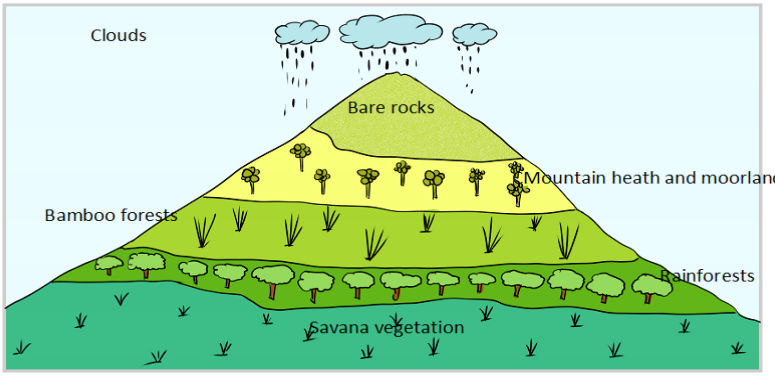
1. *Describe mountain vegetation in tropical zone.*
2. *Describe the characteristics of mountainous vegetation with reference to East Africa.*

Mountain vegetation is categorized into two types; namely, tropical mountain vegetation and temperate mountain vegetation.

9.7.1. Tropical Mountain vegetation

Mountain vegetation has a variety of vegetation ranging from tropical to temperate types. On typical Mountain slope, various vegetation types show clear demarcation zones. The savannah vegetation grows from the foothills, followed by the layer of tropical rainforests, bamboo forests, mountain heath and moorland. The rest is bare rock. This type of vegetation is traced in areas such as: Mt. Kenya, Mt. Aberdares, Mt. Kilimanjaro, Mt. Meru, Mt. Elgon, Mt. Cameroon, Mt. Ruwenzori, Mt. Virunga, Mt. Simien and Mt. Bale.

Vegetation zonation on mountain slope in East Africa



Zonation mountain vegetation

The conditions necessary for growth of mountain vegetation

- This type of vegetation requires the steep gradient.
- It needs well distributed rainfall characterized by humid conditions.
- It grows well in areas which generally are associated with strong seasonal differences.
- It requires temperature ranges of about 20° C at 900 m and 4°c in the summit region.
- It requires the annual precipitation of around 900 mm on the foothills, around 2000 mm at 1500 m and well above 3000 mm between 2000 and 2300 m on a windward side.
- It requires fertile soils that are well-developed with moderately acidic soil pH values, such as Andisol.

The characteristics of mountain vegetation

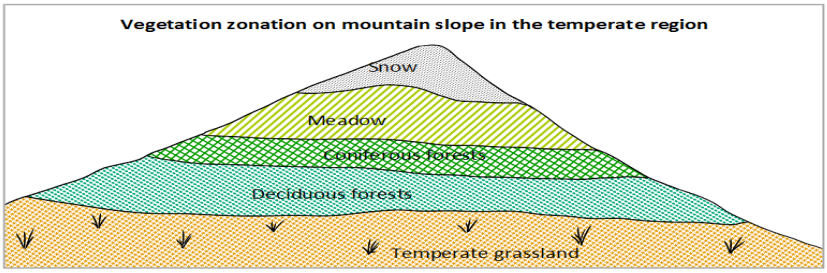
- The vegetation on the mountain slope grows in clearly demarcated zones from the foothills to the summit.
- Mountain vegetation is dominated by tussock grasses and stands of giant rosette.
- The mountain heath and moorlands grow between the bamboo forests and the snow-line or bare rocks.
- The tree species, mainly of the lower canopy are the wild olive.
- Soils in the mountains are mostly young and fertile which favours the growth of trees.
- Above snow-line, plant life is always impossible. This is attributed to low temperature and the presence of eroded bare rocks that makes it hard for plant growth.
- In mountainous areas, the decrease in temperature with increasing altitude leads to the corresponding change in natural vegetation.
- The wet temperate forests are suitable between 1000 and 2000 mm.
- Temperate forests containing coniferous trees like pine, deodar, silver fir, spruce and cedar are found between 1500 and 3000 mm.

The mountain vegetation is associated with various economic activities. These include gazetting of national park and game reserves, tourism etc.

9.7.2 Temperate mountain vegetation

Temperate mountain vegetation grows well in High Mountain of temperate regions. This grows best between 35^0 N and 60^0 N of the equator.

Temperate mountain vegetation is in the Alps, in Western Europe, in Norway, Sweden and Finland. Other traces of temperate mountain vegetation can be found in California on the Rocky Mountain slopes, British Columbia and Andes in South America.



Zonation temperate mountain vegetation

The characteristics of temperate mountain vegetation

- Temperate mountain vegetation contains both deciduous and coniferous plant species such as poplar, birch, oak and elm.
- Some trees species grow a thick bark in order to store enough water to be used in winter season.
- Tree species shed-off their leaves in winter when temperature drops below 6° c.
- Tree species especially the coniferous forests adapt themselves to the climatic conditions by growing tiny needle-like leaves.

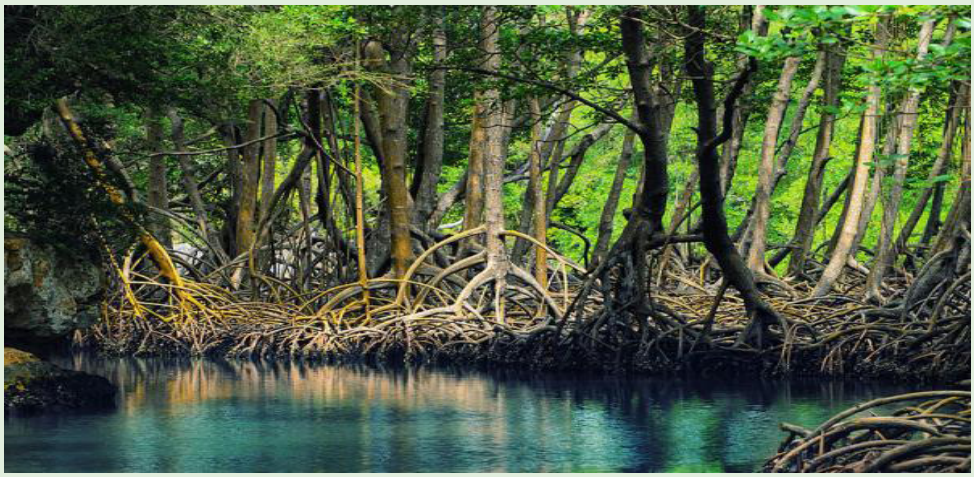
Application Activity 9.7

1. *Explain the use of mountainous vegetation with reference to Northern Rwanda.*
2. *Critically examine the role of temperate mountain vegetation to the economy of Switzerland*

9.8. Aquatic, marsh and swamp vegetation and their characteristics

Activity 9.8

Make a critical analysis of the photo below to answer the questions that follow:



1. *Identify the type of vegetation shown on the photograph above.*
2. *From your own observation describe the environmental conditions that influence the location and growth of the identified vegetation above.*

1) Mangrove vegetation

This is the type of vegetation that grows in marshy and swampy areas along the coast of West Africa and East Africa. The Mangrove vegetation is evergreen and grows along the coastal margins between 5° N and 5°S of the equator.

The conditions necessary for growth of mangrove forests:

- They need average temperatures of the coldest month higher than 20°C. The seasonal temperature range should not exceed 5°C. They can tolerate temperatures of 5°C, but the development will be affected. This is because they are not resistant to freezing.
- They need a large tidal range. This causes limited erosion and deposition of sediments.
- They need a fine-grained substrate. However, there could be some exceptions. This is the case in Papua New Guinea and Kenya, where the mangroves grow on corals.

- The shores must be free of strong wave action and tidal current.
- Mangrove vegetation requires swampy and marshy areas with deep soils which must be salty in nature.
- Mangrove vegetation requires high temperature necessary for chlorophyll making.

The characteristics of mangrove forests:

- Mangrove vegetation has broad branches and leaves and they are evergreen, dominated by trees.
- They are associated with saline soils with poor drainage.
- The mangrove vegetation grows butters root.
- This type of vegetation has a long gestation period.
- They exist in areas with poor drainage and sufficient water supply. Such areas are waterlogged that are hypoxic (oxygen deficient) waterlogged soil strata.
- Mangrove forest species, survive under temperatures above 66° F (19°C). They do not tolerate temperatures below 18° F (10° C). However, temperatures below freezing should not occur for a long time.

2) Aquatic plants:

The aquatic plant vegetation is referred to as hydrophytes or macrophytes. These plants require special adaptations for living submerged in water, or at the water's surface. Aquatic plants can only grow in water or in soil that is saturated with water.

The following are Characteristics of aquatic plants:

- These have reduced and shallow roots. The primary function of these roots is to anchor the plant to the ground.
- Plants that normally are submersed typically form their flowers raised above the water surface.
- Some of the aquatic plants float on the surface of water with no attachment to the mud or bottom. These have inflated portions of leaves, stems, or special hairs that enable the plant to remain floating.
- Plants rooted in the mud have immersed leaves with photosynthetic stems. They also have relatively small leaves similar to those of typical leaves of terrestrial plants living nearby?

Marsh vegetation:

A marsh is a wetland that is dominated by herbaceous rather than woody plant species. Marshes can often be found at the edges of lakes and streams. In such places they form a transition between the aquatic and terrestrial ecosystems. Marsh vegetation is dominated by grasses, rushes or reeds. Familiar examples of marsh vegetation include cattails, sedges, papyrus and sawgrass.

The following are characteristics of a marsh

- The marsh vegetation is a common characteristic of wetlands areas and grows in poorly drained water.
- The marsh vegetation grows in both fresh and salty waters.
- The marsh vegetation is found along the rivers and lakes.

Swamp Vegetation

Swamp vegetation occurs along large rivers where they are critically dependent upon natural water level fluctuations. When a swamp vegetation is dominated by forest, it is called a wetland. Some swamps have hammocks, or dry-land protrusions, covered by aquatic vegetation, or vegetation that tolerates periodic inondation.

Characteristics of swamp vegetation are:

- They are characterized by poorly drained soils and different plant life dominated by trees.
- The later characteristic distinguishes a swamp from a marsh, in which plant life consists largely of grasses.
- They grow in waterlogged areas where there is sufficient supply of water, that allows or stimulate decay of organisms and prevent the accumulation of organic materials.
- They are often found in lowlands associated with rivers that supply the water to some lakes.
- The number of plant species in swamps is less. While the one found in areas associated with well-watered conditions and no waterlogged land, has more plant species.

All the swamp vegetation such as mangrove, marsh, wetlands and aquatic forests, are associated with various economic activities. These include tourism, hunting and fishing of crayfish and mudfish. They are also used for research and study purposes. These support art and craft making.

Application Activity 9.8

1. *Explain the conditions that favour the growing of mangrove vegetation in West Africa.*
2. *Examine the economic importance of mangrove vegetation to man.*

9.9. Factors influencing natural vegetation

Activity 9.9

Make a field trip in your home area and observe types of vegetation. Use the results of your observation to explain the factors influencing their distribution.

There are various factors that influence the growth and distribution of natural vegetation. There is no single factor that plays a key role alone, but rather a combination of two or more factors. These factors include the following:

- **Rainfall:** Growth of vegetation depends on amount of rainfall. For example, Equatorial rainforests have evergreen and dense vegetation. On the other hand, places with low rainfall have scattered vegetation. This explains why there is little vegetation in deserts.
- **Temperature**: Forests found in cool areas have fewer tree species. Those in hot areas have more species. The cold mountain tops have heath and moorland.
- **Relief and altitude:** It has been noticed that with a rise in the altitude, the plants in the region show a stunted growth. Trees such as pine, silver fir, birch, and juniper fall in this category of vegetation. These contribute to variation in vegetative zonation along the slope.
- **Slopes:** Areas on the opposite sides of mountains have different vegetation. Steep slopes have more runoff. Gentle slopes allow water to sink into the soil. Plants use this water.
- **Soil types:** This factor provides basis for different types of vegetation. The sandy soils in the desert support cactus and thorny bushes. Wet, marshy or delta soils support mangroves and other deltaic vegetation.
- **Human activities:** These include settlement, mining, farming and livestock keeping. For example, vegetation is cleared to create space for building houses. Trees are cut for firewood and timber. New or artificial vegetation is planted.

- **Drainage:** It determines the vegetation of a place. There are plants that grow best in areas of good drainage while others grow well in swampy conditions for example papyrus which only grows in swampy area.

Application Activity 9.9

Describe the influence of human activities on vegetation distribution in Rwanda.

9.10. Importance of the natural vegetation

Activity 9.10

Make a field trip in your home area, observe nature of vegetation and explain the significance of it to man.

The following are the significance / importance of vegetation to man*:*

- Plants that form vegetation are the main source of food for humans. These foods are in form of vegetables, fruits, grains, cereals, leaves, seeds and they comprise of carbohydrates, oils, proteins, vitamins and minerals. Vegetation also provide foods for domestic and wild animals.
- Provide construction materials for example, trees are used for the construction of houses, bridges and poles.
- Vegetation helps to regulate the flow of numerous biogeochemical cycles in the atmosphere. Most critically those of water, carbon, and nitrogen. It also contributes in the local and global energy balances.
- Vegetation plays an important role in our ecosystem. Whereby, plants are known as the primary producers since they can manufacture their own food through the process of photosynthesis using sunlight.
- The natural vegetation provides man with a variety of products which include flowers, stems, roots, oil and many others. These are used to meet man's needs such as in making of perfumes, cosmetics and aesthetic purposes.
- Vegetation has contributed hugely to the world economy, particularly in the use of fossil fuels as an energy source. It provides biomass and some vegetation residuals are used to produce biogas.
- Vegetation provides timber for furniture. Items as beds, chairs and tables are made from timber. Timber is also used in construction activities.

- Vegetation plays a key role in the formation of soils. Their roots facilitate weathering.
- Dead vegetation becomes humus, which makes the soil fertile.
- Vegetation is also a natural resource, which provides number of uses to man. That is to say, products such as ropes, rubber, gum, papers, and wood are obtained. These are used in manufacturing of materials like books, rope, tyres, and seats.
- Some plants have medicinal content. These herbs are used in treatment of various diseases that threaten human lives as well as those of domesticated animals.
- Vegetation is source of materials such as cotton. This is used in textiles and fabric materials used in making of clothing for human use.
- Vegetation such as forests and grasslands attract tourists. These pay (money) when they visit to see the animals and a variety of flora. The money is used to develop the social facilities such as schools, hospitals etc.
- Vegetation helps to clean or purify air through harvesting carbon dioxide from the atmosphere. Again, trees produce oxygen that human beings and animals use for survival.
- Places with forests receive more rainfall. This is through the process of transpiration.
- Areas with forests act as sources of rivers. These are called water catchment areas.
- Many people get jobs. They are employed as researchers, forest guards and forest officers.
- Vegetation makes the landscape beautiful.
- Tree and plant roots hold the soil together. Therefore, forests protect the ground (soils) against soil erosion, mass wasting and the general impact of heavy rainfall.

Vegetation has also negative influences to man which are the following:

- Vegetation is associated with some pests such as tsetse flies and ticks which put the lives of people and animals at great risk, since they cause diseases.
- Some plants are thorny-leaved and they are harmful to human beings and animals.
- Vegetation is a habitant place for dangerous animals which may attack or harm human being.
- Some plants are poisonous and may kill human being and animals when eaten.

Application Activity 9.10

Examine the value of natural vegetation for sustainable development of the country.

Skills lab

Vegetation plays a great role in daily life. Identify any type of vegetation and link it with the appropriate economic activity in the local community.

End unit Assessment

1. *Discuss the distribution of natural vegetation in the world.*
2. *Describe the relationship between vegetation and land use.*
3. *Draw a map of the world and on it, show the following vegetation types:*
   - *Savannah humid*
   - *Mediterranean vegetation*
   - *Desert vegetation*
   - *Mountain vegetation*
4. *How do the following factors influence the distribution of vegetation in Africa?*
   - *Variation in temperature.*
   - *Variation in relief*

UNIT 10

POPULATION GROWTH IN THE WORLD

Key unit competence: The student-teacher should be able to discuss the problem of the population growth and the ways of controlling the population growth in the world.

Introductory activity

Population is one of the main complex issues in geography, its study is essential for proper national planning in relation to the provision of social services to the people. Today there is fear generally that the rate at which population is increasing presents great challenge to the world resources.

1. *Explain the term **"population"** and its related concepts.*
2. *Discuss the factors influencing population distribution in any area.*
3. *Compare and contrast the population problems in developed countries and developing countries.*
4. *Describe the population policies that should be taken by countries to control their rapid growth.*

10.1. Human diversities

Activity 10.1

The world population is composed of billions of people from different countries, speaking different languages, praying from different churches and having different cultures. This makes what geographers call "human diversity" in the World.

1. *Referring to the paragraph above explain the following concepts:*

i) Human diversity
ii) Race
iii) Languages
iv) Religion
v) Culture

Population is the number of people living in an area at a given period. The study of population growth, density, distribution and movement is referred to as demography.

Human diversity means understanding that each individual is unique, and recognizing our individual differences. These can be along the dimension of race, religion, languages and states.

10.1.1. Race

The term race refers to similarities of genetic patterns among aggregates of individuals of human populations. The varying genetic patterns find their expressions in the physical traits of human species. Races can be differentiated based on the following aspects:

- **Hair types**: People's hairs also differ. Some have black hair such as the Africans, others long, reddish hair such as the Europeans and yet others have white, short or brown hair.
- **Skin colour**: People of the world have different skin colours. For instance, in Africa though all people are black, some are brown. In other continents, people are white and others are red like the red Indians.
- **Climatic factors:** Races are also differenced by climatic location. For example, most people of the tropics are black and others though brown have black hairs like those of black Americans.

Generally, two types of classification of races have been identified;

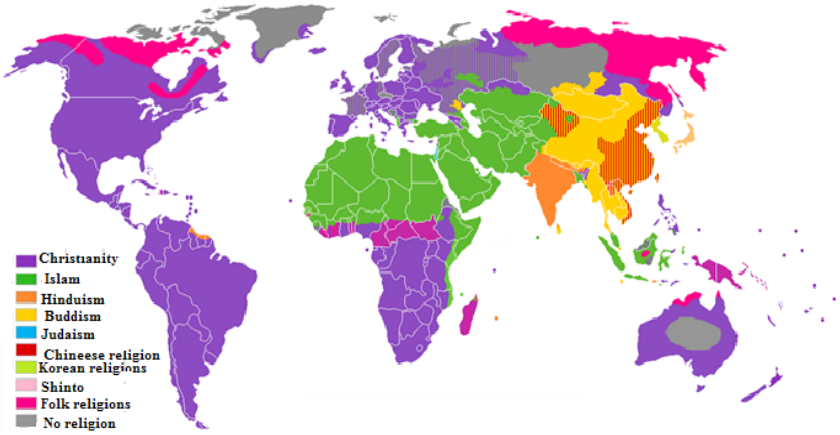
a) **Phenotypes**, in which human population is classified into various groups based on their physical features.

b) **Genotypes,** in which population is classified into groups based on genetic origin of their physical traits.

10.1.2. Religion

It is a unifying factor for the people with the same religious beliefs. For instance, some religions encourage conversion of non-believers of different races or societies such as Christianity, Islamic, Hinduism and Buddhism may bring people from all parts of the world and from all occupations together. The following figure shows the portions of the main religions in the world.

The number of adepts of main religions

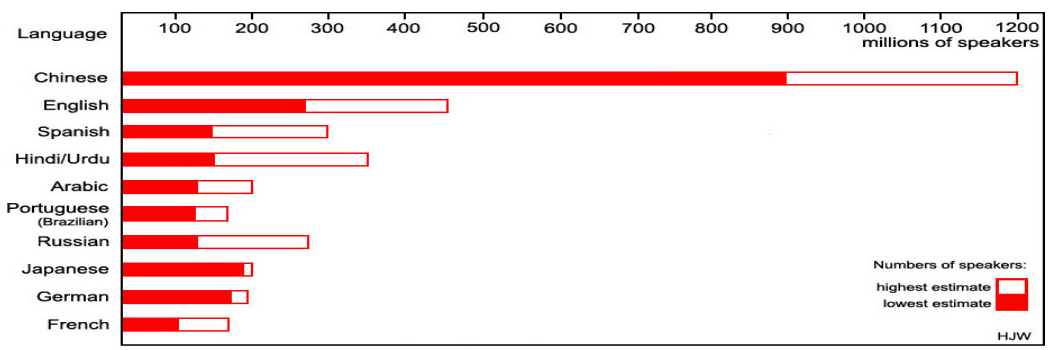


The world distribution of adepts of main religions

10.1.3. Languages

Various groups of people speak different languages. For instance, people in Rwanda speak Kinyarwanda, those of Burundi speak Kirundi, Kenyans speak Swahili, etc. There are local languages spoken by a group of people within a country as well as national and international languages. Some people speak more than one language. The language acts as unifying factor that plays an important role in solidarity among the people.

The languages can be classified according to the number of speakers as it is presented below:



Ten top languages having more speakers the world (2012)

10.1.4. States

A state refers to a nation or territory considered as an organized political community under one government. In this case, a state is taken as a country. Nevertheless, in some cases a state is different from a country. A good example is the United States of America where a country is made of the union of 50 states.

State expresses merely the actual organization of the legislative or judicial powers; thus, the actual government of the state is designated by the name of the state. In that case, people permanently occupying a fixed territory bound together by common habits and custom into one body politic exercising, through the medium of an organized government, independent sovereignty and control over all persons and things within its boundaries, capable of making war and peace and of entering into international relations with other states.

Application Activity 10.1

1. *With typical examples from Africa, identify and describe the religions operating on the continent.*
2. *Examine the main aspects considered in differentiating the types of races.*

10.2. Population concepts and their related effects

Activity 10.2

World wide areas with favourable climatic conditions, abundant natural and water sources, fertile soils, social amenities, security and political stability tend to pull people settlement and therefore, being world over crowded areas. On the other hand, areas with unfavourable climatic conditions, infertile soils, abundant natural and water sources and limited social facilities tend to limit population settlement hence being less populated areas.

1. *Why is under population undesirable in a country?*
2. *Referring to above passage, explain the following population concepts:*
   - *i) Optimum Population*
   - *ii) Under population*
   - *iii) Overpopulation*

10.2.1. Optimum population

It takes place where the population and resources are equal and the human population is able to balance and maintaining a maximum population size with optimal standards of living for all people.

The following are the major characteristics of optimum population:

- The population has the highest quality of life.
- Each inhabitant receives adequate amount of food, energy, water, and air of high quality.
- Adequate raw material to permit him/her to make all the things and devices he/she needs.
- Adequate medical care, recreational facilities and cultural outlets, etc.
- Optimum population is the one that enjoys full employment, a satisfactory level of life.
- The optimum population can be regarded as that state of equilibrium between the population and the resources, which satisfies the well-defined needs of all the members of a community.

10.2.2. Under population

It is a situation where the size of the population is below the available resources, hence they under-utilize the available resources.

i) Positive effects of under population

The following are positive effects of under population:

- *No Congestion:* A country with less population experiences little or no congestion
- *Employment opportunities*, as a result of small size of the population, there will be enough job opportunity for the people
- *Increase in social and infrastructural facilities:* An under populated country experiences a higher per capita in terms of social and infrastructural facilities available to the people in the country.
- *Availability of idle resources:* The resources available in that country is higher than the number of people, hence, many idle resources would abound everywhere.
- *Low pressure on social amenities:* Owing to low population, there is also low pressure on social amenities in the area.

ii) **Negative effects of under population**

The following are negative effects of under population:

- *Underutilization of resources:* Resources are highly underutilized in a country with low population.
- *Shortage of enough people to defend the country:* At times of war and emergency, a country might find it difficult to mobilize enough people to defend it.
- *Shortage of labour force:* The available natural resources capital stock and technology cannot be utilized properly.
- *Impossibility of specialization:* As the supply of labouris limited, specialization and rationalization schemes cannot be undertaken.
- *Low per capita income:* The underutilization of resources in the under populated countries, leads to a low per capita income.

10.2.3. Overpopulation

This refers to a situation where the number of existing human population exceeds the carrying capacity of the country.

The following are effects of under population:

- *Food shortage:* Food production cannot be rise in proportion to the increase in population. Food production lags behind the increase in population due to the influence of law of diminishing returns.
- *Unemployment:* The excessive population leads to massive unemployment. As the country's natural resources, capital stock and technology are limited. It is not possible to provide employment opportunities for all the people.
- *Fall in efficiency of labour:* When population increases after a particular stage, the number of labour also increases. As a result, each labour gets fewer amounts of capital and machinery and this leads to a fall in the efficiency of labour.
- *Increase in dependents:* The size of working population becomes less when compared to the size of children and old-aged persons. As the children and old aged-persons come under the category of dependents, their nourishment becomes a problem.
- *Pressure on the land increases:* The excessive population brings pressure on land where land remains less.
- *Decline in standards of living:* Shortage of foodstuffs, scarcity of houses, unfair distribution of national income lead to the decline of the standards of living of the people.

- *Limited transport facilities:* Some government in developing countries, due to inadequate financial resources, cannot construct and develop means of communication and transport to all parts of their countries.
- *Limited educational facilities:* Governments in developing countries, lack financial resources to invest in education due to the ever-growing population.
- *Over exploitation of natural resources,* as well as growth in energy production from coal, oil and natural gas is having a negative impact on the earth surface
- *Shortage in housing facilities:* The overcrowding results into the development of slums areas and their associated evils such as immorality and drug use.
- *Diseases:* The overpopulation leads to congestion and easy spread of disease such as dysentery, cough, cholera and others.

Application Activity 10.2

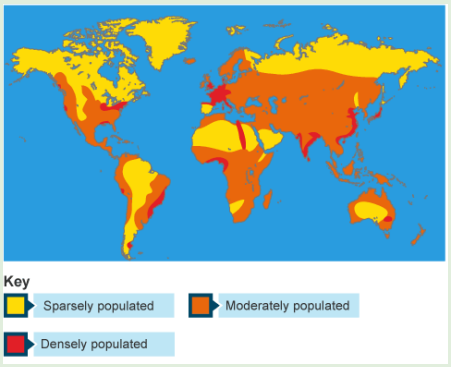
1. *Based on examples of Rwanda; discuss the effects of over population to the economic development of a country.*
2. *With clear examples, identify negative effects of under population.*

10.3. World population distribution

10.3.1. Population density

Activity 10.3

Critically observe the provided population map and answer the questions that follow:



With your own observation from the map above, identify the densely, sparely and moderately populated regions of the World.

Population distribution is the spread of the people across the world. It describes the pattern of where people live. There are places which are sparsely, moderately and densely populated.

Table 1: Top ten most populated countries in the world (2018)

	Countries	2000 population	2018 population	Growth % Pop 2000 - 2018
1	China	1,268,301,605	1,415,045,928	11.6 %
2	India	1,006,300,297	1,354,051,854	34.6 %
3	United States	282,162,411	326,766,748	15.8 %
4	Indonesia	214,090,575	266,794,980	24.6 %
5	Brazil	174,315,386	210,867,954	21.0 %
6	Pakistan	152,429,036	200,813,818	31.7 %
7	Nigeria	123,945,463	195,875,237	58.0 %
8	Bangladesh	128,734,672	166,368,149	29.2 %
9	Russia	147,053,966	143,964,709	- 2.1 %
10	Mexico	99,775,434	130,759,074	31.1 %
Total for ten Countries		3,597,108,845	4,411,308,451	22.6 %
Rest of the World		2,547,898,144	3,223,449,481	29.6 %
Total world population		6,145,006,989	7,634,757,932	25.5 %

Population density is a measurement of the number of people in an area. Population density is calculated by dividing the number of people by area. Population density is usually shown as the number of people per square kilometer. The World population distribution includes the following categories**:**

(i) The densely populated areas:

These are regions with more than 100 people per square kilometer:

- **East and south East Asia** including countries like Singapore, China, India, Bangladesh, Japan, South Korea, the Philippines and Taiwan.
- **Central and Western Europe** including countries like Germany, the United Kingdom, France, Italy, Belgium and the Netherlands.
- **The Caribbean countries** including Jamaica, Trinidad and Tobago, Cuba, West Indies and El -Salvador, Eastern USA and south eastern Canada.
- **Nile valley and delta**about 39 million people live in the Nile-Delta region.

(ii) The moderately populated areas: these are regions with between 25 and 100 persons per square km. These areas are usually dominated by agricultural occupations and typical examples include Australia, Brazil, USA, Argentina and Chile etc.

(iii) The sparsely populated areas: are regions with few people per square kilometer. They include Sahara Desert, the Atacama, Kalahari Desert and Australian deserts. The high mountain ranges: Himalayas, the Rockies, the Andes, the Alps and dense forests of equatorial regions in the Amazon, Congo and outlying islands of Indonesia.

10.3.2. Factors responsible for the distribution of population in the World

The following are factors influencing the distribution of population in the world:

- *Amount of rainfall*: Areas that receive high and reliable rainfall over 1500 mm attract high population densities because they are suitable for agriculture.
- *Soils:* fertile soils encourage growth of a variety of crops; hence food and employment attract people.
- *Pests and diseases:* Diseases carriers like tsetse flies and ticks carry diseases such as trypanasomiasis and east coast fever that discourage farming and settlement in some areas hence a low population density.
- *Altitude:* Altitude has an influence on population distribution, for example from2700 m above sea level, temperatures are extremely cold and severe soil erosion discourage settlements.
- *Vegetation:* The natural vegetation of an area is also an important influence on population distribution. Dense forests, bush land, deserts and swamps are unfavourable areas for settlement.
- *Relief:* The rugged mountains discourage settlement. For instance, the rift valley and lowlands especially along rivers are unfavourable for human settlement while some gentle slope are easy to work and build and hence attract more people.
- *Slavetrade*: This led to depopulation from areas of origin and led to increased population to the areas where they were taken.
- *Migrations:* the internal migration such as rural-urban migration leads to an increase in population in urban areas and rural-rural migration may influence population distribution from one rural area to another.
- *Civil wars:* These have reduced population in some regions like southern Sudan, Somalia, Democratic Republic of Congo and tribal clashes in some parts of Kenya Rift valley numbers causing emigration.

