FOUNDATIONS OF GEOGRAPHY

NEW LOWER SECONDARY CURRICULUM

BOOK 1

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Aligned to the NCDC New Lower Secondary Geography Sylabus

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Foundations of Geography

Aligned to the NCDC New Lower Secondary Geography Syllabus

Book 1

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THEME 1: Introduction to Geography

Topic 1: Introduction

Topic Keywords

1. Geography
2. Environment
3. Natural Environment
4. Human Environment
5. Physical Geography
6. Human Geography
7. Natural Resources
8. Environmental Degradation
9. Environmental Conservation
10. Sustainability

Learning Outcomes: By the end of this topic the learner will be able to;

a) Use fieldwork to observe, name and classify human and physical features.

b) Know the meaning of geography and environment.

c) Understand that the environment is all the things around us.

d) Realise that geography is a study of the relationship between people and their environment, both natural and man-made.

e) Appreciate that the study of geography helps us to understand how our lives are affected by the environment, and how we can preserve the environment so it remains useful to us.

f) Appreciate that caring for and preserving resources in the local environment, community and country are signs of love for one's country.

INTRODUCTION TO GEOGRAPHY

Geography Is the study of the relationship between people and their environment.
Environment means all the features surrounding us as natural and man-made features. Natural features form the physical/natural environment while the man-made features form the Human environment.

Classification of the Environment

Natural Environment		Human Environment	
Lakes	Rivers	Roads	Airports
Hills	Mountains	Schools	Railway Lines
Valleys	Rocks	Plantations	Hospitals
Forests	Birds	Town and Cities	Weather stations
Rivers	Soils	Factories	Museums

Branches of Geography

Geography is divided into two broad branches i.e. Physical and Human Geography.

Physical Geography: Mainly studies the Earth's natural systems. There are four major systems sometimes called spheres i.e Atmosphere, Lithosphere, Hydrosphere and Biosphere.

Table Showing Sub Branches of Physical Geography

Branch	Description	Example of Study Areas
Atmosphere	This is the layer of gases surrounding Earth.	Structure of the Atmosphere (Troposphere, Stratosphere, Mesosphere, Thermosphere, and Exosphere), Weather and Climate (Climatology)
Lithosphere	This is the solid part of Earth.	Structure of the Earth (core, mantle and crust), Rocks (Geology), Soils (Pedosphere), internal processes or Plate tectonics (Earthquakes, Vulcanicity, Faulting, Warping and Folding), external process (Weathering, Erosion, Transportation Mass wasting and Deposition).
Hydrosphere	This is the Part of the earth where water is found.	Drainage (river processes e.g erosion, transportation and deposition), Marine Processes (Ocean currents (warm and cold) and wave action in seas and lakes (erosion and deposition), Glaciation (Cryosphere) erosion, transportation, and deposition by ice
Biosphere:	This is the earth's life part (plants, animals, insects, birds live here)	Plants (Flora) and Animals (Fauna)

Human Geography

Human geography is the branch of geography that studies the relationship between people and their surrounding. It studies how human activities affect or are influenced by the environment.

Table Showing Sub Branches of Human Geography

Branch	Area of focus
Political Geography	Studies boundaries of countries and power relations.
Economic Geography	Studies agriculture, industries, trade, transport, and resources utilisation.
Population Geography	Studies distribution, growth, density and migration of people.
Social Geography	Studies communities in terms of health, education, living standards.
Cultural Geography	Studies languages, religions, traditional values of people.
Historical Geography	Studies how the relationship between man and environment in the past is represented today.

Importance of Studying Geography

1. Helps us to gain knowledge and understanding of the environment hence conserving it. e.g. learning how the river Nile supports farming enable the community to conserving it.

2. Helps us to understand how we can utilise the natural environment sustainably. For instance, by rotating crops to preserves soil fertility.

3. Makes us aware of the role natural environment play in sustaining human life. For example, forests provide oxygen, rivers supply water, and fertile soils produce food.

4. Lays a foundation for future careers e.g. civil engineers who planned a bridge over the Nile in Jinja used geographical knowledge directly.

5. Helps us to appreciate the lifestyles of other people. e.g. learning about pastoralists in Karamoja or fishermen on Lake Victoria helps us respect different lifestyles thus promoting harmony.

6. Helps us to understand the facts behind the formation landform hence clearing misinformation. e.g. the myth about river Mayanja in Wakiso being born of a human being.

7. Knowing about disasters like earthquakes helps us to prepare and respond effectively. For example, knowing where fault lines are allows local authorities to avoid constructing schools or hospitals in high-risk zones.

8. Knowledge of climate helps us to plan for the future. For example, if weather reports predict heavy rain in Kampala, people can carry umbrellas or wear waterproof jackets. Farmers might delay harvesting until the rain stops to protect crops.

Importance of the Environment to Humans

Humans depend on natural resources from the environment for survival and development.

Natural resources are materials or substances provided by nature without human effort, and people use them for survival, economic activities, and development.

There two main categories of natural resources i.e. Renewable and Non-renewable resources.

Renewable Resources are those resources that can be naturally replaced if used wisely e.g sunlight, wind, forests, water, fertile soil, fish etc.

Non-renewable Resources are those resources which can not be naturally replaced e.g. coal, oil, natural gas, gold, copper, iron etc.

People interact with and depend on these resources in the following ways;

1. Lakes are a source of water for home, industrial and farm use for example Lake Victoria supplies water to the surrounding homes.

2. Valleys provide space for agriculture hence increasing food supply for example the rift valley.

3. Forests like Mabira in Buikwe district modify climate by generating convectional rainfall useful in maintaining the water cycle.

4. Rivers such as River Nile generate Hydro Electric Power (HEP) a source of energy in homes and industries.

5. Mountains generate relief rainfall on the windward side which helps the food crops to grow.

6. Rocks are a source of minerals which serve a range purposes such as food (rock salt) and medicine (sulfur for skin diseases like scabies).

7. Wild birds act as pollination agents hence boosting plant reproduction and increasing food production.

8. Fertile soil support food production hence boosting the productivity of the population.

8. Swamps act as water catchment areas for excess water which would cause floods and harm life.

9. Wild animals such as elephants, lions etc act as tourist attractions hence creating job for tour guides.

10. vegetation absorbs green house gas (carbon dioxide) and makes the air clean hence reducing heat waves.

11. Sunlight send rays which makes the earth warm supporting plants and animal life.

Environmental Degradation and Conservation

Environmental Degradation is the process by which the natural resources are destroyed mainly due to human activities.

Environmental Conservation is the careful use of natural resources to prevent destruction and ensure sustainability.

Environmental Degradation Practices

Human activities reduce the quality of the environment in a number of ways including but not limited to the following;

1. Bush burning creates green house gases which trap heat and makes the earth warmer.

2. Swamp filling destroys the storage to excess water leading to floods and loss of life.

3. Poor waste disposal e.g in water sources cause stagnation and creates room for breeding of diseases carrying vectors such as Anopheles mosquitoes the cause of malaria fever.

4. Burning fossil fuels in cars supplies toxic gases which reduces the quality of air we breath hence leading to air-bone diseases like Tuberculosis (TB), Influenza (Flu), Measles, Chickenpox.

5. Deforestation affect the rainfall cycle hence leading to drought. This affects crop growth leading to famine and eventually death of people.

6. Over exploitation of natural resources leads to extinction of non-renewable resources such gold, copper and sulfur hence creating future scarcity.

7. Use of harmful pesticides and herbicides lowers the fertility of the soil making it less productive and unable to produce food to sustain the current and future generation.

8. Mining destroys ecosystems (homes) for species like rodents leading to low bio diversity (variety of species). This affects interdependency of species and energy flow leading to extinction of some species.

9. Oil spills in water bodies affects fish reproduction and hence low protein food supply.

10. Over population creates strain on land and makes if less productive to support human life.

12. Overgrazing by livestock depletes vegetation, leading to soil erosion and desertification, reducing land productivity.

13. Use of motor vehicles in Dangerous Mechanical Conditions (DMCs) add toxic gasses in the atmosphere hence reducing the quality of the air we breath.

Environment Conservation Measures

To ensure their sustainability for present and future generations, a number of actions can be undertaken to prevent environmental degradation, restore damaged ecosystems, and promote a balance between human activities and nature including the following;

1. Planting trees to restore or create forests. This helps in absorbing excess carbon dioxide and reduce heat waves hence making the earth safer for plants, animals and humans.

2. Using farming methods that protect the environment, such as organic farming, a. This helps in preserving soil fertility hence supporting food production.

3. Proper disposal of waste materials to reduce pollution and conserve resources. For example, reducing, reusing, and recycling plastics to minimize landfills and environmental contamination.

4. Practices to reduce water usage, such as rainwater harvesting, using water-efficient appliances e.g electric pressure cookers to minimize water wastage. This ensures the availability of clean water and prevent diseases linked to dirty water such as Cholera, Typhoid and Dysentery.

5. Implementing modern technologies to limit toxic emissions for example using air filters to improve the quality of air people breath. This will help to reduce air-bone diseases like Tuberculosis (TB).

6. Using renewable energy sources such hydro, solar and wind power for cooking and lighting because they can be regenerated naturally hence enabling energy access for the present and the future generation.

7. Protecting endangered species and their habitats by establishing protected areas, wildlife corridors, and anti-poaching laws. This will enable a strong ecosystem with a rich biodiversity.

8. Educating the public about the importance of environmental protection through campaigns, school programs, and media. This will help people to realise the need to protect the environment.

Activity of Integration

Scenario: *A factory in your town is dumping waste into a nearby river.*

Task: *Using your knowledge of environmental protection, write a letter to the factory manager informing him/her of the danger this will have on the physical environment and what the factory can do to reduce the danger.*

THEME 1: Introduction to Geography

Topic 2: Showing the local Area on a map

Topic Keywords

1. Map
2. Photograph
3. Representation
4. Scale
5. Sketch map
6. Symbols
7. Key (Legend)
8. Compass points
9. Direction
10 Route

Learning Outcomes: By the end of this topic the learner will be able to;

a). Know what a map is and how this can be used to show places.

b). Understand the difference between a map and a photograph.

c). Understand that maps are representations of the world at different scales.

d). Draw a sketch map of the school and/or the local area.

e). Use and interpret symbols and identify features on a map using a key.

f). Identify directions on a map using basic compass points.

g). Follow routes on a map.

h). Use the local area maps drawn in (d) above to find information about people living in the local area.

SHOWING THE LOCAL AREA ON A MAP

A **Map** is a representation of part or the whole earth's surface on a paper as seen directly from above. Maps can be used to show various features of the environment and this is what determines the type of the map. Examples of map include;

1. **Political maps:** Show boundaries such as countries, states, cities, and provinces.
2. **Mental maps:** For internal representation of the area.
3. **Topographic map**: Earth's surface with man-made and natural features.
4. **Weather maps:** Show weather conditions like rainfall, temperature, and pressure systems.
5. **Transport maps:** Display highways, roads, railways, and airports.

Maps sometimes are confused with a photograph. A **Photograph** is a representation of an object as seen from a side.

Differences Between Maps and Photographs

Maps	Photographs
Maps are taken directly from above	Are taken from a side or an angle
Some maps are drawn on scale	Do not have a scale at all
Maps use symbols to represent features	Use real images to represent features
Uses a key to define symbols representing features	Usually have no key
Maps have a compass to show direction	Do not have compass direction
Maps show selected features e.g roads and rivers.	Show real appearance e.g. shape

Qualities of a Good Map

Maps should be well labelled for easy interpretation. The table below shows the qualities of good map and their importance.

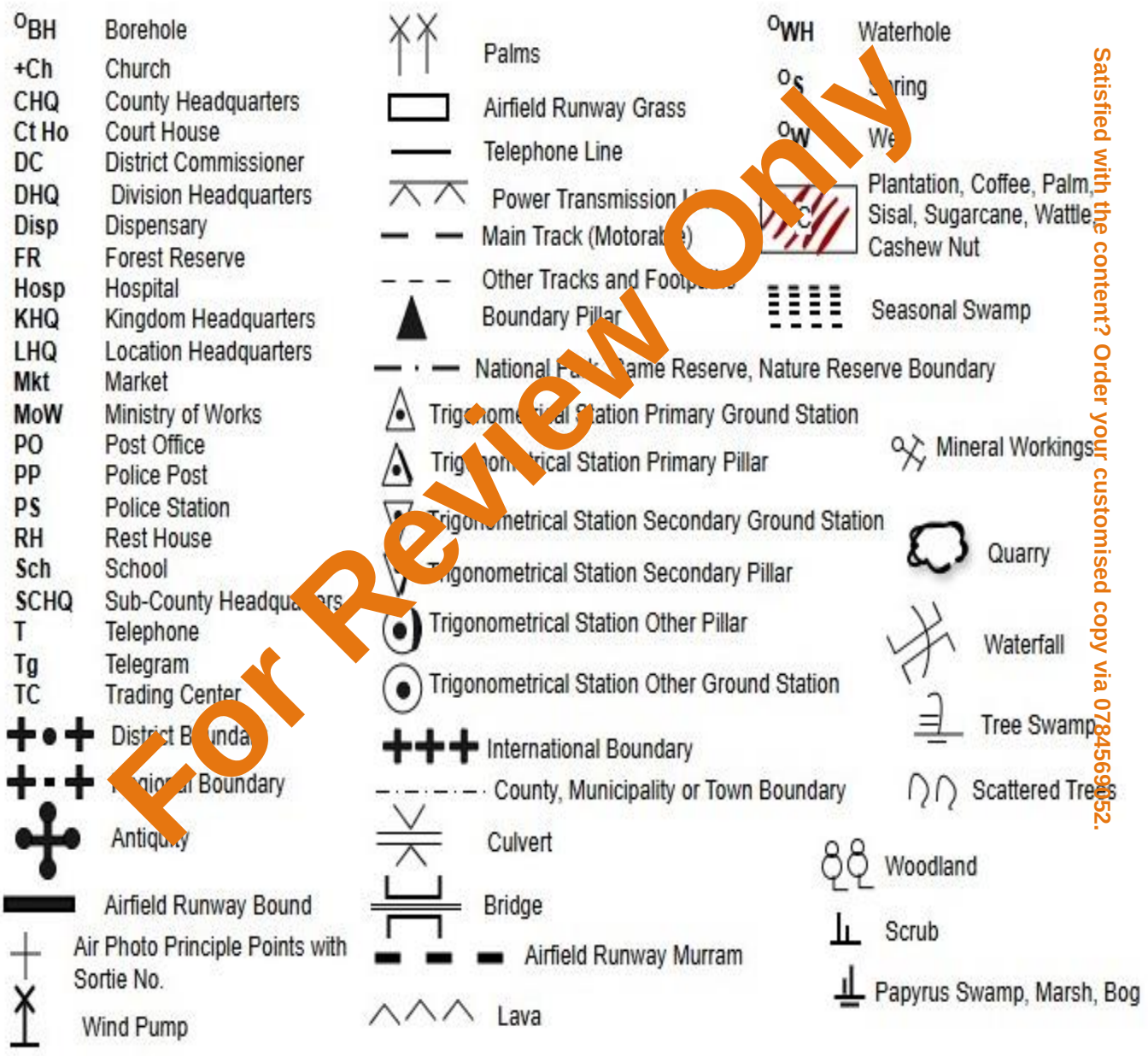
Quality	Importance
Title	Shows what the map is about e.g Map of Uganda
Scale	Helps to measure real distances on the ground
Key/Legend	Explains the meaning of symbols used
Compass	Shows orientation e.g which way is north, south, east, west etc.
Boundary/Frame	Shows the limit/extent of the map
Symbols	Standard signs make features to be seen easily and limit congestion

Activity 1.1: *Draw a sketch map of your school showing physical and human features.*

Key or Legend

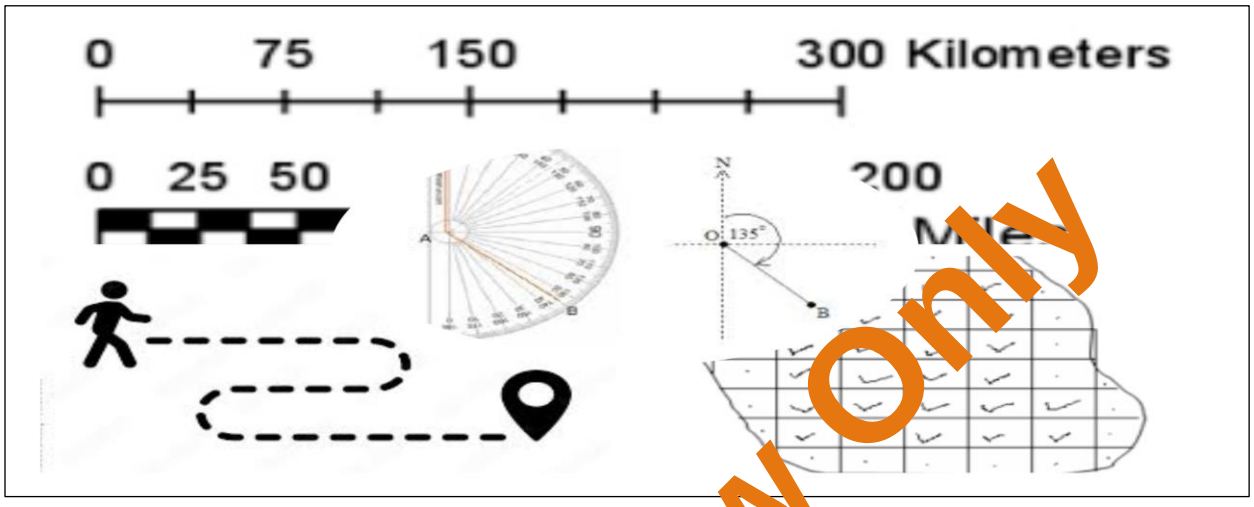
Since maps do not use real images for real ground features, the Key also known as a Legend is used to explain the symbols and signs used on the map to represent the different real-world features. Below are some of the common signs and symbols used on most topographic maps to represent real-world or ground features.

Topographic Map Signs and Symbols



THEME 1: Introduction to Geography

Topic 3: Maps and their Uses



Topic Keywords

1. Sketch map
2. Symbols
3. Key (Legend)
4. Compass points
5. Routes
6. Scale
7. Coordinates
8. Bearings
9. Latitude and longitude
10. Atlas

Learning Outcomes: By the end of this topic the learner will be able to;

a). Draw a sketch map of the school and/or the local area.

b). Use and interpret symbols and identify features on a map using a key.

c). Identify directions on a map, using basic compass points.

d). Follow routes on a map.

e). Draw a map using a simple scale and use scale on a map.

f). Use letter and number co-ordinates or bearings and directions to locate places on a map.

g). Locate places on an atlas map using latitude and longitude and describe the places from information on the map. Understand the difference between a map and a photograph.

h). Understand that there are many types of maps on different scales.

i). Use a linear scale and representative fraction to estimate distance, area and size of features on a map.

Scale

In map drawing the scale refers to the **ratio** between the actual size of an area and its representation on a map. Since real-world features are too large to be drawn at their actual size, we use a scale to shrink them proportionally while maintaining accuracy. In other words, scale is the number of times a real feature is reduced to fit on a sheet of paper.

Types of Scale

There are three main types of scale and they includes;

1. Statement or Verbal Scale.
2. Representative Fraction (RF) or Ratio Scale.
3. Linear Scale or Graphic Scale.

Statement or Verbal Scale

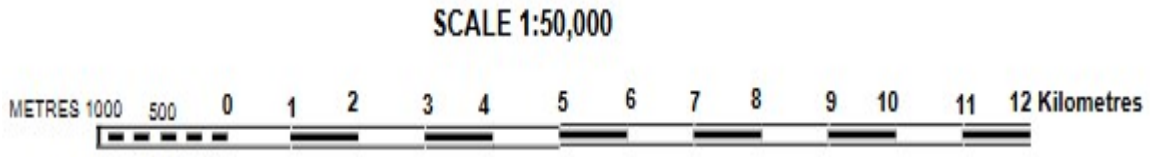
This type of scale is expressed in words. It tells you directly how much distance on the map represents a certain distance on the ground. For example, one centimeter represents one kilometer. This means that if you measure 1 cm on the map, it is equal to 1 km on the ground. If you measure 5 cm on the map, it represents 5 km on the ground.

Representative Fraction (RF) or Ratio Scale

This type of scale is written as a fraction or ratio. It shows the relationship between one unit of distance on the map and the corresponding distance on the ground, regardless of the units used. For example: 1:50,000. This means that 1 cm on the map = 50,000 cm on the ground. Similarly, 2 cm on the map = 1 km on the ground.

Linear or Graphic Scale

This type of scale is drawn as a straight line (like a ruler) on the map. The line is divided into equal parts, and each part represents a certain distance on the ground. For example, a line marked 0, 1 km, 2 km, 3 km, 4 km etc. If you measure between 0 and 1 km on that line, that distance on the map represents 1 km on the ground.



Scale Demonstration

Activity 1.3:

Your class is working on a proposal for a new, learner-friendly classroom. The planned classroom will measure 20 feet long and 30 feet wide. Before the proposal can be submitted, the class must prepare an accurate plan drawing of the proposed room. You have been selected for the job.

Task:

Using the given scale: 1 foot = 30.48 cm, draw a scaled plan of the classroom. On your drawing, be sure to include and clearly label the following features:

a) The door
b) The windows
c) The desks
d) The teacher's table

Step 1: Convert Feet to Centimeters

- 1 foot = 30.48 cm
- Length: 20×30.48 = 609.6 cm
- Width: 30×30.48=914.43 cm

Step 2: Select an Appropriate Scale

- A convenient scale for drawing could be **1:100** (1 cm represents 100 cm in real life).
- Length: 609.6/100 = 6.1 cm
- Width: 914.4/100 = 9.1 cm

Step 3: Draw the Classroom Plan

Outline a rectangle of **6.1 cm by 9.1 cm** on paper and include the required features.

a) The door
b) The windows
c) The desks
d) The teacher's table

Include features of a good map (title, key, compass, frame, and scale)

Finding Places or Features on the Map Using Grid Reference

Grids refer to the network of line that cross each other on the map to form squares. The vertical lines are called **Eastings** and this is because they increase their figures towards the Eastern direction on the map. Horizontal lines are called **Northings** and this is because they increase their figures towards the Northern direction on the map. There are two types of Grid Reference Systems i.e. Four Figure and Six Figure Grid Reference System.

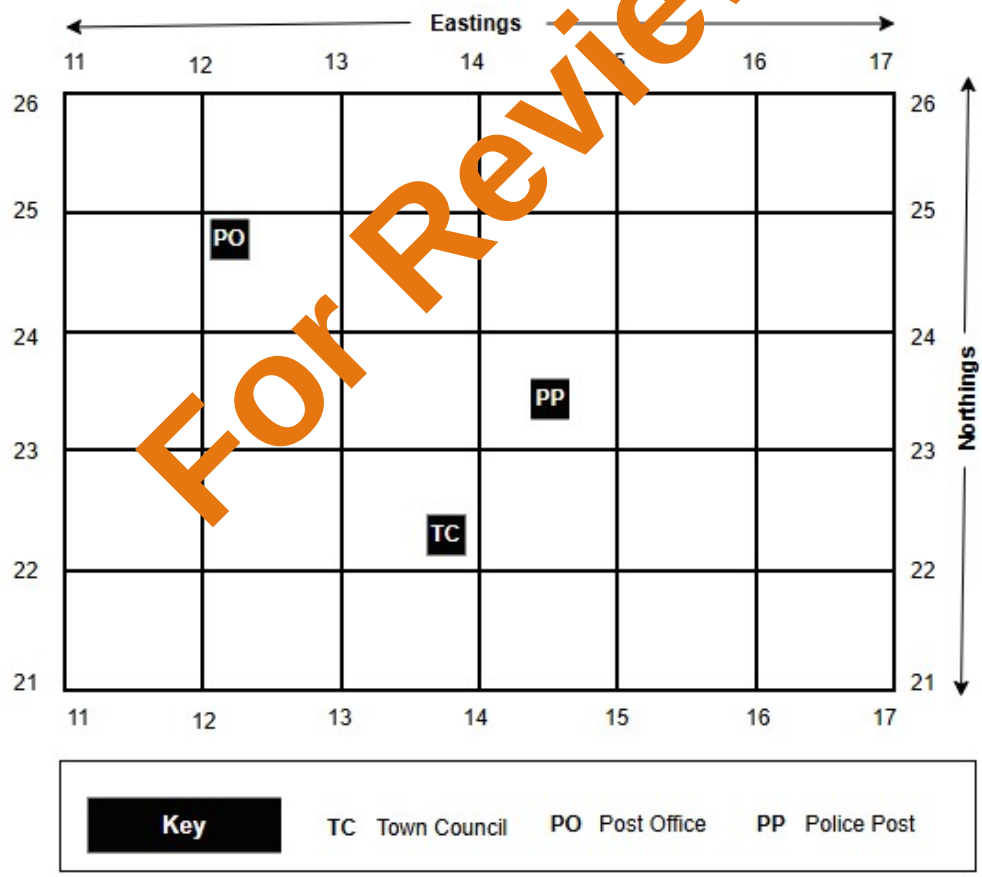
Four figure Grid Reference System

This is used to identify the square on the map where the feature or place is located.

Procedure for Finding Four Figure Grid Reference

- Identify the feature or place on the map.
- Read the figure on the Easting line.
- Read the figure on the Northing line.
- Write the Easting figure first then followed by Northing figure. This is a standard order in coordinate system).

Example:



The Four Figure Grid Reference;

Town Council ***1322***

Post Office ***1224***

Police Post ***1423***

Six Figure Grid Reference System

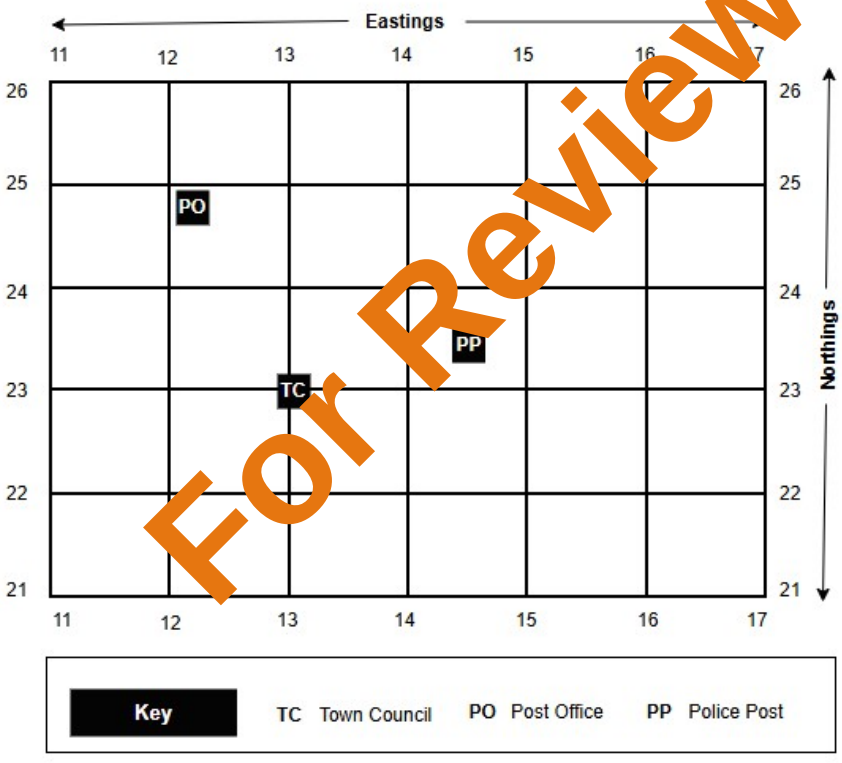
This is used to identify the exact point on the map where the feature is found with the square on the map. It has 6 figures with Easting first and then Northing last.

Procedure for Finding Six Figure Grid Reference

- Identify the square where the feature is found on the map.
- Read the figure on the Easting line and the extra distance moved by the feature.
- Read the figure on the Northing line and the extra distance moved by the feature.
- Write the Easting figure first then followed by Northing figure (This is the standard order).

The easiest way to determine extra distance moved for both lines (Easting and Northing) is by placing the ruler on the line of interest and let it touch the feature of interest. The distance covered on the ruler is then divided by 2 to get the actual extra distance. For example, 10 calibrations on the ruler cm side means extra distance of 5, 6 means 3, 7 means 3 or 4 etc.

Example:



The Six Figure Grid Reference;

Town Council **130230**

Post Office **122249**

Police Post **145235**

Activity 1.2: East Africa 1:50,000 Masaka (UGANDA) Sheet 79/3

Find the six-figure grid reference of the church at Nkoni.

Find the six-figure grid reference of the school at Ssenya.

Measuring Distance on the Map (Straight Line)

Step 1: Identify the start and end points

- Locate the two points between which you want to measure the distance.
- Mark them clearly on the map using a pencil.

Step 2: Measure the distance on the map

- Use either a ruler, pair of divers, non-elastic thread or piece of paper depending on the distance to cover and run it along the line connecting the two points.

Step 3: Read the distance

- Transfer the ruler or thread or piece of paper distance whichever you used to the major Linear Scale and read the distance. For example, if the distance transferred from the map stops at a corresponding figure such as 2 on the Linear Scale then the distance is 2km
- If the distance stops at a point with no figure corresponding then write the last figure crossed and put a point mark. The extra distance is transferred to the minor linear scale on the left (0.1-9) and the distance is recorded. For example, if the last figure crossed was 2 and the distance from the minor scale is 3 then the actual distance is 2.3km.