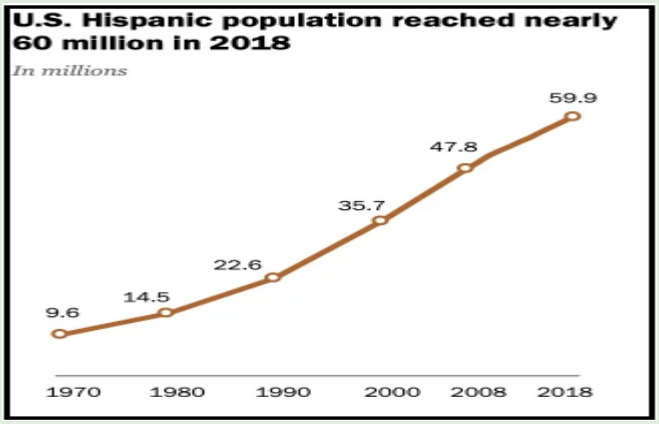
- *Government policies:* This may reduce population where land has been set aside for establishment of national parks or construction of dams, whereas some policies such as establishment of irrigation schemes in dry lands or settlement schemes lead to population increase.
- *Industrialization*: Industrial towns like Nairobi, Kigali, Kampala and Kinshasa have large industrial establishments producing chemicals, foodstuff, plastics and textiles which attract people for paid employment hence a high population.
- *Energy resources and minerals:* Energy resources and mineral attract people to settle in a given area. Minerals like coal in their prime age have greatly influenced the pattern of population distribution in countries like Great Britain, France, and Germany etc.
- *Historical factors:* Areas that were occupied by kingdoms especially near the King's palaces attracted a high population due to security.
- *Economic factors*. The economic viability of an area lies in its carrying capacity and its ability to provide employment opportunities. A specific economic system tends to arrange people in a specific distributional pattern.
- *Transport and communication:* The establishment of roads, railways and communication lines attracts dense population due to accessibility of the area.
- *Political factors:* Countries that are politically stable attract a high population, whereas political instability in some countries can cause population displacement and migrations.
- *Demographic factors:* The changes in the distribution and density of population in the world take place through variations in the rate of natural increase (fertility and mortality rates).
- *Natural hazards and disasters:* For instance, earthquakes, landslides, volcanic eruptions, floods, glacial advances, storms, epidemics, fire, and severe droughts constitute the physical disasters. These factors have discouraged population distribution in areas where they occur.

Application Activity 10.3

1. *With the aid of a drawn sketch population map of the world, identify the densely and sparsely populated areas.*
2. *Explain factors controlling population distribution in Rwanda.*

10.4. Rapid population growth

Activity 10.4



Source:*2008 Report, US. Population projections 2005-2050*

The above is a line graph indicating the population growth of U.S. Observe it careful and answer the questions that follow:

i. Compare the population growth in 1970-1980s and 1990-2018s

ii. What are the causes of the rapid population growth?

iii. What measures should be taken to control the rapid population growth?

10.4.1. Causes of rapid population growth

The following are causes of rapid the rapid population growth rate:

- Improved health care has reduced mortality rates by diagnosing health problems in a timely manner. Use of vaccines has helped to prevent illnesses that used to kill many people in the past.
- Introduction of better farming techniques has boosted the production of food. Areas where people die because of drought and famine get enough food supply thus saving lives.
- Increase in the fight against poverty has also contributed to population increase.
- Immigration has also contributed in population growth in developed countries and urban centers. This has led to an increase of population in many developed countries.

- Poor family planning in many families is one of the major contributors to population growth.
- Children are regarded to be a religious duty: Many people have the religious belief that having children is regarded to be the holy and religious duty of the married couple.
- Malnutrition due to which many people die every day. Parents are not sure that all of the children can be alive. Therefore, they want to give birth to the many children.
- Polygamy where a man gets married to multiple women, and these women give birth to more babies.
- Cultural factors where many people do not want to apply measures of family planning. They think it is unholy to use family planning measures and prevent conception.
- The social and religious values and customs are mainly based on the traditional attitudes of people. It is the conservative belief that the son is necessary to inherit parental property, continue the family line and perform the funeral rites.
- Artificial population increases, this arises from incoming migration of refugees and a natural phenomena such as war, flooding, famine landslides massively displaces people, forcing them into new lands there by rapidly increasing population in the receiving country.
- Level of education: When you take long at school and come out, you have a lower reproductive than a person who dropped out of school and married at young years.

10.4.2. Effects associated with rapid population growth

The following are some of the effects of rapid population growth:

- Available facilities become insufficient for the growing population. It leads to the falling of living standard.
- It is difficult to provide suitable employment opportunities for all. The result is large-scale unemployment which also causes the living standard to decline.
- Natural resources are over-utilized and their quality degrades.
- The environment is polluted and environmental problems occur.
- Crimes such as robbery, theft, murder and abduction increase and this leads to killing of people with property and money and stealing commercial banks for better looking of life.
- There are difficulties in finding basic needs such as food, shelter, clothing, education and health services.

- There is deforestation for agriculture and settlement.
- Land shortage, which results into land fragmentation, conflicts, food shortage and famine.
- Heavy strain on government expenditure in the provision of social services and others such as importation of drug and food to sustain the population.
- It results into a high dependency burden, this leads to low saving capital and low capital accumulation, low investments and slow economic development of a country.

10.4.3. Ways of controlling population growth

The following are some ways of controlling population growth:

- *Family planning:* It is to ensure that a woman gets a child when she actually wants one. It reduces accidental pregnancies and ensures a controlled family size.
- *Raising the level of education:* Education particularly that of women is very important in population control. Education changes cultural beliefs and attitudes.
- *Increasing employment opportunities* for women: As more women join career jobs, they tend to be occupied by work and produce fewer children.
- *Increasing income:* Increased incomes result in an increased demand for durable goods such as electronic goods, houses, furniture and leisure activities such as holiday outings, films and theatre shows, sports, and music instead of children.
- *Increased security in old age:* In some communities where children regarded as security in old age, introduction of pension schemes, insurance schemes and incomes for old people can substitute as security for old age. Efforts should be made to ensure that more people are within the National Social Security Fund.
- *Enacting child labour laws:* Where children regarded as suppliers of labour, strict laws are enforced to restrict the minimum age for child employment. For instance, laws might be enacted to make it illegal for anybody to employ a child below the age of 16.

Application Activity 10.4

1. *What are the causes of rapid population growth in developing countries?*
2. *What are the effects of rapid population growth in Africa?*
3. *Explain the appropriate population control measures to be used in Rwanda.*

10.5. Migration

Activity 10.5

When the husband left her alone with four children, Amina decided to leave her home country of Nigeria to seek a better life for her family. Unfortunately, Amina and her children felt victim to one of the smuggling networks that operate between the Horn of Africa and the Arabian Gulf. They were held captive for three months by a gang who tried to extort money from Amina's family. Eventually, after a dramatic rescue, Amina and her children were referred to IOM (International organization for migration) Yemen's Migrant Assistance and Protection team. They are now receiving food, water and shelter thanks to IOM's assistance.

1. *Identify the type of migration explained from the above passage.*
2. *With reference to the passage above, explain the causes of migration.*

Migration is the movement of people from one place to another with the intentions of settling permanently or temporarily in a new location.

10.5.1. Types of migration

There are various types of migration. It is very important to note that migration has often classified into various categories or types. Below is a detailed description of main types of migrations:

Internal migration: This is the movement of people within the country. It is further subdivided into rural-urban, urban-rural, rural-rural, urban-urban migrations.

International migration: This is the movement of people from one country to another. For example, if a person lives Rwanda and settles in USA, this type of migration will be called international migration or external migration.

Permanent migration: This is the type of migration that involves movement of people from one place to another without the intentions of coming back to the source area.

Temporary migration: This type of migration involves the movement of people or person from one place to another but with hope of returning back to the source area.

Voluntary migration: This where people move from one place to another out of their own will without being forced. It is their choice to move.

Involuntary migration: This is when people are forced to move from the areas of origin.

10.5.2. Causes of migration

The following are some important causes of migration:

- *Technology factors:* The people with more sophisticated technology may invade and conquer new areas and this attracts less developed societies to migrate.
- *Economic reason:* People are forced to migrate, and to settle in the area where the conditions reflecting the economic prosperity and offer greater employment potential.
- *Underemployment and unemployment:* This forces people mostly youth to leave their home to the places and countries where the employment opportunities are abundant.
- *Overpopulation:* an excess of population in area in relation to the resources available and technology is known as overpopulation and it can force the people to migrate to another area.
- *Social and religious causes:* The human desire to stay, work and enjoy life with the people of his ethnic, social, religious groups is also an important cause of migration.
- *Political policies:* The forced and compulsory emigration is always found with tragic highlights in human history.
- *Demographic causes:* It is obvious that the young groups migrate than other age group. They constitute the major force of work force. The young energy and skilled, therefore, at present the youth migration is more other age group.
- *Diffusion of information:* The information network and cultural contact widens the horizons for job opportunities hence migration.
- *Rise in the aspiration:* Everybody is tempted to enjoy a better standard of living. Many present generations with trainings and skills aspire for

leisure life. Thus, they migrate to other areas in search for jobs with high salaries.

- *Wars:* War has been an important cause of human migration. For instance, the two world wars I, II. The World War I (1914-1919) displaced six million people The II World war (1939-1945) displaced 16 million people
- *Love for adventure*: For instance Europeans coming to Africa (Rwanda and East Africa).

10.5.3. The effects of migration in the world

There are both positive and negative to areas of origin and destination of migrants and these are follows:

Positive effects to areas of destination

The following are positive effects of migration to the areas of destination/ recipient:

- Simplifies easy exchange of ideas among people of different countries origins.
- Provision of low-priced labour, thus adding to growth of industries, agriculture and the service sector.
- Migrants provide security services such as banks, shopping centers, suburban areas and in National security services to defend the country's interests.
- Migrants are a source of revenue to central governments through Visa fees, entry fees and work permits.
- Ready market for produced goods such as electronics, textiles leading to growth of the industrial and agricultural sectors.

Negative effects to areas of destination/ recipient area

The following are negative effects of migration in destination/ recipient area:

- Has led to spread of diseases from the origin place.
- High crime rate for instance robbery, terrorism in Nigeria, Somalia and southern Sudan, which have compromised the standard of living and loss of lives.
- Development of Slum areas, with undesirable results boosts poor sanitation conditions which compromise the people standard of living.
- Congestion on roads leading to delay of service delivery, markets in Kampala, Nairobi and Kigali.

- High unemployment level, for instance Kigali, Bujumbura and Kampala led to loss of an income for people to increase their way of living.

Positive effects on the areas of origin/ donor area

The following are the positive effects of migration in the areas of origin/ donor area:

- Reduced conflicts, for instance political migrants from Iraq, Southern Sudan Syria, Nigeria and Burundi to have resulted into political stability.
- Decreases pressure on land for example in China and Indian, this generating areas to carry out agriculture, business and development of industries at large.
- Reduction of criminal rate, for instance thieves, thus boosting the people's standard of living.

Negative effects on the areas of origin

The following are negative effects of migration in the areas of origin:

- Insufficient of market for goods, hereafter affecting industrial sector and agricultural sectors, and therefore led to under development of rural areas.
- There are limited investments established in rural areas. For instance, lack of standard hospitals, advanced research centers and modern market.
- Low agricultural productivity in rural due to active youth who run way to from rural -urban in search of employment opportunities and therefore old people at work with less output causes of shortage of food.

10.5.4. Control measures of migrations

The following are some of measures to be taken to control migration:

- Governments should encourage urban-rural migration in order to developed rural areas.
- Setting up resettlement schemes in rural areas to accommodate the landless and less privileged people.
- Improving of security in rural areas to control high crime rate and this enhance rural investments.
- Provision of employment in rural areas by establishing dairy farming to process agricultural products.

- Setting up rural electrification to develop industries, improve the standard of living in rural areas by having access to television, milling maize industries, and appropriate light during the night.
- Improvement of clean water and sanitation facilities in rural areas through development of piped water to minimized hygienic diseases.
- Improvement of communication and transport services in rural areas to boost transportation of agriculture commodities and animal's products to urban centers for sale.
- Setting up micro-finance projects in rural areas to provide loans to farmers, business, improved trader capacity, and small-scale industries to boost on the standard of living of rural population.

Application Activity 10.5

1. *With reference to examples, discuss the reasons and the results of international migration*
2. *Migration has occurred in Rwanda in past years; briefly discuss the causes and consequences of migration to Rwandans.*

Skills lab

Rapid population growth resulted into many problems across the world. Identify the problems of population in your local areas.

End unit Assessment

1) *Describe and suggest reasons for the rapid increase in the world's population in the recent times.*
2) *Explain why problems may result in areas of overpopulation and under population.*
3) *Describe the relationship between population growth and resources in your country.*
4) *With reference to Rwanda, suggest what can be done to control migration.*

UNIT 11

SETTLEMENT AND URBANIZATION IN THE WORLD

Key unit competency: The student-teachers should be able to discuss the impact of settlement and urbanization on the sustainable development of different countries.

Introductory activity

Most cities, including your home town or city, have in common a land use pattern that stretches from the center to the rural-urban fringe and to the rural area.

1. Compare and contrast the areas presented, what are common on the three pictures?
2. Which of the following photographs best explains a village? Support your answer with evidence.
3. Identify the main activities found in urban areas.
4. What are the environmental impacts of both rural and urban settlements?

The concept of urbanization is well defined from the concept of settlement. A **settlement** refers to a place where people live. It can be large or small, permanent or temporary. A settlement also means the process of settling in such a place. Settlement is associated with the concepts of shelter, infrastructure and community services like health, culture and education. There are two types of settlements: rural settlement and urban settlement.

The term '**urban**', is opposed to rural which can refer to isolated building, hamlet, village, small market town while urban is related to towns or cities. **Urban settlement** is large nucleated settlement in which the majority of the employed inhabitants are engaged in non-agricultural activities. Urban areas may be defined by national governments according to different criteria; for example, size population density, occupation of the people, and type of local government. However, the United Nation defines an urban place as a permanent settlement with not less than 20,000 inhabitants.

Urbanisation is defined as the process by which an increasing proportion of the total population, usually that of a country, lives in towns and cities. For example, according to 2012 national census, 16.5 % of Rwandans live in urban areas. Urbanization refers also to the physical expansion of urban areas, or the increase in number of urban areas or towns.

11.1. Rural settlement

Activity 11.1

With reference to your own observation and the knowledge acquired from past studies

1. *From your experience, what do you understand by the term rural settlement?*
2. *Describe the different types of rural settlement.*
3. *What are the factors that would influence someone to create a settlement somewhere?*

Rural settlement is sparsely populated community that exists in a given area. The population density in rural areas is very low compared to the urban areas and the houses are scattered. The largest land use is agriculture. This means that most people are engaged in agricultural activities and other related activities such as livestock farming, fishing, mining, hunting etc. Sometimes, there are larger agricultural agglomerations but cannot be considered as urban centers due to the primary activity common in that region.

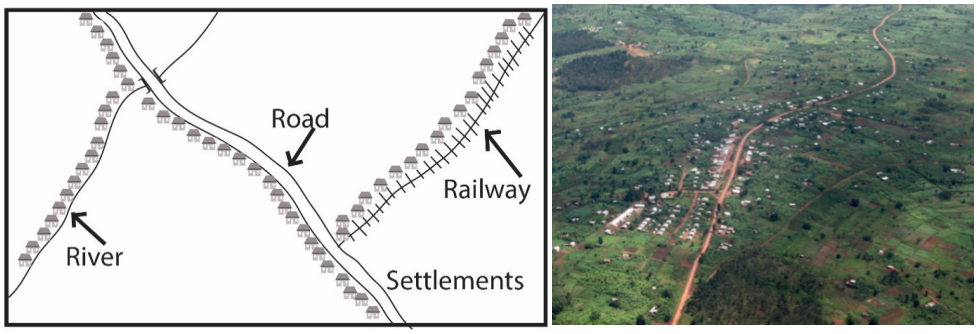
11.1.1. Types of rural settlement

The following are the various types of rural settlements:

i) **Nucleated settlements pattern**: it is also known as clustered or grouped settlements. Houses are concentrated in one place without proper arrangement. Nucleated or clustered settlements often form at crossroads or route centres. These types of settlements are known as "Imidugudu" in Rwanda. Socially, the people are closely knit.

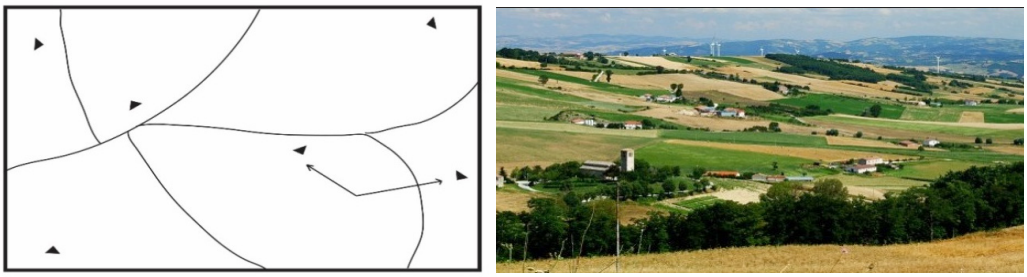
Nucleated settlement

ii) **Linear settlement pattern:** this is where houses are well planned and concentrated along the communication lines like roads, railway stations or along the coast. The fields extend behind the buildings in long, narrow strips. These are mainly influenced by economic factors. Linear settlement patterns are also known as ribbon settlement.



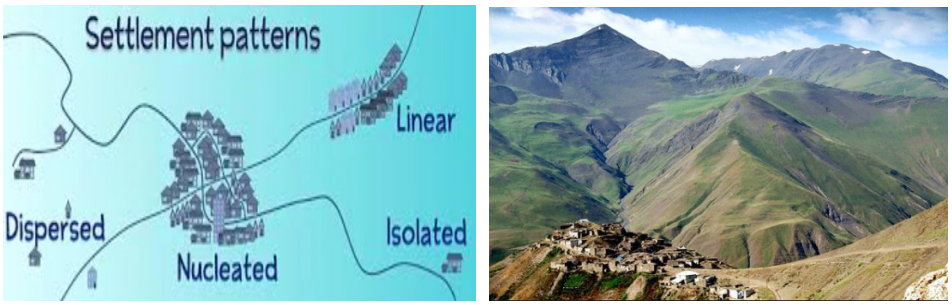
Linear settlement

iii) **Dispersed/ scattered settlement pattern:** this is where houses are scattered all over the area. The settlements are located at distance apart from each other. This type of settlement dominates in area where agricultural and livestock activities are dominant.



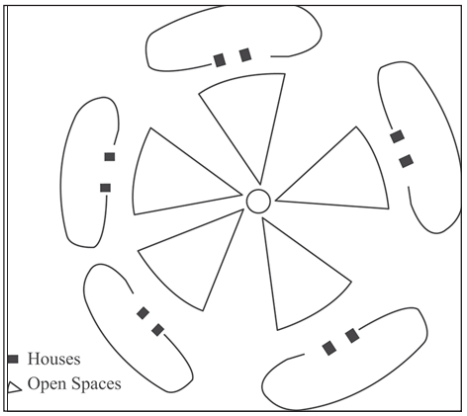
Scattered settlements

iv) Isolated settlement pattern: this is a type of settlement which characterizes people who are hunters, shifting cultivators and food gathers or other specific activity. That is people who are socially isolated by other people.



Isolated settlement compared to other types of settlements

v) Ring settlement pattern: in this type of settlement, houses make a circle. There is an open ground at the centre.



Ring settlements

vi) Planned settlement pattern: These are settlements which are deliberately designed to assume a certain shape and pattern. They may develop due to planning from the government. The emergence of the various patterns of settlement is influenced by the following factors.

Planned settlements

11.1.2. Factors influencing rural settlement

A place where a settlement starts is called a **site** of a settlement. Any settlement site is chosen because it has lots of good reasons for locating a settlement there. The following are the main factors influencing rural settlement:

- **Water supply:** Water is an important human need. It helps in deciding where a settlement might be located. Thus most settlements are located near water sources such as rivers and lakes.
- **Soil fertility:** Farmers often choose to settle at points where the land is suitable for crops growing as agriculture and livestock are the key activities in rural areas.
- **Security:** More people settle in areas where there is peace. They are able to live without fear of anything.
- **Building materials** liketimber and stone attract people to settle where they are easily available.
- **Absence of natural hazards:** Very few people live in places likely to be hit by natural hazards.
- **Climate:** People are much more attracted to settle in temperate climate areas. Few people live in very hot or very cold areas.
- **Means of transport and services:** The presence of roads, schools and hospitals attract many people for settling around them.
- **Presence of minerals:** People like to settle where mining activities are taking places as jobs are available in those areas. In those areas, the markets, schools and hospital are built to serve them.
- **Government policy:** The government decides where people should and should not settle. This is done as part of planning.

- **Cultural and social factors:** For example, a father dividing his land among his children. The children settle in the same area.
- **Relief:** Few people live on the steep slopes of mountains. On the other hand, Flat land is easier to build on and it is good for growing crop**s** that is why many people live in plateaus and the plains.

11.1.3. Effects of rural settlement

The concentration of people in rural areas has both negative and positive effects:

Positive effects

- The development of rural settlement, especially grouped and planned settlement facilitates the establishment of community services like schools, shops, hospital, electricity, water points and other basic infrastructure at the center of settlement.
- Rural settlement leads to the development of trading activities with surrounding settlements and urban centers.
- Rural settlement produce food stuffs to the urban areas.

Negative effects

- Rural settlements, especially dispersed settlements, experience shortage/lack of basic infrastructures such as water, electricity, roads, etc.
- They are exposed to pollution resulting from uncollected garbage and contaminated water.
- Rural settlement experience shortage of social services such as hospitals, schools and markets. People make a long distance to access such services.
- In rural settlement people fight for land for settlement and agriculture.
- There is high spread of disease like dysentery, cholera, and malaria due to poor hygiene and compaction of individuals.
- There is environmental degradation due to high demand for building materials, firewood, charcoal which further result into soil erosion reduction in rainfall and landslides.
- The family plots are fragmented and which makes them to be too small for commercial mechanized farming.

11.1.4. Solutions to the problems affecting rural settlement

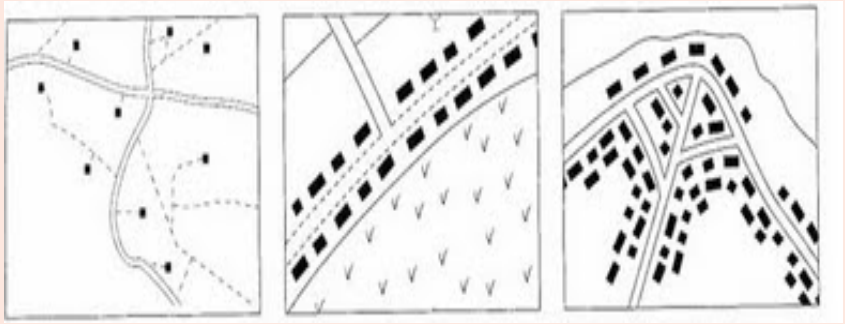
- To avail the basic infrastructures such as water, electricity, roads, etc. in the areas to be settled.
- Construction of social facilities and services such as hospitals, schools, market.
- Regular registration of land to reduce the conflicts related to the land ownership and use.
- Preparation of master plan and land use guide for all country to avoid unplanned settlement.
- Making environment management policies to avoid environment degradation.
- Establish good governance to avoid any kind of division, insecurity in population, etc.
- Sensitizing the rural settlers on the most effective way of managing the environment.

Application Activity 11.1

Make an excursion in rural areas not far from your school and

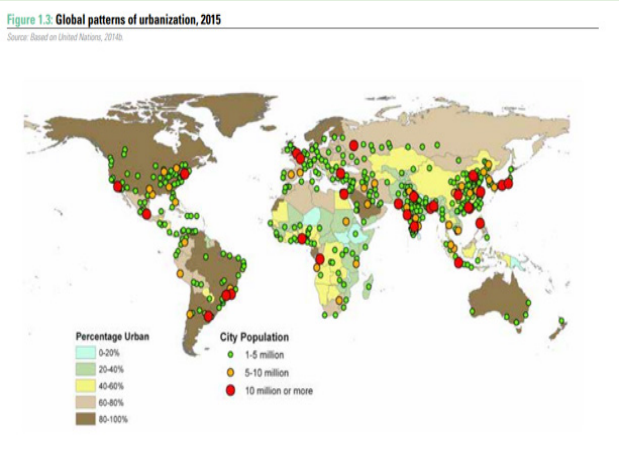
a) Examine the predominant activities.

b) Basing on what you have learnt in this lesson, associate the below diagrams with their corresponding names/ types.



11.2. Urbanization in the world

Activity 11.2



1. *Read this map above and show the most urbanized regions in the world.*
2. *Discuss the major factors influencing urban development in the world.*
3. *From your understanding, what are the socio-economic benefits of the big cities compared to small cities?*

11.2.1. Definition of basic terms

Different terms are used to express urban centers according to their size or their characteristics. The following are the commonly used terms.

- **Trading center**: A trading is a given settlement whose major occupation is associated with trading activities. It may be an area within a city or located away from the main city.
- **Town** is the smallest unit of urban settlement. Here urban functions are well marked although the possibility of some rural activities is not ruled out.
- **Town board** is the legislative body that governs a town/city.
- **Municipality** refers to a political subdivision of a state for a specific population concentration in a defined area. The municipality is bigger than a town in terms of covered area and number of population settled in that area.

- **City**: The term derived from the Latin word '***civitas***' which means community/city/town or state. It is a full-fledged urban agglomeration depicting predominance of urban occupations and complex internal structure. Any town with a population of one 100,000 or above is termed as city.
- **Agglomeration** is an extended city or town area comprising the built-up area of a central place (usually a municipality) and any suburbs linked by continuous urban area.
- **Megalopolis** denotes a large urban region formed by the out-growth of many metropolises. A megalopolis (sometimes called a ***megapolis***; also ***megaregion***, or super city) is typically defined as a chain of roughly adjacent metropolitan areas, which may be somewhat separated or may merge into a continuous urban region. Megalopolis also expresses the full mature stage of urban growth.
- **Conurbation** is a large continuous built-up area formed by the joining together of several urban settlements or town. It is an urban region consisting of a large metropolis and a number of small towns huddled together.
- **Suburb** is a mixed-use or residential area, existing either as part of a city or urban area or as a separate residential community within commuting distance of a city. Some suburbs have a degree of political autonomy, and most have lower population density than inner city neighborhoods.
- **Green city** refers to a broader metropolitan area. For example, "Chicago" represents the greater metropolitan area surrounding the city of Chicago. It aims to inform and stimulate the interest with authorities, organizations and companies which are professionally involved in planning and developing the urban area, ensuring green will be applied appropriately.
- **Slum** is defined as a highly populated urban residential area consisting mostly of closely packed, decrepit housing units in a situation of deteriorated or incomplete infrastructure, inhabited primarily by impoverished persons.

City of Mumbai and its slum

Source: http://footage.framepool.com/de/shot/603257630-worli-arabisches-meer-ghetto-mumbai

11.2.2. Factors influencing urban development in the world

Urbanization is the function of socio-economic changes that take place through time. The following are its determinants, which are mainly economic, social and demographic.

- The economic determinants are the type of economy, degree of commercialization of agriculture, the extent of diversification of economy, the changing size of agricultural landholdings, the stage of economic advancement and the degree of development of means of transportation and communication.
- The social factors that determine the nature and magnitude of urbanization are the degree of socio-economic awakening, the social value system, the stage of technological advancement, the public policies and the government decisions.
- Among the demographic factors, the rate of population growth, magnitude of migration and pressure of population are significant.
- Improvement of transportation can bring raw materials to any point quite cheaply.
- Improvement of information and technology which raised the population awareness about the available opportunities in other urban centers.

11.2.3. Impact of the world urbanization on the environment.

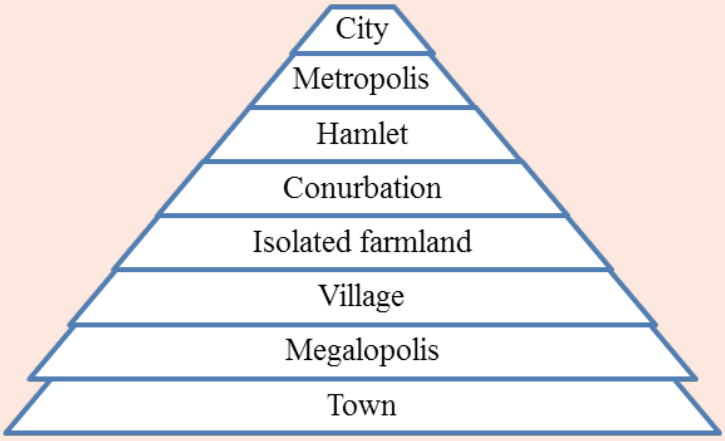
Urbanization might cause the following problems:

- Urbanization results into pollution of land, air, water and noise: This is because of poor disposal of garbage from the domestic remaining.
- Urbanization results into noise pollution from industry machineries, vehicles, and other means of transport,
- High energy consumption increases the release of CO_2 in the atmosphere. This leads to global warming.
- Most of people do not have access to safe drinking water especially in developing countries. Thus, poor sanitation and poor quality of drinking water result into water-borne diseases like Cholera, *Typhoid, tuberculosis, dysentery and gastro-enteritis*.
- Sewage also provides nutrition to a vast array *of microbes, bacteria* and fungus adding to the eutrophication of surface water bodies, seriously affecting the human environment and the entire food web in the eco system. Even the ground contaminated by the industrial effluents in the atmosphere, brought down by precipitation.
- Waste disposal is a major problem in large cities.

Application Activity 11.2

Assess the effects that urban centers have on the environment

1. *With reference to the below pyramid, arrange the settlement from the lowest to the highest level*



2. *Describe the effects of urbanization on the world and suggest some solutions.*

Skills lab

Suggest ways for improving infrastructure and social amenities in rural area for sustainable development of the country like Rwanda.

End unit Assessment

1. *With reference to Kigali city explain why towns are constantly growing both in population and area.*
2. *Suppose you are one of the urban planners, design a program that would address the problems caused by urbanization.*
3. *Describe the impact of expansion of Kigali City on the environment in Rwanda.*
4. *Kigali is currently experiencing rapid urban development in our region. From the knowledge acquired in this unit, identify the major factors which are contributing to that urban development.*

UNIT 12

AGRICULTURE IN THE WORLD

Key unit competency: The student-teachers should be able to explain the impact of agricultural activities on the sustainable development of different countries in the world.

Introductory activity

Look at the photographs above and answer the following questions

1. *How can you associate the above photographs with the word "agriculture"*
2. *Identify the contribution of agriculture in socio-economic development of Rwanda.*
3. *Describe different types of crop cultivation.*
4. *Discuss the main challenges facing agriculture?*

Agriculture refers to the growing of crops and rearing of animals either for subsistence or commercial purposes.

12.1. Crop cultivation

Agriculture is practiced in different parts of the world. It is categorized as a primary activity since it involves the production of raw materials that can be used by other industries. The following are the main types of crop cultivation.

The common types of crop production with their characteristics are briefly described in the following pages.

12.1.1. Subsistence farming

Learning activity 12.1

1. *Identify different crop cultivation methods used in farming*
2. *How does small subsistence farming differ from large scale farming?*

Subsistence farming is an advanced form of primitive agriculture. This type of farming refers to the growing of crops for domestic consumption. It is defined as a self-sufficiency farming system in which the farmer focus on growing enough food to feed themselves and their families.

Subsistence farming is commonly practiced in developing countries in Africa, Asia and amazon basin in South America.

Characteristics of subsistence farming

The following are the main characteristics of subsistence farming:

- It involves the use of members of the family as labour force.
- Subsistence farming implies rudimentary tools like hoes, pangas to cultivate and sometimes use of animals.
- Multi-cropping (growing many crops in the same field) is practiced. .
- The cultivated land is most of the time small.
- The production is mainly used for family consumption.
- There is limited or no use of technology in form of seeds, manure and tools.
- Organic manure and mulching are sometime applied on the land to improve its fertility ,
- The common crops grown in Africa (African staple food) are: maize, cassava, millet, beans, sunflower, fruits and vegetables.

Advantages and disadvantages of subsistence farming

Advantages of subsistence agriculture	Disadvantages of subsistence farming
• It is cost less because it is easy to control farm work. • It provides employment opportunities to the family members. These accept to work for small or no wage. • Food crops are usually grown and this ensures food security. • Little capital outlay is required to establish and maintain the farms. • Multiple cropping and intensive farming ensures maximum utilization of land. • Small farm sizes ensure the ease control of pests and diseases. • The well maintained small plots lead to low incidence of soil erosion.	• It is difficult to apply machines in subsistence farming such as tractors because of small farming size. • There is a low productivity because of the small area coverage. • The farming system leads to land fragmentation. The land is divided into small pieces and sometimes scattered to distant places. • Pests and diseases are spread easily since farm lands are near each other. Especially when the neighbouring farmers are growing similar crop. • It encourages the overuse of land leading to soil exhaustion • The production is too low since there is limited use of inputs.

The following are the main types of subsistence farming toe considered :

(i) Shifting cultivation

Shifting cultivation, known as non-sedentary cultivation, is an agricultural system in which plots of land are cultivated temporarily, then abandoned and allowed to revert to their natural vegetation while the cultivator moves on to another plot.

Slash and burn

Shifting cultivation is practiced especially in tropical region of Africa (example: Chipanga in Zimbabwe, Chitemene in Zambia and Masole in DRC), Central America (Milpa) in Mexico and South East Asia (Ladang in Malaysia).

The main crops planted under shifting cultivation are mainly starchy foods such as cassava, sweet potatoes, maize, millet, yams, etc.

Characteristics of shifting cultivation

- The farmers grow enough food to feed themselves and their family
- Practiced by remote tribal people residing in forests.
- The land to be cultivated usually is cleared from virgin forests.
- The farmer use fire in the process of clearing of land for cultivation.
- The pieces of land cultivated are usually very small. They rarely reach beyond 1-2 hectares.
- The plots of land cultivated are isolated from each other. Such are separated from one another by patches of forests.
- Traditional tools are used. These include digging sticks, pangas, and simple hoes.
- The farmer usually uses family members as labour force.
- The farmer abandons the piece of land when the crop yields decline and goes to a new part of forest to cultivate.
- The yields produced hardly support the food demands of the family. This calls for supplementing the crop yields with fruit gathering and bush meant from hunting.

(ii) Bush fallowing

Bush fallowing is a system of farming whereby the farmer cultivates one piece of land for some years and leave it thereafter with the aim of restoring naturally its fertility. Meanwhile, the farmer will be cultivating another piece of land since the farm is divided into clear plots.

Bush fallow farming practically occurs mainly in the humid tropics of Africa, South and Central America, Southeast Asia, and parts of Oceania.

Characteristics of bush fallowing

- It is mainly practiced by peasant farmers due to lack of agricultural inputs.
- Simple tools are used.
- The family is the main source of labour.
- Farmers are settled but the farms are the ones which are rotating.

- Bush fallowing is practiced where population density is very low.
- Farmlands are left to fallow after one or two years of cultivation.
- Farming is based on permanent and semi-permanent settlements.
- Farming depends on natural conditions for example rainfall, temperature and soil.

(iii) Small holder farming

This is a type of farming that is practiced in densely populated areas of the tropics. It is a more advanced form of subsistence farming where the lands are frequently cultivated and the community stays permanently in one spot. Crop rotation, melding, inter cropping, application of fertilizers etc. are applied.

Small holder's farmers

Source: http://www.ecorelief.org/vulnerable-people/smallholder-farmers/

Characteristics of small holder farming

- It is practiced in densely populated areas of the tropics
- Both food crops and cash crops are grown intensively on the same piece of land as well as rearing of very few animals.
- Farm plots are very small and fragmented
- As the land is small, crop rotation is practiced to preserve soil fertility as well as mulching techniques.
- Use of better farming techniques like irrigation farming on small scale, pesticides and herbicides. Manure as well as artificial fertilizers is applied on the plot.
- Available land is subdivided into small uneconomical plots to cultivate.

12.1.2. Cooperative farming and Plantation farming

Learning activity 12.2

1. *Using your own words, what does cooperative farming means?*
2. *Describe the advantages and disadvantages of cooperative farming*
3. *Examine the main features of plantation farming.*

a. Cooperative farming

This is a system of farming where farmers with similar interests pull their resources together to increase production and benefits. Individual farms remain intact and farming is a matter of cooperative initiative. The object of this organization is to help each other in agriculture for their common interests. There is collective ownership of land. The farmers are also registered and governed by laws.

Characteristics of cooperative farming

- There is collective ownership of resources such as factories, stores, and means of transport.
- Labour is provided by the members themselves.
- Profits and losses are shared equally by members.
- Credits facilities are available to the members from the funds collected.
- The members are educated and informed about new developments from time to time.
- The farms are either scattered or consolidated into one big unit.
- Land ownership may be on collective basis.
- Marketing of the produce is done collectively.
- Cooperatives are officially registered and governed by laws and regulations.
- There is quality control of the products.
- There is easy access to credits facilities to the members from the collected funds.

Advantages and disadvantages of cooperative farming

Advantages	Disadvantages
• Cooperative societies help farmers, to procure all important inputs of farming, sell the products at most favourable terms and help in processing of quality products at cheap rates. • Cooperative farming enables farmers to consolidate their small units of land for better utilization. • A single and poor farmer cannot purchase the machinery but a cooperative society can easily purchase various machine hence the reduction of the cost of production and increase the per acre yield • Cooperative farming enables farmers to live in harmony where it creates the brotherhood and love for the member as they work for the common purpose. • Belonging to the cooperative is a better position to get efficient guidance and training that will contribute to the increase of production. • About marketing, the cooperative farming will bargain in the market and will sell the product at maximum price hence the income of the individual farmer will increase. • Cooperative farming leads to the generation of employment opportunities in marketing, processing, research and other sectors. • By pooling different resources such as capital and labour together, farmers expect increase of productivity	• Cooperatives may hinder personal initiatives. The group influences and may discourage hardworking and enterprising members. • In most developing countries, processing plants set up by cooperatives often breakdown. A delay in acquiring the necessary spare parts hinders the smooth running of the cooperatives as well as mass production. • Some cooperative famers are unable to compete effectively with the more dynamic businessmen involved in the marketing and processing of production. • Sometimes there is unfair behavior of elected or salaried executives leading to lack of confidence of farmers towards leaders. • The farming operation especially crop growing depends on natural factors. In case of climatic changes such as drought, output is therefore affected. • There are social misunderstanding and disputes created because of many people working and dealing with cooperatives. • It favours misuse of cooperative properties and sometimes are embezzled by the cooperative members.

b. Plantation farming

Plantation farming is a form of commercial agriculture where a single crop is grown on a large area for profit. Countries that have plantation farming are those usually experiencing high annual temperatures and receive high annual rainfall. It is very distinctive type of agriculture which is practiced within the tropics especially in Africa, Asia and Latin America.

Tea plantation in Rwanda

Source:https://www.pinterest.com/pin/358669557794847499/

Among the most important crops found on plantations are coffee, tea, rubber, oil palm, cocoa, sugarcane and wheat. Besides, fruits such as pineapples and bananas as well as fibers like cotton, hemp, jute and sisal are examples of plantation agriculture.

Characteristics of plantation farming

- A huge labour force is required comprising of skilled, semi-skilled and unskilled workers.
- A selected crop is grown on large estates covering thousands of hectares and run by a large company or under government.
- Plantation farming requires heavy capital investment to purchase machinery and establish infrastructure.
- Production is mainly for the market and not for the farmers' consumption.
- There is specialization of labour.
- Plantations are scientifically managed. They use machineries, selected improved seeds, weed control, application of fertilizers etc. which results in high yields.

- Plantations are mainly owned by foreigners, large companies, the government or cooperatives which have the capital required to inject in the business.
- The crop is processed where it is grown for example sugarcane grown in Kabuye.
- There is less wastage of crop, e.g. from sugarcane we get sugar, sweets, animal feeds, cardboards, fertilizers, etc.
- Plantations cover large scale of land/area at least over ten hectares
- The plantation farms have well developed networks of transport connecting plantation areas, processing industries and markets.
- Plantations are normally established in sparsely populated areas.

Advantages and disadvantages of plantation farming

The following are advantages and disadvantages of plantation farming:

Advantages	Disadvantages
• Plantation farming offers employment opportunities. Many people skilled and unskilled labour are intensively employed. • Plantation farming stimulates the development of industries: the agro-based industries because they provide raw materials. • Plantation farming leads to the development of infrastructures such as roads. • The country raises foreign exchange when the crops are exported.	• The cost of setting up a plantation is very high. This discourages small farmers to establish estate farming. • The agricultural produce such as tea and coffee are subject to price fluctuations. This leads to severe losses when the prices go down. • The cultivation of one type of crop exhausts the soils reducing their fertility and therefore productivity. • It is expensive because many people cannot manage

• It offers social services to the workers: e.g. medical care, educational services, recreational facilities, etc. • It is a source of income to government through taxation. • It improves the standard of living of the people as it provides market to rural people. • It has helped to foster international relationship with other countries through international trade. • People living nearby the plantations get the technical knowledge of how to grow similar crops besides the plantation. • It provides market to the out growers • It leads to the development of urban centres. • Marketing of crops is much easier and relatively cheap • Plantations owners can easily get loan from the government • Favours training of farmers and development of cooperatives.	• It can lead to famine because food crop cultivation is neglected • Repatriation of profits to their home country instead of developing the country where the plantation is. This is because of plantations are mainly owned by foreigners • Plantations lead to the displacement of people because large areas are required. • Plantations are costly because long gestation periods where investors have to wait for a long period before first crop harvest. • When there is an outbreak of diseases or pests, the crop may be destroyed and the investor many have no alternative crop to depend on.

12.1.3. Market gardening, Horticulture and Truck farming

Learning activity 12.3

1. *How does Market gardening differ from horticulture?*
2. *Describe the main features of truck farming.*

a) Market gardening

A **market garden** is a form of farming that is relatively small-scale specializing in cultivation of fruits, vegetables and flowers as cash crops, frequently sold directly to consumers and restaurants. This form of farming is an example of intensive commercial farming as far as it involves growing of crops on small plots of land which are scientifically managed.

Most of market gardens are located near the cities or outside the city suburb areas. This practice is best developed in in densely populated industrial and urbanized countries such as the Netherlands, U.S.A, Germany, Denmark, Belgium, Canada etc.

Different crops are grown in the same plot, on right harvested

Source:https://permaculturenews.org/2011/06/09/planning-our-organic-market-garden/

Characteristics of market gardening

- Farms are generally small.
- The land is intensively farmed, i.e., getting maximum yield from limited land
- Vegetation may be grown in field or under glass

- Fertilizers and manures are applied to improve on the fertility of the soil.
- It is carried out mostly in urban and semi urban areas.
- The products are sold while still fresh to avoid risk of perishability.
- The products have high demand especially in urban centres.
- A lot of capital is invested and used in the farming activities.
- Much attention is given to the crop and most of the work is done by hand labour. it is therefore labour intensive.
- Irrigation is always practiced.

Advantages and disadvantages of market gardening

The following are advantages and disadvantages of market gardening:

Advantages	Disadvantages
• The farming practice provide large profits to the producer, investors or the owners • It does not require large tract of land Farmers have more opportunities to obtain farming skills such as application of fertilizers, controlling pests, seed selection and irrigation and nursery management • Under this farming, the Government gets much revenue from taxes.	• It put traditional farmers out of business**:** Since intensive farming allows the production of much greater volumes of fruit off a much smaller area of land, traditional farmers are unable to compete. • Sometimes it very harmful to the environment due to the use of highly concentrated liquid fertilizers and a lot of deadly chemicals.
• Market gardening creates employment opportunities since most of the activities are labour intensive. • It develops infrastructure since its products are sold while still fresh to avoid risk of perishability	• It encourages use of marginal lands near urban centres which promotes environmental degradation and ecological problems. • Fluctuation in market prices of the crops grown hence affecting the income of the farmers.

b) Horticulture

Horticulture may be broadly defined as the science and art of growing fruits, vegetables and flowers and crops like spices condiments and other plantation crops. The word Horticulture is derived from the Latin word "Hortus" meaning enclosure (garden) and culture meaning cultivation. Thus Horticulture means culture or cultivation of garden crops. The horticultural activity involves planting and tending of domesticated ornamental and food plants.

A: Nursery Plants at Nyagasambu *B: Tulip flowers garden, Amsterdam*

Source:*https://www.publicdomainpictures.net/en/view-mage.php?image=14630&picture=tulip-flower-garden*

This type of agriculture is well developed in densely populated industrial districts of North West Europe, north eastern United States of America and the Mediterranean regions. The Netherlands specializes in growing of flowers and horticultural crops especially tulip.

Characteristics of horticulture

- Most of the work on the farm is done manually while machines are used in some case where farms are fairly large.
- Modern tools of crop production are used to ensure high yield.
- The farms are relatively small in terms of size and are located where there are good transportation links with the urban centre where high income group of consumers is located.
- The land is intensively used in order to reap maximum produce.
- Irrigation is highly recommended in this farming.
- There is use of greenhouse and artificial heating in colder regions.

Advantages and disadvantages of horticulture

The following are advantages and disadvantages of horticulture:

Advantages	Disadvantages
• The horticulture needs small plots and not huge parcel of land. • It brings immediate income to the farmers. • Ability to transplant without waiting. • The study of horticulture has led to cross-bred species of plants that increase the nutritional value of the fruits or vegetables the plant yields. • It is friendly environment because of using less pesticides and herbicides. • It is easy to be managed and controlled as it is practiced on small plots. • There is high sustainability and biodiversity conservation. • Horticulture doesn't need the removal of all the trees in order to use farm. • It is possible to cultivate different plants in the same cultivation even if it is a small plot.	• Horticulture is much more productive than other types of farming. • Horticulture needs a lot of labour. • The size and significance of the horticultural sector is not always understood in the farm community and by policy makers • It cannot be applied on a larger scale because its maintenance is not easy.

c) Truck farming

Truck farming is a horticultural practice of growing one or more vegetable crops on a large scale for shipment to distant markets. It is usually less intensive and diversified than market gardening. At first this type of farming depended entirely on local or regional markets. The common crops grown include apples, asparagus, cabbages, Irish potatoes, string beans, cherries, and lettuce. Truck farming is another term for market gardening. So it has nothing whatsoever to do with trucks, although farmer may need a truck to carry his/her produce to the market.

Advantages and disadvantages of truck farming

Advantages of truck farming	Disadvantages of truck farming
• Truck farming produces more fruit per unit of land, and require less resources and less labour. • Truck farming provides fresh fruits and vegetable to consumers • it enable farmers to grow a variety of fruits and vegetable in the same plot • Trucks used in this farming are able to reach many potential client in distant urban centers.	• Risk of decay when trucks delay in the way due to traffic jam. • It put traditional farmers out of business. This means that traditional farmers are unable to compete with truck farming that produce much great volume of fruit and vegetable in smaller area of land. • It is often industrialized hence less jobs which in turn means a rise in unemployment and the problems associated with this. • It is sometimes harmful to the environment since there is use of chemicals and fertilizers.

12.1.4. Collective agriculture and Commune farming

Activity 12.4

1. *In your own words, explain what collective agriculture is*
2. *Agriculture is the best motor of growth for many countries especially developing ones*
   i) State two forms of farming adopted by Russia and China respectively
   ii) Analyze the main features of commune farming system

a) Collective agriculture

Collective farming is cooperative organization in which farmers joined together to collectively raise crops on land worked in common. This form of farming is practiced in communist countries such as Russia, Poland and Bulgaria. It involves the voluntary or compulsory grouping of land into large units with the purpose of increasing and modernizing agriculture.

Characteristics of collective farming

- Farms are merged to form a larger farm unit either voluntarily or compulsorily;
- The types of crops grown are specified;
- On the farms, there is a use of machines;
- Farms are managed communally or selected committees;
- The proceeds from the sale of farm produce are shared among the members;
- The marketing of the produce is under control of the state;
- Farmers are allowed some limited are for their own crops and livestock.

Advantages of collective farming	Disadvantages of collective farming
• New techniques in farming are learnt by peasant farmers (e.g. irrigation, disease control) which help to increase the production of food and cash crops. • The amalgamation of farms resulted into large-scale production and therefore increased output. • Farmers receive income in return for the work they do, this has increased their standard of living. • The profit obtained depends on individual skills, performance, the nature of their work and the hours they spent. • Collectivization allows the diversification in farming and the economy. • The opening up of new lands has greatly encouraged and promoted the development of infrastructure such as roads, canals and railways.	• The farming system did not take account the peasant's aspirations. • The central government took the bulk of the harvest at fixed prices far below the prevailing market prices. • Payment to farmers was very low and this contributed to the low standards of living. • The use of force provoked uprisings among the peasants, particularly the so -called women's revolts in Ukraine. • Collectivization reduces the yield because the collective farms were poorly run and managed by inexperienced cadres.

• There has been easy provision of social facilities such as hospitals, transport facilities, water, electricity etc. • The increase in agricultural products for export has led to increased foreign exchange earnings • Under this type of farming, it has been easy for the government to supervise all activities as long as there is a uniform type of land tenure. • Since all farmers work together, this has created a strong friendship and unit among	• Land owners that resisted giving up their land, even as little as two thirds of an acre, were often executed. • Farmers were forced to work on the farms and those who refused to work were punished. This acted as a discouragement time for them to work.

b) Commune farming

A commune word literally means a large gathering of people sharing common life. Communes were formed in the late 1950s as Chinese president named Mao tried to force rural people to live a more communist way of life. The Chinese commune is not merely an agricultural commune. Instead it standards for "unified management and deployment of labour power and means of production on a larger scale"

The structure of the commune was such that households were organized into *teams,* then teams formed *brigades*, and brigades formed the *commune*. Each level of organization was responsible for certain activities.

Characteristics of commune

- Land was collectively owned by the members of the commune.
- Work on the land was done collectively. All members worked together to plough the land, plant, weed and harvest.
- Preparation of meals for the members of work-team was done in one place and serving was by cafeteria method, kitchen utensils were owned collectively.
- Returns from the farm were shared equally by all members of the team.

Advantages and disadvantages of communes in China

Advantages	Disadvantages
• Through this system, the Chinese have been able to increase agricultural output to feed the larger population with the crops grown such as rice and wheat. • Under commune farms, cooperation and teamwork among farmers are strongly encouraged. • Communes are contributed to the growth of urban centers such as Shanghai and Nanjing as each commune has its own headquarters. • Under this system, industrial development is taking place. • Any surplus produce from the commune is exported and this earns the country foreign exchange. • Communes help to have access to modern farming techniques, conservation of the soil and economic use of land. • Communes undertake research to improve agricultural production under the government support.	• Governmental policies often force methods, which have fitted one region these policies however may not be suitable for another region. • The system of farming discourages advanced forms of farming since labour intensive techniques are emphasized. • The compulsory grouping of people into large units discourages individual initiative • Decisions such as what to grow, when to grow, how to grow and where to grow are undertaken by central communities with so many people to consult. • Yield is sometimes affected by harsh climatic conditions especially drought during summer months and a severe frost during winter. • Sometimes overproduction due to increased output leads to price fluctuation of the produce that in turn it affects income.

Application Activity 12.1

Using your knowledge and skills acquired in the previous lessons,

1. *Examine the effects of rapid population growth on small scale agriculture.*
2. *Using geographical document and internet, discuss on the use of cocoa and rubber.*
3. *Collectivization in Russia was set as possible solution to the food crisis. In your view, did this system resolve the problem?*

12.2. Factors for increasing the agricultural production and associated problems in the developing countries

Activity 12.5

1. *Discuss on factors that contribute to the increase of agricultural production.*
2. *Explain the major challenges facing agriculture in developing countries.*

12.2.1. Factors for increasing the agricultural production

Many factors act together to influence the productivity and profitable income from the agriculture.

- **Relief**: The farming system adopted depends on the relief of the area. So relief may influences the increase of agricultural production in different way:
  - Lowlands, such as flood plains, are more productive agriculturally.
  - Steep slopes are obstacles to the machinery use and have thinner soils; on the other hand gentle slopes are less prone to soil erosion.
  - For some crops like Tea and coffee crops do well in the well-drained soil on hill slopes
- **Soil**: The type and characteristics of soil in a certain area determines the type of farming to be practiced. Areas with fertile soils encourage crops farming, while places with poor, thin soils discourage crop growing and favour rearing of animals.
- **Drainage**: Market gardening and horticulture prefer swampy areas just because of the presence of permanent water.
- **Climate**: A prolonged drought season leads to drying of crops and pasture for animal leading to poor yield. On another hand, a reliable rainfall in an area is a vital for crop growing.
- **Capital**: Capital is the money the farmer has to invest in agricultural activities; it is useful to increase the amount of different inputs into the farm which have a direct effect on the production.
- **Technology**: Advance in technology development play a big role in agriculture. Proper use of technology helps in extending the area of optimal conditions and maximizes the expectations of farmers.

- **Market**: The wish of any farmer is to grow crops which are in demand and change to meet new demands.
- **The Government *policy*:** The government may influence a particular agricultural practice, it may also influence the crops grow through regulations, subsidies and quotas.

12.2.2. Problems affecting the agriculture in the developing countries

Here are some problems facing farmers in developing countries:

- **Harsh climate**: Despite the great advances that have been achieved in technological development, people do not have any control over climate. Example, they cannot increase rainfall in the deserts nor they cannot prevent the rivers of the temperate regions from freezing. So agriculture is affected by the seasonal nature of rainfall which makes agricultural planning more difficult.
- **Infertile soil**: Soil is a medium in which plant grow. Large areas of the tropical region have infertile soils. This reduces crop productivity.
- **Relief**: It refers to the general appearance of the landscape. Very high mountainous areas hinder agricultural activities because of the extreme low temperature, thin soils and steep slope which limit the agricultural mechanization.
- **Lack of information**: Most of small scale farmers in Africa miss out on new and improved methods of farming. Even in cases where there is some access to information, most poor farmers are unable to discern due to illiteracy which is high in rural Africa.
- **Limited capital**: Most farmers in Africa are poor financially making it almost impossible for them to adopt new farming practices. Financial support enable farmers to grow, expand, and maintain their yields by purchasing farm machinery, agro-chemicals, fertilizers, better seed varieties and to open up irrigation system and other agricultural inputs.
- **Poor transport system**: This is a major challenge facing not just agriculture but the economy in general throughout Africa. Most of the farm produce in Africa just go to waste in the remote areas and it is mostly because farmers find it very difficult to transport their farm produce to the market to sell.
- **Poor market**: Lack of market facilities and poor government regulations make it almost impossible for farmers especially small scale farmers to market their farm produce. Another issue is low

prices paid to farmer for their harvest which sometime discourage some farmers.

- **Poor technology**: Farmers in developing countries are still using simple tools like hoes, axes, pangas and digging sticks which results into low yielding per unit area.
- **Limited research**: research is a key to develop high-yielding crop varieties. In many developing countries, carrying out research in agriculture is limited due to insufficient financial support and scarcity of technical personnel to conduct the research.
- **Rapid population growth**: Population pressure on land results into land scarcity, fragmentation and overexploitation of land leading to soil exhaustion, which ultimately results, into environmental degradation and poor crop yields.
- **Natural hazards**: Many risk and uncertainties are involved in agriculture such as flood, landslides, drought, and heavy rainfall destroying crop yields. Ultimately, poor harvests led to famine.
- **Political instability:** Some countries in Africa and Asia do not experience enough security due to alternate and continuous conflict in their region. This results in abandonment of farms as people are constantly fleeing wars. The wars destroy farm machinery and does not allow a long term planning necessary to develop and improve the agricultural sector.

Application Activity 12.2

1. *The African land can provide all that people need to survive. Unfortunately, much of this land is untapped. What can people do to improve agricultural productivity?*
2. *Reference to Rwanda, discuss factors affecting the agriculture in the developing countries.*

12.3. Livestock farming

Activity 12.6

Using knowledge, skills and internet or other geographical documents answer the following questions:

1. *Give the meaning of livestock farming?*
2. *Identify the major characteristics of nomadic pastoralism*
3. *Describe challenges facing nomadic pastoralism in Africa*

Livestock farming refers to the keeping/rearing of domestic animals such as cows, goats, sheep and poultry (birds, donkeys). It is practiced for either commercial or subsistence purposes and it takes a number of forms. The following are the major types of livestock farming: nomadism, free range, transhumance, ranching, dairy farming, zero-grazing, tethering, aquaculture, poultry farming, and apiculture. Some of these are explained below in details:

12.3.1. Pastoralism

Pastoralism is a system of farming where farmers set free their livestock especially cattle, goats and sheep to graze on natural pasture. The movement of both people and animals is dictated by the shortage of grass and water in a given area.

i) Pure nomadism

This is extensive form of animal grazing on natural pasturage, involving constant or seasonal migration of the nomads and their animals. Nomadic herding is confined to sparsely populated parts of the world where the natural vegetation is mainly grass.

It is practiced in West Africa among the Fulani, East Africa among the Maasai and Karamojong, Ethiopia among Nuba, the Touareg of Sahara and the Hottentos of Botswana, Mozambique and the Republic of South Africa. It is also found in Saudi Arabia among the Bedouins, and Central Asia among the Mongols.

Characteristics of nomadic pastoralism

- Nomadism depends primarily on animal rearing rather than crop growing for survive. Nomads take milk from the animals for food and skins and hairs for clothing and tent.
- There is seasonal pattern of movement for searching grasses and water for reared animals. These movements depend on the availability or lack of grasses and water for animals in a given climatic season.

- Extensive keeping herds of livestock all year round on a system of free-range grazing.
- It is practiced in the areas of low and unreliable rainfall which typical dry season.
- Animal are kept for family subsistence and not for sale.
- The ownership of livestock is individual but the land belongs to the tribe or community as a whole.
- Nomadic pastoralist does not value education.
- Nomadic pastoralist finds prestige and proud in keeping large herds of cattle with taking into account of the amount of products because the animals kept are of poor quality and low value.
- It takes place where the population is low and scarce.