Measuring Distance on the Map (Curved Line)

Step 1: Identify the start and end points

- Locate the two points between which you want to measure the distance.
- Mark them clearly on the map using a pencil.

Step 2: Measure the Distance on the Map

- Use a non-elastic thread or piece of paper and run it along the line following the curves connecting the two points.

Step 3: Read the distance

- Transfer the ruler or thread or piece of paper distance whichever you used to the linear major scale and read the distance. For example, if the distance transferred from the map stops at a corresponding figure such as 2 on the linear scale then the distance is 2km
- If the distance stops at a point with no figure corresponding then write the last figure crossed and put a point mark. The extra distance is transferred to the minor linear scale on the left (0.1-9) and the distance is recorded. For example, if the last figure crossed was 2 and the distance from the minor scale is 3 then the actual distance is 2.3km.

Converting Map Distance to Ground Distance using Ratio Scale

Step 1: Check the scale of the map

For most map extracts ratio scale is usually 1:50,000
Which means 1 cm on the map represents 50,000 cm in real life (on ground).

Step 2: Convert the Map Distance (cm) to Real-World Distance (km)

1 kilometer = 100,000 centimeters
Real Distance = Map Distance × Scale Factor ÷100,000
For example, if the map distance is 4 cm and the ratio scale is 1:50,000: then
4cm×50,000 = 200,000cm

Step 3: Now convert cm to km

200,000 ÷100,000 = 2 km. therefore, the real-world distance is **2 km**.

Activity 1.4: Support Map East Africa (Uganda) Nakasongola Sheet5 1/2

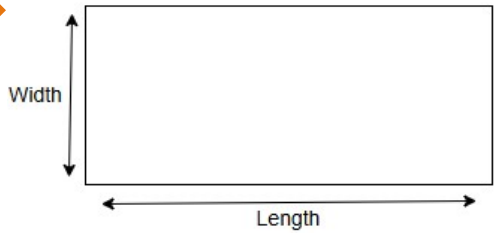
Task: *Determine the distance between the road junctions of Kakoge and Sasira.*

Calculating Area of Regular Shaped Features on the Map

Regular shapes include square, Rectangle. Triangle, Circle, Pentagon, Hexagon, Heptagon, Octagon, Nonagon, Decagon among others.

Example:

Calculating area of a Rectangle



Steps:

1. Measure the length of the Rectangle
2. Measure the width of the Rectangle
3. Multiply length by width
4. State the area in square centimetres

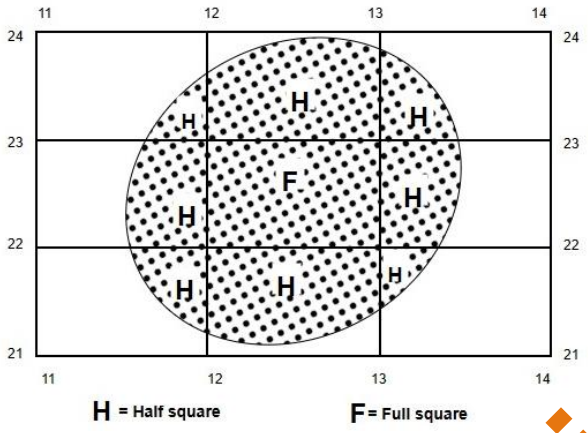
Calculating Area of Irregular Shaped Features on the Map

Irregular shaped features may include lakes, plantations, swamp, forest etc. There is no clear formula for calculating area covered by such features. Finding area for such features is done by estimating the number of grids squares the feature covers. Usually each is square equal to 1 square kilometre (km^2). The total number of full squares covered by the feature is the area of the feature. If there are any half squares covered by the feature then must be divided by 2 and the result added to total full squares.

Steps:

1. Identify the feature on the map.
2. Count all full squares covered by the feature.
3. Count all half squares covered by the feature and divide them by 2.
4. Add the result in step 3 to the result in step 3
5. Convert result to (square kilometres using 1 Square = 1 km^2
6. State the area in (km^2).

Example:



Area = Full squar + (
squares÷2)

Total f ares = 1

Total lf sq ares = 8÷2 = 4

A a = 1+4 Therefore, final result
= 5km2

Activity 1.5: Support Map: Packwach East Africa 1:50,000 (Uganda) Sheet 29/2

The government has decided to lease the forest near Marama to a community group for beekeeping. The government will charge UGX 500 per square metre as the annual lease fee.

Task:

How much revenue will the government collect in the first 10 years.

Determining Direction of Features on the Map

Direction: Refers to the position or location of a place or a feature in relation to another. It helps us describe where something is by using points on the compass. There are 3 types of directions i.e. Cardinal direction, Intermediate direction and Bearing.

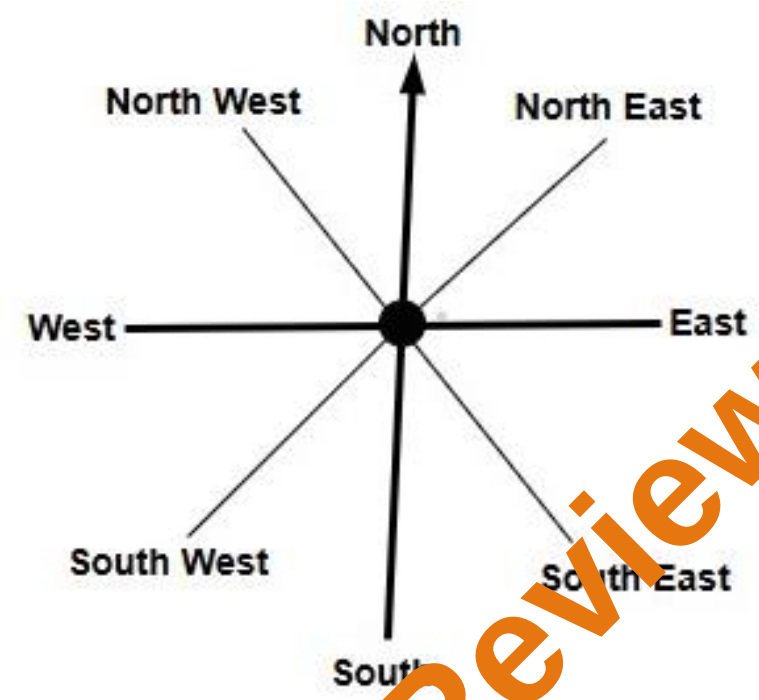
Cardinal Directions: These are the four main directions:

- East
- West
- South
- North

Intermediate Directions: These are the directions between the cardinal directions:

- North East
- North West
- South East
- South West

Diagram of Sixteen Points Compass Direction



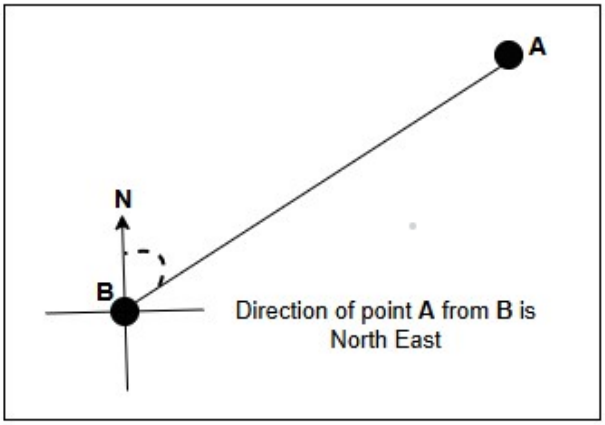
Determining direction on the Map

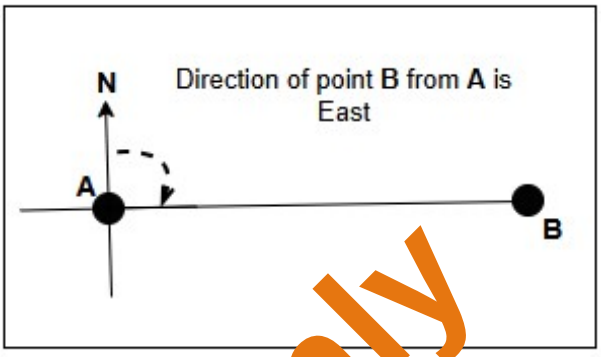
We need the compass rose, pencil, ruler and a protractor in order to determine direction of places and features on the map. To determine the direction, say of point **A** from point **B**, we shall follow the steps below.

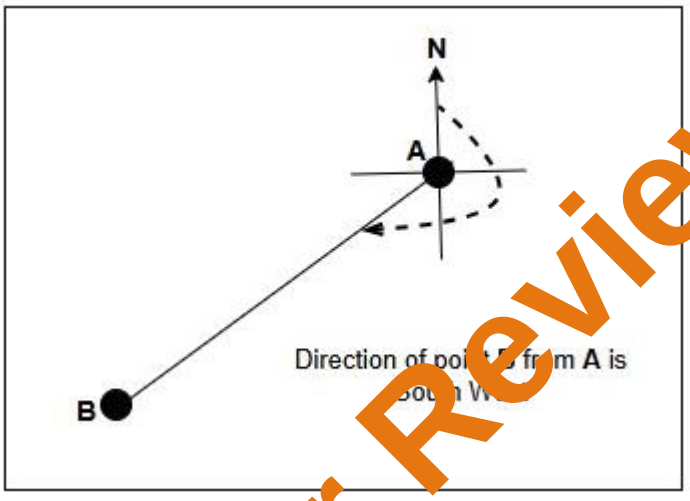
Steps:

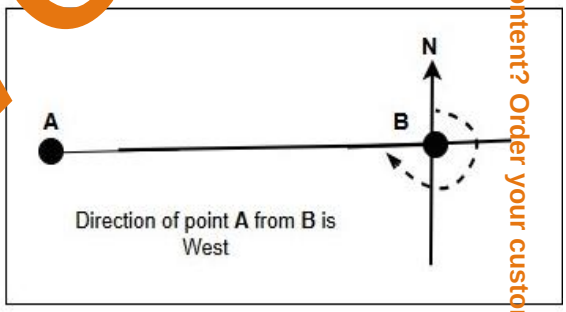
1. Find the two points on the map (**A** and **B**)
2. Draw a straight line to connect the two points (**A** and **B**)
3. Go to where it is said from and draw a compass point e.g. if it is the direction of **A** from **B** then compass point should be at **B**
4. Draw an arc from North until you meet the line connecting the two points
5. Read the direction using the compass direction points.

The diagrams below represent a demonstration of how to identify the direction of one point from another following the steps given above.









Activity 1.6: Support Map: Masaka East Africa 1:50,000 (Uganda) Sheet 79/3

Determine the direction of the factory at Nkoni from the plantation at Kingo.

Determine the direction of the plantation at Kingo from the factory at Nkoni.

***NOTE 1**: When joining the two points, the line should not cut through the points as this will mislead the arc and result into inaccurate direction. The line should be kept in the limits as per the demonstration above.*

***NOTE 2:** When determining the direction of river flow pay attention to contour lines. Since water always flows from higher altitude to lower altitude.*

Determining Bearing on the Map

Bearing: is the numerical representation of the direction from one place or feature to another, measured in degrees clockwise from the north (0°) up to 360. Bearing must have **3 digits** for example if the angle measured is **1°** then we write **001°,** if is **90°** then we write it as **090°**

- 0° or 360° = N
- 1° – 44° = NNE
- 45° = NE
- 46° – 89° = ENE
- 90° – E
- 91° - 134° = ESE
- 135° = SE
- 136° –179° = SSE
- 180° = S
- 181° – 224° = SSW
- 225° = SW
- 226° – 269° WSW
- 270° = W
- 271° – 314° WNW
- 315° – NW
- 316° – 359° NW

Steps for finding bearing on the map

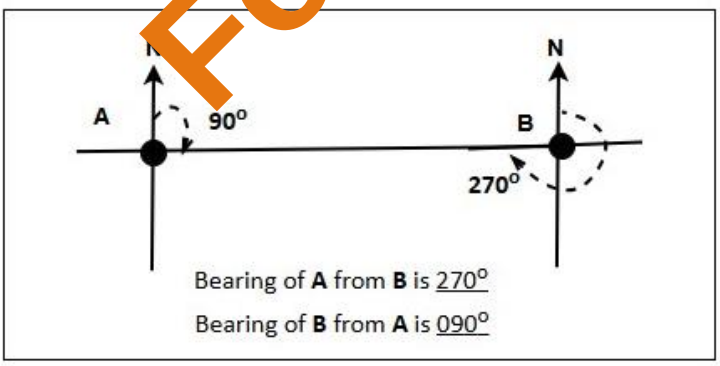
1. Locate the two points say **A** and **B**
2. Join the two places using a straight line say **A** and **B**
3. Go where it is indicated from and draw a compass point
4. Draw an arc from the North line until you meet the line joining the two points
5. Read the angle in degrees using the protractor.

NOTE: When writing bearing don't attach direction because the degrees already represent direction. For example, **225°** already means **Southwest**. Writing **225°SW** mixes two systems:

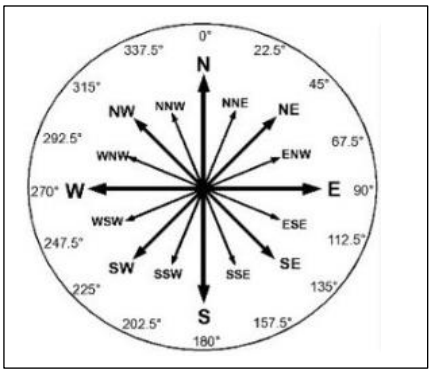
- 225° is from the bearing system
- SW is from the compass direction system

Mixing them is not standard in geography or navigation.

Example:



16 Points Compass Rose



Activity 1.7: Using *Nakasongola East Africa 1:50,000 (Uganda) Sheet 50/2*

Determine the Bearing of the road junction at Kakoge from the Post Office at Wakibombo

Locating Places and Features using Longitudes and Latitudes

Latitude refers to the angular distance of a place or feature North or South of the Equator, measured in degrees (°). The maximum values are 90° North and South of the Equator.

Major latitudes include;

- Equator – 0°
- Tropic of Cancer – 23.5° North
- Tropic of Capricorn – 23.5° South
- Arctic Circle – 66.5° North
- Antarctic Circle – 66.5° South
- North Pole – 90° North
- South Pole – 90° South

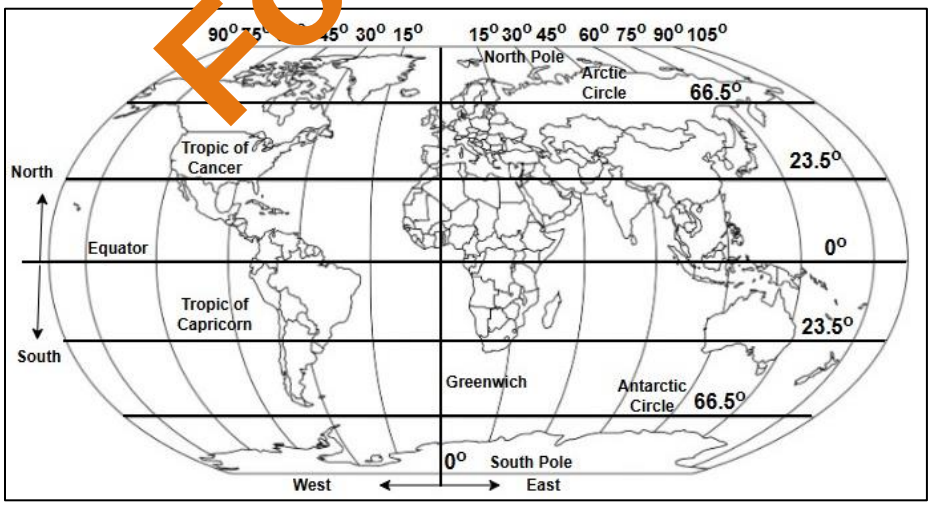
Longitude refers to the angular distance of a place or feature East or West of the Prime Meridian, also measured in degrees (°). The major longitude is the Prime Meridian (in Greenwich, England) which is 0°.

Major longitudes include;

- Prime Meridian – 0° (passes through Greenwich, England; divides the Earth into the Eastern and Western Hemispheres).
- International Date Line – Approximately 180° (opposite the Prime Meridian).
- 90° East and 90° West (quarter divisions of the Earth).

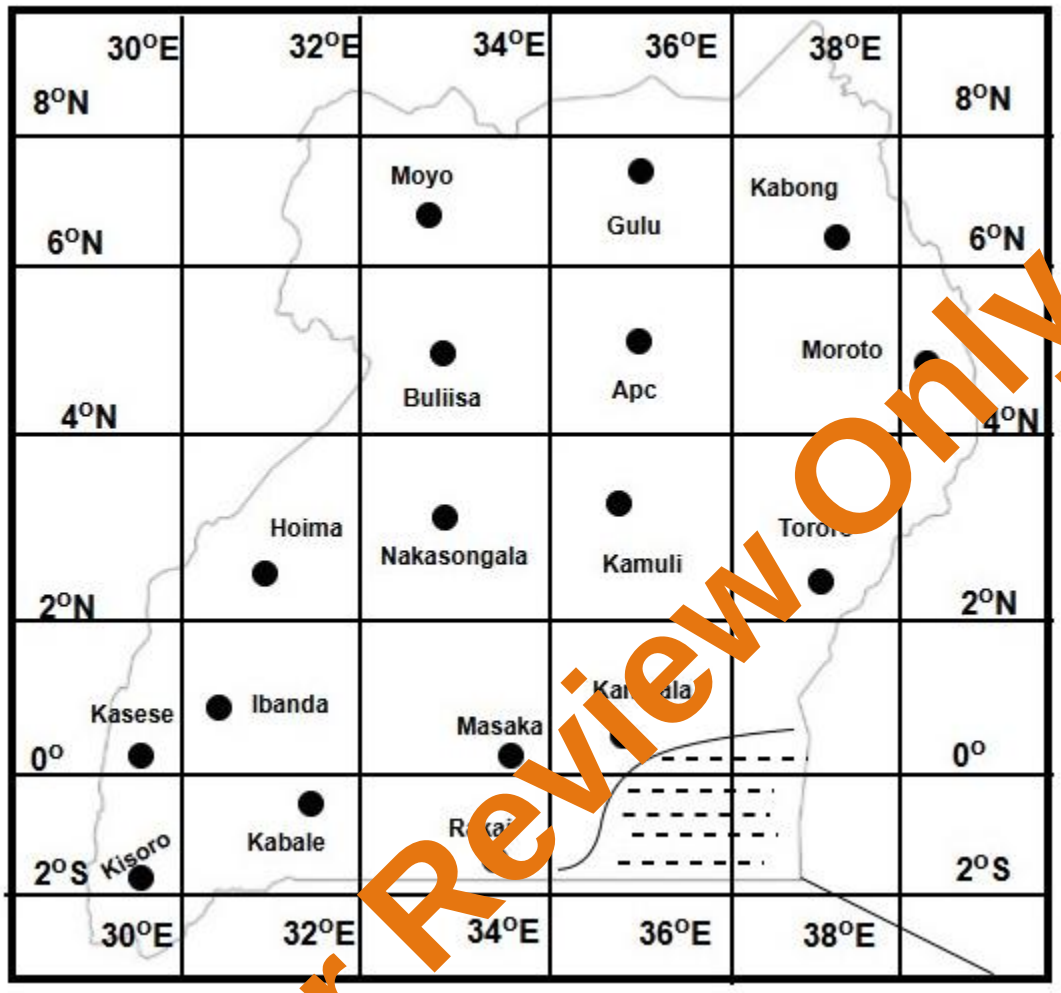
The intersection between line of latitudes and longitudes form Grids. These grids are used to locate places and features on the Map. For example, if a place is located 40° N 30° W. it means the place is located at between latitude 40° North of Equator and longitude 30° West of Greenwich. ***NOTE: The latitude is quoted first followed by longitude.***

Diagram of Earth showing Major Latitudes and Longitudes



Example:

Sketch Map of Uganda showing Major Cities



From the map Moyo is located 6°N 32°E. Apac is located 4°N 34°E

Activity 1.8: *With the help of the map above use latitudes and longitudes to find the location of major cities.*

Gulu Kabong Moroto Tororo Kamuli Kampala Masaka

Rakai Kabala Kasese Buliisa Hoima Kisoro Ibanda

Nakasongola

NOTE: *When locating places using latitude and longitude, you* ***always write latitude first, then longitude.***

THEME 1: Introduction to Geography

Topic 4: Ways of studying Geography

Topic Keywords

1. Fieldwork
2. Observation
3. Interviews
4. Questionnaires
5. Data
6. Analysis
7. Report
8. Photographs
9. Perspective
10. Sketching

Learning Outcomes: By the end of this topic the learner will be able to;

a). Know what field work is.

b). Understand how to use and apply different techniques used in fieldwork.

c). Use observation, interviews, questionnaires, drawings and photographs in field work.

d). Use maps, aerial images, photographs, graphs and charts to communicate data.

e). Analyse and present statistics gathered in fieldwork.

f). Write conclusions to summarise field work findings.

g). Know the three different angles from which photographs can be taken.

h). Know the terms used to describe the different parts of a photograph.

i). Appreciate the effect of perspective on oblique photographs.

WAYS OF STUDYING GEOGRAPHY

Geography is a practical subject that helps us understand the world around us, its people, places, and natural features. To gain this understanding, Geographers use different methods to collect, organize, and interpret data. These methods are the ways of studying Geography. In this topic, we will explore key methods of studying Geography including Field work, Photographs and Statistics (charts and graphs). Each method helps Geographers to investigate real-world situations, process data, and obtain information in order to make informed conclusions about the environment and human activities.

Studying Geography through Field Work

Field work is the process of collecting first-hand information directly from the environment or people through observation, measurement, interviews, and recording. It involves going out of the classroom to study geographical features, processes, or human activities in their natural or actual setting. For example, visiting a river to measure its width and flow or interviewing local people about farming activities in the area.

Benefits of Field Work

1. Promotes first-hand learning by enabling students to observe and experience real geographical features e.g. visiting a river to see how erosion and deposition take place.

2. Through observation attention to details is improved e.g. Identifying different rock types or vegetation zones during a field trip.

3. Through data collection and use of tools one builds practical skills e.g. it teaches data collection and use of tools.

4. Makes learning easier to remember e.g. seeing a volcanic crater in person helps students recall processes of Volcanicity more easily.

5. Encourages teamwork and communication e.g. working in groups to record rainfall data or draw a sketch map of a study area.

6. Enables application of classroom knowledge to real life e.g. when students visit a weather station to see weather instruments in use after learning about them in classroom.

7. Raises environmental awareness and care for the environment e.g. when observing deforestation in a local forest and discussing its effects on climate and biodiversity

Field Work Stages

To successfully carry out a geographical field study, Geographers follow a series of steps known as the stages of field work. These stages guide the entire process from planning, collecting data in the field, to analyzing and reporting findings. Following these stages ensures the field work is organized, accurate, and effective.

Field work in Geography is carried out in three main stages:

1. Pre-fieldwork (Preparation)
2. Actual fieldwork (Data Collection)
3. Post fieldwork (Data analysis and report writing)

Activities under Preparation Stage:

This is the first stage also called pre-fieldwork stage and it involves planning the study. Activities under this stage may include;

i) Identifying the Topic: The study topic should indicate what will be studied and where the study will take place. In other words, it is the reason why the field study will be carried out.

Features of a Good Field Work Study Topic

a) State the what (study focus)
b) State the where (location of the study)
c) Be concise (not more than 25 words).

For example, a study around Gayaza High School with focus on identifying natural features can have a study topic as "***A study on how to conserve the natural environment in Gayaza High School Wakiso District"***

ii) Setting Study Objectives: The study objectives define what the field work aims to achieve. They specify the intended information to be collected from the field. Fieldwork study objectives are guided by an acronym **"SMART"** as described below;

Specific: The objective should clearly state what aspect of Geography is being studied. For example: *"To investigate how river velocity changes with distance downstream along River Sezibwa."*

Measurable: The objective should allow data collection that can be quantified or compared. For example: *"To compare traffic flow at Kampala road during morning and evening hours."*

Achievable: The objective must be realistic within the time, resources, and skills available. For example: *"To collect soil samples from 3 villages within Kampala district".*

Relevant: The objective should link to the syllabus, classroom learning, or real-world geographical issues. For example: *"To examine the causes of soil erosion on one farmland near Mount Elgon,"*

Time-bound: The study must have a set timeframe for data collection, analysis, and reporting. For example: "To complete a land use survey of Gulu Town within two field days."

Accepted and Discouraged Study Objectives Writing Verbs

Accepted	Discouraged
❖ Find out ❖ Study ❖ Investigate ❖ Record ❖ Collect ❖ Identify ❖ Classify ❖ Count ❖ Compare ❖ Analyse ❖ Examine ❖ Map ❖ Sketch ❖ Describe ❖ Estimate ❖ Assess ❖ Evaluate ❖ Determine ❖ Observe ❖ Interpret	❖ Admire ❖ Appreciate ❖ Enjoy ❖ Tour ❖ Understand ❖ Know ❖ Realize ❖ Learn about ❖ Become familiar with ❖ Be aware of ❖ Grasp ❖ Comprehend ❖ Value ❖ Recognize ❖ Respect ❖ Feel Some accepted verbs may be used loosely e.g. ❖ Observe nature ❖ Study the river ❖ Explore the town ❖ Discover the forest

ii) Identifying Data Collection Methods: Choosing how information will be gathered for example if the study site is a market then interview and observation methods may work.

iii) Conducting a Pilot Study: A small test visit to the proposed area to check the suitability of the fieldwork study site in line with study topic and objectives. for example, if it is a factory site a pre-visit is necessary to find out the days on which it operates.

iv) Preparing Tools and Materials: Getting items ready to assist in data collection for example if you intend to write and sketch, notebooks, pens, pencils and sketch boards are some of the tools to consider.

v) Forming Groups and Assigning Roles: Organizing students into teams and assigning tasks. For example, in charge of time keeping and discipline etc.

vi) Seeking Permission: Requesting approval from authorities and informing local leaders. For example, police if the study site involves security risks so they can provide security.

vii) Arranging Transport and Logistics: Planning how to travel e.g by bus or walking if the site is near, meals and accommodation if the study trip will last for several days.

Activities under Data Collection Stage

This is the second stage also called the actual fieldwork stage and it focuses mainly on collecting data using a range of methods depending on kind of data one intends to collect. The methods may include;

i) Observation: In this data collection method the researcher carefully uses the eyes to see for example the physical and human features in the study area or the different tree species in the forest.

ii) Taking Measurements: In this data collection method the researcher uses local and modern tools to record data for example using a tape measure to determine object area, distance or elevation coverage. Pacing is a traditional way of taking measurements by footsteps.

iii) Taking Photographs: In this data collection method the researcher uses photographic camera or smart phone to capture visual evidence of features or activities for later reference.

iv) Conducting Interviews: In this data collection method the researcher asks local people questions to gather opinions or experiences on a certain topic e.g. population structures estimate in terms of gender and age

v) Filling Questionnaires: In this data collection method the researcher distributes forms with pre-written questions in order to collect written responses from individuals who may not be comfortable with oral responses.

vi) Recording: In this data collection method the researcher uses audio or video tools to record observations, counts, or measurements.

vii) Sampling: In this data collection method the researcher collects small portions of materials e.g., soil and water for further study. The researcher may eat some food items to get a sense of taste or may touch the materials to get a sense of their texture and hardness.

vii) Documentation: Using existing documents such as textbooks, magazines, map extracts etc to get information. It enables the researcher to determine information accuracy by cross checking information in existing sources like textbooks with what is actually on the ground.

ix) Taking Notes: In this data collection method the researcher used a notebook and pen or pencils capture data from other methods such as observation, interviewing and sampling for future reference

xi) Drawing Sketch: In this data collection method the researcher can draw rough land sketches, cross-section, panorama, tables among other diagrams to show location and arrangement of features in the field.

Land Sketch, Cross-section and Panorama

Land sketches are simple drawings of the general appearance of a landscape or landform. Land sketches show the outline or shape of features e.g. hills, valleys, slopes, vegetation, or settlements. They are not drawn to scale and usually by freehand. For example, a quick drawing of a hill slope showing trees, houses, and a river.

Cross-section is a diagram showing a slice through the land, drawn along a chosen line (often from a map). The cross-section shows changes in relief, slope, height, and land-use along that line. Cross-section is drawn to scale horizontally, usually based on map contours. For example, a cross-section from point A to B on a topographic map, showing a hill rising to 800m then dropping into a valley.

Panorama is a wide-angle sketch or drawing of the view seen when standing at a given observation point. The panorama shows the scenery as it appears to the eye from one spot. The panorama is drawn as though you are looking around, often showing hills, ridges, valleys, rivers, and settlements. For example, standing on a hilltop and sketching the wide view of surrounding hills and plains.

Activities under Post Field Work Stage

i) Data Analysis:

This post filed work activity focuses on processing the collected data to produce information. Data processing activities may include the following:

1. Sorting and organizing data into categories e.g. by type or location.

2. Drawing graphs and charts to represent numerical data e.g. by using bar graphs, pie charts, line graphs, etc.

3. Creating maps and diagrams e.g. sketch maps, cross-sections, or flow diagrams.

4. Drawing tables to summarizing data in rows and columns for easy comparison.

5. Interpreting data e.g. explaining the meaning of the patterns and trends in graphs.

6. Comparing data with Objectives for example checking if the data answers match the original field work objectives.

7. Making conclusions e.g. summarizing what the findings show about the area or topic studied.

ii) Report Writing: This post field work activity involves written document with information on the field study topic. The field work report may include the following

1. Summarizing findings i.e. stating the main points discovered from the field study.

2. Drawing conclusions e.g. explaining what the results mean based on the data collected and analyzed.

3. Making recommendations e.g. suggesting solutions or actions based on the findings (if needed).

4. Writing the field work report by organizing all stages and findings into a clear written report.

5. Sharing results with others through presentations, discussions, or class displays.

6. Evaluating the field work study by reflecting on what went well, challenges faced, and how future studies can be improved.