Advantages of nomadic pastoralism	**Disadvantages of nomadic pastoralism**
• It can be done in dry areas where there is no way to grow land • Is cheap since there is no much attention required. • It offers an alternative form of land use for otherwise unproductive marginal lands. • It ensures food for the family especially when the animals are many • Some traditional varieties of animals are resistant to diseases hence adaptability to any hardships environmental.	• The animals produce little milk and of low value that can satisfy large population. • This system of farming requires a lot of time to move from one place to another. • This system of livestock keeping causes soil erosion and desertification. • Many animals perish due to shortage of veterinary services

ii) Free Range farming

Free range denotes a method of farming husbandry where the animal, for at least part of the day, can roam freely outdoors, rather than being confined in an enclosure for 24 hours each day.

The purpose of this form of livestock farming is to reduce feed cost, produce a higher-quality product, and as a method of raising animals on a relatively large piece of land.

Characteristics of free range farming

- Free-range poultry farming allows chickens to roam freely for a period of the day, although they are usually confined in sheds at night to protect them from predators or kept indoors if the weather is particularly bad.

Advantages of free range farming	Disadvantages of free range farming
• Free range chickens provide us organic and high quality meat as well as eggs. This is because hens have access to various insects and organisms which are rich in protein and other organisms. • Free range farming enable farmers to save money on commercial animal feed because eat or graze different insects and wild pasture respectively. • Meat of animals kept in free range present a deep and pleasant flavour because of good and healthy setting environment. • Animals kept in free range are stress free compared to the caged animals that have higher chances of developing stress and irrational behaviour leading to some diseases.	• Basing on better conditions for free range animals, they do tend to cost more when you buy them. • There is a high risk from predators since animals roam freely in the open air setting. • Animals are probably exposed to the robbers since they are raised in remote areas • Free range animals require much attention because they may go beyond their place. For example, road, neighbour's plot etc.

iii) Transhumance

Transhumance is the practice of moving livestock from one grazing ground to another in a seasonal cycle. Most of people who practice transhumance also involve in some form of crop cultivation hence some kind of permanent settlement. Such type of livestock farming is practiced for instance, in Kenya and Tanzania by the Massai who are semi-nomadic people.

Characteristics of transhumance

- Transhumance involves constant/ seasonal migration of the nomads and their livestock in search of pasture and water.
- Livestock are moved between mountain pastures in summer and lower areas for the rest of the year.

- Herders have a permanent home: this means that only the herds and the people necessary to tend them travel, the whole family lives in tents all the year round, moving with the herd.
- Nomads mainly rely on natural vegetation for their pasture.
- Large number of herds is kept as a sign of peace.

Advantages of transhumance	Disadvantages of transhumance
• There is manure deposition on farmers' crop fields leading to the increase of crop productivity. • Availability of animals for purchase at low cost. • Availability of milk for farmers and promotion of local trade	• There is easy spread of diseases due to the constant movement of livestock • There is abusive cutting of trees. • Damage to crop since little attention is given to the animals. • Increase in conflict between livestock farmers and crops farmers. • There is a long distance travelled by transhumant herders to look for pastures and water.

12.3.2. Factory farming, dairy farming and ranching farming

Activity 12.7

1. *Describe the major features of factory farming*
2. *Discuss on factors favouring dairy and ranching farming*

a. Factory farming

The factory farming refers to the type of farming business which keeps animals at high stocking densities and uses modern technology to facilitate faster animal growth, lower illness and death rates, and higher production outputs.

The idea of factory farming started because as the population continued to rapidly increase, food production wasn't happening fast enough. Therefore, in order to feed everyone food production need to happen faster. This means without factory farming in densely populated countries, meat and dairy products would be rare and extremely more expensive than it would be today.

Its primary objective is to produce the most products and to gain as much profit as possible. The main products of this industry are meat, milk and eggs for human consumption.

Confined hog and cow production respectively

Source: https://www.chinadialogue.net/article/show/single/en/8961-The-secret-under-a-Chinese-pig-farm

Characteristics of factory farming

1. Large numbers of animals are usually held together indoors in closed confined pens and shed, and often with physical restraints to control unnecessary movement
2. Under factory farming, huge amount of antibiotics and pesticides are used to fight the spreading of diseases and bacteria.
3. Factor farms are highly standardized for efficiency. Monocultures of animals and feed crops are created highly unified through gene manipulation to help yielding consistent production every year.

Factory farms provide many benefits, but they can also lead to several drawbacks:

Advantages	Disadvantages
• **It not expensive:** with introduction of factory farming, the prices of food have dramatically dropped. the reason for this is that food are being processed and produced at faster rate by employing efficient processes	• **It risks the occurrence of animal cruelty:** Animals could fall victim to the difficult and cruel conditions of factory farming where animals are kept in small pens or cages where they don't have the space to run around and do what they naturally do, and their living areas are not cleaned as often as necessary so they're constantly surrounded by filth.

• **It does not dependent much on human labour**: Factory farming always use modern technology. For this reason, it has freed farmers from manual labour constraints. • **It allows for greater availability and variety:** Because food has become cheaper to process and produce, farm owners can make some investments in raising and growing more varieties of livestock and plants than before. Biotechnology advancements mean that we can still enjoy fruits that will be able to grow on a ground that is not previously their home • **It has fewer geographic limitations:** With factory farms, farmers will have greater access to water because of irrigation. Aside from this, they will also have easy access to fertilizers and other technologies, such as greenhouses that minimize the impact of weather and seasonal changes. • **It encourages technological development:** Since factory farming is dependent on modern technology, it encourages scientists and engineers to improve existing tools and equipment and even invent new machines that make food production faster and more efficient.	• **It can lead to high animal death rates:** Because animals would be exposed to difficult conditions, they could die in huge numbers. Among the most common reasons of animals dying are stress, disease and even heart attack. • **It can have a negative impact on the environment:** The hundreds or even thousands of animals in factory farms produce a large amount of waste that the farms can't handle. As a result, many of them opt to dump the wastes in rivers and streams and end up polluting these bodies of water. • **It can produce low-quality food:** Since animals in factory farms are kept in unsanitary conditions, they can develop illnesses that may not be treated by antibiotics and pass these on to the people who consume them.

b. Ranching

Ranching is a modern form of pastoralism aiming of rearing of animals for beef production on a large scale for commercial purpose. It is an enclosed system of extensive livestock production. Under ranching, a piece of land called a ranch is allocated.

Ranching is more developed in United States of America, New Zealand, Western Australia, Argentina, South Africa, Botswana, Zimbabwe, Zambia, Kenya, Tanzania and Uganda.

Characteristics of cattle ranching

- Livestock ranching is the commercial grazing of livestock over an extensive area which is associated with a very large land requirement, capital and human resources.
- Ranches have a continuous vegetation cover such as alfalfa, Lucerne and clovers.
- One type of animals is kept either for beef production. Therefore the choice of the animals is done very judiciously.
- There is little or no movement from one area to another since animals are confined in paddocks
- Ranches are scientifically managed through selective breeding, use of hybrid species, research and control of animal diseases.
- The animals are reared for sale (they are kept for commercial purposes).
- It is carried out in sparsely populated areas and far from urban area
- Ranches are managed run on scientific methods. The animal kept is guarded by from various disease by its regular vaccination, crossbreeding and regular attendance of veterinary surgeons to the animals.
- It is practiced in areas where rainfall is low and unreliable to give place to the crop cultivation.
- The animals in the ranches are kept for highly organized markets thus high revenue from sale of beef, hides, and dairy products.

Advantages and disadvantages of ranching

Advantages of ranching	Disadvantages of ranching
• The production is very high due to the high level of specialization and high quality animal breeds.	• Cattle ranching is a hard work job and involves far more responsibilities and levels of skill than a simply job at the office or in the construction business entails. Thus not everybody is able to engage in ranching.

• It has promoted the development of villages, towns which act as slaughtering, processing and packing centres. • It promotes industrial growth through the establishment of processing facilities. • The high yielding animals increase the income for the farmers. • Livestock ranching promotes development of infrastructure, for example roads which link the ranching areas and marketing areas. • It increases the agricultural production due to provision of animal humus to the crops. • Animals are kept in an enclosure (fenced areas)this ensure protection from predators • It is environmentally friendly because manure and urine goes back into the soil to help plants grow, and grass makes cattle fat and happy.	• A high capital investment is required to establish and maintain the ranches. • This type of farming is very limited in tropical areas because of abundance of diseases, insects and high amount of temperature and rainfall. • Ranching practice promotes overgrazing and deforestation • This practice requires fencing to keep animals in and to keep animals out of arable areas. Therefore, it does not directly favour crop farming.

c. Dairy farming

Dairying farming is the specialized rearing of cattle to produce milk and other products like cheese, butter and cream mainly for commercial purposes.

Characteristics of dairy farming

- Dairy farming aims at raising cattle to produce milk
- Dairying on commercial basis has developed in humid temperate regions, because cool temperate climate is ideal for cow-rearing.
- Capital intensive techniques of production are used
- Selected cattle breeds which yield a lot of milk are raised. Example, Jersey, Ayrshire, Alderney and the Friesian breeds.

- Rich and nutritious grasses are sawn to supplement the natural pastures to feed the animals.
- The farms are scientifically managed and any pests and diseases are controlled
- Benefits are very high due to the input and capital injection.
- Many farms own their processing plants or dairies.

Advantages of dairy farming	Disadvantages of dairy farming herding
• Scientific management ensures high yields. • It leads to maximum utilization of land as the practice does not require much space. • Export of products earns foreign exchange. Hence farmers enjoy a happy and healthier living standard. • Continuous production ensures a high and steady income for the farmer.	• Dairy farming is very expensive in terms of vaccination and feeding. Hence it requires a plan and budget to be successful. • It has a negative impact on environment since livestock are regularly injected antibiotic. As results, they affect the bacteria in the soil and water. • There is a loss of local breed and genetic due to the crossbreeding.in addition, the loss of their special genetic traits that enable indigenous breeds to adapt to any environmental conditions. • Cattle in dairy farming always need food and water, as well as clean stalls and medicine if sick. If you raise dairy cattle, there is additional care related to milking and birthing calves.

Application Activity 12.4

1. *Explain why it is necessary to improve livestock farming in your community.*
2. *Discuss how industrial food impact people's health.*
3. *Explain the advantages and disadvantages of technology in agriculture.*
4. *Analyse the economic and social benefits of pastoralism.*

12.4. Factors and problems affecting the livestock farming and ways of improving it

Activity 12.8

1. *Describe factors influencing livestock farming*
2. *Analyse problems facing livestock farming*
3. *Identify different ways of improving livestock farming*

12.4.1. Factors affecting livestock farming

There are many factors that influence livestock farming, but the most documented are the following:

- **Topography**: The areas having gentle and undulating terrains consisting of relatively flat plains and plateaus are favourable for Livestock farming. This makes it easy for animals to move freely from one place to another.
- **Climate**: the main determinant elements of climate are the following:
  - The temperature, its duration and the intensity of sun radiation, all affect the welfare of animals to a certain extent. The moderate temperature is favourable for livestock farming.
  - The moisture, whether moderate or high mean annual rainfall is essential for livestock farming. It ensures an abundant supply of drinking water and pastures for the animals.
- **Soil**: The soil, which is composed of a variety of minerals and organic substances, forms the physical support of plants to be fed the animals.
- **Land tenancy:** It includes all forms of tenancy and also ownership in any form. Land tenancy and land tenure affect the livestock farming. The land in pastoral areas is communally owned. This facilitates communal grazing and free movement of their livestock.
- **Size of Holdings**: The large tracts of land in sparsely populated areas are needed for a pasture. The size of holding and the size of farm decide the number of animals to be kept in farm.
- **System of ownership**: The collective ownership is preferable for having a very large paste and terrain for livestock.
- **Labour**: The availability of labour, its quantity and quality is determined by the technology used in livestock farming. Traditional farming methods require a big number of labourers while advanced technology requires a few numbers of skilled people.

- **Capital**: Capital defines limitations to the size and type of livestock farming to be practiced. All livestock inputs like insecticides, pesticides, feeding stuffs, purchase of land, machinery, vehicles, buildings, and veterinary services require capital. All the farmers make their decisions on the basis of capital to invest.
- **Mechanization and Equipment**: The levels of technological tools to be used play a vital role in the selection of livestock to be farmed and decision making at the farm level.
- **Market**: Availability of market for the products from livestock farming is a very important factor influencing livestock farming activities.
- **Availability of transport means**: A well-developed means of transport with appropriate equipment to quarry balky products in very necessary for transportation of animal's products to the market.
- **Pastes and of diseases**: Animals farmed may be hampered by diseases, insect-pests and wild animals. It is better to choose the areas free from those harmful animals.
- **Culture belief**: Some types of animals are not grazed by a given society due to beliefs, customs or personal convictions. For example, Muslims cannot keep the pigs.
- **Government policies:** The government policies affect livestock farming in different ways:
  - Government policies can encourage or discourage modernization of livestock. Some countries, such as Rwanda and Britain encourage the productivity and efficiency of farming by a system of donation and subsidies to farmers.
  - The government determines the ways in which farmers develop their farming and this may be a help or hindrance to animal production.

12.5.2. Problems facing livestock farming

The following are some of problems affecting livestock farming:

- **Limited rainfall**: Unreliable rainfall limits the growth of grasses and affects the growth rate of animals and the production**.**
- **Population pressure**: the world population is increasing incredibly. This reduces the availability of livestock farming and natural resources.
- **Shortage of water**: the facts that the surface of water for livestock is limited; this is a serious problem leading to death of animals in some parts of Africa and poor quality products.
- **Disease and pest infection**: Shortage of supply of skilled labour that

is required in the modernization of livestock farming contributes to the spread of different diseases. For diseases which are not treated correctly, the condition can prove fatal.

- **Institutional problems**: Lack of adequate and supportive institution in livestock farming sector. Sometimes policies are suggested and written but not implemented. This does not meet the satisfaction of a large population in terms of quality milk and meat.
- **Limited capital**: Most rural farmers do not have enough capital for developing livestock farming, the building of storage reservoirs, or the provision of veterinary services.
- **Limited skills**: Because of little knowledge farmers keep large herds of cattle which have led to over stoking and overgrazing.
- **Remoteness of grazing areas**: Potential grazing areas within the tropics are poorly served with transport network and social infrastructures. This creates limitations in facilitating the commercialization of livestock products.

12.5.3. Ways to improve livestock farming

Livestock can be improved through the following ways:

- **Settling the nomads**: In many African countries and the rest of the world, nomads hold a large number of cattle, the government should make an effort and encourage settling nomads so that they can get essential veterinary services to keep their cattle healthy.
- **Empowering animal keepers through education**: Efforts should be put in place and enlighten livestock farmers on new innovations and technology that will bring a high quality animal productivity.
- **Government support**: Government should be an initiator for livestock farming support by establishing adequate infrastructure, easy access to the loan to boost the livestock farming. this will benefit the country and farmers in general
- **Adoption of modern livestock farming methods**: Through motivation and other government support, efforts needs to be put in place to convince rural farmers to switch from traditional livestock farming to modern livestock farming which is more profitable.
- **Provision of livestock healthcare**: Extending veterinary services to all the areas where the livestock keeping is practiced is a good step to improve livestock farming. This will help to reduce the incidence of pest and diseases.
- **Encouraging tree planting on pasture land:** This minimizes the dangers of environmental deterioration in addition to provision of

shelter to animals. This will also help in improvement of grazing and watering management.

- **Adequate livestock feeds and nutrition**: The provision of feed that is adequateboth in quality and quantity is an extremely y good for livestock farming
- **Introduction of crossbreeding**: To achieve this is by replacing the local breeds of animals with the exotic to increase the output and enhance the off springs' economic value.

Application Activity 12.5

1. *Examine the impact of livestock farming on environment.*
2. *Discuss the importance of livestock farming*
3. *Suggest ways problems of livestock farming can be solved*

Skills lab

Move around your village and make a research on the types of agricultural practices in the village and suggest ways in which agriculture can benefit individuals and the village as a whole.

End unit Assessment

Read the passage below and answer the questions that follow.

The university of Lincoln is physically located in the centre of the United Kingdom's agri-business industry. Recently, 25 students had an internship and farm experience in different African countries. In Gabon, They found farmers burning forests as a way of preparing land for crops growing, in Kenya farmers grow tea for sale and livestock farmers in the North of Kenya keep large number of local cattle in an open land where they always move with while in Rwanda, most cows remain inside the stall.

1. *Describe the type of crop farming practiced in Gabon.*
2. *How the above practice affects the environment?*
3. *Analyse the economic importance of crop cultivation cited in Kenya.*
4. *The above livestock farming mentioned in Kenya faces many problems. Suggest possible solutions.*
5. *Pastoralism affects the environment in different ways. Suggest measures to prevent overstocking and overgrazing in areas of pastoralism.*

UNIT 13

MINING IN THE WORLD

Key unit competence: The student-teacher should be able to explain the impact of mining on sustainable development of different countries in the world

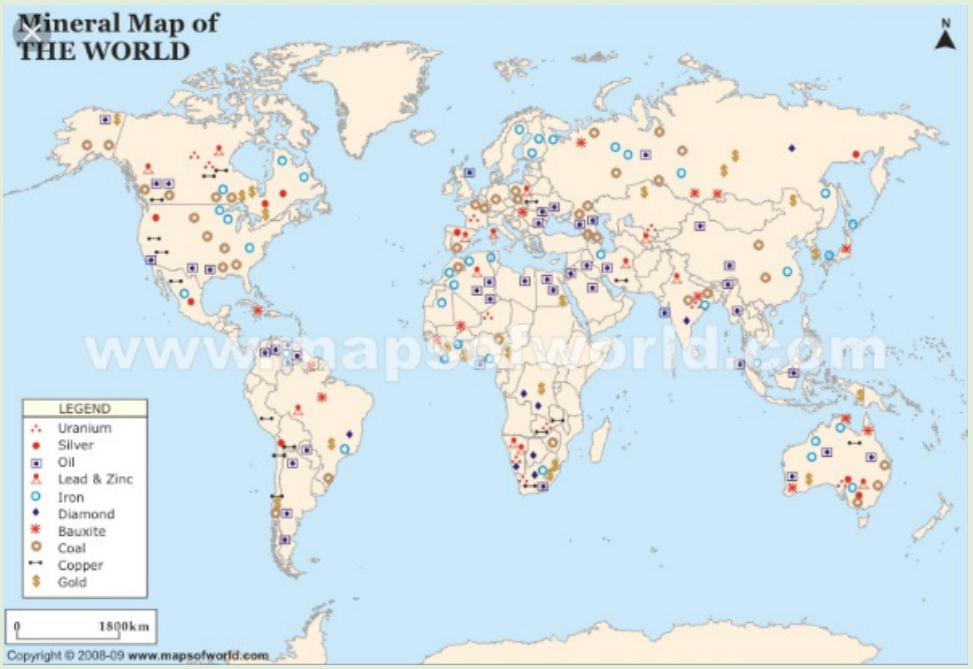
Introductory activity

The underground is very rich in natural resources, but they have to be utilized in a sustainable manner in order to support socio-economic development of different countries owning those natural resources. However, if they are not exploited well, the physical environment can be degraded.

1) *Identify the economic activity taking place in the areas shown on photographs above.*
2) *Name the major minerals of the world and mention the countries which are exploiting them.*
3) *Examine the factors that have favoured mining activities in USA or South Africa,*
4) *Analyse the effects of exploitation of minerals to the economic development of any country like Rwanda.*

13.1. World distribution of major minerals

Activity 13.1



1. *Identify the major world minerals and state where they are found using the above map.*
2. *Using the legend presented in map above, state the countries where the following minerals are exploited: Gold, copper, oil and natural gas, lead.*
3. *Explain how the natural resources in specific minerals can be exploited without affecting the environment.*

Mining refers to all the processes by which minerals are obtained from the earth's lithosphere. Minerals may be in gaseous, liquid or solid form. The processes involved depend upon the mode of occurrence of the mineral.

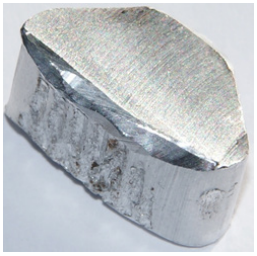
Three major mining areas may be distinguished on the basis of variety of mineral resources, amount of exploited minerals, and their production. These are:

- **North America:** From central Alaska and north-central Canada to southern Mexico. The central plains from the Gulf of Mexico to the Laurentian shield contribute more than half of the total value of minerals mined in the USA and about one-fourth that of Canada.

- **Africa:** African regions are also endowed with minerals such as petroleum, natural gas, coal, Sulphur, potash, lead, zinc, gold etc.
- **Eurasia:** From United Kingdom and the Iberian Peninsula to east central Siberia. West Europe is rich in coal, iron ore, bauxite, salt, potash etc., but it lacks in copper, lead, zinc, tin and alloys etc.
- **South-east Asia:** Includes India, China, Japan, Malaysia, and Indonesia. This region has sufficient output of earth material to cater to the domestic needs of a large population. India and China have sufficient coal, iron ore and a variety of alloys. Malaysia and Indonesia have surplus tin.

The table below shows the minerals, their uses and where they are found. The countries shown are just some among the many other ones.

Mineral	Location	Major uses
Petroleum 	Russia, USA, Iran, Iraq, Venezuela, Nigeria, China, Libya, Kuwait, UAE, Indonesia, Algeria, Mexico and UK.	It provides fuel for heat and light, lubricants for machinery and raw materials for a number of manufacturing industries.
Coal 	USA is the world leading producer of coal (25%) Russia follows with (20%), China (19%), Poland (8%), U.K. (5%), India (4%), West Germany (4%), South Africa (3.5%) and Australia (3%)	Used in generation of electricity Steel production Used in cement manufacturing Used as a liquid fuel
Iron ore  *Accordingly, iron content can be divided into:* *Magnetite-Iron content is up to 72.4%* ***Hematite: Iron content is up** 70%.*	• This is produced in many countries, but the most important ones are Brazil, Russia, Australia, U.S.A, China, India, South Africa, Canada, Ukraine, Sweden, Liberia, and France.	The uses of Iron ore include the following: Iron ore is mainly used in manufacturing of steel; which used in the making of automobiles, locomotives, ships, beams used in buildings, furniture among many others.

Limonite: Iron content is up 60%. *Siderite: Iron content is up 48%.*		
Copper 	• USA, Russia, Chile • Democratic Republic of Congo (DRC), South Africa, Canada, Indonesia, Canada, Poland, China, Mexico, Zambia.	• It is used in the engineering industry; in manufacturing ornaments; weapons and coins.
Aluminium 	• Jamaica, USA, Australia, Brazil.	• It is used in the making of cooking utensils. • It forms part of the raw materials used in the manufacturing of ships and wagon. • It is used in industries especially food processing equipment.
Tin 	• China, Malaysia, Indonesia, Thailand	• It is used in making plates; food cans (non-rust quality); an alloy with other metals /Roofing/ utensils, /ornaments and petrol tanks; making the packaging materials/ products.
Lead 	• Peru, Russia, Australia, Mexico.	• It is used in production of metals; solder bearings and castings; roofing materials; chemicals; construction materials.
Zinc 	• Canada, USA, Australia, • Russia, Peru, Japan.	• It is used in Galvanizing iron and steel, Manufacturing cars and Machine parts.

Manganese 	• Congo (DRC), India, Ghana, South Africa, Russia.	• It is used in: • As a cleaning agent in steel works. • Making of railway lines, • In making of rock crushers • Construction of steel.
Nickel 	• Canada, Cuba, USA, Australia.	• It is used in manufacturing machine spare parts, coins.
Diamond 	• DRC, South Africa, Ghana, • Namibia, Brazil.	• It is used in making cutting tools and pyramidal **gems.**
Uranium 	• Australia, South Africa, Canada, Gabon, France	• It is used in: • Energy producing factories.
Gold 	• South Africa, USA, Canada, Ghana, Mexico, Philippines	• It is used in the making of precious jewellery • It is used as medium of exchange in trade in many countries, store of wealth.

Application Activity 13.1

1. *Identify two areas outside Rwanda where tin and coltan are extracted in large quantities.*
2. *Apart from Tin and Coltan, state other major world minerals.*
3. *Draw a sketch of Rwanda and show the major areas where minerals are exploited or extracted.*
4. *Using the world map locate the major mining areas of the world.*

13.2. Methods of mining

Activity 13.2

Read the passage provided below and answer the following questions:

Mahoro is one of the prosperous investor who is interested in mining. She recently visited DRC and the research findings included the following: (i) Some mineral ores are near the surface; (ii) Some minerals are deeply located below the surface area.

1. *Using the past studies, describe the mining method that can be used by Miss Mahoro in the exploitation of the mineral ores near the surface and mineral ores occurring deep into the crust.*
2. *Identify and explain the effects of different mining methods on the physical environment and suggest the appropriate ways to deal with the negative effects of those mining methods.*

When extracting mineral from underground/ground deposits, there are various methods that can be used. These methods depend greatly on the mode of occurrence of the mineral, of the value of the mineral, and the size of deposit. The most common mining methods include the following:

13.2.1. Opencast or open pit mining

This is the easiest and the cheapest way of mining minerals that occur close to surface. This simply involves the removal of the overburden that is the earth or other rock bands lying above the mineral-bearing strata.

This is the simplest and cheapest method of mining. It is used where minerals are very close to the surface of the earth.

Opencas mining

13.2.2. Underground mining

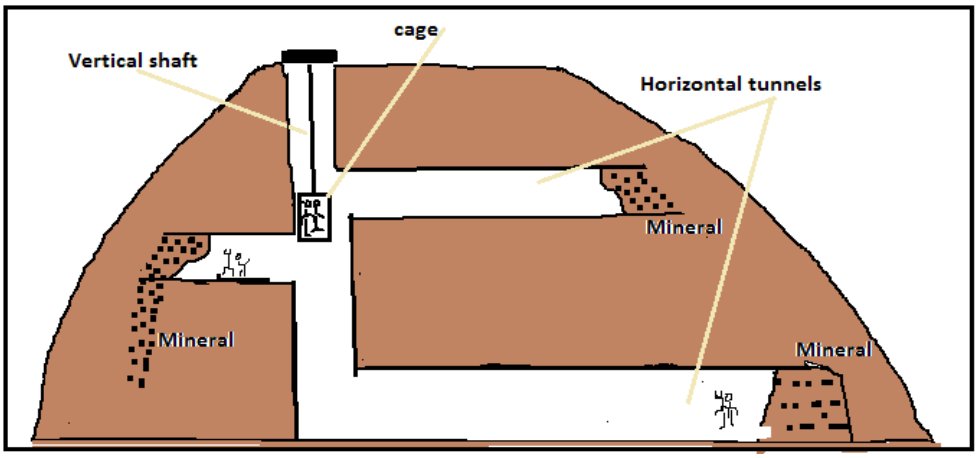
When the minerals lie deep below the surface, the overburden is too thick to be removed by mechanical shovels and underground mining methods have to be used. This mining method involves creation of network of both vertical and horizontal tunnels. These follow the mineral bearing rocks. The vertical tunnels are called shafts. The mined minerals are transported along the shafts using conveyor belts on which lifts, or cages are affixed. The cages move up and down the shaft.

There are circumstances where the mineral ore bearing rocks occur in a horizontal manner. In this case horizontal tunnels are created to have access to the mineral ore extraction. Such tunnels are called Adit or crosscut opening. There must be proper ventilation to allow the miners have clean and safe air, the roofs of the tunnels must be supported with strong pillars and strong wire mesh. This method is used in extraction of mineral ores in countries such as gold mining in South Africa, copper and cobalt in DRC and Zambia.

The following are different underground mining methods:

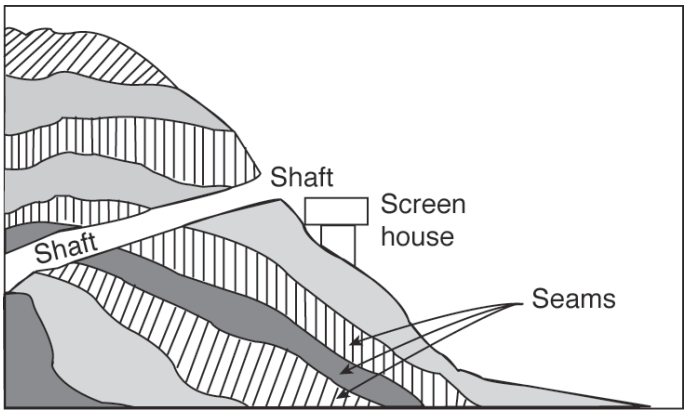
i) **Drift or Adit method:** This is whereby the minerals are extracted from the sides of a hill or a valley. The mineral bearing veins or seams are found protruding on the side of the valley or hills.

ii) **Shaft method:** this is used to extract minerals found in deep or very steep inclined seams. Vertical shafts are sunk underground. From these, horizontal tunnels or galleries are dug to reach the mineral bearing rock.



Shaft method of mining

iii) **Hill slope boring:** This is used in the extraction of minerals such as coal which may outcrop from the hill side. A gently sloping shaft is dug into the hillside to reach the mineral.



Hill slope boring method

iv) **Solution method:** This is done from the surface of the earth. Shafts are sunk down into the mineral deposits. Pipes are installed to link the deposits.

v) **Drilling method:** This method is used in the extraction of non-solid minerals such as oil and natural gas from the ground. It involves the creation of drill and after the drill reaches the mineral, pumps are inserted to transport the oil or gas to the collecting and refinery centres.

(a) On land oil drilling equipment. *(b) Off-shore oil/gas drilling derrick*

Source: *http://www.nogtec.com/bp-shelves-onshore-exploration-in-libya*

13.2.3. Alluvial mining

Alluvial mining refers to the situation where minerals are got from alluvial deposit from water bodies mainly rivers. The following methods are used to extract them:

Placer mining method: this is done by mixing the alluviums with water and tilting or rotating the gravels until the light particles (sand, mud, dust, stones) are washed off, leaving behind those with higher specific gravity like gold, tin, platinum etc.