Content of Field Work Report

1. Topic of the fieldwork study

2. Date of the fieldwork study

3. Objectives of the fieldwork study

4. Methodology i.e. how data was collected e.g. observation, interviews etc.

5. Findings i.e. summary of the main points discovered during the field work

6. Conclusions (what was learned or understood from the study)

7. Recommendations for solving problems based on the findings (if applicable)

8. Problems or difficulties experienced during the field trip

9. References (any sources of information used in preparing the report) if applicable

Activity of Integration:

Scenario: National Forestry Authority leaders plan to carry out a field study in Budongo Forest Reserve to learn about how human activities are affecting the forest ecosystem. They intend to observe the area, interact with local residents and forest officials, and collect relevant data for their report. They seek guidance on how they can carryout the task effectively

Task: Using the information in the scenario above,
a) Write a suitable fieldwork topic statement for the study.
b) State three specific objectives the students might have for their fieldwork.
c) Suggest three appropriate methods of data collection they can use during the study.

Studying Geography through Photographs

A photograph is a visual representation of a scene or object as seen from an angle or side. Photographs are classified according to the angle or side from which the photograph is taken. Photographs are categorized into two categories i.e. Ground and Aerial photographs.

Ground Photographs: These are taken when the photographer is on the ground.

Aerial Photographs: These are taken when the photographer is in space for example by use drone camera or aircraft. Photographs can be taken from the ground or space and at different angles.

Horizontal Angle: The camera is held at the same level as the object.
Oblique Angle: The camera is held at slanting angle above the object
Vertical Angle: The camera is directly above the object

Types of Ground Photographs

1. Ground Close-up Photographs: These are photographs taken from the ground and very close to the object, so they show a narrow area.

Characteristics Ground Close-up Photographs

- Taken from the ground with the camera held close to the ground, not from above or far away.
- Covers a small area.
- Gives lots of details on an object e.g you can see things clearly, like colors, shapes, and textures.
- Has a side view since they are usually taken from the side, not from the top.
- Do not show the location/ place or how it connects to other places.
- Presents about 1-3 objects
- One side of the object can be seen

2. Ground General View Photographs: These are photographs taken from the ground but from a distance, so they show a wider area.

Characteristics Ground Genera View Photographs

- The sky or horizon (where land and sky meet) is often visible.
- Shows a wide area i.e. you can see a bigger part of the place, not just one object.
- Give less detail e.g you can not see small things clearly because the photo covers more space.
- Have side view since the photo is usually taken from the side, not from above.
- Shows arrangement of scene e.g you can see how different things (like buildings, trees, or people) are arranged in the area.
- Gives general information like what a place looks like as a whole, not in detail.
- 1 to 2 sides of the object can be seen.

3. Ground Oblique Photographs: An oblique photograph is a picture taken when the camera is at slanting angle above the object. As a result of the slanting angle the final picture appear bent/slanting (as if it is falling).

Characteristics Ground Oblique Photographs

- Cover smaller area compared to Aerial Oblique.
- May or may not include the horizon.
- Objects appear slanting.
- Taken on land.
- Two sides of the object can be seen.

Types of Aerial Photographs

1. Aerial Oblique Photographs: An Aerial oblique photograph **is** a photograph taken from air at a slanting angle. It is usually taken from an air balloon, drone, or helicopter.

Classification of Aerial oblique photograph

Aerial oblique photographs are classified depending on the whether the cameral is tilted to include the horizon/sky or not.

High oblique photograph: This is taken when the camera is tilted to include the horizon/sky.

Characteristics High Oblique Aerial Photographs

- Covers a wide area.
- Angle of tilt is about 60 °-90 °
- Horizon is often seen.
- Are taken from air/space
- Three sides of the object can be seen.

Low oblique photograph: This is taken when the cameral is tilted not to include the horizon/sky.

Characteristics Low Oblique Aerial Photographs

- Covers a wide area.
- Angle of tilt is less then 60 °.
- Horizon is often not seen.
- Objects appear slanting.
- Are taken from elevated point like a hill, cliff of top of a building.
- Three sides of the object can be seen.

2. Aerial Vertical Photograph: An aerial vertical photograph is a picture taken from air directly above, looking straight down at the ground.

Characteristics of Aerial Vertical Photographs:

- ❖ Taken from the air using a plane, drone, or satellite.
- ❖ Camera points straight down 90°.
- ❖ No horizon is seen only the ground is visible.
- ❖ Top parts of the object can be seen.
- ❖ Covers a small area compared to oblique area.

Parts of the photograph: The photograph has 3 main parts i.e. Foreground, Middle ground and Background. Each part is further divided into three. Altogether adding up to 9 parts

Drawing Land Sketch from Photograph

Drawing a land sketch from a photograph involves interpreting key features such as buildings, roads, vegetation, and land use patterns from a visual image and representing them accurately on paper. This skill helps in understanding the area arrangement of physical and human-made features and is useful in Geography, planning, and environmental studies.

Steps taken when drawing a land sketch from a photograph

1. Observe the Photograph carefully to identify key features like roads, buildings, vegetation, water bodies, hills, etc.
2. Divide the photograph into 9 position to identify the different grounds e.g. Right Foreground, Left Middle Ground, and Middle Background etc. This helps in understanding the layout and relative position of features in the photo.
3. Select Key or important features that are clearly visible and relevant.
4. Draw a Rough Outline or frame of a similar shape as that of the photograph.
5. Draw each feature in its correct location and relative size using simple symbols.
6. Label the Features Clearly e.g., river, school, road etc.
7. Add a title to reflect what the sketch shows.

NOTE: Land sketch drawings from a photograph is informal and artistic representation which may not carry a key, compass direction and scale. These elements qualify for sketch map drawing.

Activity 1.10: *Stick an environment photograph of your choice and complete the following tasks.*

a) *Draw the land sketch represented in the photograph*
b) *Label the physical features.*
c) *Label the human features.*

Studying Geography through Statistics

Studying Geography through statistics helps us understand patterns and trends in human and physical environments by analyzing data such as population figures, climate records, and how people use land. It allows Geographers to make informed decisions and predictions based on evidence.

At this level, the common statistical methods used include Bar Graphs, Line Graphs, Combined Bar Graphs, and Pie-Charts to present and interpret data clearly.

Features of a Good Bar Graph

- Should have a title to show what the graph is about.
- The x-axis and y-axis should be labeled with the correct units.
- Bars should be evenly spaced with the same width and spaced equally.
- The y-axis should have a consistent scale to show values clearly.
- Should be neat and easy to read (use colors or shading, but avoid clutter).

Features of a Good Line Graph

- Should have a title to describes what the graph is showing.
- Labeled axes, X-axis (often time) and Y-axis (the value being measured).
- Data points plotted correctly and placed accurately.
- Lines connecting the points to show trends over time clearly.
- Clear scale and units which are even and understandable.

Features of a Good Pie Chart

- Should have a title to explains what the chart represents.
- Correct proportions i.e each slice must be sized accurately according to the data.
- Labels or key/legend to show what each slice represents (category and percentage).
- No overlapping labels i.e keep it clear and readable.
- Use of different colors to distinguish the sections.

Activity 1.11:

Population of Selected African Cities in 2020

City	*Population (in millions)*
Nairobi	*577*
Kampala	*427*
Kigali	*133*
Dar es Salaam	*856*
Bujumbura	*135*

Tasks:

a) *Using the data table above present the Population of Selected East African Cities in 2020 on a bar graph.*

b) Identify the city with highest and lowest population.

Activity 1.12:

Monthly Rainfall at Olarim farm in 2007 in Millimetres

Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
12	*20*	*45*	*70*	*65*	*40*	*20*	*15*	*18*	*35*	*55*	*25*

Tasks:

a) *Identify the month with highest and lowest rainfall at Olarim farm in 2007.*
b) *Calculate the mean annual rainfall at Olarim farm in 2007.*
c) *Calculate the annual rainfall range at Olarim farm in 2007.*
d) *Using the data table above present the Monthly Rainfall at Olarim farm in Millimetres on a line graph.*

Activity 1.13:

Land Use in Green Valley area

Land Use Type	Percentage (%)
Farming	25
Mining	40
Forest	5
Settlement	10
Other	10

Tasks:

a) Identify the land use type with the highest percentage in Green Valley area.

b) Identify the land use type with the lowest percentage in Green Valley area.

c) Using the data table above draw a Pie-Chart to represent the land use in Mwache area.

d) How can Green Valley area increase percentage land use for farming?

e) Identify the likely environmental hazards in Green Valley.

f) How can the hazards identified in (e) above be controlled?

THEME 2: Introduction to Geography; Introduction to East Africa

Topic 5: The Earth and its Movements

Topic Keywords

1. Rotation
2. Revolution
3. Axis
4. Orbit
5. Greenwich
6. Seasons
7. Equinox
8. Solstice
9. Tilt of the Earth
10. Leap Year

Learning Outcome: By the end of this topic the learner will be able to;

a) Understand the relationship between the Earth and the sun and how this affects temperatures and seasons.
b) Draw diagrams to show the relationship between the Earth and the sun's rays and the causes of temperature variations and use these to show why the Earth can be divided into tropical, temperate and polar regions.
c) Understand how the rotation causes day and night
d) Know how we can locate places on a globe by using a grid including the use of latitude and longitude.
e) Use and measure latitude and longitude
f) Calculate time using longitude.
g) Appreciate how the movement of the Earth in relation to the Sun affects the way people live: the effect of temperatures and seasons, lengths of day and night

THE EARTH AND ITS MOVEMENTS

The Earth is a unique planet in the solar system that supports life. Other planets in the solar system include,

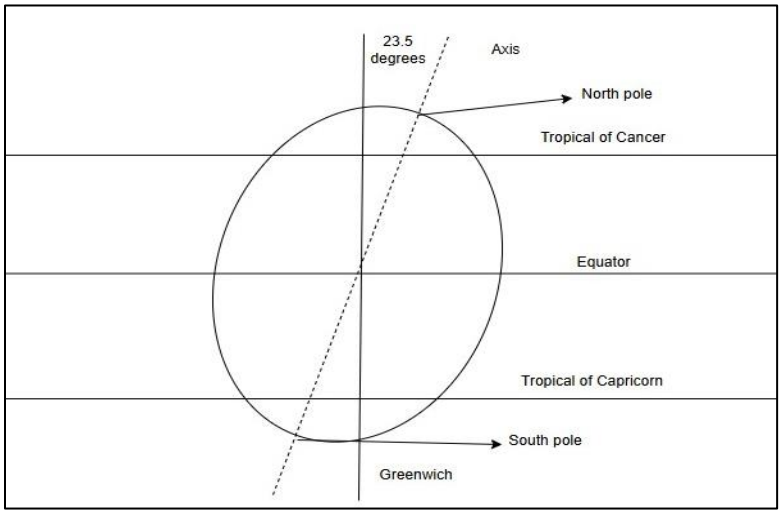
Mercury: The closest planet to the sun, a rocky, terrestrial planet.
Venus: A rocky, terrestrial planet and Earth's "sister planet" in size.
Mars: Sometimes called the "Red Planet," is a rocky, terrestrial planet.
Jupiter: The largest planet and a gas giant.
Saturn: Known for its prominent rings and is a gas giant.
Uranus: The second last planet from the sun and an ice giant.
Neptune: The farthest planet from the sun and an ice giant.

Like all planets, the Earth is constantly in an anti-clockwise or counter clockwise motion. The two main movements of the Earth are **Rotation** and **Revolution**. These movements are responsible for important natural events such as day and night, seasons, and the variation in the length of day and night throughout the year. Understanding the Earth's movements helps us to better explain many of the natural changes we observe in our daily lives and to appreciate the balance that makes life possible on our planet.

Diagram Showing the Solar System

The Earth is not perfectly round, it has a spherical shape. It has a slight bulge at the equator and slightly flattening at South and North poles. This shape affects how the Earth moves and how sunlight reaches different parts of the world.

Diagram Showing the Spherical Structure of the Earth



Rotation of the Earth

Rotation is the spinning of the Earth on its axis. The Earth's axis is an invisible line that goes through the North Pole and South Pole. The Earth rotates around this fixed axis, staying in the same place as it spins. It takes 24 hours (1 day) for the Earth to make one full rotation. The time it takes the planet to make a full spin varies due to difference in formation and composition. For example, Jupiter despite being the largest planet only 10 hours to finish one rotation yet it takes 24 hours for the smaller planet Earth to finish a single rotation. This difference exists because by formation Jupiter collected huge amounts of gas which makes it gaseous and light while the Earth gathered more rock particles making it solid and heavy. Therefore, friction is less with Jupiter and which is why it rotates faster than the Earth.

Diagram Showing the Rotation of the Earth

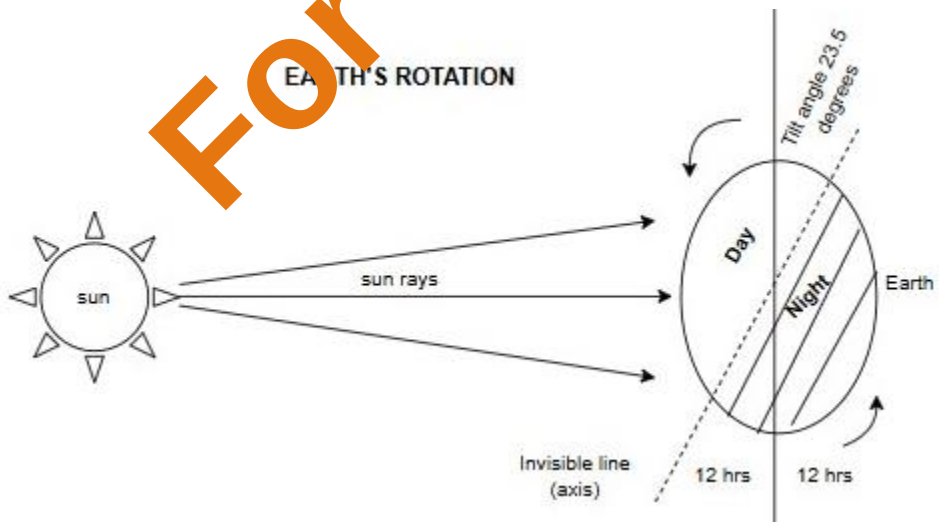


Table Showing Planets and Rotation Time

Planet	Rotation Time
Mercury	59 Earth Days
Venus	243 Earth Days
Earth	24 Hours
Mars	24 Hours 37 Minutes
Jupiter	9 Hours 56 Minutes
Saturn	10 Hours 33 Minutes
Uranus	17 Hours 14 Minutes
Neptune	16 Hours 6 Minutes

Effects of the Earth's Rotation

Causes Day and Night: As the earth spins on its axis, different parts of it face the sun. The side facing the sun has day, and the side away from the Sun has night.

Causes Time Zones: Time is not the same for all places on earth. This is caused by the earth's rotation. The world time zones are based on the prime meridian which passes through Greenwich. As you move 15^{o} from the prime meridian eastwards you gain one hour. You lose one hour for 15^{o} of longitude you move westwards.

Cause Changes in Temperature: The temperature is not the same all the time. The earth receives sun rays from the sun. This change in the temperatures is caused by the daily rotation of the earth on its axis. The nights are usually cool and this is because the sun is hidden away from the side of the earth. And days are hot because the sun is visible to the side of the earth

Activity 1.14:

Amina recently visited Kampala from New York. At exactly 12:00 noon in Kampala, the sun was shining brightly and people were having lunch.

At the same time, she called her family in New York and found that they were still asleep because it was night there.

Surprised, Amina asked herself, "How can it be daytime here and nighttime in New York at the same time? Is it the end times?"

Task:

As someone who has studied the Earth and its movements, explain to Amina what is actually happening to help her understand and overcome her confusion.

Revolution of the Earth

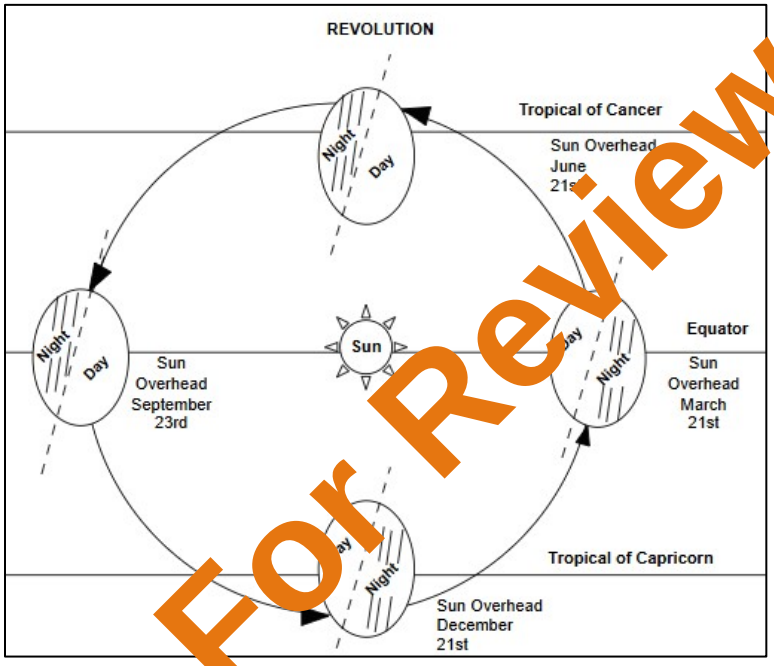
Revolution is the movement of the earth around the sun in a fixed path called an orbit. It takes about 365 days (1 year) for the Earth to go all the way around the sun.

What Causes the Earth's Revolution?

The Earth revolves around the sun because of the sun's gravity. The sun's gravity pulls the Earth and keeps it moving in a circle around it. This keeps it from falling straight into the sun and creates a stable path around the sun, which we call an orbit.

The time it takes the planets to make a full revolution varies due to difference in the distance from the sun. Planets far from the sun have a longer orbit (path) compared to those near the sun. For example, it takes Mercury the closest planet to the sun only 88 days to finish one revolution and then 165 years for Neptune which is the farthest planet from the sun.

Diagram Showing Earth's Revolution



Planet	Revolution Time
Mercury	88 Earth days
Venus	225 Earth days
Earth	365 days
Mars	687 Earth days
Jupiter	12 Earth years
Saturn	30 Earth years
Uranus	84 Earth years
Neptune	165 Earth years

Effects of the Earth's Revolution

Causes change in the Length of Day and Night (Equinox and Solstice): As the Earth revolves around the sun, the tilt of its axis causes different parts of the Earth to receive more or less sunlight at different times of the year.

Causes Seasons: As the Earth moves around the sun in its orbit, the tilt of the Earth's axis causes different parts of the Earth to get more or less sunlight. This causes variation in temperature and rainfall patterns in the four seasons: summer, autumn, winter, and spring.

Seasons and Associated Weather Patterns around the World

Season	Common Weather	Northern Hemisphere	Southern Hemisphere	Equator
Spring	Rain begins, flowers bloom	March to May	September to November	Hot and Wet
Summer	Hot and sunny, some rain	June to August	December to February	Hot and Wet
Autumn	Less rain, cooler in some areas	September to November	March to May	Hot and Wet
Winter	Cooler or dry weather	December to February	June to August	Hot and Wet

Note:

1. The Equator stays warm all year and mostly experiences rainy and dry periods.

2. Northern and Southern Hemispheres have opposite seasons.

Equinox and Solstice

Equinox (equal length of day and night): An equinox is the time of the year when day and night are nearly equal in length all over the world. It happens because the sun is directly above the equator meaning that neither the Northern nor Southern Hemisphere is tilted toward or away from the sun. therefore, both hemispheres get equal sunlight. Equinox happens twice a year:

1. March Equinox (around March 21st)
2. September Equinox (around September 23rd)

Solstice (Longest or Shortest Day): There are two solstices in the year as explained below;

1. June Solstice: Around June 21st the sun is directly overhead at the Tropic of Cancer (Northern Hemisphere) meaning that the sun's rays shine more directly north. This is summer season and on this particular day (June 21st) the day is longer than the night (longest day, shortest night in the northern hemisphere) on the other hand It is winter in the Southern Hemisphere and the day is shorter than the night (shortest day, longest night).

2. December Solstice: Around December 21st the sun is directly overhead at the Tropic of Capricorn (Southern Hemisphere) meaning that the sun's rays shine more directly south. This is summer season in the northern hemisphere and on this particular day (December 21st) the day is longer than the night (longest day, shortest night) on the other hand It is winter in the Northern Hemisphere and on this specific day, the day is shorter than the night (shortest day, longest night).

Average Day and Night Length during June and December Solstice in Northern Hemisphere

Around June 21 In Europe or North America, daylight can last up to 16–18 hours. Meaning that the night can last up to around about 6-8 hours.

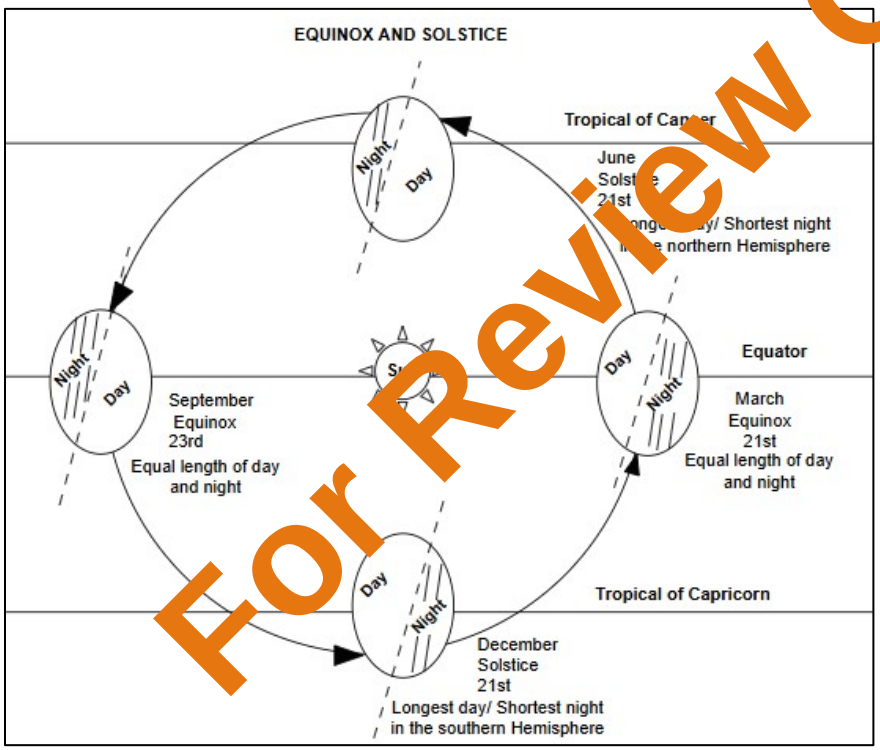
Around December 21 in countries in Europe and North America far north such as Norway and Canada, daylight can be as short as 6 hours or even no daylight at all in the Arctic Circle!

Average Day and Night Length during June and December Solstice in Southern Hemisphere

Around June 21st is the Winter Solstice in the Southern Hemisphere. Countries such as South Africa, Australia and Argentina daylight may last for only about 8–10 hours, while the night can last up to 14–16 hours.

Around December 21st is the Summer Solstice in the Southern Hemisphere. Countries such as South Africa, Australia and Argentina daylight can last up to 16–18 hours in some places.

Diagram Showing Equinox and Solstice



Region	Seasons Experienced	Examples of Countries
Temperate	Spring, Summer, Autumn, Winter	USA, Canada, Germany, Japan, China
Tropical	Wet and Dry seasons only	Uganda, Kenya, Indonesia, Brazil, Congo
Polar	Long Winter and Short Summer	Antarctica, Greenland, N. Canada, Russia

Note: *Although the earth is moving very fast, we do not see or feel this movement and this is because, it moves very fast, smoothly and gently. Everything around us like air, trees, buildings etc, is moving with the Earth. In other words, the Earth movement experience is like sitting in a car that is moving straight and smoothly (same speed). You do not feel it unless the car stops or turns.*

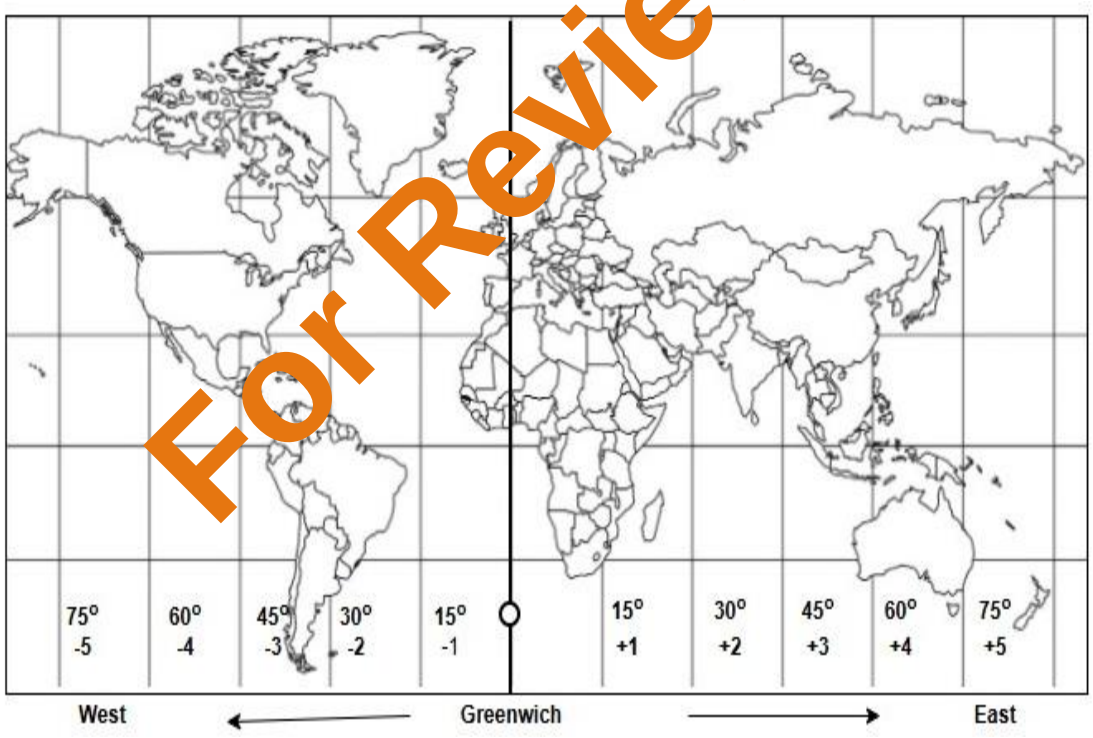
A similar experience is being in an aeroplane flying smoothly at a steady speed and height. You do not feel the movement while it is flying evenly through the air only when it takes off, lands, changes direction or crashes do you notice it.

Calculating Local Time Using Longitudes

The Earth is divided into 360 lines of longitude, with the Prime Meridian (0° longitude) at the center. As the Earth rotates, different places face the sun at different times, creating time differences across the globe.

The Earth rotates 360° in 24 hours, which means the Earth turns 15° every 1 hour and 1° every 4 minutes. By knowing the time at one location and the difference in longitude, we can calculate the local time at another location.

Diagram of the Globe Showing Longitudes



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Steps for Calculating Local Time Using Longitudes:

1. Find the difference in longitude between the two places by subtract the smaller longitude from the larger one.

2. Divide the difference by 15 to get the time difference in hours because 15° = 1 hour.

3. If answer in step 2 has part of an hour e.g. 2.8, convert 0.8 into minutes by multiplying it by 60 because 1 hour = 60 minutes then 0.8 in minutes will 0.8x60 = 48 minutes. Therefore, 2.8 means 2hours and 48 minutes.

4. Determine the direction and add the time difference if the place is East of the known location, add the time difference. If it is west of the known location then subtract the time difference

Relationship Between Prime Meridian and Greenwich

The Prime Meridian is the imaginary line of 0° longitude. It divides the Earth into the Eastern and Western part. It is used as the starting point for measuring longitude. There is only one Prime Meridian in the world and passes through Greenwich. Greenwich is a place (a town in London, England) where the Prime Meridian was officially established in 1884.

Activity 1.15: *Determine the local time in the following tasks based on prime meridian time*

a) *It is 12:00 noon in Mombasa (40°E).*

What is the local time in Dakar (17°W)?

b) *The local time in Accra (0°) is 2:00 PM.*

What is the time in Addis Ababa (45°E)?

c) *When it is 6:00 AM in Cape Town (18°E),*

What is the time in Buenos Aires (60°W)?

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THEME 2: Introduction to Geography; Introduction to East Africa

Topic 6: Weather and Climate

Topic Keywords

1. Climate
2. Weather elements
3. Weather instruments
4. Measurement
5. Weather maps
6. Clouds
7. Rainfall
8. Climate graphs
9. Human activities
10. Weather

Learning Outcomes By the end of this topic the learner will be able to;

a). Understand the differences between weather and climate.

b). Understand the elements of weather and how they are measured.

c). Carry out a project to observe, measure and record the elements of weather, make suitable instruments and visit a weather station.

d). Know the names of the main instruments used for recording the different elements of the weather and how each one is used.

e). Know the terms used for plotting weather on maps.

f). Know the names and characteristics of the main kinds of clouds and rainfall.

g). Appreciate that people's lifestyles are influenced by the type of weather and climate.

h). Understand the positive and negative effects of weather on their own lives and those of their communities.

i). Draw and use climate graphs of local and other areas to describe climate.