Panning: This method is used by small scale miners. This involves mixing of water with mineral bearing deposits scooped from riverbeds. The mixture is then lifted into a pan. The pan then is rotated vigorously and later tilted to incline on one side. The lighter material of sand, mud, dust and stone debris are left behind stuck on the wet drier side of the heavier material consisting of the mineral is found at the bottom of the water.

Panning mining method

i) **Hydraulic mining:** This is use of water sprayed from powerful pumps on the sides of valleys or slopes to bring down the alluvial deposits once the alluvial deposits have landed on the floor of the valleys, they are collected.

Application Activity 13.2

Analyse the photographs below and use them to answer the questions that follow:

Figure A

Figure B

1) *Name the economic activities that are taking places at the areas represented by figure A and figure B.*
2) *Describe other methods of mining used in the world.*
3) *Analyse the impact of the two methods mentioned represented by figure A and B on the physical environment.*

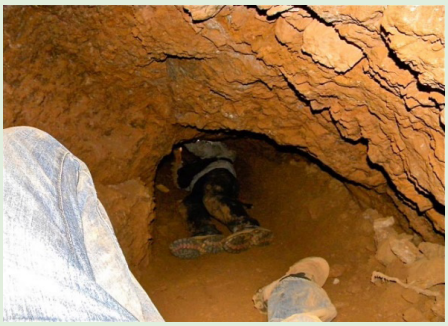
13.3. Factors affecting mineral exploitation

Activity 13.3

Read the passage shown below, and use it to answer the following questions:

Several countries of the world have a variety of mineral. Some countries are enjoying the successful economy due the mining activities while others are still lagging behind economically despite having large deposits of minerals.

A



B

1. *Explain the factors that have contributed to the differences associated with mining represented in the passage above.*
2. *Evaluate the effects of the activity being carried out in Figure A on the physical environment.*

The factors that influence or affect mineral exploitation include the following:

- **The value of the mineral**: Minerals of high value such as diamond are exploited at any cost. They can be mined without incurring losses.
- **Size of deposits**: This factor influences the nature and type of equipment to be used. The bigger mineral deposit attracts more investors since they do not fear the loss.
- **Transport costs**: when transport facilities are well developed and the transport costs are affordable mineral deposits around attract the investors
- **Mode of occurrence of minerals**: Minerals that are near the surface of the earth are more profitable to exploit since less expensive mining methods and equipment are involve. This means that, if the mineral is deep underground, it becomes costlier to exploit it.

- **Labour**: Mining requires both skilled and semi-skilled labour. In developed countries, it is easy to get the required labour unlike in developing countries.
- **Capital**: The presence of adequate capital will encourage the exploitation of minerals. This because mining requires heavy equipment that is expensive to purchase. When capital is not enough it means that the mineral deposits can hardly be mined.
- **Market:** Mining is majorly conducted for commercial reasons. Therefore, its success depends entirely on the presence or availability of enough market. If there is a high demand for a given mineral, such mineral will be exploited.
- **Technology**: Mining requires appropriate technology. Countries with advanced levels of technology exploit their deposits better than developing countries with low levels of technological advancements.
- **Political climate**: When the country is secure in terms of security and political stability, minerals will be exploited. This is so, because both foreign and local investors will be interested in making business ventures in the sector of mining.
- **Government policy**: Minerals can only be exploited when there are favourable and friendly governmental policies. Such as tax holidays, quick and on-line registration of companies and affordable licensing procedures**.**
- **Power**: Mining requires adequate supply of power and energy. This because of the heavy equipment used in the exploitation of minerals. Therefore, in areas where power is unreliable it is very hard to exploit minerals that are deep in the underground.

Application Activity 13.3

1. *Account for the low levels of mineral exploitation in the developing world.*
2. *To what extant is the mode of occurrence of mineral ore responsible for its exploitation in DRC.*

13.4. The effects of mining to the economies of the world

Activity 13.4

Use the Internet, Geography textbooks, previous knowledge acquired in Geography to;

1. *Evaluate the effects of mining to the socio-economic development of the countries.*
2. *Analyse the effects of mining operations on the physical environment in Rwanda.*

The mining sector contributes a lot to the socio-economic development of countries. Some of the contributions are positive while others are negative. Below is a detailed explanation of the effects of mining to the economies of the world:

13.4.1. Positive effects of mining to the economies of the world

The mining industry has had an influence on the economy in a number of ways, which may be summarized as follows:

- **Employment opportunities**: There are thousands of people employed by the sector of mining either directly or indirectly. These people have their lives improved because of the salaries they earn.
- **Development of transport and communication facilities**: Mining has influenced the establishment of varying forms of transport and communication infrastructures. There are feeder roads and all whether roads radiating from mining centers to ports and urban centers. For example, the Tazara railway line was constructed because of copper mining in Zambian.
- **Source of revenue**: The companies that are involved in mining sector, pay taxes to the government. They must attain license and such calls for payment of a given fee. The revenue collected is thereafter used to development the country.
- **Source of foreign exchange**: Mining sector contributes a lot to the earning of foreign exchange to the countries. Minerals are exported to other countries and such has enabled them to have huge sums of foreign currencies.
- **Urbanization of many areas**: Mining operations have encouraged the growth and development of the urban centres. That is, many people move to mining areas and such increasing population numbers attract

other infrastructural development to the area and eventually, towns and cities develop. The good examples are: Lubumbashi, Belfast, Johannesburg, and Lagos.

- **Growth and development of industries**: Mining has led to the development of large manufacturing industries. There are industries engaged in smelting of mineral ores, others processing minerals to both semi-finished and finished goods. On the other hand, there are other industries that are dealing with manufacturing of mining equipment.
- **Diversification of the economy**: Mining has assisted the countries to have another alternative economic activity. This implies that the countries are able not to depend on few economic activities such as agriculture, fishing, industrialization and tourism, the country can utilize the mining sector too.
- **Improved international relations**: The exporting and importing countries always tend to have a friendly relationship. This means that as one provides mineral ores another provides market. This interdependence results into having political allies that can support one another times of crisis.
- **Improved standards of living**: People earn income in form of wages and salaries which is used to better and improve their way of living, such as sleeping well, dressing, good shelter, acquisition of education for their children and meeting the domestic demands such as food, medical treatment among others.
- **Acquisition of skills**: The people employed by the mining sector, learn a lot of skills through the staff development trainings. These skills acquired can be later utilized by individual to start up their own business projects.
- **Exploitation of other resources such as generation of HEP**: Mining has influenced the tapping of other resources such as using of water falls in power generation such as Hydro-electric power. This so because of the high need for power in running of the heavy machines.
- **Tourist attraction**: The mining operations and installations attract many people from various parts of world. These people pay a fee to the concerned countries and companies in concern. Such therefore, develops tourism which is one of the sources of foreign exchange.

13.4.2. The negative effects of mining to economic development of countries

Mining industry has played a positive role in the economic development of the world's countries. However, this sector is known to have contributed negatively

to the economic development in various ways. The following are some reported negative effects of mining on the economic development:

- Mining has become the chief cause of **pollution** in many countries of the world. Waste soils, impurities, fumes from the equipment used and by products associated with mining operations have resulted in pollution of rivers and environment. This has also contributed to serious global warming as a result of environmental degradation.
- The mining sector has also contributed to depletion of natural resources in and around mining areas. The exhaustion of minerals causes unemployment of miners, which becomes a challenge to the governments and increases **overdependence ratio**.
- There are sometimes great losses incurred by the mining companies. This because some minerals are of low demand. Such reduces the investment base of the people.
- The shortage of mineral and the fluctuation of prices make it hard for the economic planners to have a reliable policy designing system that is workable and functional. Such leaves a great gap within economic development. To worsen the situation, some companies fail because of registering losses.
- Mining has become one of the attractive sectors that employ thousands of people. This has however, left other economic sectors with **reduced productivity**.
- **Soil exhaustion** land suitable for agriculture is wasted or removed when mining is taking place using Open cast. This has left some areas faced with shortage of food.
- There is increased environmental degradation caused by the high demand for timber which is used in the mining sector. At the same time, large chucks of forested areas are cleared as minerals are being searched leading to **deforestation**.
- **There is increased government expenditure** as it tries to address the challenges caused by the mining sector. Such as rehabilitating depleted areas and filling up the deep pits left behind by the mining companies. The money spent would otherwise be used to develop other sectors that directly benefit the citizens.
- **Displacement of people**, many homesteads is involuntarily displaced when mining operations are to take place from a specific area. This breaks the social ties that families share. Resettling them in other parts of country too is costly.
- **Profit repatriation**, most of the mining sectors are owned and

managed by foreign companies. These have always repatriated the profits and leaving little for reinvestment in the country.

- **Urbanization associated effects**, has partly come into existence because of mining operations in some areas. This has come along with slum developed, organized crime, and other ill-effects. All these put together affect the development of the economy.

Application Activity 13.4

1. *Assess the contribution of mining on the economic development of Rwanda.*
2. *Discuss negative effects of mining to the physical environment of Rwanda.*

13.5. Case studies of mining in selected countries

Activity 13.5

Using the geographical documents, text books and internet:

1. *Describe mining activities taking place in Russia, China and South Africa.*
2. *Examine the factors that have favoured the development and growth of mining sector in China.*
3. *Assess the contribution of mining sector to the socio-economic development of South Africa.*

13.5.1. Mining in Russia

The mining industry in Russia is among the highly developed sectors in the country and the world at large. Russia is known for having almost all known minerals resources in the world. Russia has the world's largest proven iron ore reserves and the world's second largest coal reserves (20%). The mining industry of Russia is one of the leading mining industries in the world. Russia having been naturally endowed with a wide range of mineral resources, the country put them to better use and became the world's leading mineral resources producer. It contributes up 14% of the world's total mineral extraction, Russia possesses the following minerals reserve: Iron ore, Manganese, Chromium, Nickel, Platinum, Titanium, Copper, Tin, Lead, Tungsten, Diamonds, Gold, Oil, Natural gas, Coal.

There are four major mining regions in Russia. These are:

- Southern region of Russia which is known for coal mining and oil drilling.
- West Siberia also known for coal and oil.
- Urals region which is important in copper, manganese, platinum and tungsten mining.
- Murmansk region which is known for exploitation of copper and lead.

Factors that favour mining in Russia

- **The presence of a wide variety of mineral reserves**, the country is blessed naturally with a variety of minerals that have enabled a steady supply of the minerals on the international market.
- **The availability of capital** from the state and from the international mining companies that exploit minerals in the area. This explains why they are able to use modern equipment as well as hiring the experts.
- **Supportive government policies**, these have favoured the establishment of mining companies since they are offered tax holidays and subsidization in times of economic hardships.
- **The availability of both skilled and unskilled labour** from the locals and immigrants in the country. The mining sector requires enough labour force. Having it at a hand's reach provides the opportune moments of prosperity.
- **Presence of advanced technology** that is required in the mining sector. The Russian mining companies have managed to exploit the deeply concealed minerals and drilling of oil from off-shore oil deposits. This is all attributed to the availability of technology that s advanced.
- **Adequate power supply** that is required to power the sector. The nuclear power production as well as other forms of power and energy in large levels, has enabled the mining companies to operate at all time.
- **The presence of a well-developed transport and communications system** needed for the transportation of minerals and their products. The Russia is one of the countries of the world with well-developed means of transport.

The challenges faced by the mining sector in Russia

- **Depletion of mineral reserves.** The prolonged period of exploiting minerals in Russia has left most of the mineral ore deposits exhausted.
- There is a **low discovery rate** of new reserves. This has put the mining sector of Russia at a significant risk of having some minerals being expensive to get.

- The mining sector of Russia is still devoted to **the traditional machinery** used in the reasonable years gone by.
- **High death rates,** in the mining sites of Russia are very high. This is because the soils of Russia in places where mining is conducted are less consolidated such as in coalfields.
- There is **stiff competition** from other countries engaged in mining sector.
- The mining sector is challenged with prominent levels of **pollution** of all kinds.
- In some places mining has led to the **displacement of people** from their homes. In areas where mineral resources are found, in most case people are displaced and resettled in other places. This is costly and socially challenging.
- **Land degradation**, Mining scars of exhausted areas that are completely of less or no importance in terms of production.

13.5.2. Mining in China

China is one of countries with a variety of mineral resources. In terms of scale and magnitude, China's mining industry ranks third in the world. The mining sector in Chinese is greatly supported by high levels of technology and supportive government policies. The country has several minerals such as: ***gold, cobalt, iron and steel, nickel, vanadium, molybdenum*** and ***manganese***. There are several mining centers in china, but the most dominant and major ones include the following:

Mining regions and mineral produced in China

Mining centers	Mineral ores exploited
Xikuangshana	Antimony
Jinfeng	Gold
Zhalanzhangzhi mines	Iron ore

Other mining centers include Tayeh, Bayan Obo, Anshan, Shantung, Kiuchuan, Xinjiang and Guangzhou. An increasing demand for mineral resources has made the Chinese industries to supplement the locally mined minerals with the imported ones. The country has oil fields in Beijing, Lanzhou and Chongqing among other regions.

The factors that influence the development of mining sector in China are similar to the ones discussed on a general perspective earlier. At the same time, refer to the factors that favour the development of mining sector in Russia.

13.5.3. Mining in South Africa

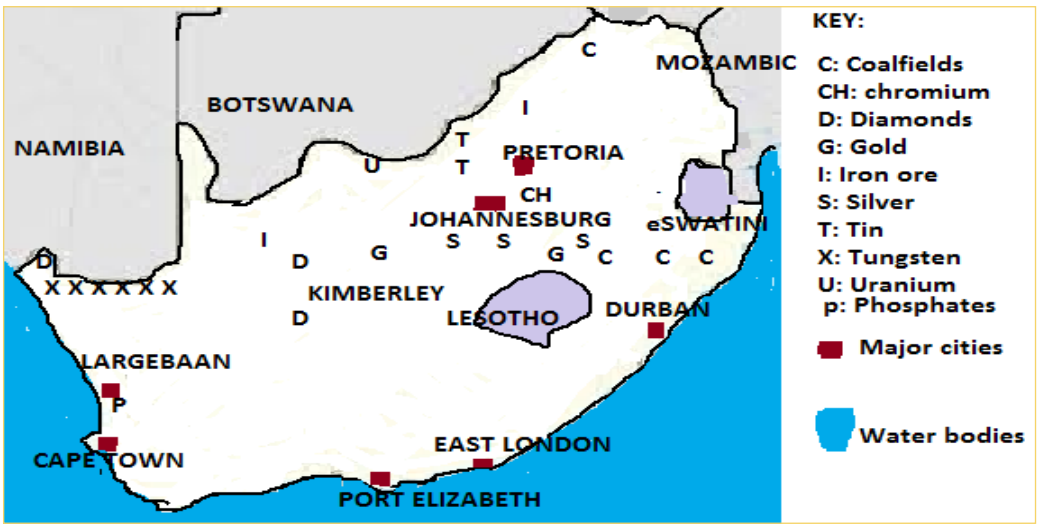
In South Africa, mining has been the main driving force behind the history and development of this African's most advanced and richest economy, after Nigeria.

Large scale mining started with the discovery of ***diamond*** on the banks of the Orange River in 1867 by Erasmus Jacobs and the subsequent discovery and exploitation of the ***Kimberley pipes*** a few years later. This has been followed by the discovery of **Gold** in Kaapvaal Craton, chrome, platinum, vanadium, vermiculite, manganese are also produced in South Africa. This country is also a huge producer of iron ore. In 2012, it overtook India to become the world third biggest iron ore supplier to China.

Diamond and gold production may now be well down from their peaks, but South Africa remains a cornucopia of mineral riches.

The country is endowed with a variety of natural resources. It has large mineral reserves. The Republic of South Africa is the world's largest producer of manganese ore, platinum group metals and gold.

Other minerals found in South Africa include; diamond, coal, copper, uranium, iron ore, asbestos and silver.



Location of major minerals of South Africa

The factors that have contributed to the development of mining in South Africa and the effects of mining in South Africa are not different from those discussed on general perspective of mining. You can refer to them.

Application Activity 13.5

1. *For either Russia or China, account for the successful mining sector.*
2. *Note down the lessons you have learnt from the study on mining in Russia and show how you can use them to improve mining sector in your country.*

End unit Assessment

Study the photograph provided below and use it to answer the questions that follow:

The above photograph shows the pollution of water as result of mining. This polluted water flows to the bigger water bodies and their outlets further redistribute the water to other parts.

1. *Assess the impact of mining on the environment.*
2. *Suppose you were living in the area where this photograph was taken, explain the challenges you are more likely to face.*
3. *Create a program which aims at addressing the negative impact of mining on the physical environment.*
4. *Identify and explain the environmental concerns associated with mining.*

UNIT 14

POWER AND ENERGY PRODUCTION IN THE WORLD

Key unit competence: The student-teacher should be able to evaluate the success of sustainable development projects in the power and energy production in different parts of the world.

Introductory activity

1. *Observe pictures provided below and answer the following questions:*

i) Identify the types of power and energy shown above.

ii) Which ones are renewable among them?

iii) Explain how each type of power and energy works.

iv) Indicate the types of power and energy used in Rwanda within those shown on the pictures above.

2. *Describe the problems that some countries face in power and energy production.*

3. *3. How can power and energy contribute to the sustainable development of our planet?*

14.1. Sources and forms of energy used in the world

Activity 14.1

1. *Make a short tour in the school and the surrounding environment and answer the following questions:*

   i) Identify the activities that require power and energy at your school.

   ii) Describe the forms of power and energy needed for each activity identified above.

2. *Discuss the sources of power and energy exploited and not exploited in Rwanda.*

Classification of energy resources

There are two main categories of energy resources:

- ***Non-renewable resources*:** These are resources of energy without the capacity of replenishing themselves after being used. When used they get exhausted and cannot be re-used. They include minerals, natural gas, oil and coal.
- ***Renewable resources*:** They are inexhaustible. These are resources of energy with the capacity of replenishing themselves after being used. They include water, wind, solar, plants (biomass) and animals (biogas).

A. Non-renewable energy sources

Non-renewable energy resources are available in limited supplies. This is usually due to the long time it takes for them to be replenished. They include nuclear energy and fossil fuels energy resources like coal, oil and natural gas.

i) Nuclear energy (Uranium)

Nuclear energy is energy obtained from uranium through a chain reaction. When it was realized that when the nucleus of an atom is bombarded by electron it disintegrates and release enormous quantity of energy

Generation of electricity involves a lot of technical know-how and so far, only highly developed countries have been able to master it.

ii) Coal

Coal is a sedimentary deposit formed by the slow action of heat and pressure on plant remain buried in the long past. It is a mechanical mixture of carbon, hydrogen, nitrogen, sulphur, etc.

The coal can be used in the following:

- In thermal generators to produce thermal electricity.
- As a domestic fuel for heating and indirectly in the form of a gas and electricity.
- In iron smelting e.g. through use of metallurgical coke in blast furnaces.
- To provide a number of raw materials for the chemical industries like coal gas, coal tar, benzene and ammonium sulfate

iii) Petroleum (oil)

Petroleum is an inflammable mixture of oil hydrocarbons with very complex properties. Petroleum literally means '**rock oil**.' It exists underground in solid, liquid and gaseous form.

The following are uses petroleum:

- for heating homes
- as industrial power to drive/move engines and for heating furnaces and producing thermal electricity;
- as transport power for driving railways, motorcars, ships and aeroplanes;
- as lubricants of machines especially high-speed machines;
- as a raw material in various petro-chemicals industries, such as synthetic rubber, synthetic fibres, fertilizers and medicines.

iv) Natural gas

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulfide, or helium.

Natural gas (Methane) as a fuel may be used for cooking, heating and even to generate electricity. It has the advantage that it can be pumped through pipes from wells to consumption sites. It is also a "clean fuel". This means that it causes less air pollution. Natural gas can be shipped in liquid form, called liquefied natural gas.

B. Renewable energy sources

These are resources of energy with the capacity of replenishing themselves after being used.

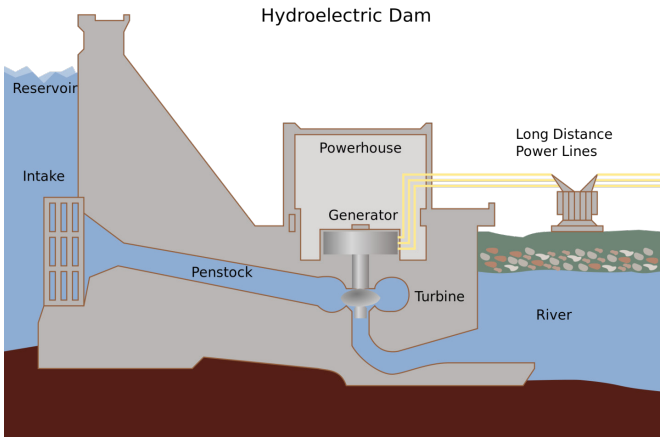
They include the following:

i) Wind energy

Wind energy or wind power is the use of wind to provide the mechanical power through wind turbines to turn electric generators. Wind is an almost unlimited, free, renewable, clean and safe source of energy. It has a moderate net useful energy yield and is based on fairly well developed technology.

ii. Water energy

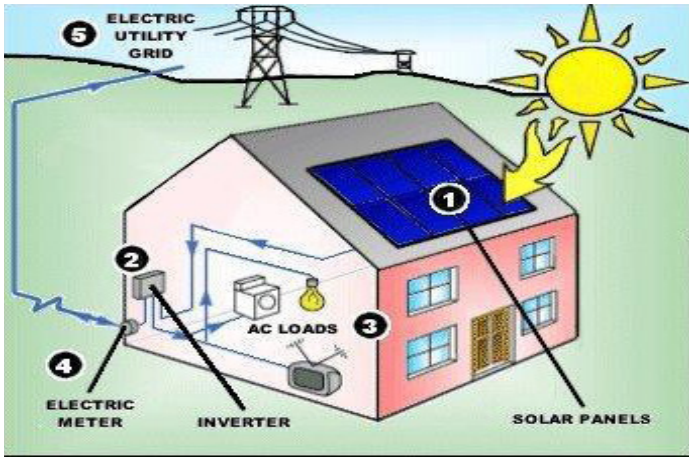
This is the energy produced from running water. Usually, a dam is constructed along a river to store water. The water is then made to fall over a steep gradient. It then passes through a turbine hence spinning the blades of the turbine. Rotation of the blades causes the turbine to turn an electric generator that produces electricity.



Hydro-electric power station set up

iii. Solar energy

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics, indirectly using concentrated solar power, or a combination.



Solar panel

iv. Biomass

Biomass is organic material that comes from plants and animals, and it is a renewable source of energy. Biomass is a renewable energy source for the two reasons: first the energy in it comes from the sun, second, biomass can re-grow over a relatively short period of time compared with the hundreds of millions of years that it took for fossil fuels to form.

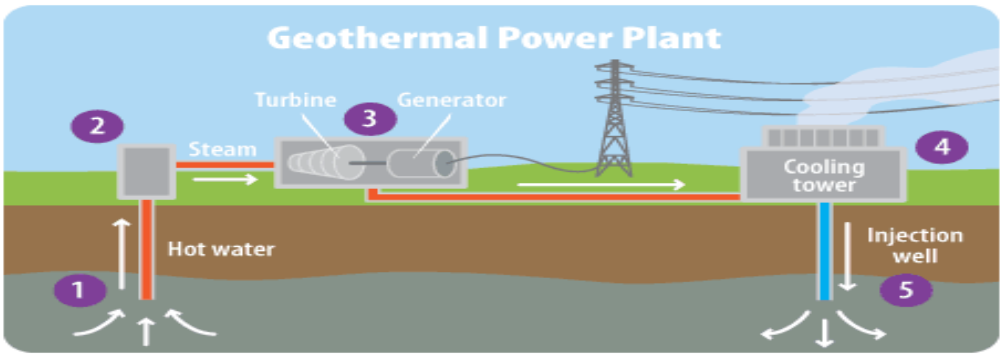
Biomass energy includes: wood fuel, Bio-gas and Gasohol.

- **Wood fuel:** This is a very important source of energy in third world countries. The wood obtained from forests is either used directly or converted to charcoal.
- **Waste products (Bio-gas):** This is a flammable gas produced by micro-organisms, when organic matter is fermented under specific temperatures, moisture content and acidity. It is mainly composed of methane which burns with a blue flame.
- **Gasohol**: Plant material may be converted to alcohol which is a fuel. Wood, wood wastes and garbage can be heated to produce methanol. Most plants containing starch and sugar like sugarcane and cassava can be converted to ethanol. Corn, corn stalks, manure and sewerage can be fermented and distilled to give ethanol. Both methanol and ethanol are directly burned as a fuel.

v. Geothermal

Geothermal energy is produced when rocks lying deep below the earth's surface are heated to high temperatures by energy from the decay of the radioactive elements in the earth and from magma. Geothermal energy can be considered as renewable source of energy if deep underground heat flows can be tapped.

Geothermal energy can either be used for heating water, directly and space heating needs in agriculture and for domestic purposes or it can be converted into electricity.



Generation of geothermal energy

Application Activity 14.1

1. *Describe the sources of power and energy exploited in Rwanda.*
2. *Indicate the main hydro-electric power stations in Rwanda.*
3. *Suggest other alternative sources of power and energy that can be used in the world.*
4. *What types of energy sources promote environmental sustainability?*

14.2. Factors and importance of power and energy production in the world

Activity 14.2

1. *Describe the areas of power and energy production in Rwanda, showing the reasons of their geographical location.*
2. *What are the challenges that Rwandans would be facing if those areas identified above were not there?*

14.2.1. Factors favouring power and energy production in the world

The following are the major factors influencing power and energy production in the world:

- Availability of market to consume the electricity produced. For example, densely populated areas, industrially and commercially advanced, have a great demand for electricity.
- Availability of capital to invest in power and energy production. Production of energy/power, setting up power houses, and transmitting electricity through wires to the areas of consumption require a lot of capital in terms of money.
- A high degree of technical knowledge and skills.
- The potentiality of power and energy generator, the amount of hydro-electrical power to be produced depends on the quantity of water and velocity of stream.
- The natural environment of the area where the power and energy will be produced and transported such as the topography (e.g. nature of terrain and slope), climate (e.g. amount of rainfall, sunshine), hydrology (e.g. quantity and quality of water), affect the production of power and energy.

14.2.2. Importance of power and energy in the development of the world

Power plays a role in the development of a country in different ways such as:

- **Earns foreign exchange**: Energy can be exported in neighboring country and in that way, it is contributing to the earning of foreign exchange.
- **Development of industrial sector:** 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.
- **Development of transport sector:** Petroleum is used in road transport, water transport and air transport meaning that it the basic element in transport.
- **Creation of employment opportunities:** The generation of electricity is offering employment to a good number of people.
- **Development of agricultural sector:** Solar energy is used to dry grains and other produce 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.

- **Improvement of welfare of people in general:** Various forms of energy is used for various purposes such as cooking, lighting and heating.

Application Activity 14.2

1. *Describe requirements for Rwanda to fully exploit its available power and energy resources.*
2. *Visit your local industrial areas and identify the role of power and energy in an industry.*

14.3. Problems and possible solutions for power and energy

Activity 10.3

Visit a power station in your environment and do the following:

i. Identify the problems of power production

ii. Suggest the possible solutions to the identified problems.

14.3.1. Problems hindering the development of power and energy in the world

The energy crisis is still experienced in different parts of the world. This is due to the following reasons:

- Overdependence on oil and its products. Many countries rely on petroleum and petroleum products in industrial, transport and agricultural sectors. It therefore becomes quite difficult to switch to other sources when there is a problem with the supply of oil.
- Economic and political embargoes fixed by the rich countries. For example, in 1973 the oil producing countries in the Middle East imposed oil embargo on USA because of its interference in the Israel and Palestine war.
- Increase in oil prices imposed by the Oil Producing and Exporting Countries (OPEC).
- Depletion of wood fuel due to overexploitation of forests.
- Exhaustion and deepening of coal mines. Coal is a non-renewable

source of energy. Its continuous use leads to the deepening of the mines hence its exhaustion. Consequently, the cost of extraction increases leading to high prices of coal in the world market.

- Environmental pollution: Some sources of energy like coal and petroleum emitted Carbon dioxide in atmosphere. The increase of carbon dioxide in atmosphere leads to ozone layer depletion and climate change with their consequences.

14.3.2. Possible solutions for power and energy in the world

The following are the solutions to the problems of power and energy in the world:

- Move towards renewable resources: Reduce the world's dependence on non-renewable resources and to improve overall conservation efforts.
- Buy energy efficient products: Replace traditional bulbs with fluorescent tube lights CFL's and light emitting diode (LED's). They use less watts of electricity and last longer.
- Energy Simulation: Energy simulation software can be used by big corporates and corporations to redesign building unit and reduce running business energy cost. Engineers, architects and designers could use this design to come with most energy efficient building and reduce carbon footprint.
- Government may come in and improve on public transport efficiency so as to reduce the need to use personal vehicles to reduce the use of petroleum.
- On the domestic front, energy conservation can be achieved by making electrical appliances like refrigerators, television, electric cookers more energy efficient. This can be supplemented by switching of electricity gadgets when not in use.
- Educating the public about the importance, the conservation and the sustainable use of energy resources.

Application Activity 10.3

This is an extract of an interview with Wilson Karegeya, a firm's director for commercial services, Rwanda Energy Group held with iPAD Rwanda Power & Infrastructure Investment Forum in Kigali.