WEATHER AND CLIMATE

Weather: This can be defined as the short-term condition of the atmosphere at a specific location, typically measured over a period ranging from hours to one day. Weather plays a significant role in shaping our daily lives. For instance, when it is cold you might wear warm clothing, while rainy conditions may prompt you to carry an umbrella. Weather is characterised by elements such as Temperature, Humidity, Rainfall, Wind, Sunshine, Cloud Cover, Visibility, Atmospheric Pressure etc.

Climate: Even within the same country, different types of weather can be experienced at various times of the day. When atmospheric conditions are observed and recorded over a long period, typically 30 years or more, the average of this data is referred to as climate.

Weather Elements and Associated Weather Condition

Weather Element	Type of weather
Temperature	Hot or Cold
Rainfall	Rainy
Wind	Windy
Sunshine	Sunny
Cloud Cover	Cloudy
Humidity	Humid (moist and damp)

Measurement of Weather

Measurement of weather is done at a Weather Station. This is a place where all weather recording instruments are kept. The study of weather is called meteorology and people who collect and record weather data are called meteorologists.

Conditions for Setting up a Weather Station

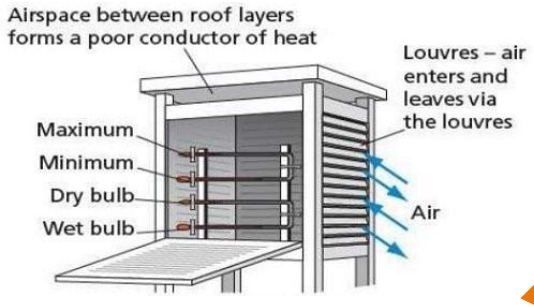
1. Should be in an open area, away from tall buildings, trees, or obstacles that may block wind or sunlight.
2. The ground should be flat and free from obstructions to ensure accurate measurements.
3. Avoid places near artificial heat sources (roads, concrete walls, chimneys, etc.) that may affect temperature readings.
4. The site should be easily accessible for regular maintenance and data collection.
5. Security of instruments must be ensured to prevent vandalism or tampering.
6. Preferably located on natural ground (grass, soil) rather than concrete or tarmac, since these surfaces retain heat and distort temperature readings.
7. The ground cover should be uniform and representative of the surrounding environment.
8. Place instruments away from sources of water spray or irrigation that could affect readings.

9. Instruments should be mounted at standard heights e.g Thermometers at 1.25–2 m to ensure consistency with meteorological standards.
10. Avoid areas with frequent shade or reflection from nearby objects that can distort temperature or humidity readings.
11. Ensure proper ventilation around instruments to allow accurate air flow for reliable measurements.
12. Record the exact location and surroundings so future changes in the environment can be accounted for in data analysis.

Stevenson Screen

Some weather recording instrument such as Thermometer are delicate and require special storage for safety. A Stevenson Screen is a special wooden structure designed to store delicate weather instruments.

Diagram showing Stevenson Screen



Feature of the Stevenson Screen

1. Painted white to reflect solar radiation and minimize heat absorption.
2. Designed with horizontal slatted (louvered) sides to allow air circulation while shielding instruments from direct sunlight and rain.
3. Double-louvered walls to ensure ventilation from all directions while preventing radiation from reaching the instruments.
4. Mounted on legs/stand about 1.25 to 2 meters above the ground to avoid ground heat effects.
5. Has a double-layered sloping roof to provide insulation from solar heating and protection against rain.
6. Made of wood because it has low heat conductivity, reducing heat transfer to the instruments inside.
7. North-facing door (in the Northern Hemisphere). The door usually opens towards the north to prevent direct sunlight from entering when opened.
8. Installed in an open area, away from buildings, trees, or artificial heat sources.

Weather Elements and Recording Instruments

Weather Element	Instrument
Minimum and Maximum Temperature	Sixth's Thermometer
Rainfall	Rain Gauge
Wind Speed	Anemometer
Sunshine	Camp-Bell Stokes Sunshine Recorder
Wind Direction	Wind vane
Wind Strength	Wind Sock
Air/Atmospheric Pressure	Aneroid Barometer/Mercury Barometer
Humidity	Hygrometer

Temperature

Refers to the he degree of hotness or coldness, in the atmosphere. Temperature is measured using scales like Celsius (°C) or Fahrenheit (°F), which quantify this hotness or coldness. Temperature keeps changing from time to time and Geographers use different kinds of Thermometer to measure the change in temperature.

Maximum Thermometer

Is used to measure the highest temperature reached during a specified period, most commonly the highest temperature recorded in a day, often in the afternoon. It uses mercury which expands when temperature rises and push the metal index up. When temperature falls the mercury contracts preventing the metal index to move down. Thus, the highest temperature reading is taken. The metal index is then drawn back using a magnet.

Minimum Thermometer

Is used to measure the lowest temperature reached during a specified period, most commonly the lowest temperature recorded in a day, often in the afternoon. It uses alcohol which contracts when temperature falls and push the metal index down due to surface tension. When temperature rises the alcohol expands past the metal index. The index stays at the lowest (it does not move). Thus, the lowest temperature reading is taken. To reset the index, you tilt the thermometer so the index slides back into contact with the liquid column, ready to be pulled again when the next fall occurs.

Six's Thermometer

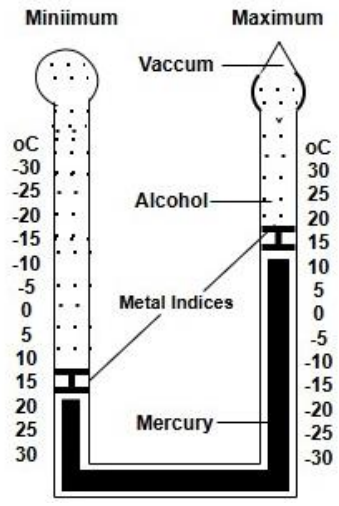
Is used to measure both the Minimum and Maximum temperature. The Six's Thermometer has a U-shaped glass tube containing mercury in the lower part and alcohol in the two upper arms. One arm has a vacuum bulb at the top to allow mercury to move freely. It has two indices which are placed inside the alcohol in each arm of the U-tube.

Reading the Maximum Temperature: When the temperature rises, the alcohol in the bulb expands. This expansion pushes the mercury down in that arm and up the opposite arm. The rising mercury then pushes the metal index on the maximum (right) side to its highest point. The index remains in this position, marking the highest temperature reached.

Reading the Minimum Temperature: When the temperature falls, the alcohol contracts. The weight of the contracting alcohol pushes the mercury down in the maximum (right) arm and up the minimum (left) arm. The rising mercury in the minimum (left) arm pushes its associated index to its lowest point. This index also remains in place, marking the lowest temperature.

Resetting the six's Thermometer: To reset the thermometer for a new reading, a magnet is used to drag the indicators back to the surface of the mercury in both arms of the tube.

Diagram Showing Six's Thermometer



Rainfall

This is the atmospheric moisture falling to the Earth's surface as liquid water. It is a crucial component of the Earth's water cycle. It is measured in millimeters by an instrument called Rain Gauge.

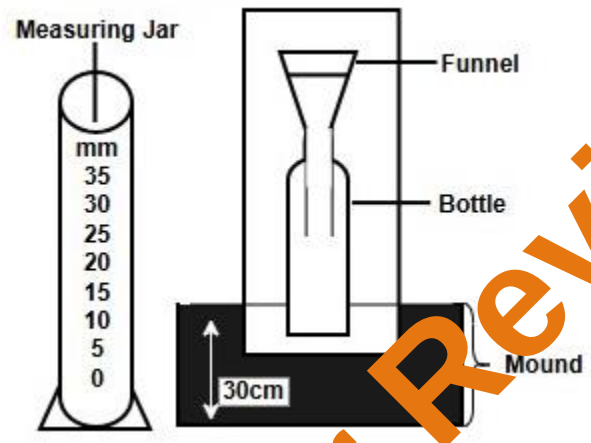
Measuring Rainfall using the Rain Gauge

A rain gauge works by collecting rainfall in a funnel that directs it into a collecting jar. When the rain stops or in a period of about 24 hours, the water in the collecting jar is transferred to the calibrated measuring cylinder for recording of its depth, usually in millimeters.

Condition for Setting up a Rain Gauge

1. The rain gauge should be placed in an open area, away from any structures, trees, or other objects that could block the rain or create wind currents that affect the reading.
2. The rain gauge must be placed on level ground and not on a slope.
3. The rain gauge should be installed straight and vertical.
4. The top of the rain gauge should be at least 30cm from the ground to prevent potential bouncing back of water droplets from the ground.
5. Ensure the rain gauge is securely fixed to prevent tipping over during strong winds or storms.
6. Keep the gauge clean by regularly removing leaves, dust, or debris that might block rainfall entry.
7. Record measurements consistently at the same time each day to ensure accurate rainfall data over time.

Diagram Showing the Rain Gauge



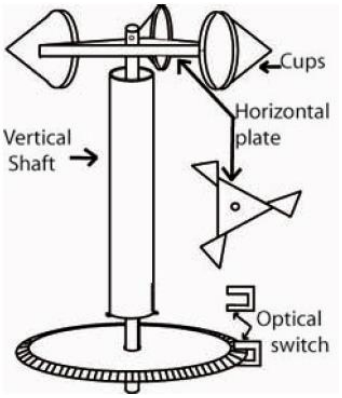
Wind

Wind is the movement of air in the Earth's atmosphere, caused primarily by the sun's uneven heating of the planet. This differential heating creates areas of high and low atmospheric pressure, and air naturally flows from high-pressure zones to low-pressure zones. Wind has speed, direction and strength.

Measuring Wind Speed

The speed of wind is measured by an instrument called Anemometer. An Anemometer works by measuring the effect of wind on its component such as metal cups. The cups on arms spin when wind hits them and the faster they spin, the higher the wind speed. A magnet inside the rotating assembly passes by a read switch for each rotation, sending a digital signal to a computer which then records and converts into the wind speed measurement in metres per second is m/s.

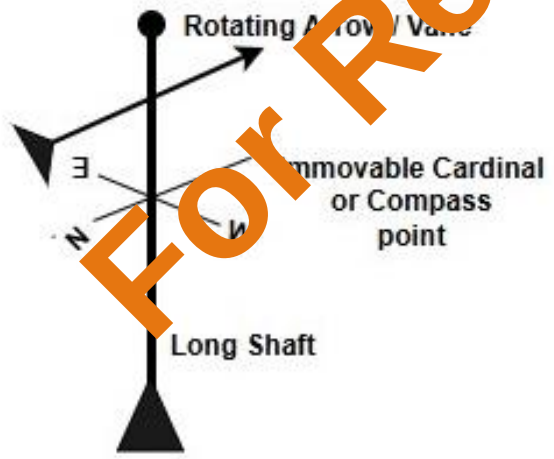
Diagram Showing an Anemometer



Measuring Wind Direction

The direction of wind is measured by an instrument called Wind Vane. A Wind Vane has two main parts: a pointer (like an arrow) and a larger tail. The wind exerts pressure on both the pointer and the tail. Because the tail has a much larger surface area than the pointer, it creates more resistance. The wind pushes more forcefully against the tail, causing the entire vane to rotate. This rotation continues until the large tail is positioned directly away from the wind, meaning the smaller pointer is facing directly into the wind. The direction the arrow points is the direction the wind is coming from. So, if the arrow points north, the wind is coming from the north.

Diagram showing Wind Vane

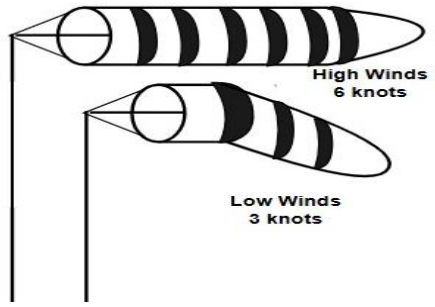


Measuring wind strength

The strength of wind is measured by an instrument called Windsock. The Windsock measures both direction and strength of the wind. The larger, open end of the windsock acts like a funnel, catching the wind. This wind pressure fills the cone-shaped tube, causing the sock to lift and stand out from the pole. The narrow, free end of the windsock points in the direction the wind is blowing, so the windsock is pointing away from the wind. The windsock's inflation level provides an estimate of wind strength. As wind speed increases, the sock inflates more. The colored stripes on the windsock help pilots estimate the strength of wind.

Each full stripe extended indicates a certain amount of wind, such as around 3 knots for the first stripe to lift. A fully extended, horizontal sock indicates a much stronger wind.

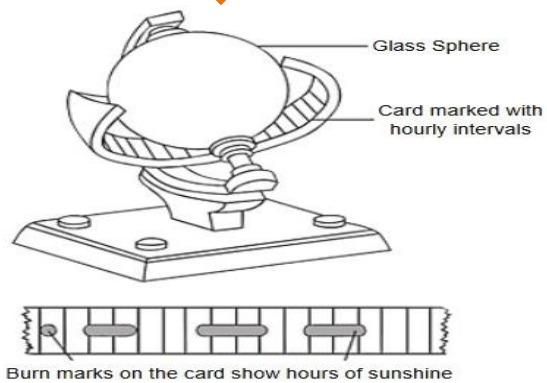
Wind Sock



Sunshine

The presence of sunlight on the earth is measured in duration by an instrument called Campbell Stokes Sunshine Recorder. It consists of a glass sphere held by a metal frame. Inside the frame is a sensitive card labeled in hours and minutes on the margin. As the sun apparently moves across the sky it rays burn traces on the card if the sun is not constant. However, if the sun is constant its rays burn a continuous line on the card. The total hours of sunshine in a day are got by adding all the burnt section from the calibration side of the card. The sensitized card is changed every day.

Diagram showing Campbell Stokes Sunshine Recorder



Humidity

Humidity is the presence of water vapor in the atmosphere, a measure of how much moisture is in the air. Humidity varies with temperature. For example, when temperature increases humidity increased due to increased evaporation and therefore air will contain more water vapor.

Absolute Humidity: Is the actual mass of water vapor in a given volume of air, without considering temperature.

Specific Humidity: Is the ratio of water vapor mass to the total air mass, expressed as grams of water vapor per kilogram of air.

Relative Humidity: Indicates the actual amount of water vapour contained in a given volume of air expressed as a percentage or ratio of the maximum water vapour it can hold when saturated. Air is said to be saturated when it contains more water vapour than what it can hold at that temperature. At this point air cannot absorb any more water vapour.

Measuring Humidity

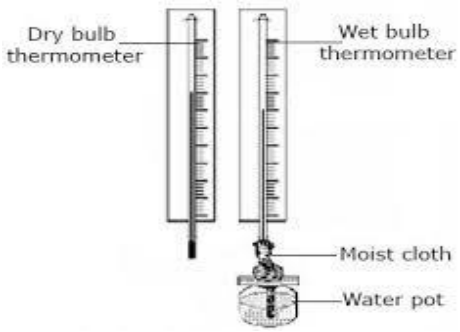
Humidity is measured using an instrument called Hygrometer. The Hygrometer uses different methods to measure humidity but the most common is the use of a **Psychrometer** that uses two Thermometers (one Wet, one Dry).

This method relies on evaporative cooling. It uses two Thermometers. A wet-bulb thermometer with a damp cloth over its bulb and a dry-bulb thermometer exposed to the air. The wet bulb is cooled by evaporation, and its temperature will be lower than the dry bulb.

Interpretation of Hygrometer Readings

If the wet bulb temperature is lower than the dry bulb temperature, the air is dry. This indicates low humidity. If the wet bulb temperature is close to the dry bulb temperature, the air is wet. This indicates low humidity. If the wet bulb temperature is equal to the dry bulb temperature, it means the air is saturated (air cannot absorb any more water vapour). Therefore, Relative Humidity is 100%

Diagram Showing Hygrometer



Atmospheric Pressure/Air pressure

Atmospheric pressure is the force exerted on the Earth's surface by the weight of the air above it. Air has mass, and the Earth's gravity pulls these air molecules downward, giving the air weight. This weight creates a force per unit area on the Earth's surface, which is atmospheric pressure.

Atmospheric pressure acts equally in all directions, not just downward, it's also pushing upwards, sideways of our bodies too which is why humans do not feel crushed. Atmospheric Pressure can be measured by two instruments (Mercury Barometer and Aneroid Barometer)

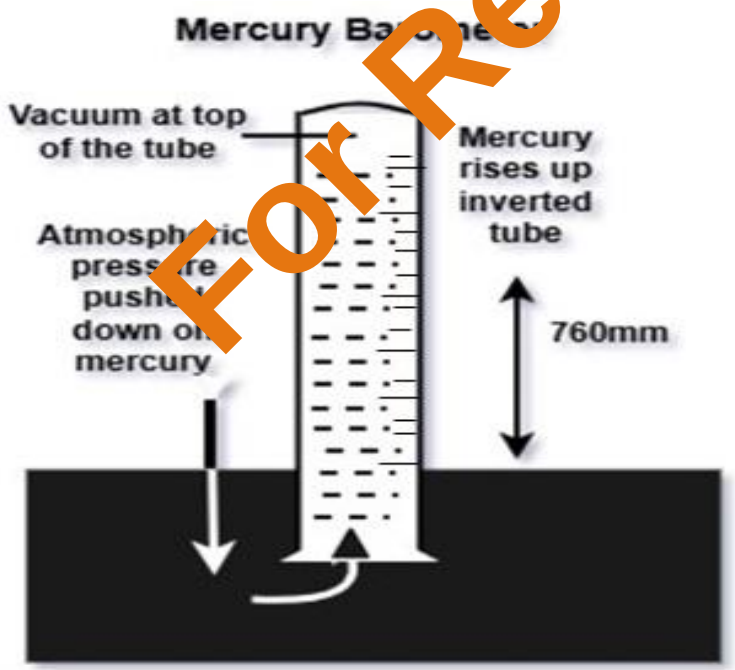
Measuring atmospheric Pressure using Mercury Barometer

The Mercury Barometer consists of a shallow, open dish containing mercury and a vertical glass tube, closed at one end and open at the other. The tube is filled with mercury, then inverted and placed with its open end submerged in the mercury-filled basin.

The atmospheric pressure pushes down on the mercury in an open basin, forcing it up into the inverted tube. The height of the mercury column in the tube rises or falls in direct proportion to changes in atmospheric pressure, with higher columns indicating higher pressure and lower columns indicating lower pressure.

Thus, reading is taken in millimeters of mercury. The space above the mercury in the tube is a vacuum, which does not exert pressure.

Diagram Showing Mercury Barometer



Measuring atmospheric Pressure using Aneroid Barometer

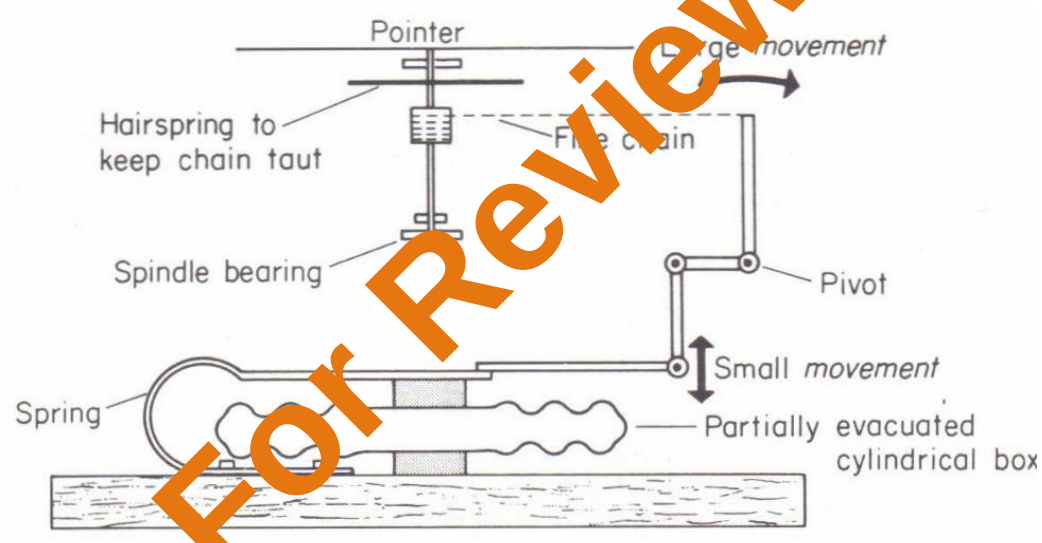
The Aneroid Barometer consists of a Aneroid Cell, a partially evacuated, corrugated metal box with a flexible diaphragm top. The diaphragm is prevented from collapsing by an internal spring. It has a series of levers which translate the diaphragm's expansion and contraction into mechanical motion.

It has a chain which connects the lever system to a pulley, which rotates as the levers move. It has a pointer attached to the pulley and moves across a graduated scale on the barometer's face. The scale is calibrated to show different atmospheric pressure readings.

When atmospheric pressure increases, the higher pressure pushes the aneroid cell's diaphragm inward, causing it to contract. This movement is amplified by the lever system, causing the pointer to move to a higher pressure reading on the dial.

When atmospheric pressure decreases, the aneroid cell expands outward. This expansion moves the levers, which turns the pulley and the pointer to a lower pressure reading on the dial.

Diagram Showing Aneroid Barometer



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Recording Weather on Maps and Graphs

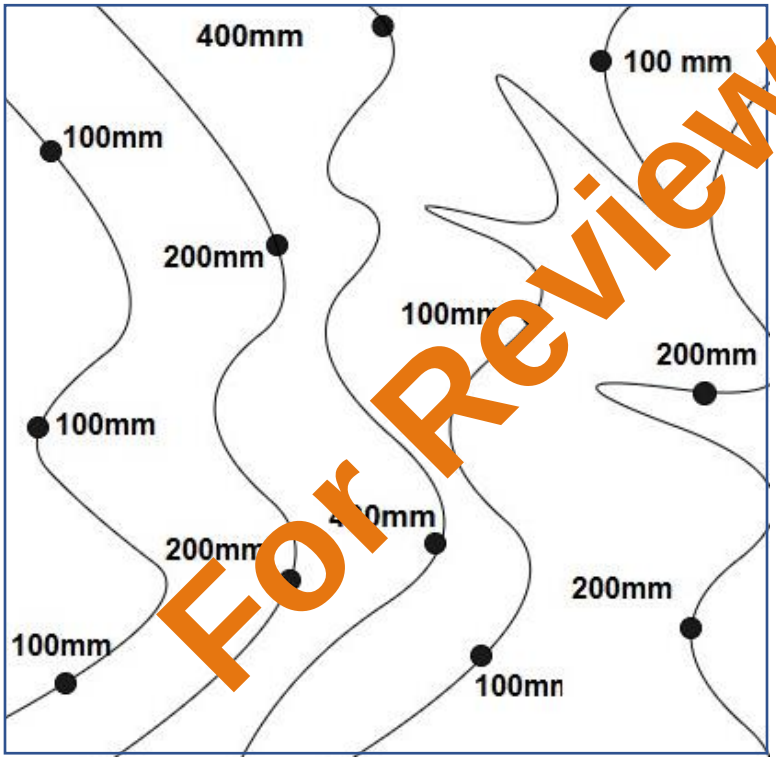
There are various ways of recording and representing weather data on maps and graphs, such as using symbols, lines (like isobars and isotherms), bar graphs, line graphs, and tables to show changes in elements like temperature, rainfall, and wind.

Table Lines Connecting Places of Equal Weather Elements

Aspect	Name of Isoline
Temperature	Isotherms
Atmospheric Pressure	Isobars
Rainfall / Precipitation	Isohyets
Humidity	Isohumes
Wind Speed	Isotachs
Sunshine (Duration)	Isohels
Cloud Cover	Isonephs
Snowfall	Isoneiges
Evaporation	Isoevap
Sea Surface Temperature	Isotherms

Places with equal Altitude/Height on map are connected by contour lines (Isopleths)

Diagram Showing Rainfall Isoline Chart



Activity 1.16: Table Showing Rainfall at Konge Weather Station in 2005

Month	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	78	65	89	102	140	180	210	195	160	110	90	85

Task: Draw a bar graph to represent the information in the table above

Activity 1.17: Table Showing Temperature at Konge Weather Station in 2005

Month	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°C)	12	14	17	20	24	28	30	29	26	21	17	13

Task: Draw a line graph to represent the information in the table above

Influence of Local Climate on People's Way of Life

The local climate affects many parts of our daily lives including what we wear, what we eat, how we build homes, and how we travel.

Life Aspect	Tropical Climate	Polar Climate
Clothes	People wear light, loose-fitting clothes to stay cool.	People wear thick, insulated clothes like coats, boots, and gloves to stay warm.
Housing	Houses are built with good ventilation and materials that reflect heat.	Houses are tightly sealed with heating systems to keep out the cold.
Food	Tropical fruits like mangoes and bananas grow easily; diets include fresh vegetables and seafood.	Fewer crops grow, so people rely on imported food or preserved items like dried meat and fish.
Outdoor	Outdoor work often starts early to avoid midday heat. People stay outdoors during the hottest hours.	Outdoor work and school may be limited during harsh weather; people spend more time indoors.
Transport	Roads can be affected by heavy rains, so people may walk or use motorbikes where cars can not go.	Snowmobiles and sleds are common, and some roads may be closed during heavy snow.
Water Supply	Water may be scarce; people rely on wells or rainwater collection.	Water sources may freeze; indoor plumbing must be protected from freezing.
Leisure	Activities like swimming, beach outings, and open-air festivals.	Skiing, snowboarding, and indoor games are more common.

Effects of Extreme Weather and Climate Change on People's Lives

1. Droughts lead to crops failure hence food shortages and higher food prices.
2. Due to drought farmers lose income, communities face hunger and water scarcity.
3. Heavy rains cause rivers to overflow, damaging homes and roads.
4. Floods also get people displaced, schools close, and disease spread e.g cholera.

5. Changing Rainfall Patterns for example rain coming too early or too late, or not at all affects planting or harvesting hence poor crop yields.
6. Heat waves lead to extremely high temperatures for long periods. This leads to health problems especially for the elderly.
7. Heat waves cause wildfires which affects biodiversity and ecosystem.
8. Heat waves cause power shortages due to increased air conditioner use.

Clouds: Clouds are visible accumulation of ice crystals in the earth's atmosphere. They are formed when water vapor cools and condenses onto tiny ice particles.

Classification of Clouds: Clouds are classified by their altitude (high, middle, and low) and their shape (feathery, puffy, layered etc).

Types of Clouds

Altitude	Examples	Shape and other features
High Clouds Typically found between 20,000 and 43,000 feet above the ground	Cirrus	1. Thin 2. Wispy (look like a feather) 3. Usually white
	Cirrostratus	1. Thin 2. Sheet like (flat)
	Cirrocumulus	1. Small 2. White 3. Fluffy (looks like wool) 4. Arranged in rows 5. Look like ripples or fish scales
Medium Level Clouds Typically found between 6,500 and below 20,000 feet above the ground	Altostratus	1. Gray or blue in colour 2. Usually thin enough to see the sun faintly 3. Often brings light rain or drizzle
	Altocumulus	1. White or gray 2. Layers of fluffy (looks like wool) 3. Rounded clouds
Low-level clouds Typically found between 2000 and 6,500 feet above the ground.	Stratus	1. Flat (Sheet-like) 2. Gray 3. Cover the sky like a blanket 4. May bring light drizzle or mist.
	Stratocumulus	1. Large mass of clouds with breaks of clear sky 2. Usually gray or white 3. Rarely bring rain
	Nimbostratus	1. Thick 2. Dark gray 3. Bring steady, continuous rain or snow

However, some clouds follow in more one level of altitude and these are clouds of vertical development. They include the following.

Cumulus	Fluffy, white (cotton-ball-like clouds).
	Flat bases and clear space between them.
	Rarely bring rain unless they grow into cumulonimbus.
Cumulonimbus	Cumulonimbus clouds span into all three levels: low, middle, and high.
	Towering, massive clouds shaped like an anvil or mushroom.
	Bring thunderstorms, lightning, heavy rain, hail, strong winds, and sometimes tornadoes (destructive winds).

Rainfall

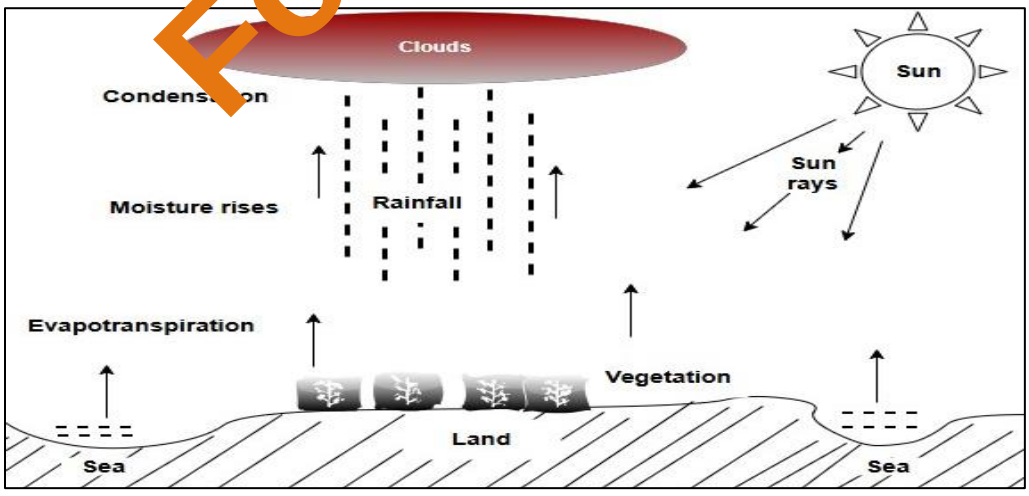
Rainfall is a type of precipitation where liquid water falls from clouds to the Earth's surface. Rainfall typically occurs when moist air rises, cools, and condenses. The water droplets merge into larger drops, and when they become heavy enough, they fall as rain.

Types of Rainfall: Type of rain depends on what causes air to rise.

Convectional Rainfall Formation

The sun's energy warms the land and water surfaces and consequently, the air above them. Water from these surfaces adds moisture to the air in a process called evaporation. Moist air becomes lighter and less dense, causing it to rise into the atmosphere. This upward movement of air is known as convection. As the air rises, it cools. When it cools at the dew point, the water vapor condenses into water droplets forming heavy cumulus clouds. This process is called Condensation. When the clouds become heavy and saturated with water, they release the excess moisture as precipitation, leading to intensive, often heavy, rain. This process is common in tropical and equatorial regions.

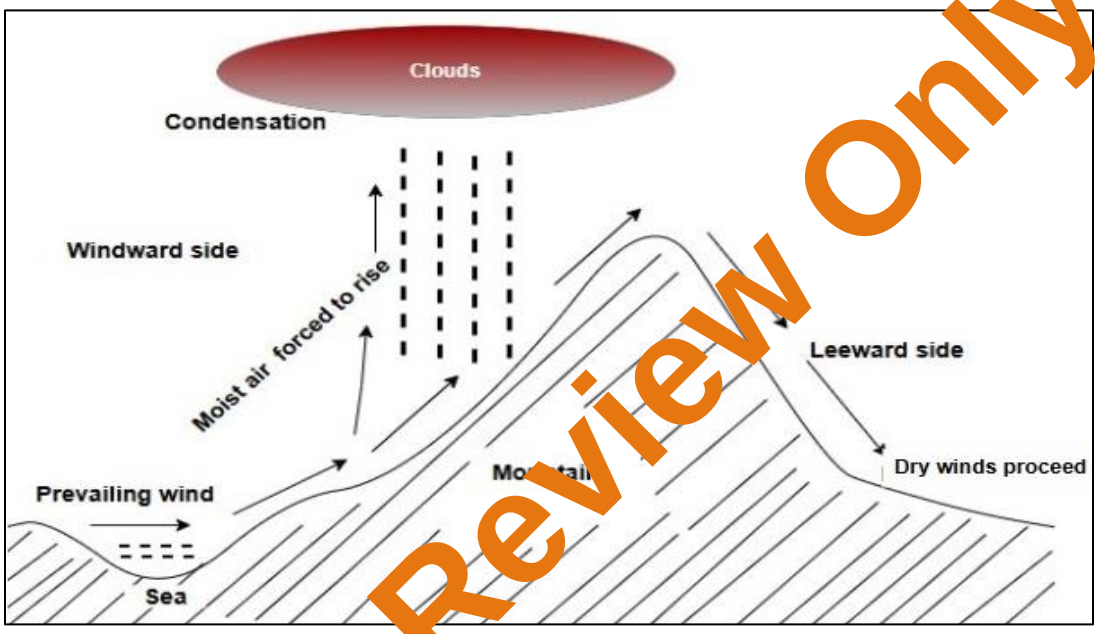
Diagram Showing the Formation of Convectional Rainfall



Formation of Orographic (Relief rainfall)

Warm, moist air moving horizontally encounters a mountain or upland area. The mountain acts as a barrier, forcing the air to move upward along its windward slope. As the air rises, it expands and cools due to decreasing temperature, causing the water vapor to condense and form clouds. The level at which water vapor to condense and form clouds is called the dew point. When enough water vapor condenses, the droplets grow large enough they fall to the ground as rain on the windward side of the mountain. Leeward Slope (Rain Shadow) receives less rainfall as the air descends, warms, and dries out on this side of the mountain.

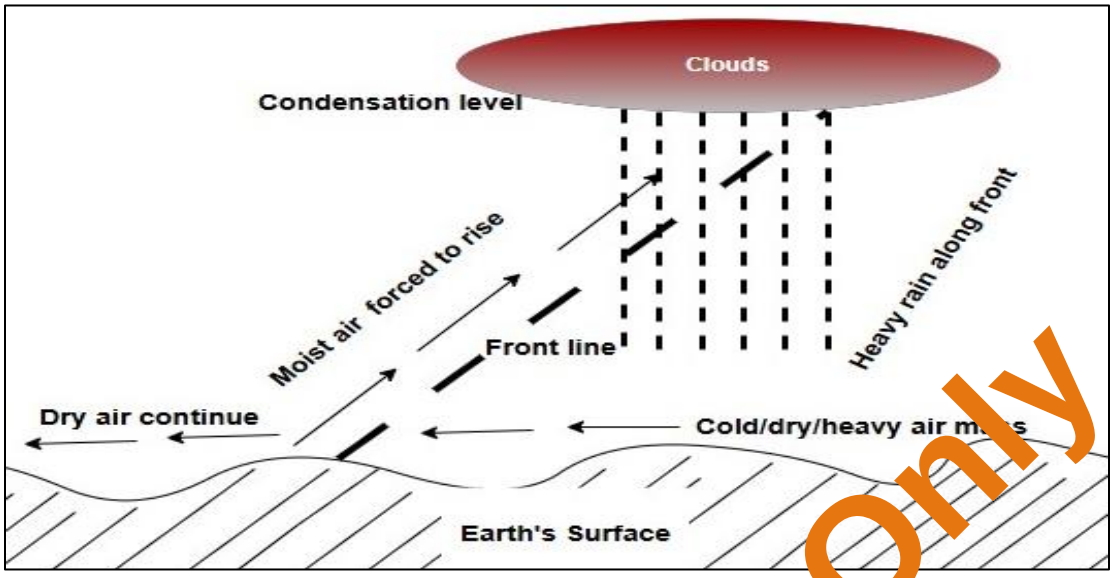
Diagram Showing the Formation of Orographic (Relief rainfall)



Formation of Frontal (Cyclonic Rainfall)

A boundary known as a weather front forms where a warm air mass meets a cold air mass. The warm air is less dense and lighter than the cold air. Because of this, it is forced to rise up and over the colder, denser air mass along the slanted front. As the warm air rises, it expands and cools. When it cools to its dew point, the water vapor within it condenses around tiny particles in the air to form clouds. The water droplets within these clouds continue to grow. When they become heavy enough, they fall to the ground as precipitation, resulting in frontal rain.

Diagram Showing the Formation of Cyclonic (Frontal Rainfall)



Other Forms of Precipitation

Feature	Fog	Mist	Haze
Composition	Tiny water droplets	Tiny water droplets	Tiny dry particles like dust, smoke, or pollution
Visibility	Less than 1 km	1–2 km or more	Can reduce visibility, but not as much as fog
Humidity	Very high (close to 100%)	High humidity	Low humidity (air is dry)
Feel	Damp, cool, wet	Slightly damp	Dry may feel scratchy
Cause	Cooling air causes water vapor to condense	Same as fog, but less intense	Air pollution, wildfires, dust, or smog
Places	Valleys, near lakes, early mornings	Valleys, near lakes, early mornings	Urban areas, dry regions, near wildfires

THEME 2: Introduction to Geography

Introduction to East Africa

Topic 7: Location, Size, and Relief Regions of East Africa

Topic Keywords

1. Population
2. Human Activities
3. East African Community
4. Boundary
5. Geographic Region
6. Area
7. weather
8. Climate
9. Relief
10. Physical features

Learning Outcomes: By the end of this topic the learner will be able to;

a). Use maps, statistics, graphs and diagrams to analyse population.

b). Appreciate that East African countries vary greatly in area and population.

c). Know the East African countries, their approximate population and area.

d). Use contours to show physical features on maps and draw cross-sections from simple contour maps.

LOCATION, SIZE, AND RELIEF REGIONS OF EAST AFRICA

Location of East Africa

East Africa is located on the Eastern side of the African continent. The region extends from approximately 23° North, to 12° South latitude and from 22° East to 51° East longitude. The region is crossed by Equator. East Africa is bordered by the Indian Ocean to the East and the Red Sea to the Northeast. To the West, it borders Central Africa and the Democratic Republic of Congo.

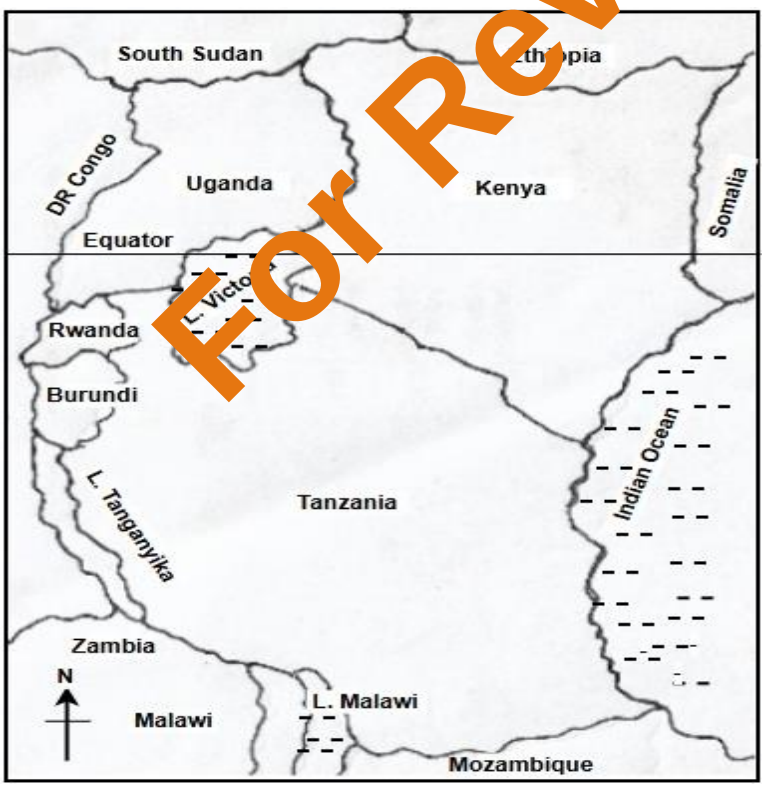
Size of East Africa

Geographically East Africa is made up of three countries (Uganda, Kenya and Tanzania). The region of East Africa covers a total land area of 1,768,313 KM^2 with Tanzania occupying the biggest land area (945,087 KM^2), followed by Kenya (581,677 KM^2) and Uganda (241,548 KM^2).

It is important not to confuse the Geographical size of East Africa with the economic union or political community (East African Community). On the other hand, the East African Community is bigger in terms of size and the partner states include Burundi, Kenya, Rwanda, Somalia, South Sudan, Tanzania, Uganda, and the Democratic Republic of the Congo.

In this topic however, we are referring to the traditional idea of East Africa as Uganda, Kenya and Tanzania.

Sketch Map Showing the Location of East Africa



RELIEF REGIONS OF EAST AFRICA

Relief refers to the appearance of land in a particular area of the Earth's surface. It includes features like: Mountains, Hills, Valleys, Plains etc. The relief regions of East Africa include the Coastal Plains, Rift Valleys, Highlands, the Eastern Plateau as well as the Central and Lake Plateau. These regions are defined by their varied altitudes

1. Coastal Plains

These are low-lying, gently sloping areas that lie along the Indian Ocean, with altitudes generally between 0 and 250 meters above sea level. Primarily formed by river and wave deposition of sedimentary rocks from the Indian Ocean. Examples includes areas around major rivers like the Tana in Kenya and Rufiji in Tanzania.

2. Rift Valleys

A rift valley is a long, deep depressions on the Earth's surface, bounded by steep slopes on either side. Rift valley is formed by significant tectonic faulting within the Earth's crust. The East African Rift valley has two arms (the Eastern and the Western arm). The western arm cover Uganda, Burundi, Rwanda and Tanzania and the eastern arm covers Kenya and Tanzania. Both arms consist of lakes which provide rich base of fishing activities. Examples of lakes in the western arm include (L. Albert, Tanganyika, Malawi, George and Edward). Examples of lakes in the eastern arm include (L. Turkana, Baringo, Naivasha Nakuru and Magadi).

3. Highlands

These are areas of high altitude extending between 1500 and 600o meter above sea level. Often highlands are characterized by volcanic mountains and ranges. Formed by volcanic activity, where magma erupts solidifies, and creates layered structures. Example of highland in East Africa include, Mount Kenya, Mount Elgon, and Mount Kilimanjaro.

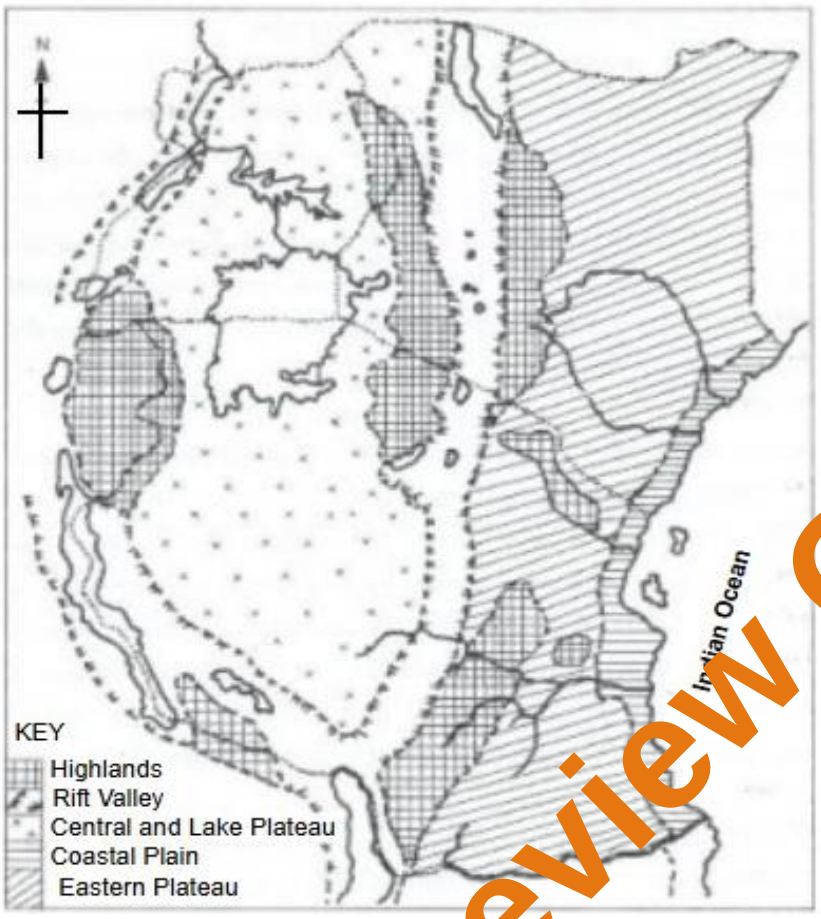
4. Eastern Plateau

This is an upland area with a relatively uniform surface, typically situated between 250 and 1100 meters above sea level. The surface gradually rises towards the west and is sometimes interrupted by isolated hills and inselbergs. Often called the Nyika Plateau, covers parts of southeastern Kenya and Tanzania. Key features include the Taita Hills in Kenya and inselbergs in the Morogoro and Iringa regions of Tanzania.

5. Central and Lake Plateau

This region encompasses the interior of East Africa, lying between the Eastern and Western branches of the East African Rift Valley. This region is a high-altitude, gently sloping, and largely flat area, known for its scattered hills and the presence of shallow, irregular-shaped lakes. The Central and Lake Plateau in East Africa primarily covers Uganda and parts of Western and Northern Tanzania, encompassing the lakes of Victoria, Kyoga, and their associated basins.

Sketch Map of East Africa Showing Relief Regions



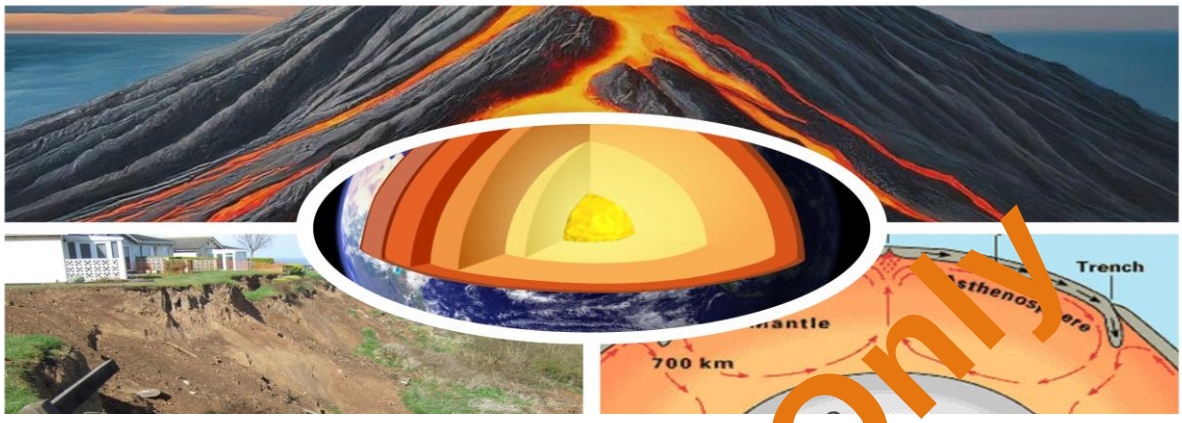
Influence of Relief on Weather and Climate

1. When moist air meets a mountain or highland, it is forced to rise, cools and condenses, forming clouds and causing heavy rainfall on the windward side (side facing the wind). On the leeward side (sheltered side), the air descends and dries causing a rain shadow with little or no rainfall.
2. For every 1000 meters increase in altitude, the temperature drops by about 6.5°C (known as the environmental lapse rate). Higher altitudes are generally cooler. For example, Kabale, located in the highlands of southwestern Uganda, is cooler than Kampala because it is on higher altitude compared to Kampala.
3. High elevations are more likely to experience fog and low-level clouds due to cooling and condensation of moisture at those altitudes.
4. Relief creates microclimates in form of small areas with distinct weather/climate conditions compared to surrounding regions. For example, a valley might be warmer during the day but colder at night.
5. Mountains can act as barriers to larger air movements to reduce the risk of storm and create calm zones.

THEME 3: Introduction to East Africa

W o r l d C l i m a t e s

Topic 8: Formation of Major landforms and Drainage in East Africa



Learning Outcomes: By the end of this topic the learner will be able to;

a). Know the main types of landforms and drainage features of East Africa.
b). Understand how igneous, sedimentary and metamorphic rocks are formed and how each influences landform.
c). Understand the process of weathering and how weathered rock particles form the basis of soil. d). Understand how each of the main types of landform was formed: by rocks themselves or by the rocks being worn away or eroded away.
e). Understand the relationship between drainage and landforms.
f). Recognize the landforms on photographs.
g). Locate the examples of landformation on maps of East Africa.
h). Appreciate that the rocks, landforms and drainage affect the way people live.
i). Understand the main concepts of plate tectonics and how this has led to the formation of the main physical features of East Africa.
j). Understand the characteristics of important kinds of physical features in East Africa, including mountain ranges, volcanoes, plateaus, basins and rift valleys.
k). Study through field work any of the above physical features in the local area.
l). Draw a map to show the main relief regions of East Africa.
m). Recognise physical features from photographs. Understand how their own lives and the lives of their communities are affected by physical features, including natural hazards.
n). Understand through case studies how the physical features affect the lives of people in selected areas of East Africa.
o). Draw diagrams to show the formation of important physical features.

Keywords: Landforms, Drainage, Rocks, Weathering, Erosion, Soil, Plate tectonics, Rift valley, Relief, Denudation, Mass Wasting, River Profile,

FORMATION OF MAJOR LANDFORMS AND DRAINAGE IN EAST AFRICA

Rocks

A rock is a naturally occurring, solid, non-living material composed of one or more minerals that have been cemented together by geological processes.

Classification of Rocks

Rocks are classified into three main types based on how they form

Igneous Rocks

Igneous Rocks form from the cooling and solidification of molten rock either in the interior of the earth or on the surface of the earth. Thus, igneous rock exists in two types (Extrusive and Intrusive igneous rocks)

Intrusive Igneous Rocks

Also called Plutonic rocks originate from magma, which is molten rock found beneath the Earth's surface. Unlike extrusive igneous rocks that form on the surface, intrusive rocks cool slowly beneath the Earth's crust hence intrusive igneous rocks.

Features of Intrusive Igneous Rocks

1. Large in size due to the slow cooling rate allows large size formation.
2. Have a rough texture due to slow cooling of magma.

Examples of Intrusive Igneous Rocks

1. Granite usually white, pink or gray, and is often used as a building material.
2. Diorite used for crushed stone and building materials.
3. Peridotite dark colored, durable and used in construction.
4. Pegmatite can contain quartz, feldspar, and mica, as well as other hard-to-find minerals.
5. Other includes Gabbro and Basalt.

Extrusive Igneous Rocks

Also called volcanic rocks form when magma from the Earth's mantle travels to the surface through volcanic vents. Once at the surface, this magma is exposed to the much cooler external environment, causing it to cool rapidly and solidify to form extrusive igneous rocks.

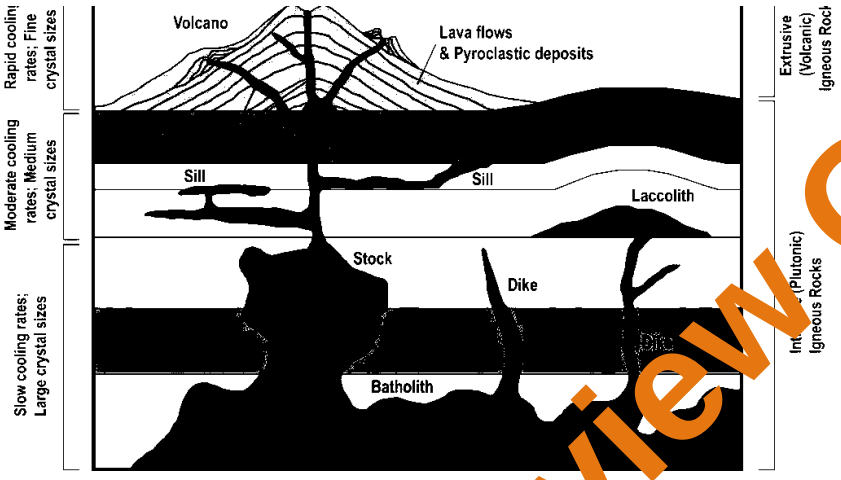
Features of Extrusive Igneous Rocks

1. Small in size due to rapid cooling which prevent large crystals from forming.
2. Igneous rocks have a very fine-grained or glassy texture.

Examples Extrusive Igneous Rocks

1. Basalt: A common, dark-colored volcanic rock, often found in large ocean floor formations.
2. Andesite: An extrusive rock of intermediate composition, commonly found in volcanic arcs.
3. Rhyolite: A felsic volcanic rock, the extrusive equivalent of granite, which can lead to glass like obsidian due to high silica content.
4. Obsidian: A natural glass formed when lava cools so rapidly that no crystals form.

Diagram Showing the Formation of Igneous Rocks



Batholiths form when magma, or molten rock, rises into the Earth's crust but does not erupt onto the surface. Instead, it cools and hardens deep underground over millions of years.

Laccoliths form when viscous magma intrudes into a horizontal layer of sedimentary rock. The magma is too thick to spread out like a fluid and instead pushes the overlying rock layers upward as it solidifies, forming a mushroom-like rock with a generally flat base and a rounded top.

Sills form when magma rises from the Earth's interior and intrudes between existing horizontal layers of rock, forcing them apart and spreading out laterally. This molten rock then cools and solidifies into a tabular or sheet-like rock feature that is consistent with the surrounding rock layers.

Dykes form when magma from deep inside the Earth rises up and forces its way into these cracks. When the magma cools and solidifies inside the crack, it forms a vertical wall of rock called a called a Dyke

Lapoliths form when a large volume of thick magma intrudes horizontally between existing layers of rock, forcing the overlying rock layers to sag downwards into a concave shape as the magma cools and solidifies. This creates a saucer-shaped, rock feature called Lapolith.

Sedimentary Rocks

Sedimentary rocks form from plant and animal remain and the already existing rock materials. The process of forming sedimentary rocks takes place in four stages (weathering, erosion, transportation and deposition)

Formation of Sedimentary Rocks

Plant and animal remain as well as pre-existing rocks are broken down into smaller pieces called sediment by physical forces or chemical processes.

The resulting sediment is carried away from its source by agents such as rivers, wind, or glaciers.

The sediment eventually comes to rest in a new location, such as a lake, ocean, or valley floor.

Over time, layers of sediment accumulate. The weight of the overlying sediment compresses the lower layers (compaction), and dissolved minerals in the water seep into the spaces between the particles, hardening and binding them together (cementation).

Types of Sedimentary Rocks

Mechanically Formed Sedimentary Rocks

Mechanically formed sedimentary rocks form when fragments of pre-existing rocks (called clasts) are physically broken down, transported, and then deposited as sediment. These loose sediments undergo compaction under the weight of overlying layers, squeezing out water. Finally, minerals dissolved in water cement the grains together, hardening the sediment into a solid rock through a process called lithification.

Examples of Mechanically Formed Sedimentary Rocks

The type depends on the size of the clasts. For example, sandstone is made of sand grains, while mudstone and siltstone are composed of silt and mud, respectively.

Organically Formed Sedimentary Rocks

Organic sedimentary rocks form when the remains of plants and animals accumulate and are then buried under layers of sediment. Over vast periods, the immense pressure and heat from the overlying layers transform this organic matter through a process called lithification, compacting and cementing it into rock.

Examples Organically Formed Sedimentary Rocks

Coal, which forms from compressed plant material

Limestone, made from cemented marine shells and skeletal remains.

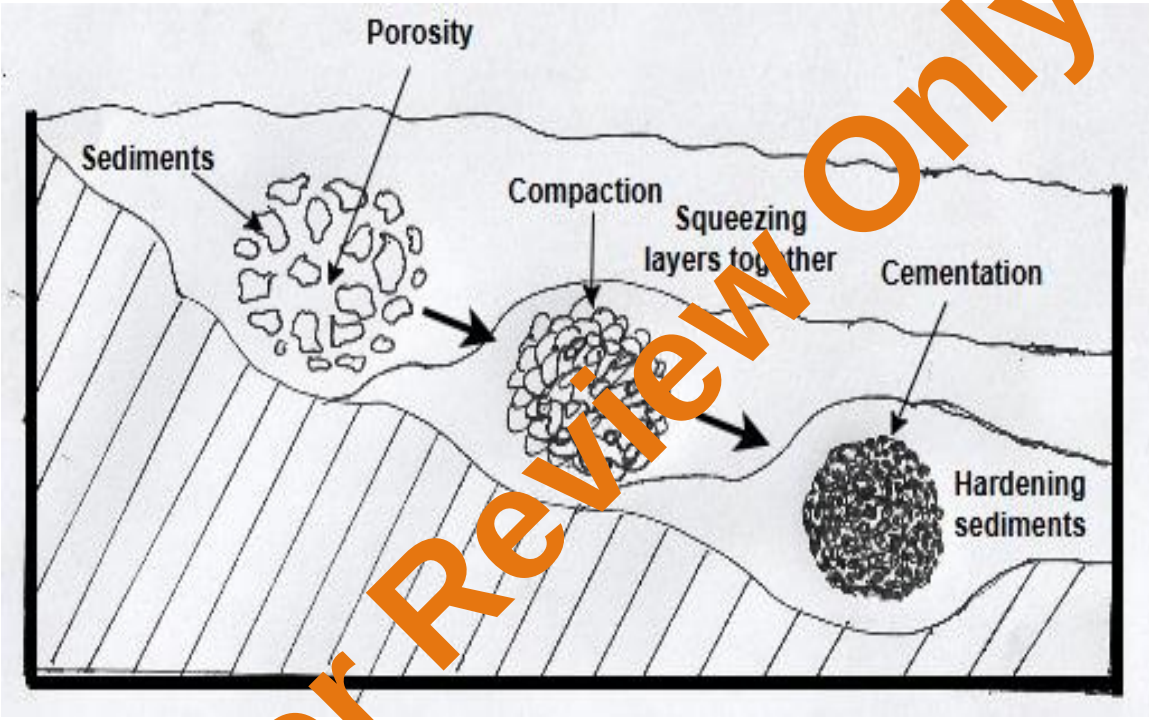
Chemically Formed Sedimentary Rocks

Chemical sedimentary rocks form when dissolved minerals separate from a water solution to become solid rock. This process, known as precipitation, occurs either when the water evaporates, leaving the minerals behind.

Examples of Chemically Formed Sedimentary Rocks

Common examples include evaporite rocks like rock salt and gypsum, as well as limestone formed when dissolved calcium carbonate precipitates from seawater.