This interview was conducted two months before splitting EWSA into WASAC and REG. Read it carefully and answer the questions related to it.

Let's start with an update on the reform of the energy and water organisations in Rwanda.

Rwanda Energy Group today was still EWSA two months ago. EWSA was the Energy, Water and Sanitation Authority, a government parastatal, which they thought splitting the organisation would ensure more efficiency, better and quick service delivery. So it was split two months ago, forming two corporations: one for water, the Water and Sanitation Corporation, headed by a Managing Director.

It was a department in EWSA and is now a standalone company and still 100% owned by government. There is also the Rwanda Energy Group (REG), which will specifically deal with energy projects. REG also has two subsidiaries, the Energy Development Corporation Ltd and the Utility Corporation. The Energy Development Corporation will mainly address generation and new investments.

What do you hope to achieve in the next 12 months?

We have now embarked on asset separation; EWSA had a lot of assets that need to be shared between the water company and the electricity company. There are issues of accounts and fixed assets like land and buildings that need to be split and shared. That is what the new companies are doing right now. We are being assisted by Price Waterhouse and some other specialised companies to make sure the reform is done well for better service delivery.

And we expect, of course, more specialisation for these companies. The water company will now specialise in making sure that they deliver clean water to the population. They will be less distracted because they will be mainly focused on providing clean water. And the electricity company will now not be overstretched, looking into water and electricity but looking specifically into electricity projects, so I expect more focus for these companies that will lead to better service delivery.

The energy projects that you will invest in, can you highlight specific challenges and how you will overcome them?

One challenge is that we were used to government investments where government invests in energy projects. We have now adopted an approach to involve the private sector more in the generation phase of it: where we identify projects that need to be developed, advertise them, attract private investors, (IPPs) and negotiate the power purchase agreements with them, once we agree and sign the contract, the project is up and running. Where I see challenges is in the contract management. It is an issue that we are not used to working with IPPs. Although you

sign a PPA with an independent power producer, it is more about managing the contract from day one up to the last day of the contract. So that is a challenge there but we hope to overcome it by training our staff to make sure they know how to deal with IPPs, know what to expect and when and what the IPP has to deliver. That is very important.

In terms of generation capacity in Rwanda, what is currently available and how much are you projecting?

Currently we are at 110 megawatts capacity and we expect to generate up to 563 megawatts by 2017. That is the target we have. There are on-going projects that will enable us achieve this targeted megawatts and some are nearing completion. We have also taken the direction of using the regional interconnectors in order to share power with the neighbouring countries. We are currently negotiating a PPA with Kenya aiming at purchasing power from Kenya through Uganda.

Power generation goes hand in hand with other infrastructure development such as roads; rail etc. what are the plans there?

In the transmission sector we have also started using private developers. We recently advertised a tender to attract investors to come and do the transmission lines and improve the networks as we expand the capacity. Of course, there is a need to improve the network, so we are doing that concurrently.

What is a day like in Rwanda in terms of electricity supply?

Until recently there weren't many power outages in Rwanda. But now industry is growing and the demand for energy is growing and we are striving every day to increase the capacity to serve all our customers, be it investors, industrial or domestic. Of course, you get investors who come to us saying "I want 5 megawatts, I want 15 megawatts, I want up to 10 megawatts", so you have to work hard to make sure you use all the resources available to provide such electricity.

A recent example is a new cement factory that has asked for up 15 megawatts, and we have a total capacity of 110 megawatts for the whole country. So you can imagine how hard we have to work. The good news is that we have secured the power the factory requires.

Who looks at tariffs and the regulation around tariffs?

It is RURA (the Rwanda Utility Regulatory Agency). But if we are attracting investors for projects above 5MW, we negotiate a tariff. For projects below 5 megawatts, there is a feed in tariff set by RURA. For big projects, Rwanda Energy Group negotiates with the developer and agrees a tariff at which it will supply electricity.

What is the situation with residential access to power?

For now, the residential users are connected and satisfied. The challenge we are facing is the new industries that are emerging. Otherwise the domestic customers had no issues sofar. Perhaps they might have to start competing for the insufficient power that we have – to share this among the commercial and domestic clients that we have. But we are working very hard to bridge the demand gap that is growing day by day.

What do you see happening in the East African region in the next five years?

My personal view is that if the current trend of cooperation among the East African member States continues, I see success. When I look at the engagement between member countries, sharing power, that is success. When I see the opening of borders for trade, that is success, and opening of borders for human capital, that is success. If this trend is maintained I see a powerful East African Community.

Extracted from: ESRI AFRICA: AFRICA'S POWER JOURNAL, Published on September 10, 2014

Questions:

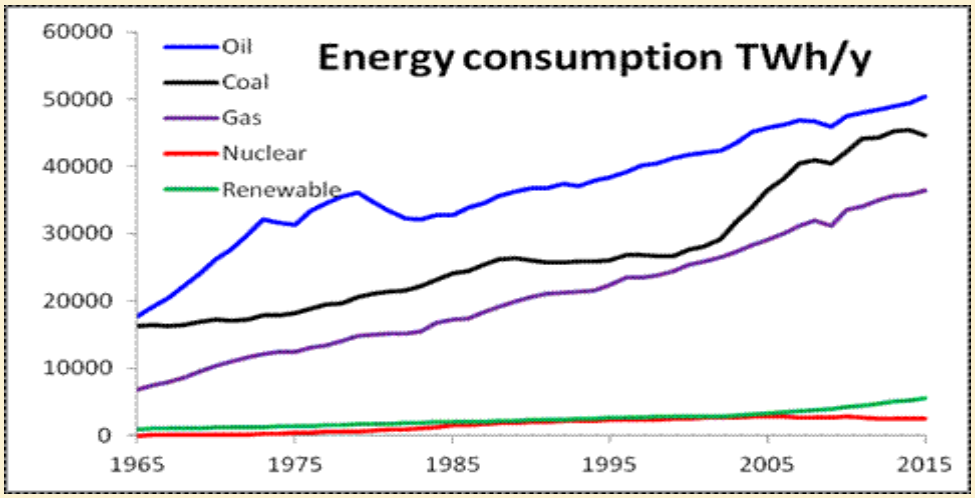
1. *Account for the energy status of Rwanda and its importance to national development.*
2. *Describe the problems highlighted in the interview.*
3. *Basing onexperience from the East African Community countries, explain the importance of power distribution.*

Skills lab

They are many sources and forms of energy across the world. Evaluate any form of energy which is successful to the sustainable development.

End unit Assessment

1. *Assess your district infrastructures and suggest the potential power and energy sources to be exploited*
2. *If you were the chairperson of African Union propose appropriate strategies for sustainable power and energy development in Africa.*
3. *Account for the status of power and energy production in the world.*
4. *Basing on relevant examples or case studies, explain how energy resources contribute to the development of some countries. What about Rwanda in that regard?*
5. *Analyze the figure below and discuss the trend of the use of energy in the world and the challenges that it is likely to cause in the future.*



UNIT 15

INDUSTRIALIZATION IN THE WORLD

Key unit competence: The student-teachers should be able to evaluate the success of the sustainable development projects in the industry in different parts of the world.

Introductory activity

Mr. Gatete is a farmer, he grows crops like coffee, cotton, bananas and fruits and rears cows and goats. He sells both crops and animal products to Amahoro Cooperative Society which transforms these products into Juice, Packed milk, Cheese, Clothes etc.

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 with the factory.*
3. *Make research on internet / geographical documents and find out five examples of more industrialized countries in the world and describe the factors for their industrial development.*

15.1. Definition, classification of industries, factors influencing location of industries and major industrial regions of the world

Learning activity 15.1

Use experience from your local environment and answer the following questions:

1. *Identify the categories of industries observed.*
2. *Describe the factors that influenced their location.*

15.1.1. Definition of industry

An industry is an establishment that involves production of goods and offering of services. It also refers to the processing of raw materials into finished goods.

Industrialization refers to the concentration or to the development of industries in an area, country or region.

15.1.2. Classification of industries

There are three categories of industries which are closely interrelated.

(i) Primary/ Extractive industries

These are industries which produce raw materials. They are concerned with the extraction of natural resources. They involve agriculture, forestry, mining and fishing.

(ii) Secondary/ Manufacturing industries

These are industries that transform raw materials into finished products suitable for consumption. They include food, beverages, chemical products, etc.

They are subdivided into two categories:

- **Heavy industries:** Such as engineering, metal goods, chemical, ship building industries, etc.
- **Light industries:** Such as food processing, plastics, textiles, electrical equipment, cosmetics and toilet articles etc.

(iii) The tertiary/ Service industries

These are industries involved in the provision of services. The tertiary industries do not produce goods but provide backup services to the industrial sector. The services provided include transport and communication, trade and commerce, financial insurance, printing and publishing, education, health, banking, etc.

15.1.3. Factors influencing the location of industries and industrial development

There are several factors that influence the location of industries and which contribute to industrial development. They are briefly described in the following paragraphs:

- **Efficient labor force:** An adequate or skilled labor force is essential in the initiation and continuance of an industry. It gives the company a maximum output with lowest possible costs.

- **Power and energy:** Any industrial establishment must be located in the areas with enough fuel or other sources of energy.
- **Land:** The location of any industry requires extensive land for set up and future extension.
- **Government policy:** Government's policies which encourage industrial development and job creation are also an important factor. This can be done through tax reduction, provision of land to investors to establish industries and availability of energy in the area.
- **Raw materials:** various types and availability of local raw materials are important in the location of industries. The availability, affordability, size, quantity, quality and weight of the raw materials among others are essential requirements for industrial location.
- **Transport and communication:** Modern industries require constant supplies of raw materials, often in great bulk from various sources. Finished goods have to be distributed to many places as well. Thus the availability of a good network of transport facilities is another important factor in the location of industries.
- **Market:** There is a very strong justification for industries to be located near the markets which consume their finished products. Some types of industries are more likely to be located near markets than others; e.g. perishable goods, fragile goods, bulky goods etc.
- **Capital:** No industry can be developed unless it has financial support. Many for purchasing the land and machines, constructing factories, acquisition of the required raw materials, and transportation of both raw materials and finished goods and for the payment of workers, or in every phase of industrial development need to be available.
- **Water supply:** Certain industries, especially iron and steel, aluminum smelting, thermal power generation, pulping of timber, synthetic fibre manufacture and chemicals, consume enormous quantities of water either in processing the raw materials or for cooling purposes.
- **Industrial inertia:** This is when an industry remains in its original location even if the initial advantage that led to its location is no longer available**.** This is due to three main factors:

  The presence of a good transportation network of roads, railways, canals and so on. An industry moving to a new site might face transportation difficulties.

  — Influence of skilled labor and experienced workers built up in that area.

  — The cost of building and equipping a factory is extremely high.

Industrial establishments do not readily undertake a complete move with the new building and tooling-up costs that this entails.

- **Sites:** Some industrial plants have to be sited on leveled ground instead of hilly regions. Others require vast acreage of land and the cheapness of the available land is a primary consideration.
- **Climate:** Climatic factors sometimes have to be taken into account especially in countries with extremes of climate. Costs of heating, air conditioning factories or offices may be prohibitive. Hot climate may create problems of storage. Climatic factors such as severe winters or annual floods may affect transportation adversely.
- **Political stability:** encourages long term investment necessary for industrial development. This is why countries with little political instability like Western Europe are advanced in industrial development than developing countries of Africa and Asia.

Application Activity 15.1

1. *Describe the categories of industries common in Rwanda.*
2. *Identify two industries of Rwanda and describe the factors that led to their location.*

15.2. Major industrial regions in the world

Activity 15.2

1. *Make research and identify the major world industrial regions.*
2. *Explain the factors that are responsible for the location of industries in USA, RUSSIA, China, Egypt and South Africa.*

There are major industrial areas in both developed and developing countries. USA, and Russia are the example of industrialized countries in developed countries, Egypt, South Africa, China in developing countries.

15.2.1. Major industrial regions in developed countries

A. Industrialization in USA

i. Factors for the high level of industrialization in USA

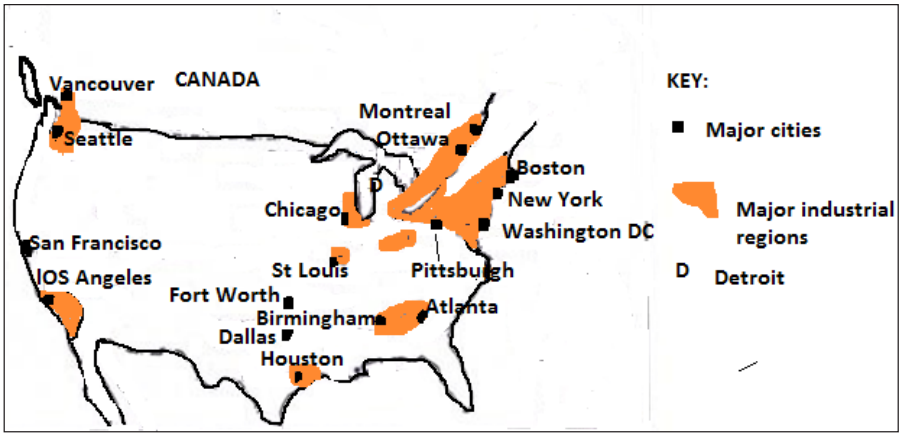
USA is the world's leading industrial nation. About four-fifth of the industrial output of North America is contributed by the United States alone. The factors, which helped in the industrial development of USA, are:

- A wide range of raw materials such as agricultural raw materials and mineral raw materials.
- The population of USA was made up of immigrant from many advanced European countries especially from U.K, France, Germany, Holland and others. These immigrants brought with them the experience skills and technical knowhow of their mother countries. This encouraged rapid industrial development.
- USA is located on the opposite side of Atlantic from Europe. This has stimulated trade and growing world markets. It has also led to industrial expansion.
- USA has extended water transport from St. Lawrence Seaway to the heart of the continent via the Great Lakes. This has stimulated industrial development by providing cheap means of transport for raw materials and finished goods.
- USA has a high level of technology. This has been maintained by adequate educational and training facilities and a technological system. This system attracts skilled scientists and technologists. This brain drain helps to give the USA a lead in scientific modern industries such as electronics computers and so on.
- USA has abundant petroleum, natural gas, local and hydro-electric power. The availability of various sources of power in economic quantities has stimulated the development of large manufacturing industries.
- Availability of capital generated from international trade (from exports) encouraged industrialization.
- The government of USA also encourages rapid industrialization. It encourages export promotion.
- There is internal competition among the industries and this has stimulated industrial development.
- Availability of extensive land for industrial development.

ii. Industrial regions of USA

There are six industrial regions in USA:

1. **Southern New England:** It is centered in Boston with two types of industries; shipbuilding and textile,
2. **Mid-Atlantic States:** This region includes cities of New York, Philadelphia and Baltimore. The industries here include iron and steel, engineering, printing, electrical goods, foot wear and consumer goods.
3. **Pittsburgh – Lake Erie region:** this is the core of heavy industries, engineering, glass, pottery, chemicals, synthetic, rubber, tyre making, generating hydroelectric power from Niagara Falls, flour milling etc.
4. **Detroit industrial region:** this is the greatest automobile manufacturing region of the USA. Other industries include electrical wires, glass, batteries, paints, alloyed steel etc…
5. **South Appalachian region:** It is centered in Birmingham. Industries include steel making, Hydro Electric Power generation, cotton textiles, metal works, machinery manufacture etc.
6. **Eastern Texas:** It has major cities like Dallas, Fort Worth and Houston. This region is the major USA source of oil and gas.



Major industrial regions of USA

B. Industrialization in Russia

i. Factors for high level of industrialization in Russia

- Presence of a variety of minerals such as Iron, copper, gold, diamond, coal etc.
- Improved transport network of railways, aircrafts and developed road network.

- Existence of agricultural raw materials such as cotton for textiles, milk for dairies, hides and skins for leather and footwear industries.
- Availability of capital from financial institutions to promote industrial development.
- Improved research to develop cheap and highly efficient methods of production. This has led to technology and industrial development.
- Government policy of promoting self-sufficiency in most of the manufactured goods consumed in the country.
- Attraction of foreign investors from Europe, Japan and USA has greatly contributed to industrial development.
- Presence of a large population which provide a large domestic market and cheap labor force.
- Skilled labor in form of electrical, mechanical, chemical engineers, laboratory assistance.

ii. Industrial regions of RUSSIA

The Russian industries are concentrated in the four major areas:

1. **The Moscow – Gorki region:** this region has diverse industries including heavy engineering, steel industries, railways, equipment, automobiles, aircraft and food processing.
2. **The Ukraine industrial region:** This region has developed during the period of USSR (Union of Soviet Socialist Republics) the main industries are iron and steel, making machinery, chemicals, etc.
3. **The Urals industrial region:** engineering (heavy) and metallurgical industries dominate all other activities,
4. **The Kuzbas region:** This area has large thermal plants, extensive coal deposits, engineering, hydro-electric power plants, metallurgical plants, chemicals including petrochemicals.

Major industrial regions of Russia

15.2.2. Major industrial regions in developing countries

(i) Industrial development in China

Industrial development in China began after the beginning of Communist rule in 1949, and now China is an art industrial power of Asia and of the world. There has been a complete transformation of the industrial system during the last 60 years.

Under the new system and policy, China is developing its industrial system in a planned manner. Rapid development has made China a leading producer of iron and steel, textiles, and cheap consumer goods such as toys, household goods and light metal goods.

a. Factors for industrial development in China

Large quantities of natural resources: They constitute the raw materials for industries such as coal, copper, zinc, lead, and manganese. This has given rise to industries dealing in copper processing, steel products, electrical equipment etc.

Deposits of coal and petroleum: They act as a source of energy for the industries. Coal is the single most important energy source.

Large population: With over 1.3 billion people, China has large domestic market for its industrial goods. Chinese manufactured goods have a ready market even in other countries like USA, Japan, UK, and the European Union.

Location of China: On the Asian main land and the most populated continent provides the market for manufactured goods, the promotion of trade and procurement of raw materials.

Government policies: Communist system has great influence on the development of industries where each commune was encouraged to have its own industries.

Education: Chinese system provides the basic skills on practical knowledge required in industries and workshops.

Cheap labor force: With a large population, China has a big labor force which is cheap, skilled and unskilled. China has a largest labor force in the whole world.

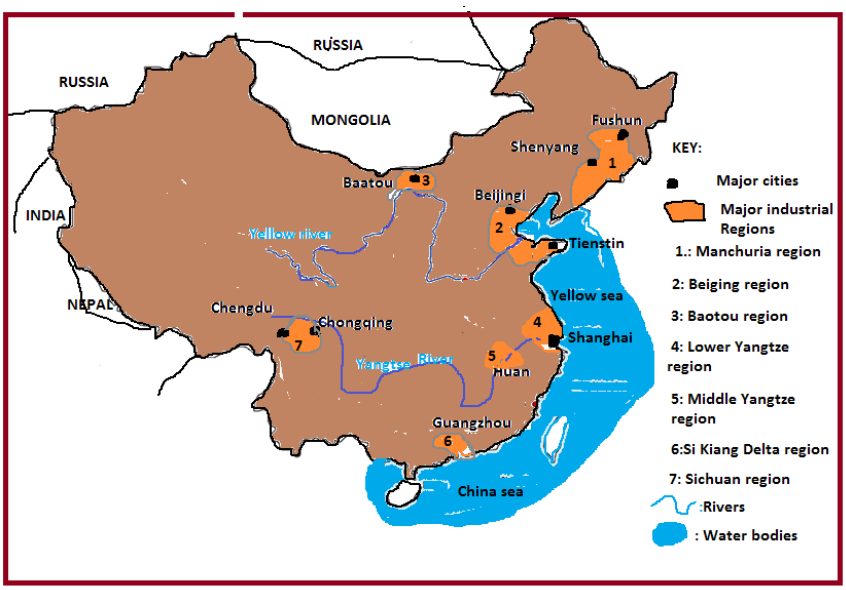
Transport and communication systems: Aircraft is developed to communicate with the entire world and railway transport is improved for acquisition of raw materials and distribution of manufactured goods. Also the country has navigable inland water ways but has been improved by construction of canals.

b. Industrial regions of China

- **Manchurian Industrial Region:** This is the most important industrial area of China with centers at Anshan (steel industry), Penki (steel industry), Fushun (coal, lubricating oil, and chemicals), Mukden or Shenyang (machinery and tools) and Dairen (mills and shipyards). All of them are nearby coal and iron ore deposits.
- **Tientsin and Beijing Region:** This is a second industrial area located at the northern end of the North China Plain, near the Kailan coal reserves, with Tientsin, Peking or Beijing and Tangshan as its main centers. The presence of coal-fields in Shansi and Hopei has contributed to the rise of the metallurgical and engineering industries here.
- **Lower Yangtze Industrial Region:** This is China's oldest industrial region. It existed since the middle of 19th century. Shanghai is the main industrial town and port of this industrial region. The main goods produced are cotton, silk, textile, food, leather, radio, television sets, utensils, leather, etc.
- **The Middle Yangtze Industrial Region:** It is located on the middle Yangtze plain around the former tree towns of Hankow-Hanyang-Wuhan. There iron and steel works there that are based on Peninsiang coal and Tayeh iron ore. Shipbuilding, metallurgical and heavy industries, railway equipment and chemicals are important items of production.

- **Sichuan (Szechwan) Industrial Region:** Sichuan (Szechwan) province above the Chang Jian (Yangtze Kiang) gorge has many important industries around Chongqing (Chungking) and Chengdu (Chengtu). The rich deposits of coal, iron, Ferro-alloys and abundant agricultural raw materials have all encouraged industrial development. Iron and steel, textiles, paper and pulp, machinery, cement, and chemicals are made here.
- **Si Kiang Delta Region:** The port of Canton is the main industrial centre at the mouth of the Xi Jiang (Si Kiang). Canton lacks local raw materials and once was known largely for commerce. Modern industries are centered on silk production; there are silk mills, jute and cotton goods are manufactured, rubber is processed, and there are food-canning and match factories. Iron works and machine factories occupy sites near the docks.

In China, many cities are considered to be the industrial cities. Some towns such as Anning, Kiuchuan (iron and steel); Yumen and Hangzhou or Hangchow (oil refining); Lanzhou or Lanchow (chemicals, textiles, mining equipment) and Kunming (chemicals, machinery,textiles) have industrial development**.**



Major industrial regions of China

(ii) Industrial development in Egypt

In the 1920's, the Egyptian economy was characterized an agricultural economy. Three quarters of the Egyptian exports was raw cotton. As a result, industrial output was mainly cotton spinning and weaving, followed by preserved food, cigarettes, soap and handcrafts.

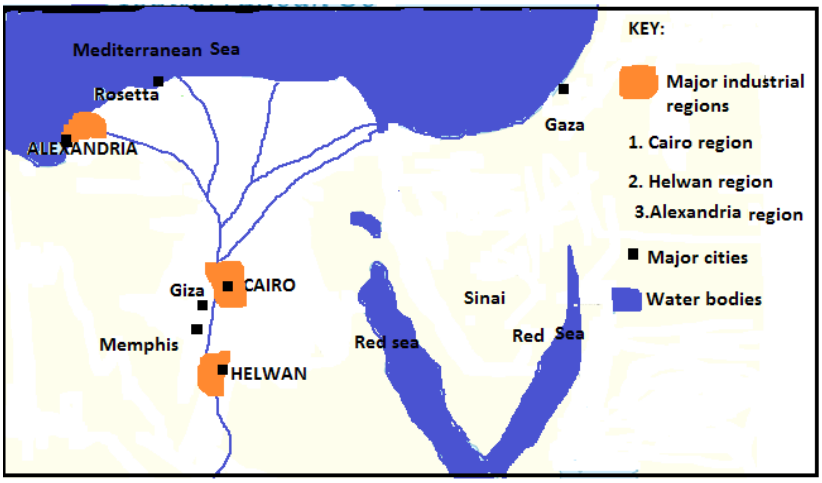
a. Factors for industrial development in Egypt

Factors for industrial development in Egypt include:

- **Availability of raw materials:** Egypt has agricultural raw materials to feed the industries like cotton for textile and sugar for agro-based industries.
- **Availability of minerals**: Egypt has various mineral resources such as oil, Iron, Zinc, Copper, Lead, phosphate that lead to the development of industries.
- **Availability of power and energy**: Egypt has the cheapest source of fuel (HEP) due to Aswan High Dam which allowed the connection of most Egyptian villages to use electricity.
- **Internal market:** Egypt as one of the most densely populated countries in Africa, its population is the ready market for manufactured goods.
- **Availability of water:** Despite that Egypt is a desert country; it has high strategies to use available water from the Nile River. Water is used as a raw material in food processing, construction, cooling machines and other industrial activities.
- **Improved transport:** Water, canals, roads, and railway, provide the cheapest water transport cost of raw materials and finished goods.
- **Relief:** The gentle relief of Egypt enables the construction of industries and transport routes which facilitate the development of industries.
- **Government policy:** The government is currently adopting an industrial policy that entails large-scale privatization of state owned enterprises as well as the gradual removal of subsidies and price controls in the remaining public sector companies.

b. Major industrial regions of Egypt

- **Cairo:** It is the industrial centre of Egypt with textile industries, food processing, motor vehicle assembling and chemical industries. There are also Iron and steel industries located at Hulwan near Cairo city.
- **Alexandria:** It is the main industrial centre in Egypt as well as the country's largest sea port. It has agricultural, textile and chemical industries etc.
- **Helwan industrial area:** It is found on the bank of river Nile with several industries mainly the agricultural industries, sugar, gases and steel industries.



Major industrial regions of Egypt

(iii) Industrial development in South Africa

South Africa is the most industrialized country in Africa. Today South Africa exports a large amount from manufacturing sector. Two thirds of South Africa's national outputs are derived from manufacturing industries.

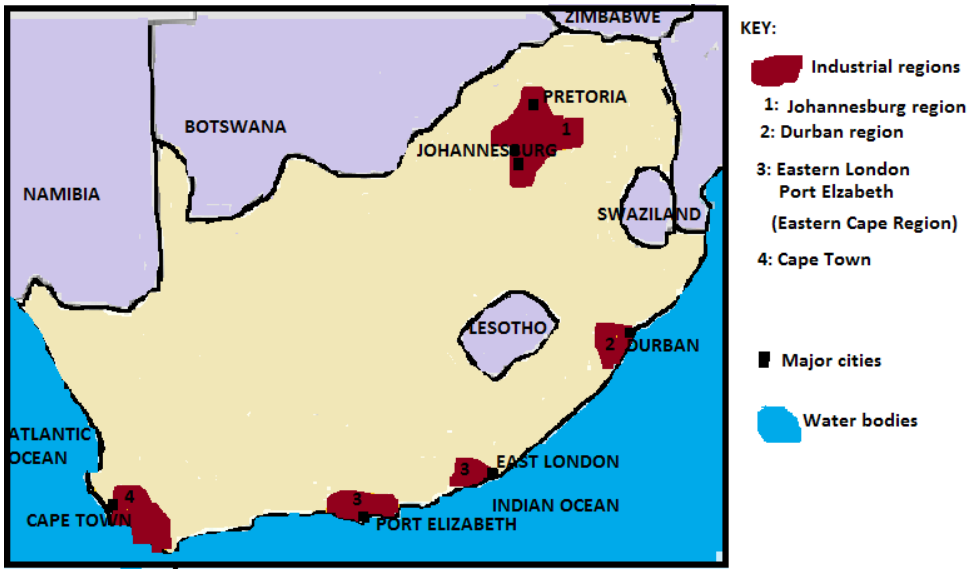
a. Factors for industrial development in South Africa

- **Large quantity of mineral resources:** South Africa is endowed with a wide range of mineral resources which constitute raw materials for industries. The exploitation of minerals has stimulated industrial development.
- **Presence of energy**: The most important of this is coal. There are also numerous rivers, which produce hydro-electric power. Such rivers include orange, the Transvaal River and others.
- **Climate:** Ranging from the temperate climate, Mediterranean, desert and tropical climate. The variety of climate contributes to a wide range of agricultural products, which form the raw materials for many industries.
- **Forest resources:** contribute to the development of sawmills, furniture making and manufacture of paper industries.
- **Fish resources:** South Africa has one of the most developed fishing industries on the Africa continent. This has given rise to fish canning, freezing, fishmeal and fertilizers industries.
- **Labour:** Abundant labor supply.
- **Market:** Large market for its finished manufactured products.
- **Capital:** Enough capital to invest in Industries.

- **Transport and communication:** Good transport and communication networks.
- **Government policy:** Encouragement from the government.
- **Land:** Availability of land for industrial location and extension.

b. Major industrial regions of South Africa

- **Johannesburg:** The main industries found here are textile industries, chemical industries, paper and printing, engineering, electrical equipment, saw milling etc.
- **Springs:** The major industries in this town include manufacturing of mining machinery, electric goods, printing machinery, sheet glass, paper and food canning industries.
- **Durban:** Industries in this region include ship repairing, oil refining, soap manufacture, textile, light engineering etc.
- **Cape Town:** It has food processing, textile, chemical, paper and printing etc.
- **Pretoria:** industrial establishment include glass, cement, metal working, manufacturing railway wagons etc.
- **Eastern Cape Industrial Zone:** Is formed by East London and Port Elizabeth. It is the important port for international trade. It produces building material, soft drinks, furniture, clothes, local agricultural products etc.



Major industrial regions of South Africa

Application Activity 15.2

1. *Explain how the following factors have contributed to the development of industry in RUSSIA*

   i) High level of technology

   ii) Improved transport

   iii) A wide range of raw materials.

2. *Explain the factors that have contributed to the development of industries in the following countries:*

   i) China

   ii) Egypt

   iii) South Africa

15.3. Importance of industries and problems affecting industrial development

Activity 15.3

According to you, why is it important for a country to have industries?