Diagram Showing the Formation of Sedimentary Rocks



Metamorphic Rocks

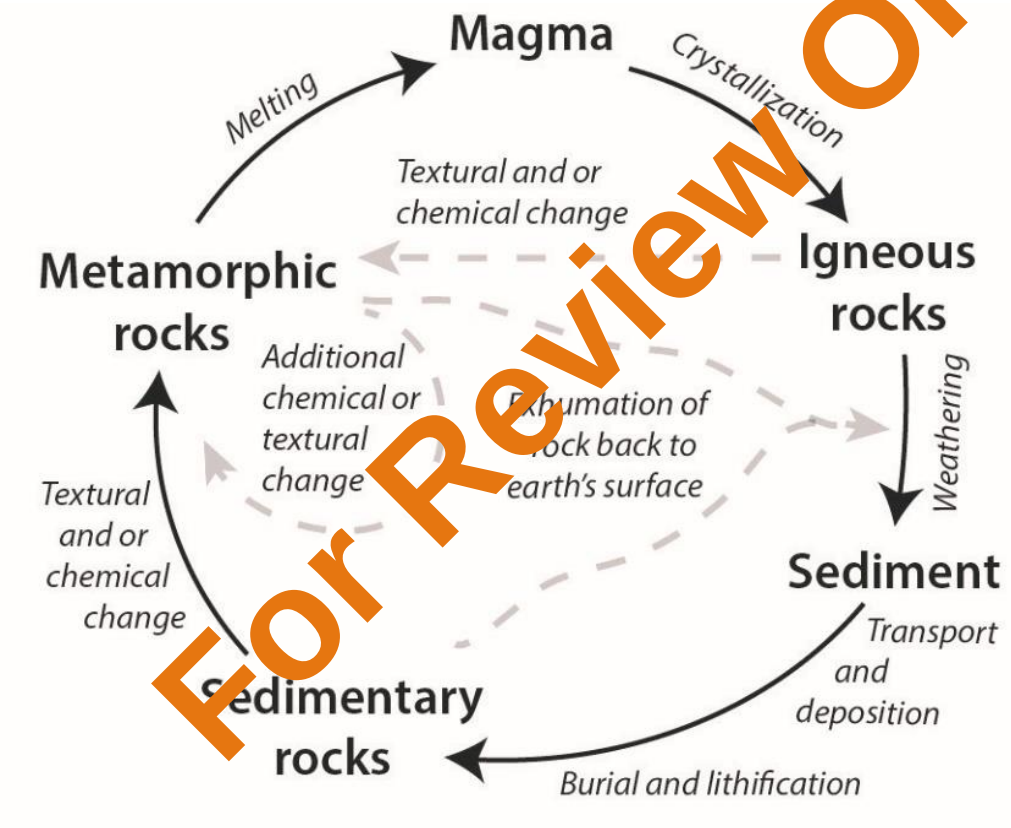
Metamorphic rocks form when existing igneous, sedimentary, or other metamorphic rocks are subjected to intense heat, pressure hence changing the texture, colour and mineralogical content of the original rock. These conditions occur deep within the Earth, often where tectonic plates meet, leading to changes like the formation of new minerals and the alignment of existing minerals into layers.

Examples of Metamorphic Rocks

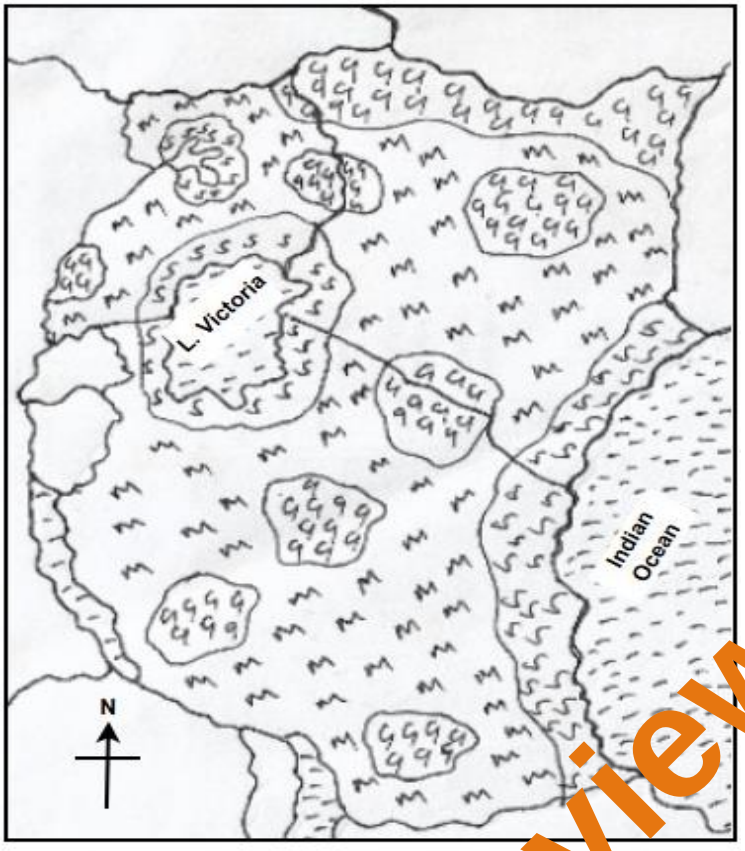
Original Rock	Heat and Pressure	Metamorphic Rock
Limestone (sedimentary)	→	Marble
Clay (sedimentary)	→	Slate
Coal (sedimentary)	→	Graphite
Sandstone (sedimentary)	→	Quartzite
Granite (igneous)	→	Gneiss

The formation of rocks is a cycle which describes the continuous process of transformation between the three main types of rocks (igneous, sedimentary, and metamorphic) over geologic time, driven by Earth's internal forces like heat and external forces like weathering and erosion.

Diagram Showing the Rock Formation Cycle



Sketch Map of East Africa Showing the Distribution of Rocks



KEY **SS:** Sedimentary **GG:** Igneous **MM:** Metamorphic

Relationship Between Rocks and Landforms Formation

1. Very hard Igneous rocks like granite or basalt are usually and resistant to weathering. They form rugged landforms such as cliffs

2. Sedimentary rocks like limestone or sandstone are softer and often layered. They tend to form plateaus and plains through erosion and deposition.

3. When hard rocks lie next to softer ones, erosion acts faster on the soft rocks, creating features like escarpments, ridges, and valleys.

4. Cracks and breaks in rocks guide rivers, waterfalls, and gorges. For example, waterfalls often occur where resistant rock overlies softer rock.

5. Movement of rocks within the Earth's crust uplifts, folds, and fractures them, producing mountains, rift valleys, and plateaus.

6. The mineral composition of rocks determines how quickly they break down. For example, limestone (calcium carbonate) dissolves in acidic rain, forming karst landforms like caves and sinkholes.

Problems Associated with Rocks

1. Rocks in the ground can damage expensive machinery used in agriculture and mining, leading to high maintenance and replacement costs.

2. Rocks that are soluble, weak, or prone to changing in water content create risks in construction foundation for buildings and can lead to collapse.

3. Rocks can contain harmful or toxic minerals, such as asbestos, which can pose serious health risks, including cancer.

4. Rock masses can become unstable due to factors like crustal movements, earthquakes, and weathering, leading to landslides, which threaten life and property.

5. Weathering of certain rocks may release harmful substances like excess salts, leading to salinization and soil infertility.

6. Volcanic eruptions originate from molten rocks, destroying properties and lives.

7. Hard rocks (like granite) are difficult and expensive to cut, drill, or build through when constructing roads, tunnels, or dams.

8. Heavy metals in rocks (like lead, mercury) can pollute water sources.

Importance of Rocks to the People

1. Rocks are the primary source of vital minerals like iron, gold, copper, aluminum, and precious stones. These are used in manufacturing, technology, and jewelry.

2. Materials like granite, limestone, sandstone, and gravel are quarried for building homes, roads, bridges, and monuments.

3. Sedimentary rocks contain fossil fuels such as coal, oil, and natural gas, which are crucial for heating, transportation, and industrial power.

4. Rocks like limestone are used to make cement, while other types produce ceramics, glass, and bricks for various industries.

5. The gradual disintegration and weathering of rocks is the origin of all soil which support agriculture.

6. The porous nature of certain rocks, such as sandstone, allows them to be used in water filtration systems.

7. Beautiful stones like marble and limestone are carved into sculptures, used as decorative flooring, and for monumental art.

8. Unique rock formations and masses serve as popular tourist attractions, drawing visitors and generating income.

Formation of Landforms in East Africa

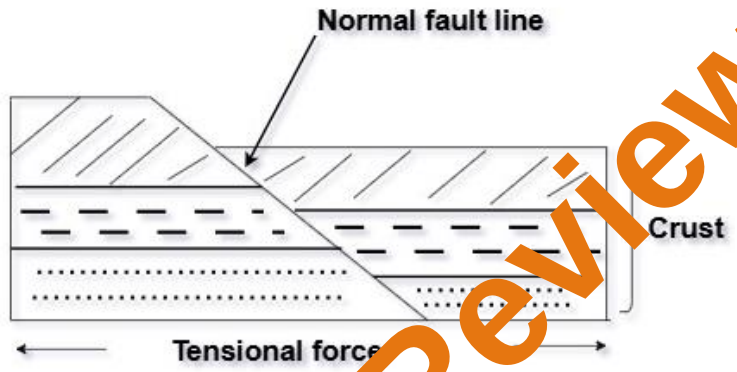
The formation of land forms in East Africa is attributed to plate tectonics. The earth's crust is made up of blocks called tectonic plates which keep moving relative to one another due convection current force generated by great heat and pressure in the underlying rocks. The underlying rocks are partially molten and form the upper mantle. The movement of tectonic plates result in the formation of landforms through faulting, Vulcanicity and warping.

Faulting in East Africa

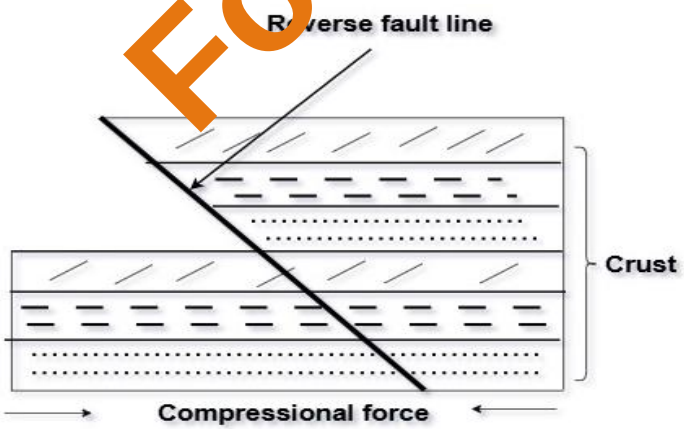
Faulting is the process by which rocks in the Earth's crust crack and move along a fracture called a fault due to tectonic forces such as tension, compression, or tear force.

Types of Faults:

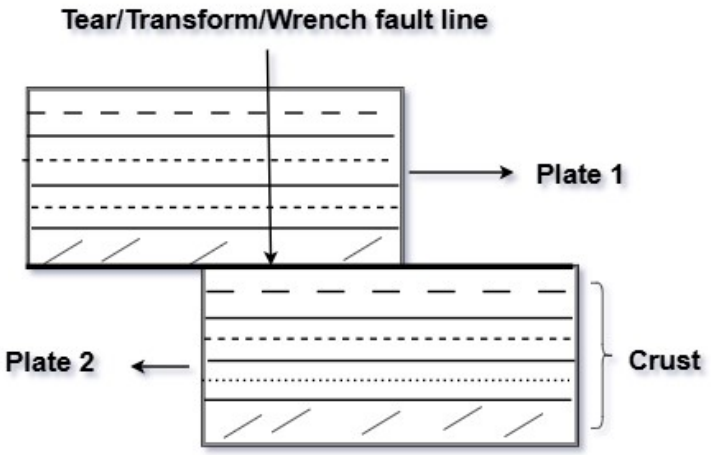
Normal Fault: Tension forces pull the earth's crust apart forcing the hanging wall to move down relative to the footwall.



Reverse Fault: Compressional forces push the earth's crust together forcing the hanging wall to move up relative to the footwall.



Tear/ Wrench Fault: Tear forces slide rock in the earth's crust past each other horizontally.



Earthquakes

Earthquakes can result from movement on tear faults. When stress builds up along a fault due to the "stick-slip" motion of tectonic plates, eventually leading to a sudden rupture and the release of energy as waves that cause shaking.

Landforms Resulting from Faulting

Landforms resulting from faulting include Block Mountains/Host, Rift Valleys, Sault Scarps/Escarpment, Rift Valley Lakes/Graben, and Tilted Blocks.

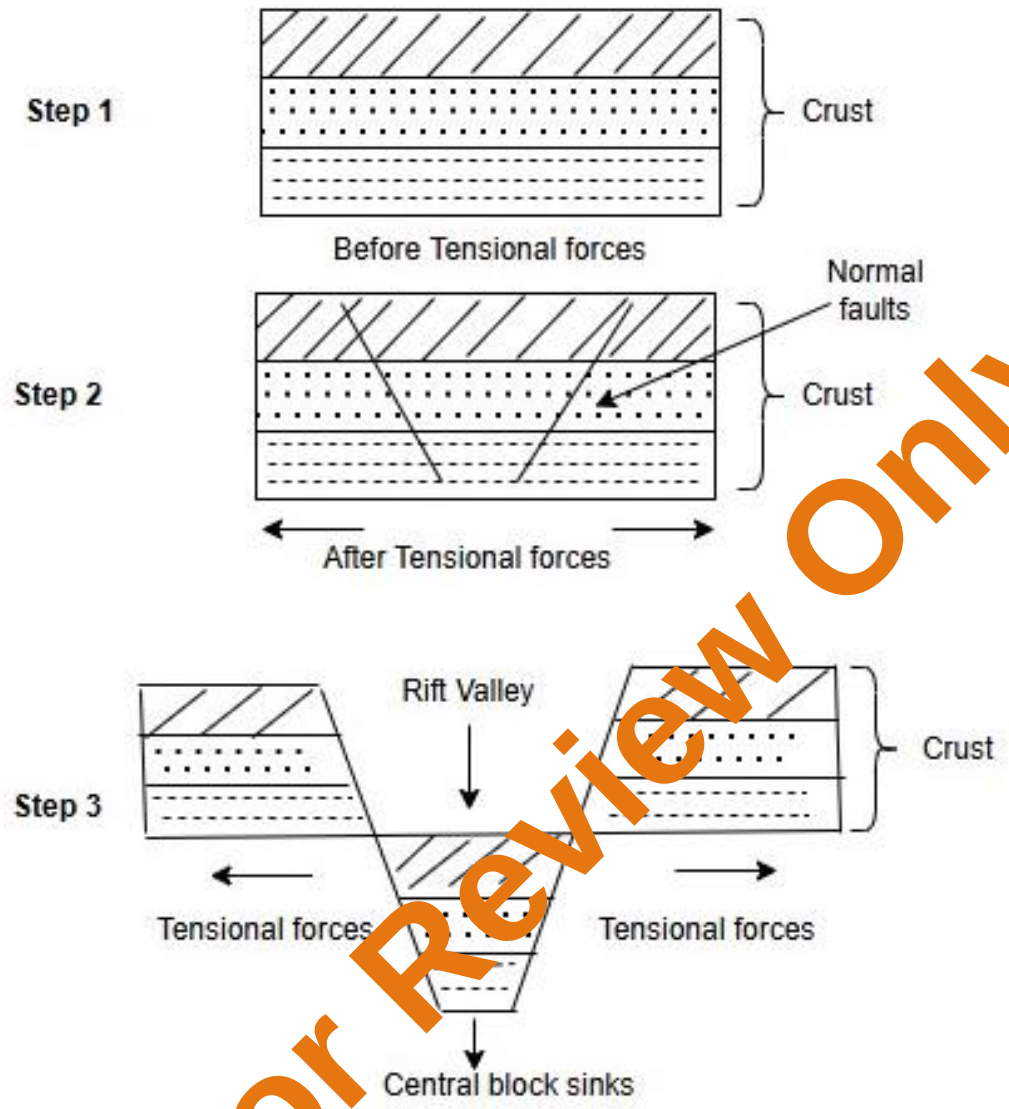
Rift Valley

A rift valley is a long, narrow, steep-sided depression on the Earth's surface, formed as a result of tensional and compressional forces acting on the earth's crust.

Formation of a Rift Valley by Tensional Forces

Tensional forces pull apart the Earth's crust, causing it to crack and create a normal fault line. The block of crust in the middle sinks between these faults forming a depression called Rift Valley. The blocks on either side remain standing higher, forming Escarpments.

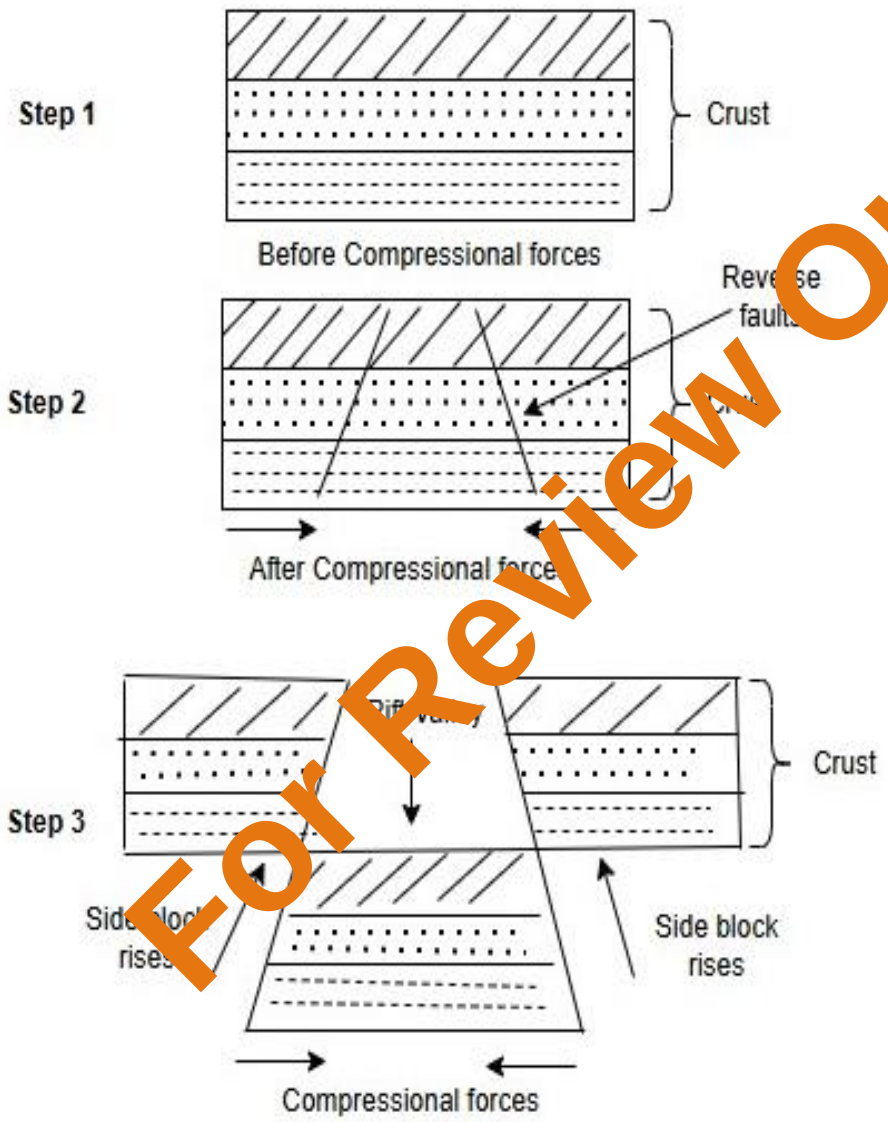
Diagram Showing the Formation of the Rift Valley by Tensional Forces



Formation of a Rift Valley by Compressional Forces

Compressional forces push the earth's crust towards each other, causing it to crack and create a reverse fault line. The central block of land is squeezed downwards relative to the sides, forming a depression called a Rift Valley. The blocks on either side remain standing higher, forming Escarpments.

Diagram Showing the Formation of the Rift Valley by Compressional Forces



Sketch Map of East Africa Showing the Rift Valley and Rift Valley Lakes

Importance of the rift valley to the people of East Africa

1. The Rift Valley has spectacular landscapes e.g Lakes and Escarpments that attract tourists, earning foreign exchange and creating jobs.

2. Rift Valley contain minerals such as soda ash in Lake Magadi, Kenya for making glasses, Sodium Carbonate a white powder used primarily in household cleaning products like detergents.

3. Rift Valley lakes and rivers supply domestic and industrial water.

4. Many Rift Valley sites are important for human history and archaeology e.g. Olduvai Gorge in Tanzania where early human fossils were found.

5. Fertile soils in the Rift Valley floor support crop growing.

6. Rift Valley lakes are used for fishing hence supplement local food production.

Problems Faced by People Living in Rift Valley Region of East Africa

1. The steep escarpments and rugged terrain make construction of roads, railways, and airports very expensive.

2. Landslides and rock falls on steep escarpments threaten life and property

3. Rift Valley lakes e.g. Lake Albert and Naivasha sometimes flood, displacing people and destroying crops.

4. Swamps in the valley can harbor disease vectors like mosquitoes for malaria and snails for bilharzia.

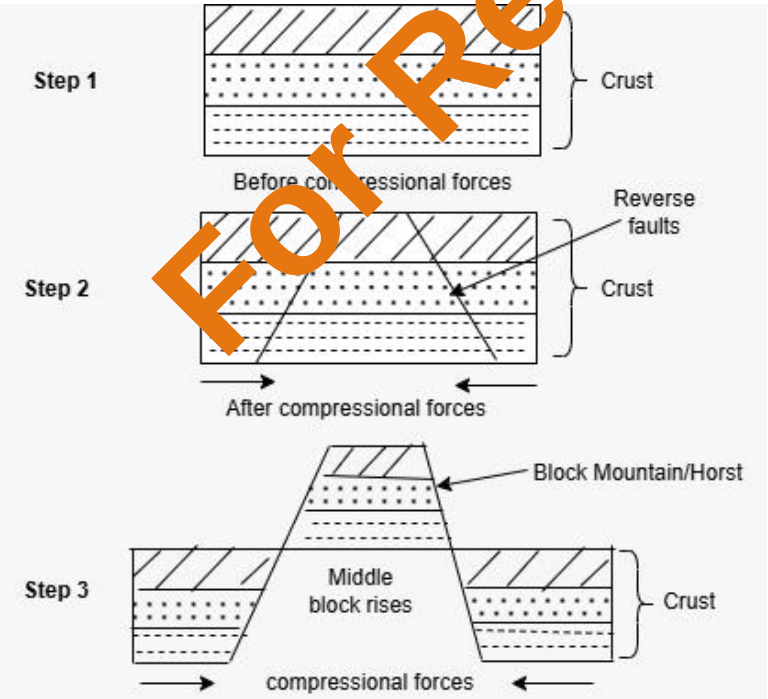
5. Some parts of the Rift Valley have saline or alkaline soils especially nea[illegible] so[illegible] la[illegible]es like Lake Magadi, which limit farming.

6. Rift Valleys are habitats for wildlife, but wild animals sometimes att[illegible]k crops, livestock, and people, leading to conflicts.

Formation of a Block Mountain/Horst by Compressional Forces

Compressional force pushes the earth's crust against ea[illegible]o[illegible]her, exerting compressional force on the Earth's crust. This pressure causes the crustal b[illegible]cks to fracture and form reverse faults. The central block called Horst is pushed upwards [illegible]ela[illegible]ive to the surrounding blocks hence forming a Block Mountain

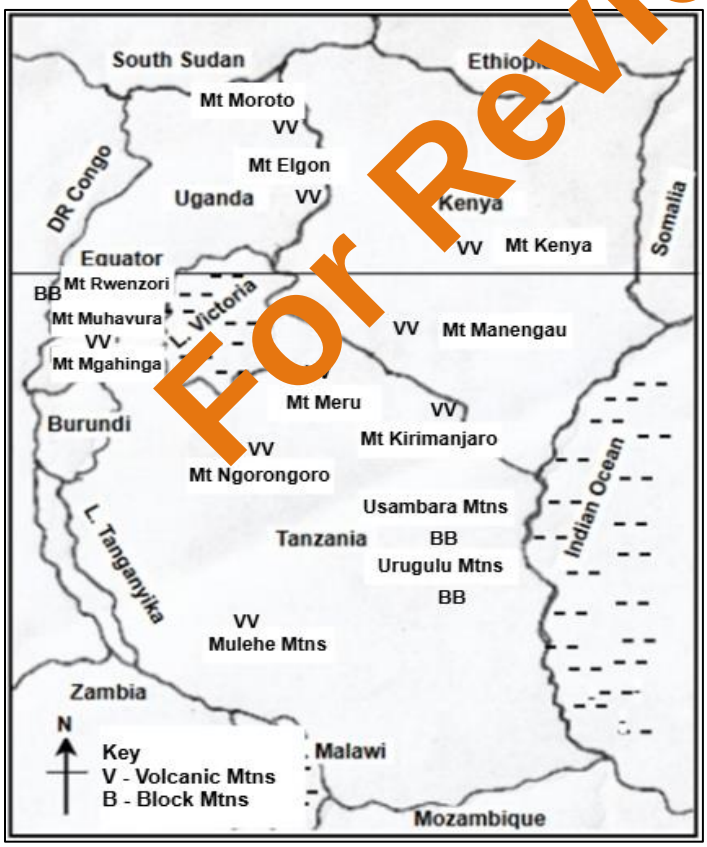
Diagram Showing the Formation of a Bl[illegible]k M[illegible]ountain/Horst by Compressional Forces



Importance of Mountains to the People of East Africa

1. Rivers which generated HEP often originate from mountains e.g, river Nyamwamba, Mubuku, Ruimi, Butawu, Lamya and Bujuku all originate from Rwenzori. The same rivers are also used for transport.
2. Crater and caldera lakes on volcanic mountain tops are sources of fish which add on food supply.
3. Valleys and lower slopes of mountains are good for grazing livestock due to abundant pastures.
4. Mountains influence rainfall formation through orographic rain when air rises, cools, and condenses to form clouds and rain.
5. Mountains like Rwenzori in Uganda, Kilimanjaro in Tanzania attract tourists for their beauty, wildlife, glaciers, and adventure sports.
6. Mountain forests provide timber, fire wood, medicinal plants, and fruits.
7. Some mountain regions support settlements because of fertile soils and cooler climate.
8. Many mountains are considered sacred as they are part of people's cultural identity and heritage.
9. Mountains act as conservation area because they host unique plants and animals not found elsewhere.

Sketch Map of East Africa Showing the Distribution of Volcanic and Block Mountains



Problems Faced by People Living in Mountain Regions of East Africa

1. Landslides and rock falls are common on steep slopes e.g. Mt. Elgon.
2. Earthquakes and volcanic eruptions occur in some mountain regions, destroying property and threatening lives.
3. Avalanches (rapid flow of snow from a mountains) and floods from melting glaciers can also be deadly.
4. Very cold temperatures at high altitudes limit human settlement and farming.
5. Thin air at high altitudes causes breathing problems for people and animals.
6. Soils on steep mountain slopes are often shallow and easily eroded.
7. Farming on slopes leads to soil erosion and landslides if not managed properly.
8. Some mountain areas act as hiding places for rebels or cattle rustlers, making them insecure.
9. Border Mountains sometimes cause boundary disputes between countries.
10. Mining, construction, and industrial development are difficult and costly in mountain areas.

Vulcanicity

Vulcanicity is the broader process of magma (molten rock) and gases from the Earth's interior moving into, or onto, the Earth's crust. Volcanicity on the other hand refers specifically to the extrusive processes where magma erupts onto the earth's surface to form volcanoes and related features.

Landforms due to Volcanicity

Volcano: Volcanoes form when intense heat from the Earth's core melts rocks deep within the mantle to create magma. Due to magma's light weight and internal pressure, it ascends through crack in in the Earth's crust (also called volcanic vent), where it eventually erupts onto the surface. During an eruption, molten rocks, ash, and other volcanic materials are ejected and fall back to the Earth's surface. These materials accumulate around the vent, gradually building a mountain over successive eruptions.

Classification of Volcanoes

Volcanoes are classified in two ways (activity and shape)

Classification Volcanoes by Activity (Life Status of the Volcano)

Active Volcano: Currently erupting or has erupted recently e.g. Mt. Nyiragongo in DRC.

Dormant Volcano: Not erupting at the moment, but shows signs that may erupt again in the future e.g. Mt. Kilimanjaro in Tanzania.

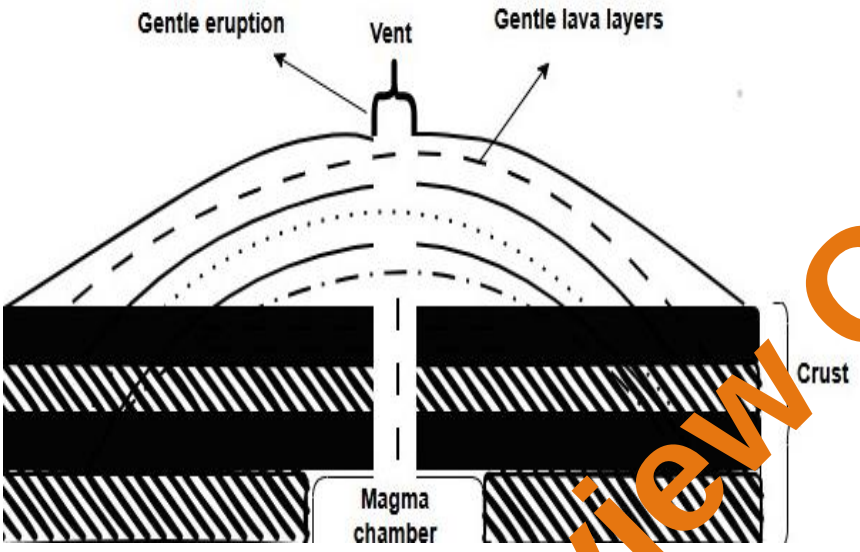
Extinct Volcano: has not erupted for thousands of years and is not expected to erupt again e.g. Mt Elgon in Uganda).