15.3.1. Importance of industries

Industries have the following advantages:

- Industries provide self-sufficiency in essential goods rather than the need for imports and dependency on foreign aid. In other words, it causes import substitution and export promotion, which encourages development.
- Self-sufficiency gives greater political and economic strength. It makes a country more independent of foreign political or economic domination.
- It creates employment. It employs both skilled and unskilled labor.
- Industrialization earns the country foreign exchange. If the products are manufactured for export, the value of the commodities is increased and so the revenue obtained from their sale also increases.

- Industrialization raises living standards of the population as they contribute to increase their income.
- It contributes to the diversification of the economy and reduces reliance on agricultural products which may fluctuate in prices.
- Industrial growth is cumulative and can stimulate growth in other sectors of the economy.
- It provides infrastructure particularly electricity, transport and communication.
- Industries also improve social amenities like schools and hospitals.
- It contributes to the development of research and technology and the regular training of skilled man power.

15.3.2. Problems affecting industrial development

There are several problems that affect many industries. Below are the main and common ones:

- Inaccessibility to the distant world markets which results into low demand for the manufactured goods especially in landlocked countries.
- Lack of real capital investment. Many countries have a problem of inadequate funds to set up industries.
- Shortage of unskilled, semi-skilled and skilled labor. Inadequate managerial and entrepreneurship skills have also affected industrial growth.
- Lack of adequate supporting infrastructure. This is critical for the development of industrial activity.
- Developed countries face the twin challenges of reduced demand and increased unemployment levels in older industries as well as finding new market for their industrial output.
- Competition for markets has led to blocks of countries grouping to reduce trade barriers and to increase integration of supply and demand. Such trade agreements allow individual countries to take advantage of agglomeration economies and cheap labor among themselves. However, for countries outside the trading block, they act as barriers to trade and tariffs.
- The infrastructural facilities in the developing countries are not at the level necessary to produce and support industrialization.
- The shortage of valuable minerals in some countries, such as iron ore which form a basis for the establishment of industries. These countries have to import raw materials at high costs.

- In developing countries, poverty lead to a low demand for industrial goods resulting into a limited market, thus affecting the process of industrialization.

Application Activity 15.3

1. *Explain why the industries in developed countries are highly developed than the ones in developing countries.*
2. *Explain the importance of industry in RUSSIA, China and Egypt.*

15.4. Problems resulting from industrial development and ways to mitigate them

Activity 15.4

Why is it not advisable to live near industrial areas?

Industrial development has both positive and negative effects on a given country.

- **Pollution of the environment:** In the areas of heavy industrial concentration, land, air and water are contaminated by industrial wastes.
- **Wildlife extinction:** Industrial pollution affects habitats of wildlife and destroys its species; it is hard to recover them in the environment. For instance, major industrial accidents like oil spills, fires, leak of radioactive materials cause great damages.
- **Global warming:** With the rise in industrial pollution, global warming has been increasing at a steady pace. Smoke and greenhouse gases are being released by industries into the air and this contributes to global warming. Melting of glaciers, existence of floods, tsunamis, hurricanes are some of the effects of global warming.
- **The accidents caused by the machines used in industries:** The machines used in industries for various purposes may cause the accidents from the misuses by the employees or from other external causes; e.g. Lightening, tsunami, electricity, collapses of mining tunnels, etc.
- **Leaching of resources from the environment:** Industries do require large amount of raw materials to process into finished products. This

requires extraction of minerals from beneath the earth. The extracted minerals can cause the environment destruction in different ways.

Ways to mitigate the problems caused by industries

- Isolation of industries from settlements and sources of water to reduce the effects of pollution.
- Reducing of greenhouse effects through neutralizing industrial fumes before they are disposed into either air or water.
- Efforts should be made to control pollution. These can take the form of industries treating their wastes before disposing them as well as recycling some of those waste products and the use of biodegradable materials.
- Promotion of training skilled manpower and use of appropriate technology to reduce accidents in industries.
- Creation of special areas/ zones where industrial wastes are channeled or poured.

Application Activity 15.4

1. *Analyse the problems resulting from industrialization in USA.*
2. *Examine the ways of reducing problems caused by industries in developing countries.*

15.5. Case studies

(i) Developed Countries and Developing Countries

Activity 15.5

1. *Draw a sketch map of Japan and South Korea and on it, indicate the major industrial regions.*
2. *2. Examine the factors that lead to the development of industry in developed and developing countries.*

a. Developed countries: Japan

i. Factors for high level of industrialization in Japan

Japan is the most highly industrialized country of Asia and ranks among the main industrial nations of the world. Despite its shortage of industrial raw materials, Japan has been able to develop her industries because of the following reasons:

- Development of hydro – electric power resources to provide enough power to support rapid industrial development because of little quantity of coal.
- Efficient use of its limited raw materials such as copper, manganese, iron ore, sulphur and timber.
- The coastline and many large ports facilitate the importation of large quantities of raw materials from all over the world. This is because of the geographical location of Japan.
- The population that provides a large supply of labor and the development of industries since it has small land for agriculture.
- The government that encourages industrial development. It has formulated a technically based education system. This has improved the country's technological development.
- A high and expanding market potential. It is located near Asian countries which are mainly agricultural dependent. These provide market for Japanese goods.
- Aid from USA: after the Second World War, Japanese industrial establishments were destroyed. It got financial assistance from rich countries specifically the USA. These loans were used to replace and rebuild the ruined industries.
- Advanced technology: Japan adapted latest techniques from Western industries and have been able to improve upon them.
- Improved transport network: water transport, modern ports were build, roads and railways were improved.

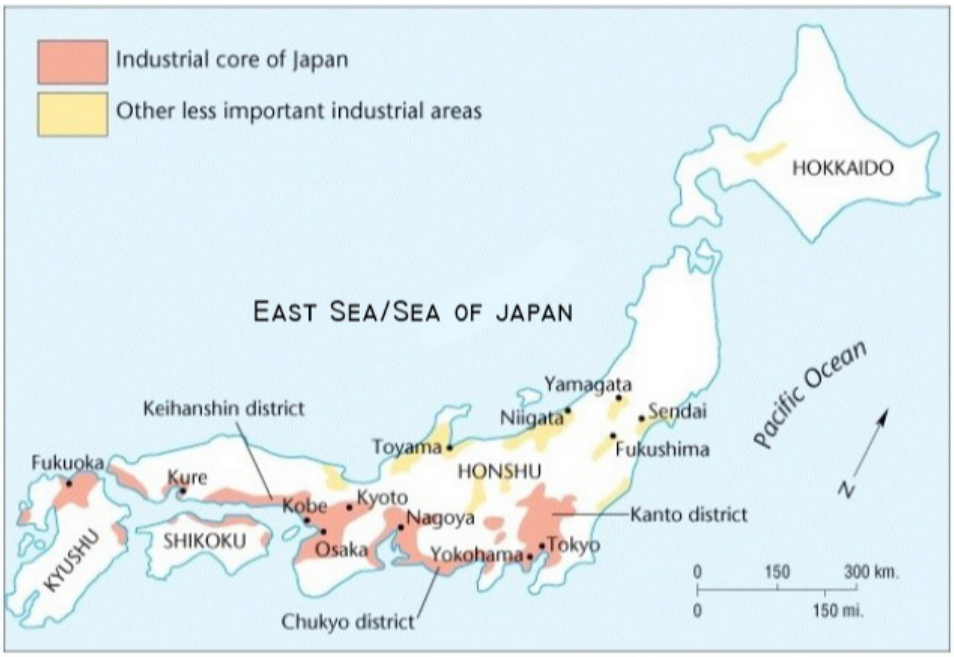
ii. The Major industrial regions of Japan

Japan is the most industrialized country in Asia and ranks among the industrial nations of the world. There are four main industrial zones in Japan:

- **The Keihin Region**: This is the most industrial region in Japan located on the Kwanto plain to the East of HONSHU. It is formed by the conurbation of three important towns; Tokyo, Kawasaki, and Yokohama. This region has 20 % of the Japan's population and account for 33 % of the country's output.

  The major industries found in this region are Chemicals, machinery, textiles, food processing, furniture.
- **The Hanshin Region:** this stretches across a great industrial conurbation of three major cities formed by Osaka, Kobe and Kyoto. It accounts for about 20 % of Japan's industrial output. It is important for the manufacture of textile, iron, and steel products, handcrafts, and shipbuilding.

- **The Ise Bay Region:** this is the third industrial region dominated by NAGOYA industrial Region on the Nobi Plain with a wide range of manufacturing industries including textile mills that process local silk, imported cotton , wood and also synthetic fibres ; engineering industries including all kinds of machinery , automobiles ,locomotives and aircraft .
- **The Kitakyushu Region**: in the northern Kyushu area, the Chikugo coalfield and good accessibility gave rise to a conurbation, called Kitakyushu. This one, embraces several towns, including Yawata, Kokura and Moji. The industrial area extends southwards to Fukuoka and Nagasaki. It makes steel, ships, machine parts, chemicals and textiles.



Major industrial regions of Japan

ii) Developing countries: South Korea

a. Industrial development in South Korea

South Korea is located in Eastern Asia between the Yellow sea and the East sea/ Sea of Japan.

i) Factors for industrial growth in south Korea

Highly skilled labor force: The education system provides basic skills required in industries and workshops. There is highly trained labor force in managerial and marketing which help the country to compete with other countries.

High technology: In industries, microelectronics and computers which keep in touch with scientific advancement.

Government support: Policies aiming at export-oriented industries, rather than to supply the local market.

Agricultural development: The country is self-sufficient in rice growing with large schemes of irrigated land this has made the rural economy more efficient.

Many business people: Companies or businessmen from Europe, USA, Japan who had the capital and skills to build industries have been attracted by low wage rates in South Korea.

Infrastructural development: Well developed transport and communication network which makes the exportation of goods very easy.

Research: This is highly emphasized especially in electronic industry, so as to improve all the existing products and develop new products to meet the market demands.

ii) Major industrial regions of South Korea

- The major industrial regions of South Korea are: Seoul, Yeosu, Chongju, Gwangju, Masan (Changwon), Ulsan, Pohang, Taejon, Busan, Yongdimpo.
- Industries the most developed in these regions are Iron and steel, petrochemicals, ship building, agricultural equipment, machinery, electronics, textiles and light industries.

Major industrial regions of South Korea

Application Activity 15.5

1. *Discuss how human factors have influenced the growth of industries in South Korea and Japan.*
2. *Assess the factors that are responsible for the development of industries in Japan and South Korea.*

Skills lab:

Industrialization is one way of developing the country. Carry out a field visit in your local community, and propose the type of industry that can be establishing in your local area.

End unit Assessment

Make a field trip in any industrialized area around and answer the following questions:

1. *Discuss the physical and human factors that have influenced the location of industries in this area.*
2. *Describe how industrialization contributes to sustainable development.*
3. *Analyse the ways of improving the level of industrialization in developing countries.*

UNIT 16

TRANSPORT AND COMMUNICATION IN THE WORLD

Key unit competence: The student-teachers should be able to analyze the impact of transport and communication projects on the sustainable development of different countries in the world.

Introductory activity

Read the passage below and answer the following questions.

In Eastern province of Rwanda there is a high production of banana. Mr. Gatabazi imported a lorry to help the people to carry their harvests to the market instead of using their heads. Gatabazi extended his businesses and became a businessman in the city of Kigali. He started to import his products from China. Sometimes he goes there to purchase goods or calls his partners using his mobile phone, then orders his goods, and pays using his BK Visa card, and finally gets his goods without moving from Rwanda to China.

1. *What types of transport mentioned are above?*
2. *Explain the economic importance of the transport that Gatabazi introduced in that area.*
3. *Describe the types of transport that he uses to import goods from China.*
4. *What form of communication that he uses to get his products?*
5. *Mention other types of communication he can use to order for his goods.*

16.1. Transport

Activity 16.1








1. *Observe the above photographs and identify the types of transport shown.*
2. *Which type of transport is common in your area and why?*

This unit is about transport and communication. **Transport** is the medium to carry people goods from one place to another. It includes roadways, water transport, airways etc. **Communication** is a process of expressing one's idea thought between two or more people. It includes direct talk, radio, television, internet, telephone, WhatsApp, etc.

16.1.1. Meaning and types of transport

(i) Meaning of transport

The term **transport** refers to the movement of passengers and goods from one place to another. All means of transport need places where journeys start and end. These are called **terminals.**

Terminals for land transport are called **Bus station or Train station**. Those for air transport are **Airports** while terminals for water transport are called **ports**.

(ii) Types of transport

There are three main types of transport as described below with their advantages and disadvantages:

- ***Land transport*** which includes human portage, water transport, animal transport, road transport, railway transport and pipeline transport.
- ***Water transport***.
- ***Air transport.***

i. Land transport

Land transport is the type of transport that takes place on land. It can be subdivided into: Human portage, Animal transport, Road transport, Railway transport and Pipeline transport.

a. **Human portage**

This is when people carry their load on their heads, on their backs or in their hands. It is the most used transport by most people in various parts of the world.

Human portage

Advantages

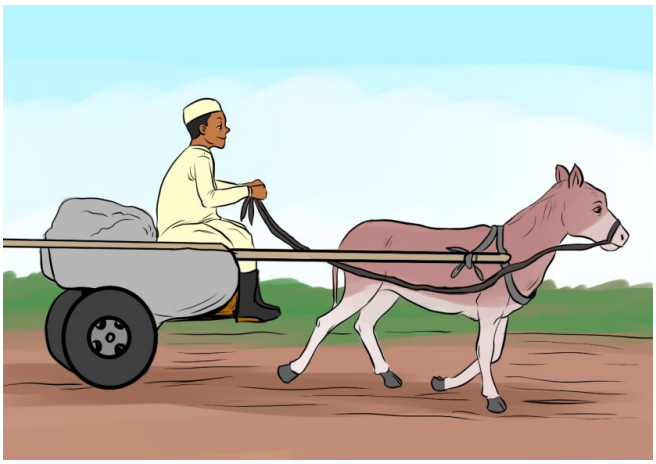
- It helps in inaccessible areas.
- It is cheap compared to other forms of transport.

Disadvantages

- It is very slow compared to other forms of transport.
- It requires a lot of human energy and it is time consuming.

b. Animal transport

This form of transport is commonly used in areas where it is not easy to develop other means of transport especially in arid (desert) areas. Animals used include: Camels, cows, Horses, Donkeys etc.



Animal transport

Advantages

- It is used in wild areas where other means are not possible.
- It is quicker than the human portage.
- It is suitable in areas where human labour is limited.

Disadvantages

- It is slow compared to road transport.
- Some animals cannot move in hilly areas.
- Some animals cannot withstand certain climatic conditions.

c. **Road transport**

This involves the movement of goods and passengers mainly by vehicles, bicycles and motorcycles.


Road transport in California (left) and in Kigali (right)

Advantages

- Roads can be constructed in areas which are accessible to other forms of transport.
- Because of being flexible goods can be sold on route or can be delivered any time.
- It is cheaper and faster for short distances.
- In some cases, it does not require large capital, except road construction.
- It is easier for people to own and purchase vehicles, bicycles and motor cycles than airplanes, motor boats and ships.
- It provides door to door services.

Disadvantages

- Heavy loaded Lorries are too slow.
- Weather conditions affect road transport especially during rainy season.
- There are expensive to construct and maintain especially in towns.
- Roads are affected by congestion and traffic jams in heavily populated urban areas.
- Unsuitable for heavy and bulky goods compared to water transport
- Vehicles at times run empty because of not having a scheduled timetable.

d. Railway transport

This involves the carrying of passengers and goods by train or tram along designated routes.

A) Trams *B) Train*

Advantages

- It is cheaper for transporting bulky goods.
- It is less affected by weather conditions.
- It uses known routes and known timetable.
- It carries more loads and a big number of people.
- It is safe since the chance of accidents or breakdowns are minimal.

Disadvantages

- The use of railway lines does not allow trains to reach remote areas.
- It is very expensive for short distances.
- It is not suitable for carrying perishable commodities.
- It is time consuming/ slow.
- It is costly in terms of maintenance. Currently trams are being replaced by buses in modern cities.

e. Pipeline transport

This involves the movement of liquids and gases through a pipe from one point to another.

Pipeline

Advantages

- It is cheap and easy to maintain.
- It is relatively fast.
- It can be used to transport large quantities of liquids at a single time.
- It is not affected by weather conditions.
- It does not pollute the environment.
- It is free from traffic congestions.
- It is convenient in transporting highly inflammable commodities such as petroleum.

Disadvantages

- It cannot be used to transport other commodities, apart from gas and liquid only.
- It may be damaged leading to heavy losses.
- It does not provide door to door services.
- It is expensive to construct.

ii. Water transport

This is the movement of goods and passengers on water by use of ships, ferries, canoes and boats. It involves both in-land and marine water ways.

A) Marine transport

B) Boat transport in Lake Kivu

Advantages of water transport.

- It does not require any route construction.
- It is the cheapest for bulky goods.
- Bulky commodities can be transported over a long distance.
- It experiences less traffic congestion compared to road transport.
- It is suitable for carrying fragile goods because there is no shaking.

Disadvantages of water transport.

- Construction of sea port is too expensive to be afforded by most countries.
- It is used by areas with navigable water bodies i.e. limited in use by landlocked countries.
- It can be affected by sea pirates.
- It is very slow in movement compared to air and road transport.
- Obstacles on rivers such as rapids, waterfalls, floating vegetation, sand bars, aquatic animals, make them un navigable hence affecting movement of water going vessels.
- Canals are affected by seasonal changes.
- Storms and winds sometimes interfere with the ship schedule.

iii.Air transport

This is the form of transport that uses flying objects in the air such as airplanes, drones and balloons.

A) Rwandair (airbus 330-200)

B) balloon

C) drone (right)

Advantages of air transport

- It is the fastest and most comfortable method of transport.
- It is suitable for transporting perishable commodities.
- It is suitable for carrying urgently needed goods.
- It can go to any place with an airport.
- It is secure, not subjected to robbers.
- It is less affected by relief features.
- It does not need any route construction compared to road and railway transport.
- Its time saving since it follows a specific time schedule.

Disadvantages of air transport

- It causes air and noise pollution.
- It has limited storage space.
- Usually weather conditions such as fog interfere with its schedule.
- It is very expensive in terms of movement costs.
- Long time is taken in air traffic control at airfields. e.g. checking and booking.
- It requires large capital in airport construction and aircraft purchase.
- It requires highly skilled man power to operate.
- It is a target for terrorist attacks.

Application Activity 16.1

1. *Explain why land transport is the most used type of transport in Rwanda compared to air and water transport.*
2. *Describe the challenges associated with road transport.*

16.1.2. Factors influencing the development of transport and importance of transport

Activity 16.2

1. *Rwandair is improving its business worldwide. Explain the importance of that improvement?*
2. *Make research and analyze the physical and human factors that influence the development of transport in your district.*

(i) Factors influencing the development of transport

The factors affecting transport are physical, political and socio- economic. They are discussed below:

- **Relief:** Steep slopes make the construction of roads and railway lines expensive. On the other hand, valleys have swamps, which contain water logged soils that are too soft to allow heavy objects like trailers, Lorries and trains to move on them.
- **Climate:** Too much rainfall results into floods and landslides, hindering transport on the ground. On the other hand, accumulation of fog and

clouds reduce visibility hence affecting transport.

- **Vegetation:** Thick vegetation cover makes construction of road and rail networks difficult because it requires uprooting big trunks of trees. Furthermore, thick vegetation modifies climate through evapotranspiration hence affecting air transport.
- **Capital:** The construction of roads, railway lines and airports is expensive. At the same time, a lot of money is required to buy ships, trucks as well as airplanes.
- **Political instabilities:** Wars lead to massive destruction of transport means and infrastructure such as roads, wagons, airports and ports, making transport extremely difficult.
- **International restrictions based on international boundaries:** These affect transport in that they restrict amount of freight. The same applies to road transport.
- **Economic factor:** The structure and nature of transport costs are examined, together with service quality and methods of pricing and charging.
- **Government policy:** Supportive government programs towards the investments in transport and regulation of transport prices lead to development of transport.

(ii) Importance of transport to the development of countries

Efficient transport is an important factor for economic development on both global and national scales. It can be a boost or a barrier to economic growth. Transports can contribute to economic development in the following ways:

- Transport promotes trade and industrialization through the transportation of necessary raw materials to factory for production of goods and finished goods to consumers
- Transport systems offer employment opportunities to many people.
- Transport promotes urban development as many urban centers have developed where transport networks converge.
- Promotion of international relations since transport brings leaders together for face-to-face talks.
- Promotion of tourism industry, tourists move by use of means of transport.
- Stimulation of the development of other sectors such as, agriculture, fishing and mining.
- Transport increases revenue through taxes to the government and income to local transporters.

Application Activity 16.2

Visit the nearest taxi park and note what you observe in terms of economic impact of the transport.

16.1.3. Problems/challenges affecting transport

Activity 16.3

Analyse the photograph below taken in Nyabugogo and explain the phenomena that occurred in relation to the problems affecting transport.

(i) Problems/challenges affecting transport

These are major problems affecting transport activities:

- **Inadequate capital:** Transport requires enough capital investment. That is why it becomes difficult for developing countries that have weak economies to construct and maintain transport facilities such as roads, airports, ports, and railway lines.
- **Natural barriers:** Hostile environment such as deserts, forests, rugged and mountainous terrain hinders the establishment of transport facilities.
- **Political instability:** Some countries have undergone periods of political instability. With long periods of fighting in these countries,

transport facilities were targeted for destruction while new lines were not established.

- **Climate:** Heavy rainfall and floods make roads muddy and slippery. Bad climate disturb air transport also.
- **Mass wasting** like landslides and mudflows affect roads in mountain areas and block roads for some times.
- **Low technology** causes over dependence on imported expertise and technology which are expensive. This is associated with limitedness of skilled man power to construct infrastructure.
- **Presence of water falls and rapids** along river courses and their tributaries make water transport difficult.

(ii) Ways of improving transport

- Ensuring political stability and avoid wars that destroy transport facilities.
- Containerization of the ports and harbors for effective handling of goods and reduce delays.
- Government policies. Governments have to develop and implement international transport projects like building international highways or railways as the project understudy between Rwanda and Tanzania. Such policies boost transport development.
- Bridges are constructed across rivers to connect different areas across rivers and streams.
- Draining swamps for road construction.
- Improve engineering technology and use of national resources and materials to construct transport infrastructures. There is also need to train skilled manpower.
- To develop air transport for both domestic and international connections in big countries like it is the case in USA, in areas with large impenetrable rainforests like Equatorial forests in DRC or Amazonian forest in South America and large water bodies (oceans).

Application Activity 16.3

1. *Using examples, explain the challenges affecting transport in Rwanda.*
2. *Suggest different ways Rwanda as a landlocked country can use to improve its international transport.*

16.1.4. Case study on transport

Activity 16.4

Make research, and find where the St. Lawrence sea way is located on the world map.

St. Lawrence Sea way (USA-CANADA)

St. Lawrence Seaway stretches from Port Duluth on Lake Superior to port St. Lawrence on the Atlantic Ocean. It covers a distance of 3,800 Km. It is the longest inland waterway in the world with the largest volume of traffic. It serves **Canada** and the **USA**. It allows passage of ocean going vessels. Before the sea way was constructed, large ships could only sail on the great lakes up to St. Lawrence town as far as Montreal. The construction of St. Lawrence Seaway was a joint project venture between the governments of Canada and USA. The construction works began in 1954 and ended in 1959.

- The main aim was to create deep water for navigation between Lake Ontario and Montreal. This would allow ocean going vessels to sail from the mouth of the St. Lawrence River onto the western shores of Lake Superior.

St. Lawrence sea way

(i) Economic benefits of St. Lawrence seaway for the USA and Canada

Economic benefits of St. Lawrence seaway for the USA and Canada include:

- **Cheap transport**: The seaway has offered a cheap means of transport from the interior of North America to the Atlantic Ocean. This has enhanced the movement of people and goods.
- **Creation of employment:** Through transportation of raw material and finished products along the seaway, there has been an increased volume of traffic. This has created job opportunities.
- **Generation of hydroelectric power:** The construction of dams along the seaway like Saunders and Beauharnous on Niagara Falls has led to the generation of abundant power which is cheap and reliable.
- **Growth of Towns:** St. Lawrence Sea Way has encouraged urbanization along its shores. This is because the ports have attracted settlement along. Examples of such towns are Quebec, Duluth and Hamilton.
- **Increased volume of trade**: St Lawrence Seaway has led to the increase of the volume of trade between the USA, Canada and the rest of the world. This has been due to the ease of transporting of goods such as iron ore, copper, wheat and manufactured goods.
- **Development of tourism**: The seaway with the spectacular Niagara Falls is a great tourist attraction. This has earned foreign exchange to the two countries.
- **Development of industries**: The seaway has contributed to the development of industries in the USA and Canada. The power generated from the dams is directly used in the industries. Likewise, water from the dams is used in cooling industrial plants.

(ii) Problems of St Lawrence sea way

- Congestion, unemployment, high crime rate due to the growth of urban centers.
- High cost of maintaining the seaway like dredging to solve the problem of silting.
- Decline in fishing activities due to destruction of wetlands and fish habitant as a result of dredging and blasting as well as pollution of water.
- Many rocks used to adjust the level of water to improve navigation delay the movements.
- Increase of pollution due to oil and chemical spills as a result of enormous increase of cargo size as well as industrialization.

Application Activity 16.4

1. *Explain the problems hindering the development of St Lawrence Sea way and the problems it caused to the neighbouring countries.*
2. *Briefly describe how St Lawrence seaway has contributed to development of both the USA and Canada. .*

16.2. Communication

16.2.1. Meaning and types of communication

(i) Meaning of communication

Communication is a medium of sending and receiving information through various means. It is a very vital aspect of the society. Without communication, spatial interaction between people and communities would not be possible. People communicate to get needed things such as information, money, advice or just emotional support.

Activity 16.5

Observe the following images and explain how these devices are used for communication purposes

(ii) Types of communication

There are different links, instruments and devices used in the transmission of information from one point to another. Early modes of communication included sending runners with verbal messages, fire and smoke signals, and later drums

and horn blowing. The invention of writing led to improved communication as letters could be delivered to various destinations.

Those methods of communication were found to be slow and inaccurate in some instances and limited in terms of the distances they could cover. The rise in electrical technology led to a new concept in communication known as **telecommunication**, which is communication over long distances.

The current modes of communication include telegraph, telephone, fax, e-mail, courier, handwritten, television, radio, social networking.

Application Activity 16.5

Explain the most forms of communication used in Rwanda and why.

16.2.2. Importance of communication, problems affecting communication and their solutions

Activity 16.6

Many business people in the city of Kigali no longer need to travel to purchase their goods in the foreign countries. They use different types of communication to order for the goods and get them in few days in Kigali.

1. *What do you think can be the consequences of such form of communication?*
2. *Explain the importance of communication.*

A. Importance of communication

The following are the main positive effects of communication:

- Communication system facilitates economic development by sending information to various locations of the world. Communication system connects industries and business communities to take right decisions at the right time by providing them with information and news related with business and financial matter.
- Communication is the basis of organizational functioning: good communication is an essential tool in achieving productivity and maintaining strong working relationships at all levels of an organisation.
- Communication sector has led to the creation of employment opportunities to a variety of categories of people such as journalists, media managers and users.

- Investors in the sector of communication such as radio, television and social media (e.g. Facebook, WhatsApp, YouTube, etc.) get more revenue and many of them belong now in the world's richest class.
- Communication facilitates easy dissemination of information to remote areas.
- Communication helps in building good public relations: good public relations comprise relations of the enterprise with outside agencies, particularly consumers and the public at large.

B. Problems affecting communication

The following are the problems affecting communication:

- **Inadequate capital:** Many developing countries experience a problem of weak economies and few industries. They thus have insufficient funds needed to construct and maintain communication facilities.
- **High taxes:** There are high taxes attached to the importation of communication equipment as well as high operation charges.
- **Inadequate technical know-how:** This has hindered the growth of telecommunication since most countries have to rely on expatriates whose payments are very high.
- **Natural barriers:** Desert, forest, rugged and mountainous terrains have hindered the establishment of communication facilities like telephone boosters.
- **Competition:** There is competition between the local companies involved in the sector and free online communication systems.
- **Lack of skills:** There is general lack of knowledge and skills to use telecommunication devices such as computers, radios, newspaper, etc.

C. Possible solutions to the problems affecting communication

Drawing from the problems facing communication discussed above, it is evident that most of them can be overcome by way of reversing them.

- **Political stability**: There should be dialogue between countries and the use of peace talks should be emphasized.
- **Investing in communication** and where capital is not available, looking for ways of getting it through loans or aid.
- **Training of personnel**: Countries should invest more on training their people so as to equip them with knowledge to hand the ever-changing technology. It is cheaper to train home-grown personnel than to hire expatriates.

- **Increase the knowledge in technology**: Use the recent technology radio, telephones, television, and internet to improve the standards of communication.
- Communication is the link between knowledge and information. Therefore, there is need to provide knowledge of the people to be able to communicate properly.