Classification of Volcanoes by Shape and Structure (How the Volcano Was Built)

This classification is about appearance, materials, and eruption style:

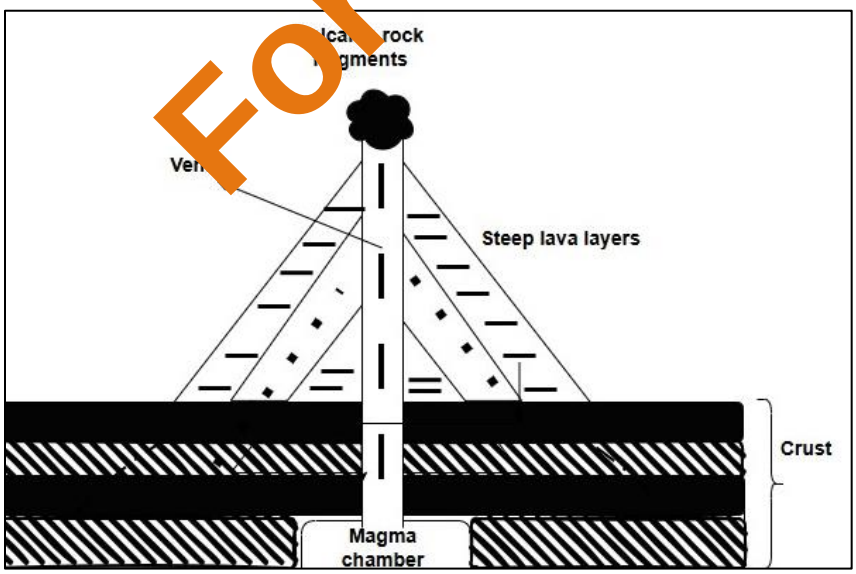
1. Shield Volcano: Is broad with gently sloping sides formed by many layers of fluid/basic lava that flows for long distances before cooling.

Diagram Showing the Formation of a Shield Volcano



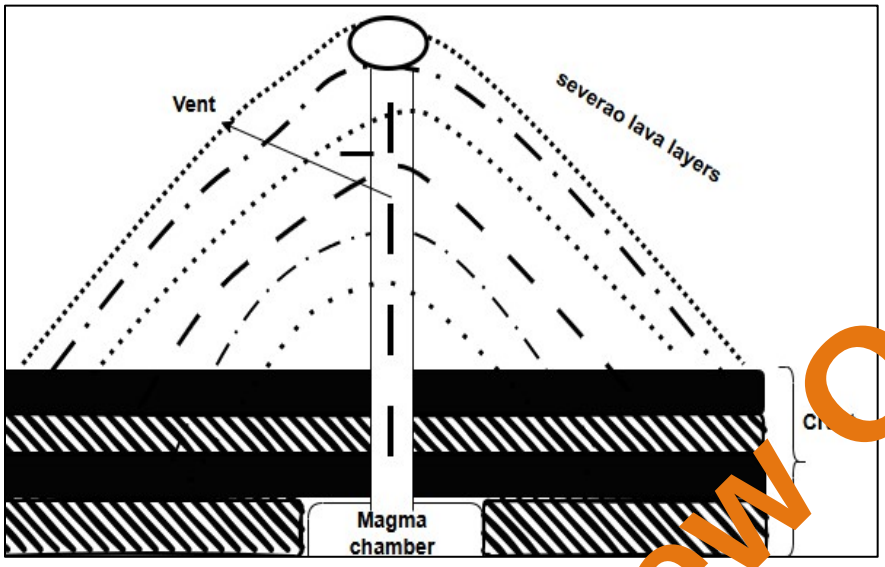
2. Ash and Cinder (Cinder Cone) Volcano: S[illegible], steep-sided; made of ash, cinders (small lava fragments), and volcanic bombs ejec[illegible]d during eruptions e.g. Mt. Napak (in Karamoja, northeastern Uganda).

Diagram Showing the Formatio[illegible]f Ash and Cinder Cone Volcano



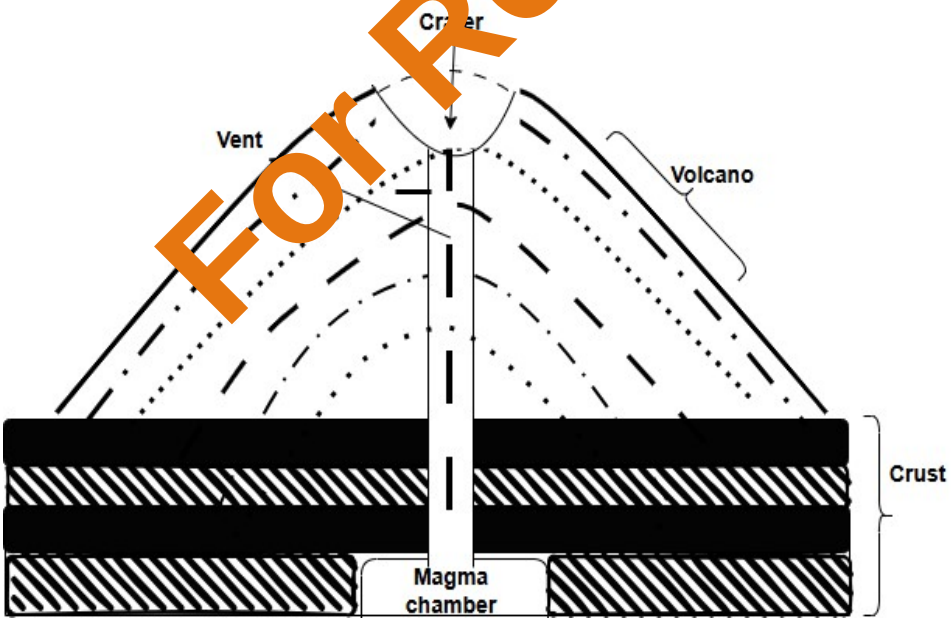
3. Composite (Strato) Volcano: Tall, cone-shaped; built of alternating layers of lava and ash; often very explosive e.g Mt. Elgon (Uganda/Kenya).

Diagram Showing the Formation of a Composite (Strato) Volcano



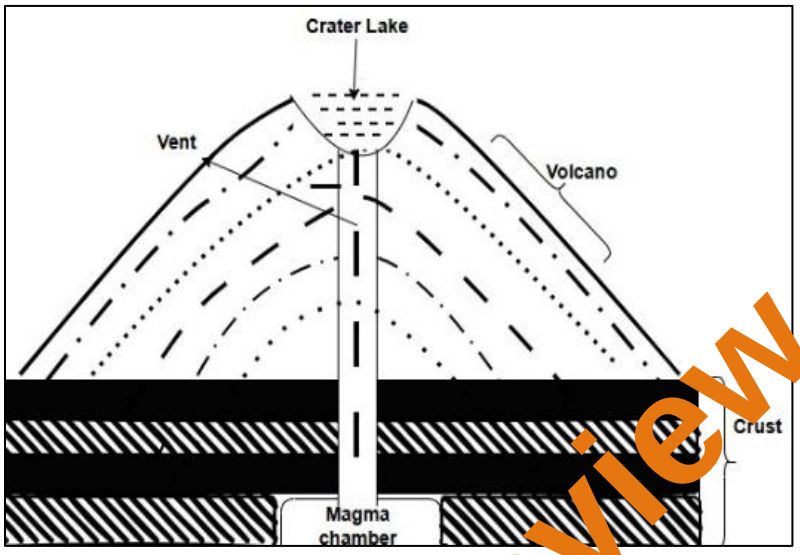
Crater: A crater is a bowl-shaped hollow or depression found at the top of a volcano formed due to volcanic eruption.

Diagram Showing the Formation of a Crater



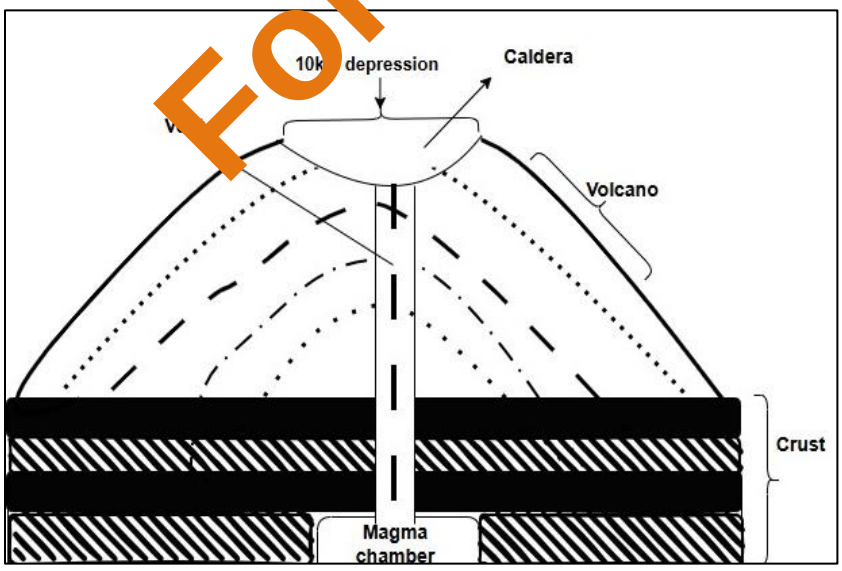
Crater Lake: During an eruption, magma and gases explode out of the vent. The force of the eruption blows away the surrounding rocks. This leaves a circular hollow (crater) at the summit of the volcano. When this depression fills with water it forms a crater lake. Examples of craters in East Africa include**:** Ngorongoro Crater in Tanzania, Bonagura and Katwe Explosion Craters in located in Queen Elizabeth National Park. Examples of Crater Lakes in East Africa include**:** Lake Katwe: The largest of the crater lakes and a significant source of salt. Lake Nkugute in Bunyaruguru and Lake Kyaninga near Fort Portal.

Diagram Showing Formation of a Crater Lake



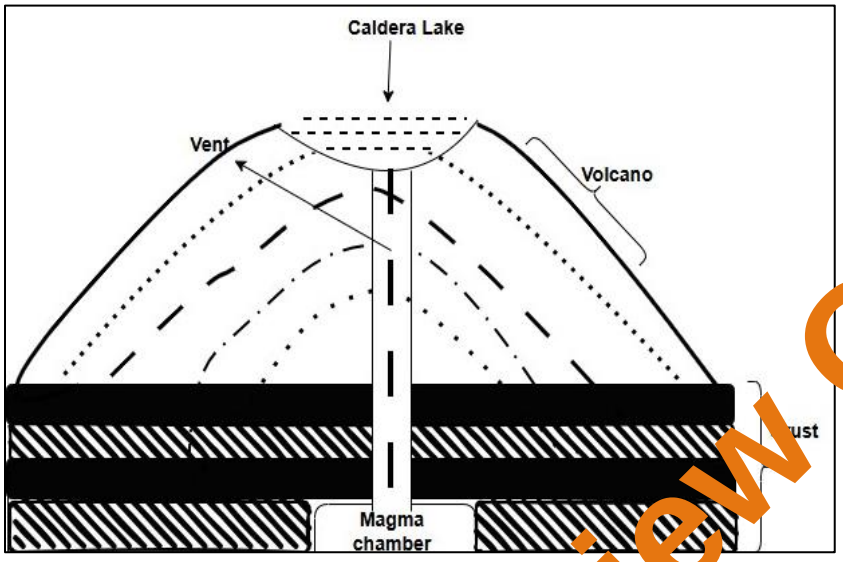
Caldera: A caldera is a very large, wide depression at the top of a volcano, much bigger than a normal crater.

Diagram Showing the Formation of a Caldera



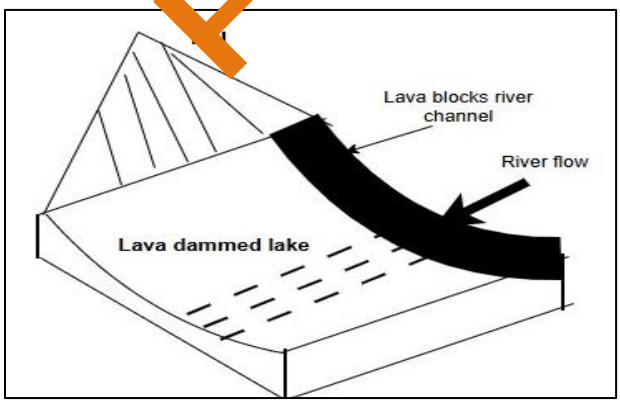
Caldera Lake: When a very violent eruption occurs, huge amounts of magma are emptied. The emptied magma chamber cannot support the weight of the volcano's summit. The top of the volcano collapses inwards, leaving behind a large depression (Caldera). When this depression fills with water it forms a Caldera lake. Examples of Calderas in East Africa include; Ngorongoro in Tanzania, Menengai and Longonot in Kenya.

Diagram Showing the Formation of a Caldera Lake



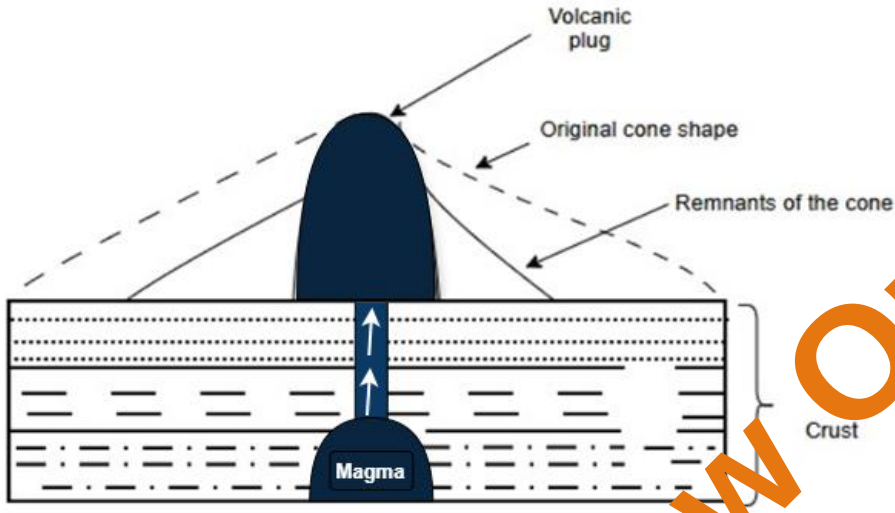
Lava-Dammed Lake: Lava-dammed lakes form when lava from a volcanic eruption flows into and blocks a river valley, creating a natural dam that causes water to accumulate and form a lake upstream. This process involves the solidifying lava impeding the natural flow of the river, leading to back-ponding of water behind the newly formed lava dam. Most lava dammed lakes in East Africa are found in Southwestern Uganda. They include Lake Bunyonyi in Kabale. Lake Mutanda near the border with the Democratic Republic of Congo and Rwanda. Lake Mulehe and Lake Kayumbu in Kisoro.

Diagram Showing Formation of Lava-Dammed Lake



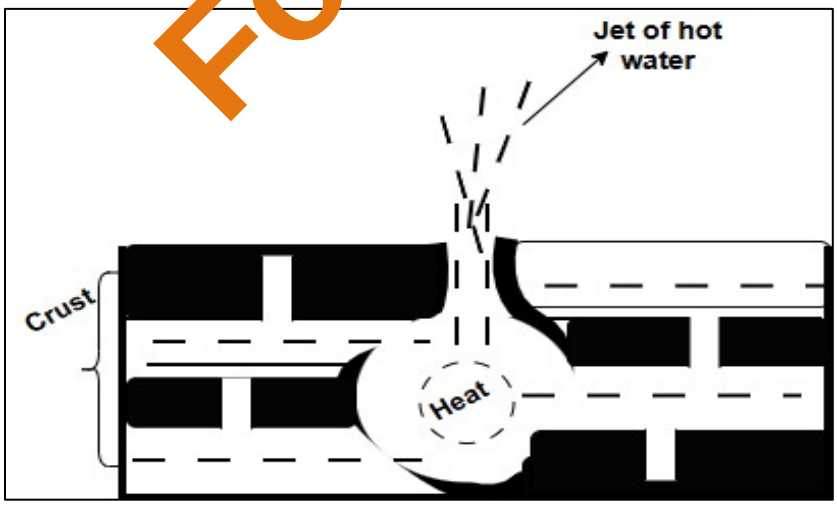
Volcanic Plug: A volcanic plug forms when magma hardens and cools inside a volcano's vent, effectively sealing it. Over time, weathering and erosion wear away the softer surrounding rock of the volcano, leaving the solidified magma plug standing as a distinctive, vertical landform. Examples of volcanic plug include Opiyai Rock in Soroti and Tororo Rock in Tororo.

Diagram Showing the Formation of a Volcanic Plug



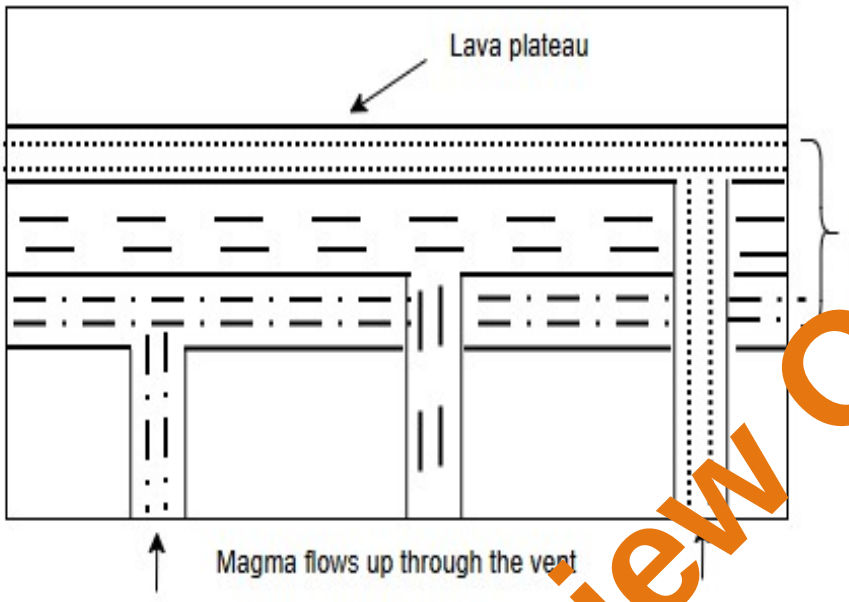
Hot Springs and Geysers: Hot springs and Geysers are jets of hot water formed when underground water heated by hot rocks in the mantle, rises to the surface. The key difference is that a Geyser is a specific type of Hot spring with a unique hot water emission system, causing periodic, explosive eruptions of water and steam into the air. In contrast, Hot springs do not have unique hot water emission system hence water and steam is constantly pushed into the air. Examples of Hot springs include Sempaya Hot Springs in Semuliki National Park Bundibugyo District, Kitagata Hot Springs in Sheema district of Western Uganda.

Diagram Showing the Formation of Hot Spring and Geyser



Lava Plateau: Lava plateaus form from successive flooding of highly fluid lava. During these extensive and long-duration eruptions, basic lava flows from numerous cracks or weak points in the Earth's crust, spreading over vast areas. As the lava cools and solidifies in thick, successive layers, it builds up to create a wide, flat, elevated landform (Lava plateaus)

Diagram Showing the Formation of a Lava Plateau



Advantages of Living in Volcanic Areas

1. Weathered volcanic rocks produce rich, fertile soils e.g along the slopes of Mt. Elgon, Mt. Kilimanjaro that support farming of crops like coffee, bananas, tea, and fruits.

2. Volcanic regions provide minerals such as copper, gold, and building stones e.g pumice, and basalt. These create jobs in mining.

3. Hot rocks beneath volcanoes are tapped for geothermal power e.g., Olkaria power station, Kenya which provides cheap, renewable electricity. For homes and industries.

4. Volcanoes, Crater lakes, Hot springs and Geysers attract tourists e.g Sempaya hot spring in Semuliki National park. Tourism brings foreign exchange and jobs.

5. Mountains and volcanic lakes supply freshwater for drinking, irrigation, and fishing.

6. Some volcanic features are considered sacred or are part of local traditions e.g initiation rituals around Mt. Elgon.

7. Volcanic mountains modify climate by causing relief rainfall on their windward slopes, leading to reliable rainfall for agriculture, e.g. the windward slopes of Mt. Elgon.

Problems Faced by People Living in Volcanic Areas

1. Magma flows, ash, gases, and volcanic bombs can destroy lives, homes, and farmland e.g Mt. Nyiragongo in DRC erupted in 2021 and destroyed parts of Goma.

2. Volcanic areas often experience tremors and landslides e.g Mt. Elgon landslides in Bududa, Eastern Uganda.

3. Volcanoes release gases like sulfur dioxide and carbon dioxide, which are dangerous to people and animals.

4. Fresh lava and volcanic rocks may cover land, making it unusable for farming until weathered.

5. Steep volcanic slopes and rugged terrain make roads, railways, and buildings expensive to construct.

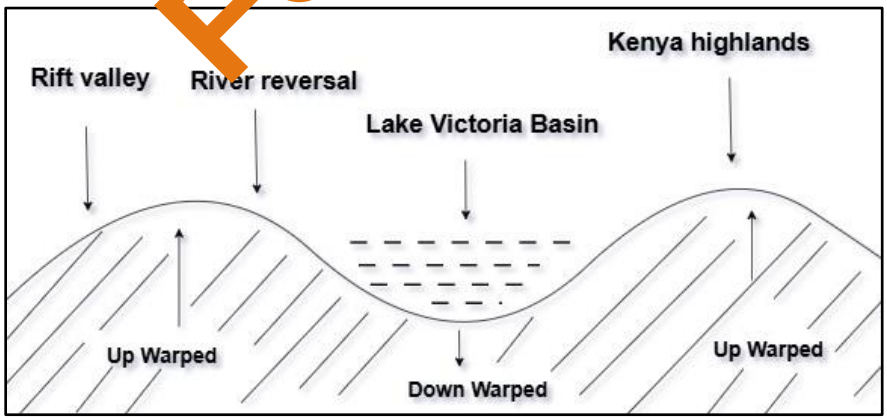
6. Volcanic ash can pollute water sources and damage crops, making water unsafe for drinking and reducing agricultural productivity. For example, ash fall from eruptions around the Virunga Mountains can contaminate rivers, lakes, and rainwater used by nearby communities.

Warping

Warping is the vertical movement upward or downward of large parts of the Earth's crust due to internal forces/endogenic forces. Warping produces gentle, broad uplifts or depressions. In East Africa, Lake Victoria Basin and Lake Kyoga Basin are believed to have formed through crustal warping.

It is believed that due to internal crustal movements, the western and eastern parts of Uganda, as well as central Kenya, experienced upwarping, leading to the development of highlands. In contrast, central Uganda experienced downwarping, forming a depression that resulted in the creation of the Kyoga and Victoria basins.

Diagram Showing the Formation of Lake Victoria



DRAINAGE IN EAST AFRICA

Drainage refers to the collection and discharge of water from a natural water sources like glaciers, rivers and lakes.

Lakes: These are permanent or semi-permanent bodies of water that occupies a depressions or basins on the Earth's surface. Lakes can vary in size from small to very large. Lakes form in diverse environments and originate from various internal geological processes such as Volcanicity, Faulting and Warping. Then external processes such Glaciation,

Process	Type of lake	Example
Faulting	Rift Valley Lake/ Graben	L. Albert, Edward and George
Volcanicity	Crater lake Lava-Dammed lake	L. Katwe (Crater) L. Bunyonyi (Lava-Dammed)
Warping	Basin/ Crustal lake	L. Victoria and Kyoga
Glacial activity	Tan or Corrie lake formed in Cirque	Lake Speke and Lake Catherine on Mt. Ruwenzori

River: A river is a natural, flowing body of water that moves under the force of gravity. Rivers start from a source like a spring or mountain and eventually emptying into a larger body of water such as an ocean, lake, or another river.

Tributary: A small river that feeds or joins the main river.

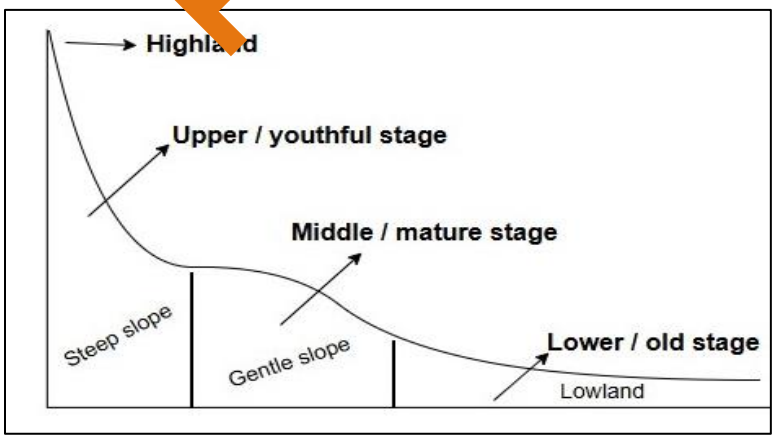
Distributary: A small river that leaves the main river.

Deferred tributary: A tributary that flows parallel to the main river before joining it.

River confluence: A point at which the tributary joins the main river.

River profile: The profile describes the cross-sectional view of the river (shows the river's gradient, which is steep at the source and gentler at the mouth).

Diagram Showing a River Profile



Upper Stage River Characteristics

1. Very steep gradient (the land slopes sharply).
2. The river flows fast and has high energy.
3. Channel is narrow, shallow, and V-shaped.
4. Water volume is small (because tributaries have not yet joined).
5. Vertical erosion dominates (river cuts downward into the bed).
6. Carries mostly large rocks (boulders).
7. Transportation is by traction (rolling) and saltation (bouncing).

Middle Stage River Characteristics

1. The gradient is gentle than in the upper course.
2. The river flows more smoothly, though still fairly fast.
3. The river channel becomes wider and deeper as tributaries add more water.
4. The valley becomes more open and less steep-sided than in the upper course.
5. Lateral erosion (sideways) becomes more dominant than vertical erosion.
6. The load carried is smaller than in the upper course (mostly pebbles, gravel, and sand).

Lower Stage River Characteristics

1. Very gentle gradient (almost flat land).
2. River flows slowly and sluggishly.
3. Channel is widest and deepest here.
4. River carries a large volume of water (collected from tributaries).
5. Deposition dominates over erosion (little energy left for erosion).
6. Load carried is mostly fine material (silt, sand, and clay), transported mainly in suspension (fine material floating in water) and solution.

River Erosion Processes

Hydraulic Action: This is the direct force of the running water against the banks and bed. The water's pressure forces air into cracks in the rock, weakening and breaking it apart.

Abrasion: The water carries sediment, which acts like sandpaper, rubbing against the bed and banks. This constant scraping and grinding wears away the rock and soil.

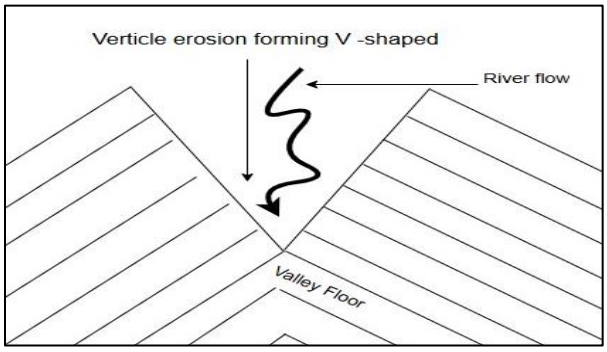
Corrosion (Solution): If the river flows over rocks that are soluble (like limestone), the water can chemically dissolve them. This is a slow but continuous process that breaks down the rock material.

Attrition: The load of rock and sediment that water carries is constantly knocking against itself. This collision causes the particles to break down into smaller, more rounded pieces over time.

River Erosion Landforms

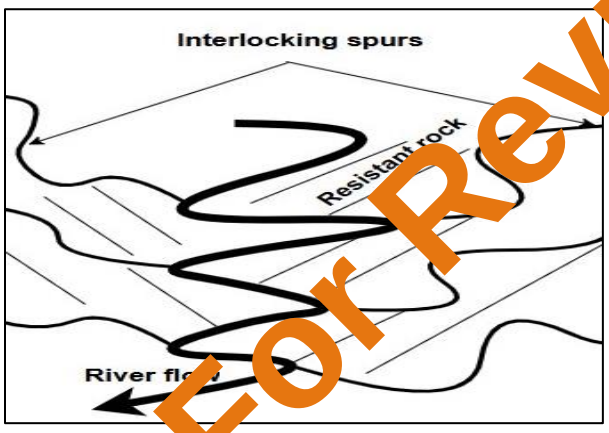
V-Shaped Valleys: These are formed by vertical erosion, which carves the river channel deeper, giving the valley its characteristic V-shape.