D. Interrelationship between Transportation, Communication and Economic Development

1. Both transportation and communication play some major roles in the economic uplift of a country as they promote internal and external trade.
2. Transportation and communication systems help to promote the use of natural resources, mobility of skilled labour-force, diversification of markets, provision of fuel, increase in agricultural and industrial production.
3. Efficient transport and communication systems help to establish relationships among people in different parts of the world; these have also strengthened the feeling of unity among people in different cultural backgrounds.
4. Transport and communication systems help to create job opportunity for people living in the rural areas by connecting labourers and creating employment for them in the industries; however these have also solved the needs of industries and reduce unemployment.
5. The development of transport system also leads to development of industries because transport system utilizes the product of industries and both complement each other in different ways.
6. Efficient means of transport and communication have indeed shortened time, distance, and cost that would have been used to move and to deliver goods and information from one person to another.
7. Transportation and communication help to increase the size of the market of your products by helping you to transport your products across different countries which will help you to increase your sales in those countries that is, by penetrating new markets.
8. Through the effective transport and communication systems one will know how to strategies in terms of war and also curtail crisis from taking place at any point in time.
9. Government can swiftly evacuate or inform her people against any occurrence of natural disaster, outbreak of diseases and other social

problems through the means of transportation and communication system.

10. Transportation revolution has significantly improved accessibility of places and therefore bringing more developments and growth. This is because transportation is the main vein through which developmental facilities and services are channelled.

Application Activity 16.6

1. *Explain factors hindering effective communication in your area.*
2. *What is being done by Rwandan government to improve communication?*

End unit Assessment

1. *Examine the relationship between communication and transport.*
2. *Explain the role of the government in ensuring effective communication in Rwanda.*
3. *Referring to MTN and AIRTEL –TIGO explain the importance of telecommunication companies in the development of the country.*
4. *Explain the factors that have contributed to the development of transport in developed countries than developing countries.*
5. *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.*

UNIT 17

TRADE AND COMMERCE IN THE WORLD

Key unit competence: The student-teacher should be able to evaluate the impact of trade and commerce on the sustainable development of different countries in the world.

Introductory activity

For different reasons, many countries come together and create regional bloc such as European Union or East African Community. Conduct your own research and answer the following questions:

1. *Identify different regional integrations operating with Rwanda.*
2. *What advantages does a country benefit from being a member of a trading bloc?*

17.1. Definition, types of trade and factors influencing international trade

Activity 17.1

Madame Kayitesi buys goods in large quantities from Inyange Industry. She owns one of the biggest shops in her village. Her products are bought by the local people and she takes some to the nearest markets in her district. Some of Inyange industry products are exported overseas.

1. *Identify the major imports of Rwanda*
2. *Mention the types of trade indicated in the passage.*
3. *Explain the factors influencing trade between Inyange industry and overseas countries.*

17.1.1. Definition of key terms

Trade is the activity of buying and selling or exchange of goods and services at many levels. within a country or between countries. It also occurs between two individuals through the exchange. Trade is part of commerce.

Commerce is the activity of buying and selling goods and services, especially on large scale or huge quantities.

The earliest form of trade was probably "***barter trade***" in which one type of commodity was exchanged for another of equal value. The present trade is based on the ***exchange of goods and services for money***.

The present trade includes:

a. **Internal trade:** This is the exchange of commodities within a country. It is also known as domestic trade. Traders normally need to exchange what they have with what they don't have.

b. **Whole sale:** This occurs when traders buy goods in bulky from both the manufacturers and importers.
   - **Retail trade:** This is where traders buy goods from the wholesalers and sell them in detail to the individual customers. Goods are sold into smaller units to kiosk owners, hawkers, shopkeepers and supermarket.

c. **International trade**: This type of trade occurs between different nations of the world, on a global scale. Its rationale lies in the fact that no country can produce everything that it needs. It involves:
   - **Bilateral trade:** it is a trade between two countries.
   - **Multilateral trade:** it is a trade between many countries, through the exchanging imports where goods and services bought and brought into the country, and exports where goods and services are transferred to another country for sale.

17.1.2. Factors influencing international trade

The type and volume of trade that takes place at any level in any place is influenced by a number of factors. The most important factors are:

- **Capital:** This is the greatest single factor influencing trade. Money is the engine that runs trade. Traders require capital to establish their businesses, purchase their wares and transport the commodities. Where capital is inadequate the volume of trade will also be low.
- **Demand and supply**: For trade to take place there must be sufficient demand and good chain of supply of the items.

- **Transport and communication:** Traders and goods need to move from one place to another to effect various trade related transactions.
- **Trade barriers:** This includes the quota system for international trade, where a country may impose limits on imports and exports.
- **Government policy:** This is where the government influences trade in certain commodities through taxation. For example, the government levies heavy taxes on certain goods such as cigarettes and alcohol.
- **Creation of trading blocs:** The creation of regional common trading markets enhances trade due to increased cooperation between the member countries.
- **Political climate of a country:** Political problems such as wars affect both internal and external trade because wars discourage foreign investors and at times destroy industries; whereas good diplomatic relationship between countries encourages foreign investments.
- **Population size and structure**: This offers ready market for consumption of commodities and labor in trading activities.

Application Activity 17.1

Discuss how the following factors influence international trade in Rwanda:

- *Regional integration*
- *Government policy*
- *Population*

17.2. Causes of low levels of international trade in developing countries and importance of international trade in the development

Learning activity 17.2

Learning activity 17.2

Most of the industrial products used in developing countries are imported from Europe, USA, ASIA etc. African countries also export agricultural products to the rest of the world but the gap between imports and exports in less developed countries still remains big.

1. *Identify the products exported by European countries in Africa.*
2. *Outline the major exports of Rwanda to the developed countries.*
3. *Explain the causes of this inequality between exports and imports.*

17.2.1. Causes of low levels of international trade in Developing Countries

The following are the major factors causing the low levels of international trade in developing countries:

- Difficulty to access the foreign markets**:** The foreign markets are dominated by the goods and services from developed countries because they have better quality and produce more quantity of goods.
- Inadequate and insufficient domestic supply on the international market: This causes the increase in prices and this affect the final consumers.
- Exportation of unprocessed products: Most of the developing countries export unprocessed products due shortage of industries or low level of technology.
- Exportation of bulk and perishable products: Bulky and perishable goods such as horticulture products, fruits, vegetables and animal products, etc. present high risks to be damaged in transport process, or conservation.
- Anti-competitive practices: Most of the developing countries are under anti-competitive practices by private enterprises in restricting the market access of developing countries to industrialized countries.
- Capital inflows: The growing constraints on foreign aid and the difficulties in attracting increased foreign private financing and investment are affecting the growth prospects of countries lagging behind in global integration.

17.2.2. Importance of international trade in development

International trade helps in development as follows:

- **Foreign trade and economic development**: Foreign trade plays an important role in the economic development of any country.
- **Foreign exchange earnings:** Foreign trade provides foreign exchange which can be used to reduce poverty. The foreign earnings for developing countries are obtained through exportation of products especially agricultural products and raw materials.
- **Market expansion:** The demand factor plays very important role in increasing the production of any country. The foreign trade contributes to expand the market and encourages producers.
- **Foreign investment:** Besides the local investment, foreign trade encourages investors to invest in those countries where there is a shortage of investment.

- **Increase in national income:** Foreign trade increases the scale of production and national income of a country. To meet the foreign demand, we increase the production on large scale so Gross National Product (GNP) also increases.
- **Price stability**: Foreign trade helps to bring stability in price level. All those goods which are short and prices are increasing can be imported and those goods which are surplus can be exported. There by stopping fluctuation in prices.
- **Specialization**: this refers to the quality and quantity of products by a given country. Each country adopts the specialization in the production of specific commodities, in which it has comparative advantage. So all trading countries enjoy profit through international trade.
- **To improve quality of local products**: Foreign trade helps to improve the quality of local products and extends market through changes in demand and supply as foreign trade can create competition with the rest of the world, and reduces the cost of importing production.
- **Import of capital, goods and technology**: The inflow of capital, goods and technology in some less developed countries has improved their economies, due to foreign trade. Foreign trade is also responsible for spreading or acquisition of knowledge and how-to-do from developed countries to under developed countries.
- **Cooperation**: Foreign trade provides an opportunity to the people of different countries to meet, discuss, and exchange views and ideas related to their social, economic and political problems.

Application Activity 17.2

1. *Assess the role of international trade in the economic development of Rwanda.*
2. *Suggest ways of reducing the gap between low exports and high imports in developing countries.*

17.3. Major financial centers and trading blocs of the world

Learning activity 17.3

1. *Make research and explain the objectives of International Monetary Fund (IMF).*
2. *Using specific examples, explain how the trading blocs improve the economic development of member countries.*

17.3.1. Major financial institutions and centres in the world

(1) Major financial institutions in the world

A financial institution exists to provide a wide variety of deposit, lending and investment products to individuals, businesses or both. While some financial institutions focus on providing services and accounts for the general public, others are more likely to serve only certain consumers with more specialized offerings.

The major financial centers include:

a. The International Monetary Fund

The International Monetary Fund (IMF) was created in1945 and has Washington D.C. as the Headquarters. It began with 45 members.

The aims of IMF are to promote international economic cooperation and international trade, strives to help stabilize exchange rates among member countries. IMF takes a lead in advising member countries and ultimately helps to avoid financial crises. The IMF also provides loans to help its members tackle balance of payment problems, stabilize their economies and restore sustainable economic growth.

b. The World Bank

The World Bank or the International Bank for Reconstruction and Development (IBRD) was founded in 1944. Its headquarters is in Washington D.C.

It was set up with the aim of reconstructing the war-affected economies of Europe (during the Second World War) and assisting in the development of the less developed countries of the world.

Today, the World Bank is more concerned with the development of member countries especially the developing ones. It provides loans for the purchase of capital goods necessary for development. In so doing, the World Bank

concentrates on loans for projects that are clearly profitable. The World Bank's current focus is on achievement of the Millennium Development Goals (MDGs).

(2) The major financial centres in the world

A financial centre is a location that is home to a cluster of nationally or internationally significant financial services providers such as banks, investment managers, or stock exchanges.

The major global financial centres include:

- **Amsterdam**: (in Netherlands) is well known for the size of its pension fund market. It is also a centre for banking and trading activities.
- **Chicago**: The Illinois city has the "world's largest exchange-traded derivatives market."
- **Dubai**: In the United Arab Emirates, Dubai is a growing centre for finance in the Middle East, including for Islamic finance.
- **Dublin**: In Ireland, is well known because of its International Financial Services Centre, "IFSC". It is a specialized financial services centre with a focus on fund administration and fund domiciling. It also conducts activities such as securitization and aircraft leasing.
- **Frankfurt**: (In Germany) Frankfurt attracts many foreign banks which maintain offices in the city.
- **Hong Kong**: (China) as a financial centre, Hong Kong has strong links with London and New York City. It developed its financial services industry. Most of the world's 100 largest banks have a presence in the city. Hong Kong is a leading location for initial public offerings, competing with New York City.
- **London**: (England) London has been a leading international financial centre since the 19thcentury. And is the largest centre for derivatives markets, foreign exchange markets, money markets, issuance of international debt securities, international insurance, trading in gold, silver and base metals and international bank lending. London benefits from its position between the Asia and U.S.A
- **Madrid**: (Spain) Madrid is the headquarters to the Spanish company Bolsas y Mercados Españoles, which owns the four stock exchanges in Spain, the largest being the Bolsa de Madrid. As a financial centre, Madrid has extensive links with Latin America and acts as a gateway for many Latin American financial firms to access the EU banking and financial markets.
- **New York City**: (USA) Since the middle of the 20th century, New York City, has been described as a leading financial centre. New York City remains the largest centre for trading in public equity and debt capital

markets, driven in part by the size and financial development of the U.S. economy.

- **Paris**: (France). It is home to the Banque de France and the European Securities and Markets Authority. Paris has been a major financial centre since the 19th century. The European Banking Authority (EBA) has a headquarters in Paris fromMarch 2019.
- **Seoul:** (South Korea) It is the capital that has developed significantly as a financial centre since the late 2000. Seoul has continued to build office space with the completion of the International Financial Center in 2013.
- **Shanghai:** (China)This is one of Chinese and world financial centre. It competes with New York and London. China is generating tremendous new cap ital and state-owned companies in places like Shanghai**.**
- **Singapore**: Singapore has developed into the Asia region's largest centre for foreign exchange and commodity trading, as well as a growing wealth management hub. It is one of the main centres for fixed income trading in Asia.

17.3.2. World trading blocs and regional integration

(i) Definition

A trade bloc is a type of inter-governmental agreement, often part of a regional inter-governmental organization, where regional barriers to trade, (tariffs and non-tariffs barriers) are reduced or eliminated among the member states

Regional integration is a process in which neighboring states enter into an agreement in order to upgrade cooperation through common institutions and rules.

(ii) Advantages of trading blocs and regional integration

The following are the advantages of trading blocs and regional integration:

- **Foreign direct investment**: An increase in foreign direct investment results from trade blocs and benefits the economies of participating nations. Larger markets are created, resulting in lower costs to manufacture products locally.
- **Economies of scale**: The larger markets created via trading blocs permit economies of scale. The average cost of production is decreased because mass production is allowed.
- **Competition**: Trade blocs bring manufacturers in numerous countries closer together, resulting in greater competition. Accordingly, the increased competition promotes greater efficiency within firms.

- **Trade effects:** Trade blocs eliminate tariffs, thus driving the cost of imports down. As a result, demand changes and consumers make purchases based on the lowest prices, allowing firms with a competitive advantage in production to thrive.
- **Market efficiency:** The increased consumption experienced with changes in demand combines with a greater amount of products being manufactured to result in an efficient market.

(iii) Disadvantages of trading blocs and regional integration

The following are the disadvantages of trading blocs and regional integration:

- **Limited fiscal capabilities:** Some regional integration agreements that involve the creation of a common currency most notably the European Union's lead to fiscal crises.
- **Cultural centralization:** Strong integration like the European Union can lead to the loss of unique minority cultures within a region. The European Union has a series of languages that it deems to be the official languages of the EU government. These do not include minority languages spoken by remote communities in Europe.
- **Loss of sovereignty**: A trading bloc, particularly when it is coupled with a political union, is likely to lead to at least partial loss of sovereignty for its participants.
- **Concessions:** No country wants to let foreign firms gain domestic market share at the expense of local companies without getting something in return. Any country that wants to join a trading bloc must be prepared to make concessions.

(iv) Factors affecting regional integration

The factors affecting regional integration are the following:

- Homogeneity of the goods produced among the member states can hinder trade. If countries produce the same goods, there is no need to trade amongst each other. This situation is seen among East African countries which produce almost the same agricultural products such as maize, sugar etc. this undermines trade among them.
- Shortage in foreign exchange. Some countries may not have enough foreign money to trade and buy from other countries. This may be because they do not earn enough from their exports.
- Countries may have different ideologies. They may not be comfortable with their cultures or opinions. This makes it difficult to synchronize / harmonize their economic strategies.

- In the trading blocs, trade is undermined by poor transport and communication. This is experienced mainly in developing countries. This makes it difficult to trade and move from one country to another.
- For business to flourish there must be a peaceful environment. Therefore, if a member state is experiencing political instability, it will affect trading relations in the whole bloc. This undermines trade among the member states.
- Some countries have trading partners who are not in the trading bloc. They prefer to trade with them rather than the member states of the bloc.
- Member states could experience lack of funds or capital. They are unable to pay for goods ordered. This interferes with the functionality of the trading bloc.
- Member states may not use the same language. There will be a language barrier among them making it difficult to communicate. This will make trading in the bloc more difficult and hinder economic integration.
- Countries in the bloc may have different levels of development. Countries that are more developed will benefit more from the common market. The less developed countries will feel unfair trading practices against them.
- In trading blocs, especially Africa, the member countries sell unprocessed primary goods. This limits trade because there are limited manufactured goods in the market.
- There is interference from developed countries that are not in the trading bloc. They impose conditions that limit trade among the member states. This will undermine the union.

(v) Problems affecting international trade

Trade, like other human activities is facing some problems at regional and international level. They could be economic, social, political, environmental and cultural in nature. Problems of international trade include:

- **Protectionisms**: There are ways of implementing a protectionist policy, and every country in the world protects some of its goods.
- **Tariffs***:* The effect of high tariffs is to make imported goods equally or more expensive than home produced articles.
- **Quotas**: If tariffs are ineffective in halting the inflow of cheap foreign goods, countries may resort to imposition of quotas. By a quota system a country refuses to import more than a specified quantity of a certain commodity.

- **Subsidies***:* The government of a country may pay subsidies or give tax relief, in order to keep home prices down. This operates in much the same way as tariff but involves assistance to home industry rather than penalization of foreign producers.
- **Trading blocs**: In recent times trade has been modified by the formation of economic unions such as EEC (European Economic Community). Though tariffs are broken down between the member nations and there is greater flow of the trade amongst them.

(vi) Possible solutions to problems of international trade

The following are the solutions to the problems of international trade:

- Joining and enforcing trading blocs like EAC, EEC**.**
- Common market or grouping which not only reduces tariffs and other restrictions within the group but at the same time raises tariff barriers against outsiders.
- Construction and rehabilitation of infrastructure among member countries
- Political negotiations and discussions to reduce and final end political instability and insecurity so that a favorable trading atmosphere is created.
- Improving the quality of manufactured goods so that they are attractive and competitive on the international market.
- Foreign investment to diversify domestic economy within countries. This may overcome the problem of similarity of goods on the market.

Application Activity 17.3

Answer the following questions:

1. *Discuss why Rwanda should make trade with other countries.*
2. *Analyse the challenges faced by Rwanda in carrying out trade with other countries.*
3. *Discuss how "gains from international trade are mostly beneficial to rich countries"*
4. *Suggest what the city of Kigali can do to become an international financial center*

17.4. Case studies

17.4.1. Regional integration

Learning activity 17.4

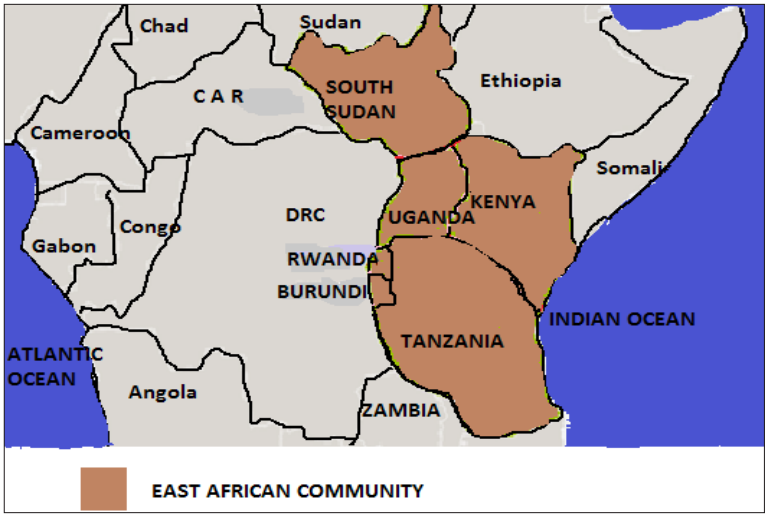
1. *Describe the major objectives of EAC.*
2. *Analyse the challenges faced by ECOWAS member states in implementing its objectives as a regional block.*

(i) The East African Community

The East African Community (EAC) is an intergovernmental organization composed of six countries in the African Great Lakes Region of Eastern Africa. The country members are: Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda. The headquarters of EAC is at Arusha in Tanzania.

The organization was founded in 1967, collapsed in 1977, and was revived on 7 July 2000. In 2008, after negotiations with the Southern Africa Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA), the EAC agreed to an expanded free trade area including the member states of all three organizations. The EAC is an integral part of the African Economic Community.

In 2010, the EAC launched its own common market for goods, labour and capital within the region, with the aim of creating a common currency and eventually a full political federation. In 2013, a protocol was signed outlining their plans for launching a monetary union within 10 years.



East African Community Member States

Aims of EAC

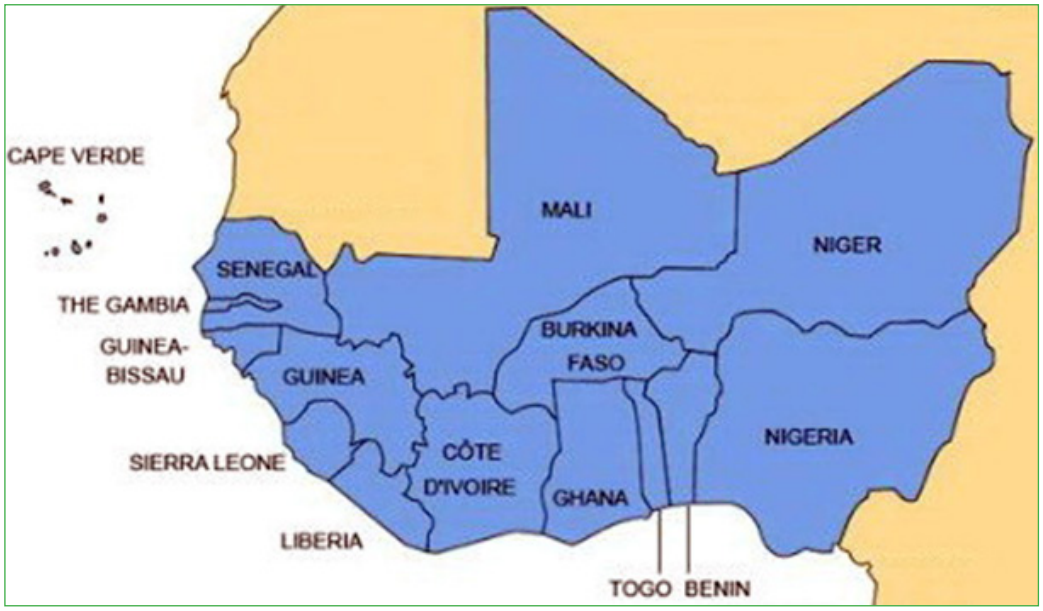
The following are the aims of EAC:

- To revive free movement of people, goods, money, and services.
- To create common (tax) tariff.
- To create large market for goods and services.
- To promote regional cooperation.
- To improve communication.
- To share electricity.
- To promote industrialization in the region

(ii) Economic Community of West African States

The Economic Community of West African States (ECOWAS) was created in May 28,1975 via the treaty of Lagos. ECOWAS is a regional grouping with a mandate of promoting economic integration in all fields of activity of the constituting countries.

Member countries of ECOWAS include Benin, Burkina Faso, Cape Verde, Cote d' Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo.



ECOWAS Member States

Objectives of ECOWAS

The following are the objectives of ECOWAS:

- To promote economic cooperation
- To uplift living standards of member states
- To achieve and maintain economic stability of member countries
- To enhance free movement in member states without immigration formalities.

This regional organization has achieved the following:

- ECOWAS has frozen all customs and tariffs on goods originating within West African and this has led to industrial growth.
- It has decreased prices among the member states of some products like petroleum.
- It has increased technological exchange among the member states.
- There has been an improvement of communication in the region.

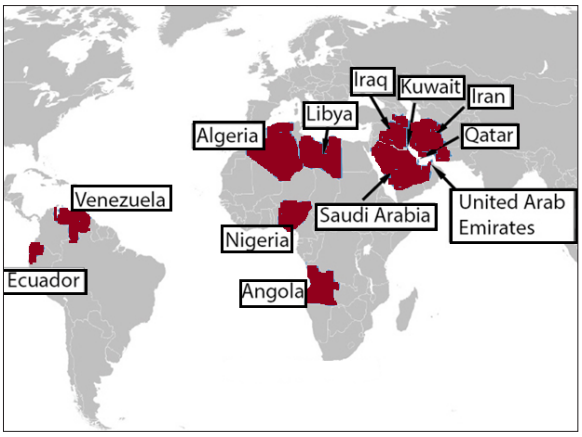
17.4.2. Trading blocs

(i) Organization of Petroleum Exporting Countries

The Organization of Petroleum Exporting Countries (OPEC) is an organization of oil-producing countries. It controls 61 percent of the world's oil exports and holds 80 percent of the world's proven oil reserves. OPEC's decisions have a huge impact on prices. The country members are: Algeria, Angola, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela.

OPEC's three goals

- To **keep prices stable**. It wants to make sure its members get what a good price for their oil.
- To **adjust the world's oil supply** in response to shortages.
- **To coordinate and unify the petroleum policies** of its member countries and ensure the stabilization of oil markets.



Organization of the Petroleum Exporting Countries

(ii) The European Union

The European Union (EU) is a union of 28 independent states based in Europe. It is the largest single common market in the world. The European Union has a common currency, the euro, which is acceptable in all member states. EU helps in promoting trade, agriculture and creation of employment.

Member states of the EU are Austria, Netherlands, Hungary, Belgium, Portugal, Latvia, Denmark, Spain, Lithuania, Finland, Sweden, Malta, France, Poland, Slovakia, Germany, Slovenia, The United Kingdom, Greece, Ireland, Italy, The Czech Republic, Estonia, Luxembourg and Cyprus.

The European Union Member States

Application Activity 17.4

1. *Describe the major aims of OPEC.*
2. *Explain how ECOWAS member states have benefited from this integration.*

Skills lab

Trade and commerce has a great impact on the sustainable development of different countries in the world. Evaluate the impact of EAC to the sustainable development of Africa.

End unit Assessment

1. *Draw the map showing the member countries of E.A.C.*
2. *Conduct your own research to identify different regional integrations operating with Rwanda and show their main objectives.*
3. *Examine the role of regional integration in the social, economic development of Rwanda.*
4. *Analyse the reasons for low level of international trade in developing countries.*

GLOSSARY

Acid lava: A molten material flowing from a volcanic vent. Acid lavais high in silicates, viscous, and does not flow far. It creates a steep sided dome

Adit: Horizontal tunnels that have access to the mineral extraction.

Aquaculture: Refers to breeding, rearing and harvesting of plants and animals in all types of water environments.

Ashes: The solid remains of fires. Specifically, it refers to all non- aqueous, non-gaseous residues that remain after something is burned

Bedding: An arrangement of rock strata in bonds of various thickness and characters.

Brine: It is water that contains salt.

Buffer zone: It is an area of land designated for environmental protection.

Cinder cones: These are the simplest type of volcano. They are built from particles and blobs of congealed lava ejected from a single vent.

Circumnavigation: Originally meant going around something, by ship. Usually it means people going around the world.

Colluvial complex: This is the lower concave slope where there is gradual deposition of eroded material

Condensation: This refers to the process by which water vapour in the air is changed into liquid water. Condensation is crucial to the water cycle because it is responsible for the formation of clouds. These clouds may produce precipitation, which is the primary route for water to return to the Earth's surface within the water cycle.

Continental shelf: The submerged, gently sloping margins of a continent.

Contour: It is a line drawn on a map joining all the places with the same altitude above sea level.

Deciduous forests: Forests or shrubs which shade all their leaves at certain season of the year as opposed to evergreen forests.

Drill: It is a hydraulic method of mining and conveying coal in substantially vertical seams.

Escarpment: Fault scarp or the wall of a rift valley.

Extensive farming / agriculture: Is an agricultural production system that uses limited inputs of labour, fertilizers, and capital, in comparison to the land under cultivation.

Family planning: The practice of controlling the number of children one has and the intervals between their births, particularly by means of contraception or voluntary sterilization.

Foot: It is an a measure of length used in some systems, 1 foot = 0.3048 metres.

Fossil: Is any preserved remains, impression, or trace of any once-living thing from a past geological age.

Gem: A precious stone that has been cut and polished and is used in jewellery.

Gravity: The force which attracts objects towards one another, especially the force that makes things falls to the ground.

Inch: It is a measure of length used in some systems, 1 inch = 0.0254 metres; there are 12 inches in one foot.

Independent variable: These are variables being tested. Whereby its change directly results into a change in dependent variables.

Inland water bodies: Sources of water that are found within a country. They include rivers, lakes, and swamps.

Jewellery: Decorative objects worm on your clothes or body which are usually made from valuable metals such as gold and silver and precious metal.

Leap year: A year that happens every four years and has an extra day on 29 February.

Light year: The distance that light travels in one year (about 9,500,000,000,000 km).

Metropolitan: It refers to a large city, its surrounding suburbs, and other neighbouring communities.

Mile: It is an English unit of length, 1 mile = 1,609 metres.

Mineral deposit: Is an aggregate of a mineral in an unusually high concentration. About half of the known chemical elements possess some metallic properties.

Mineral ore: A naturally occurring solid material, from which a metal or valuable mineral can be extracted profitably.

Open-pit, open-cast or open cut mining: Is a surface mining technique of extracting rock or minerals from the earth by their removal from an open pit or borrow.

Plankton: The food for fish either in form of tiny sea organisms or plants that grow in water bodies**.**

Population policy: A population policy is a set of measures taken by a State to modify the way its population is changing, either by promoting large families or immigration to increase its size, or by encouraging limitation of births to decrease it.

Sewage: Used water and waste substances that are produced by human bodies, that are carried away from houses and factories through special pipes (= sewers).

Shaft: A long narrow, usually vertical passage in an underground mining, used especially for a lift/elevator or as a way of allowing air in our out.

Sluice: A sliding gate or other device for controlling the flow of water out or into a canal to wash something with stream of water.

Subduction: A geological process that takes place at convergent boundaries of tectonic plates where one plate moves under another and is forced or sinks due to gravity into the mantle. Regions where this process occurs are known as subduction zones.

Tsunami: The waves caused by sudden movement of the ocean due to earthquakes, landslides, large volcanic eruptions or meteorite impact in the ocean.

Vulcanicity: The process through which gases and molten rock are either extruded on the earth's surface or intruded into the earth's crust.

Wood fuel pellets: Pellet fuels (or pellets) are biofuels made from compressed organic matter or biomass. Pellets can be made from any one of five general categories of biomass: industrial waste and co-products, food waste, agricultural residues, energy crops, and virgin lumber.

Xerophyte: This is a species of plant that has adaptations to survive on an environment with little liquid water such as a desert or an ice or snow covered region.

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