Diagram Showing the Formation of a V-shaped Valley



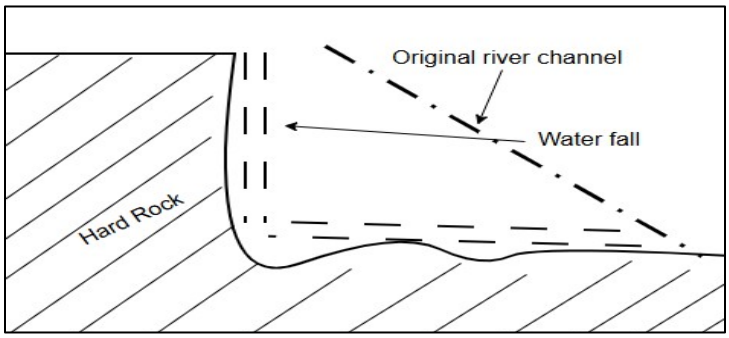
Interlocking Spurs: As the river erodes the valley, it winds around obstacles of hard rock that project from alternate sides of the valley. This process by the river result into a feature called Interlocking Spur.

Diagram Showing the Formation of Interlocking Spurs



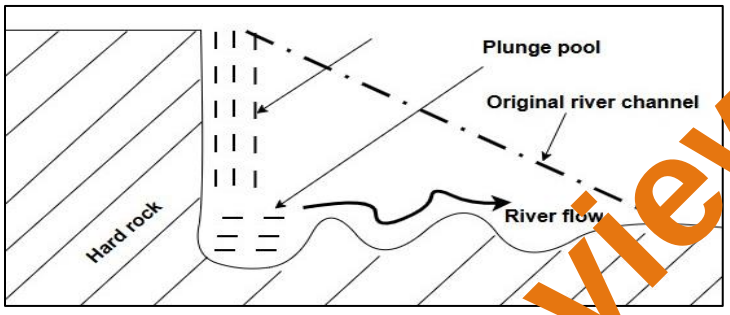
Waterfalls: These occur when the river flows over a band of hard, resistant rock underlined by the softer rock. The softer rock erodes faster, causing the river to steepen and drop over the hard rock.

Diagram Showing the Formation of a Waterfall



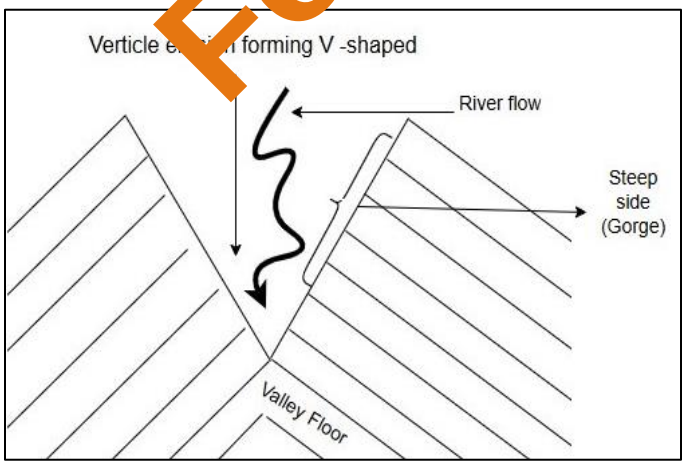
Plunge Pools: The force of the water at the base of a waterfall erodes the rock, creating a deep hollow called a plunge pool.

Diagram Showing the Formation of a Plunge Pool



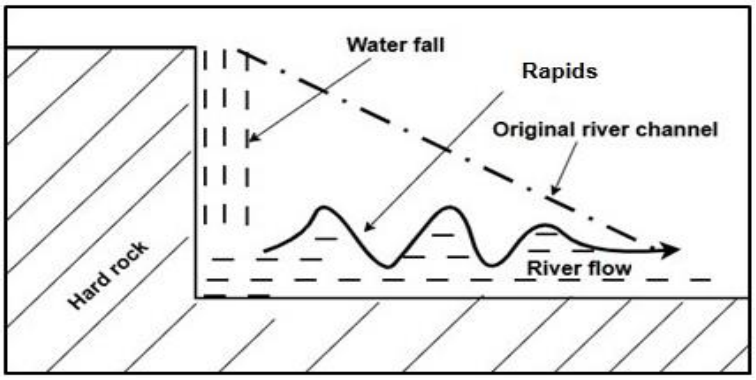
Gorges: These are narrow, steep-sided valleys that can form as a result of vertical erosion, often developing at the site of a waterfall as it retreats. An example of a Gorge is river Biria in south western Uganda. When a gorge is extremely deepened due to prolonged undercut then it forms a Canyon for example river Kalambo Canyon in Tanzania

Diagram Showing the Formation of a Gorge



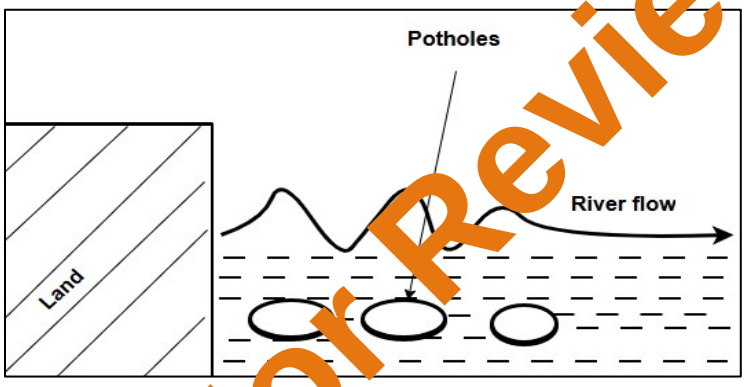
Rapids: These form from fast-flowing water over an uneven riverbed, caused by differential erosion where softer rocks erode faster than harder rocks, creating a staircase-like drop.

Diagram Showing the Formation of Rapids



Potholes: These are round shaped holes on the bedrock created due to saltation and traction movement of large boulder that hit against the river bed. Examples of Potholes are found on River Athi in Kenya.

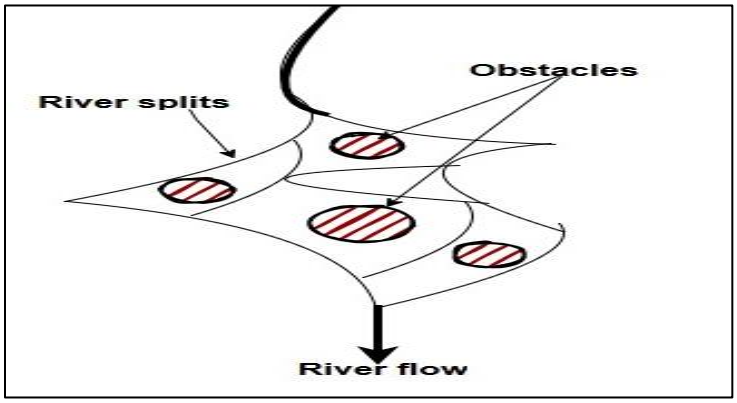
Diagram Showing the Formation of Potholes



River Deposition Landforms

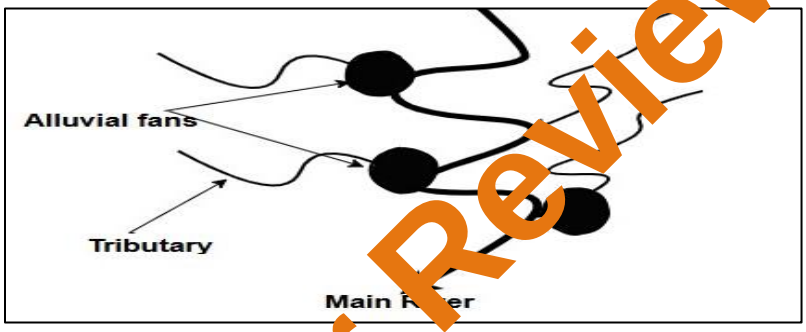
Braided Channels: Braided channels form when a river transports a high volume of sediments causing the main channel to split into multiple, smaller, interconnected channels separated by obstacles. This happens when a river loses energy, often due to a sudden decrease in gradient, leading to the deposition of sediment and the formation of islands, which in turn force the water to flow around them and create new braids.

Diagram Showing the Formation of Braided Channels



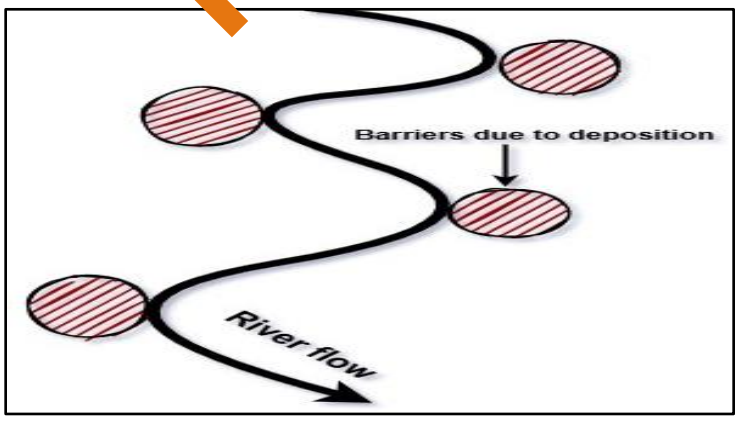
Alluvial fans: Alluvial fans form when a fast-moving, sediment-laden stream flows from a steep slope, like a mountain into a flat, open area, causing the water to slow down and lose its energy. This sudden loss of speed reduces the stream's capacity to carry sediment, leading to the deposition of sand, gravel, silt, and boulders in a fan or cone shape at the foot of the mountain.

Diagram Showing the Formation of Alluvial Fans



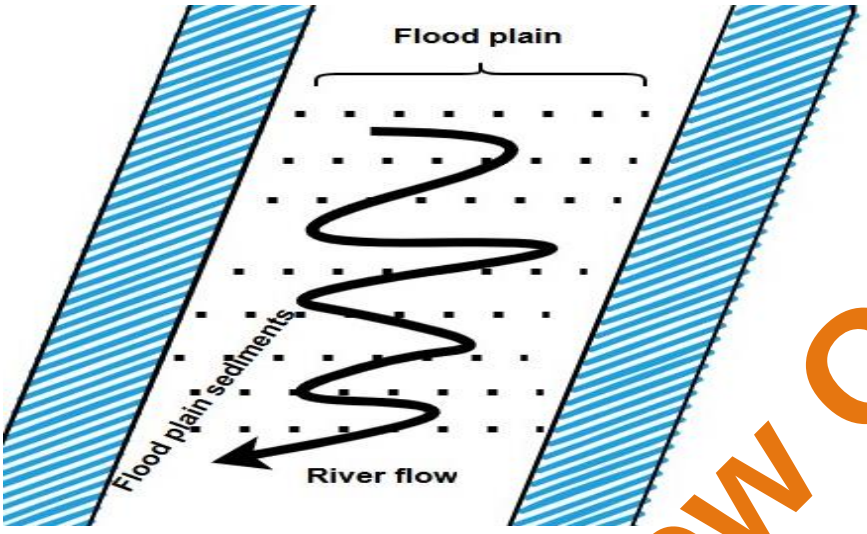
Meanders: These are formed when the river tries to dodge an obstacle in its flow.

Diagram Showing the Formation of a River Meander



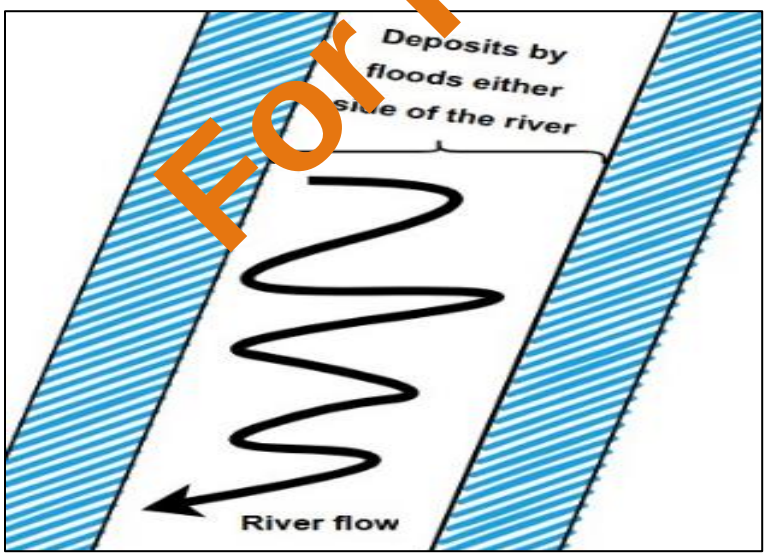
Floodplains: These are relatively flat areas of land adjacent to a river or stream. In the lower course, a river flows over flat land and often floods its banks. During floods, the river water spreads out and deposits fine silt and clay across the valley floor. Over many floods, these layers build up into a wide, flat fertile plain (Floodplain).

Diagram Showing the Formation of a Flood Plain



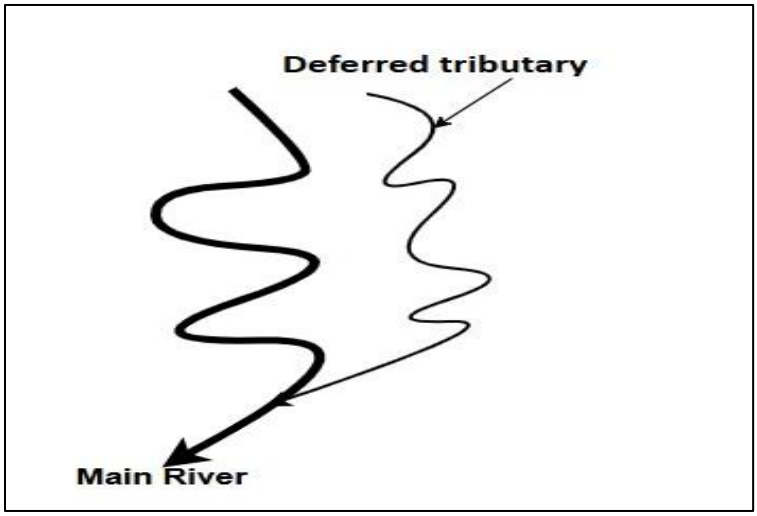
Levees: A levee is an elevated ridge that runs parallel to a river's banks to prevent flooding of the adjacent areas. It is formed when a river floods and overflows with high energy near the channel. Heavier materials (sand, gravel) are deposited right next to the river banks as the water slows. Repeated flooding builds raised ridges (Levees) along the river.

Diagram Showing the Formation of Levees



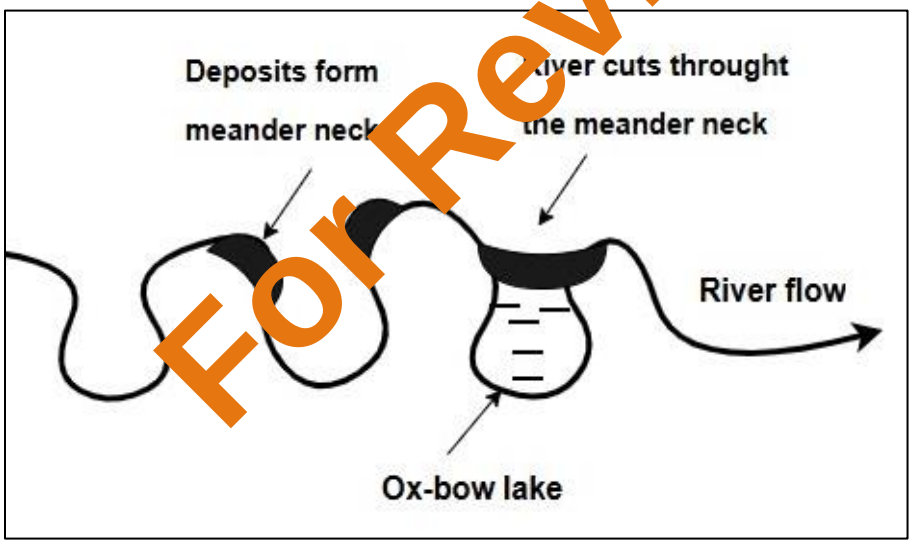
Deferred Tributary: A tributary that flows parallel to the main river before joining it.

Diagram Showing the Formation of a Deferred Tributary



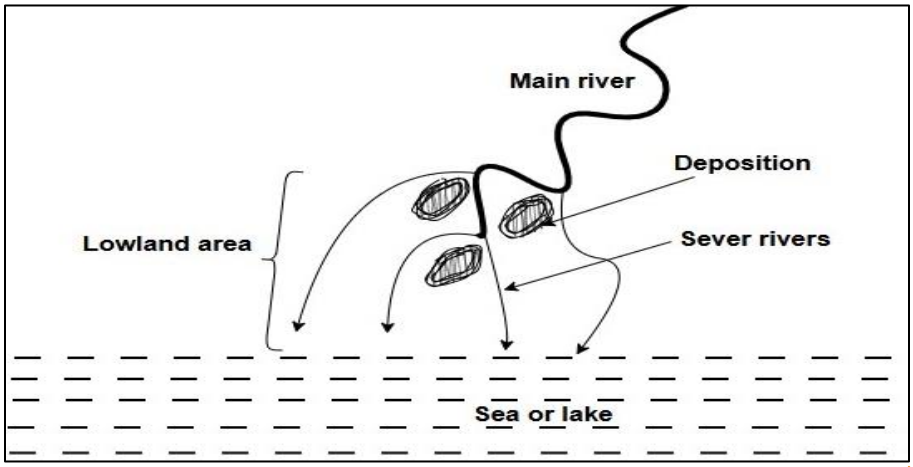
Ox-Bow Lake: Form when a meander in a river is cut off fr m the main river channel. This cut-off loop is eventually sealed off by deposited sediment, ea g it as a separate, free-standing body of water.

Diagram Showing the Formation of an Ox-Bo La



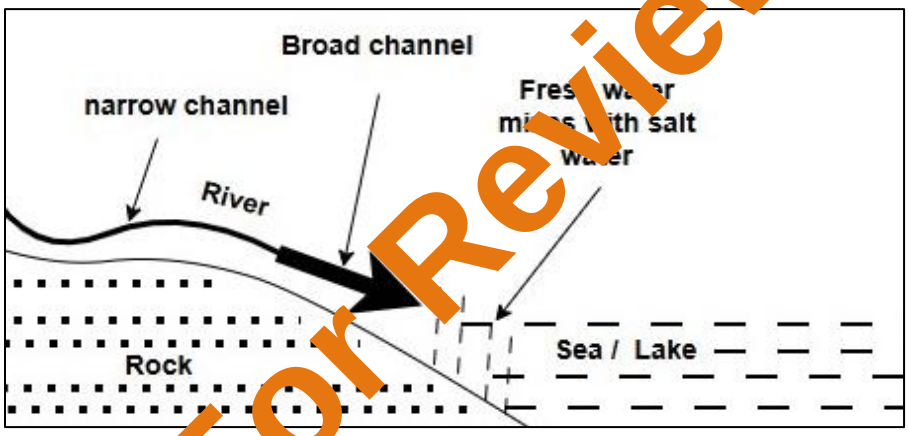
Deltas: When a river enters a lake or sea, its speed drops sharply. It loses energy and deposits silt and alluvium at the mouth. Over time, these deposits build outwards into the water, forming a delta.

Diagram Showing the Formation of a Delta



Estuaries: Instead of a delta, some rivers end in a broad, funnel shaped mouth. Here, the river mixes with tides and sea water (fresh + salt water). Strong tidal currents wash away sediments, so deltas cannot form. Such a mouth is called an Estuary.

Diagram Showing the Formation of an Estuary



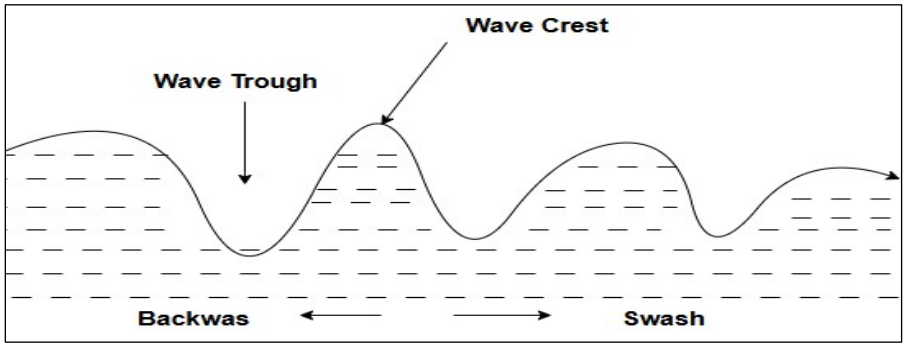
SEA AND LAKE ACTION

Sea and Lake Erosion

Erosion: Is the process by which rocks, soil, and other surface materials are worn away and removed from one place and transported to another by natural agents such as water, wind, ice, or waves**.** Erosion at the sea or lake is mainly by waves.

Waves: These are oscillations of water on the sea or lake surface, mainly caused by the wind blowing across it. When waves reach the shore, they move water and sediments. The forward movement of water up the beach is called **Swash**, while the backward movement returning to the sea due to gravity is called **Backwash**.

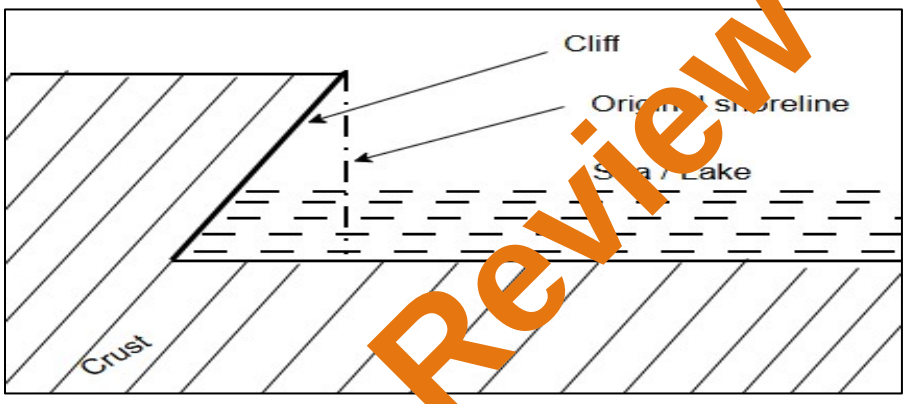
Diagram Showing the Formation of Waves



Features Formed by Lake and Sea Erosion:

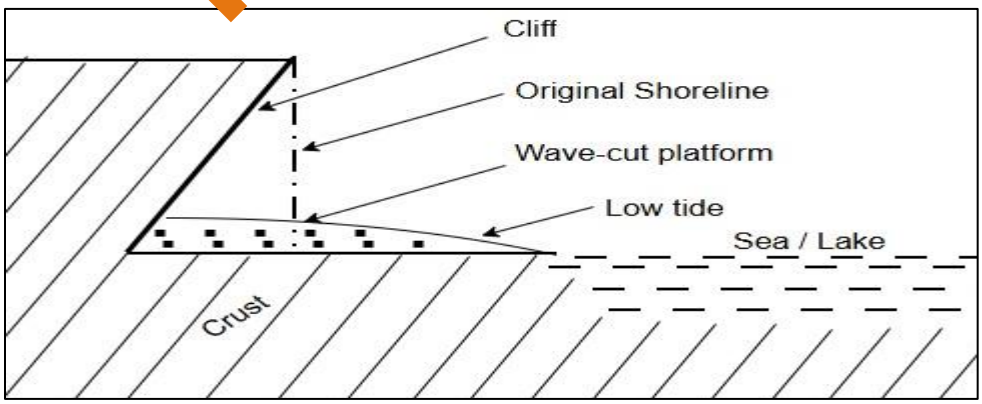
Cliff: Is formed when wave action erodes the base of a coastline, creating a steep, vertical rock face.

Diagram Showing the Formation of a Cliff



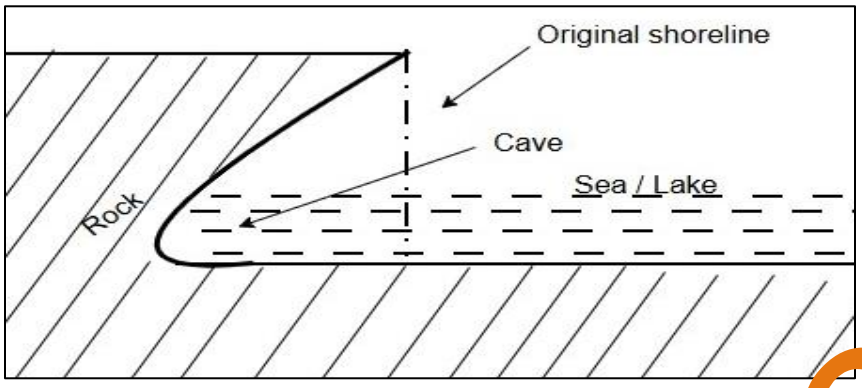
Wave-cut platform: Is a flat, horizontal surface, often at the base of a cliff that is exposed at low tide. It is created as waves wear away the coastline.

Diagram Showing the Formation of a Wave-Cut Platform



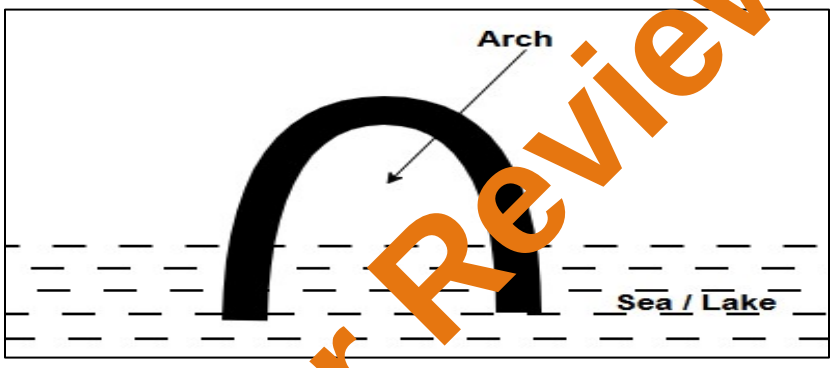
Cave: A cave is a natural hollow formed in the coastal rock, usually at the base of a cliff, mainly by wave erosion. Examples of caves can be seen at Kasenyi landing site on the shoreline of Lake Victoria.

Diagram Showing the Formation of a Cave



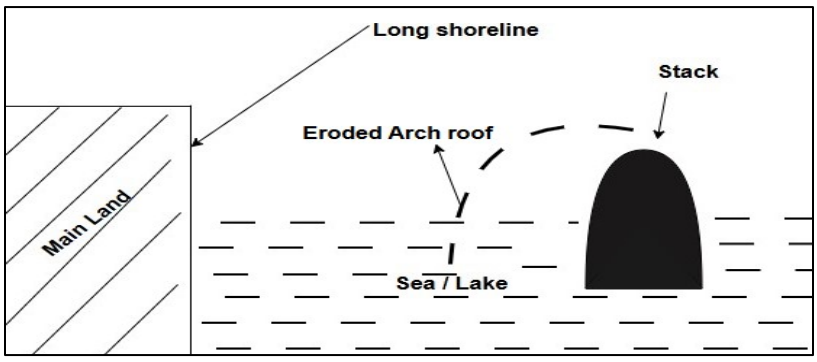
Arch: Is formed when a cave erodes through a headland, creating a tunnel-like structure.

Diagram Showing the Formation of an Arch



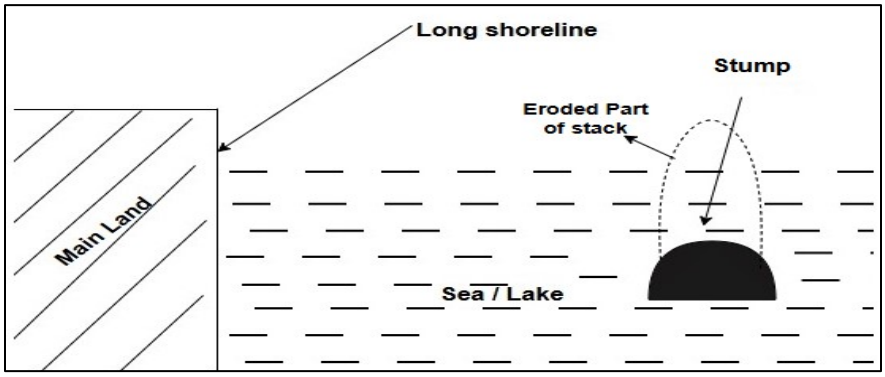
Stacks: Occur when the roof of a sea arch collapses, leaving behind a detached, pillar of rock formation.

Diagram Showing the Formation of a Stack



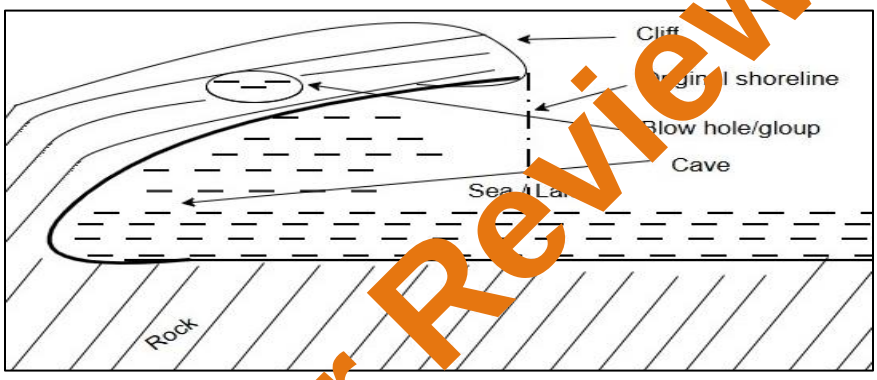
Stumps: A stump is a remain of an eroded stack which is only visible at low tide. At high tide it becomes submerged.

Diagram Showing the Formation of a Stump



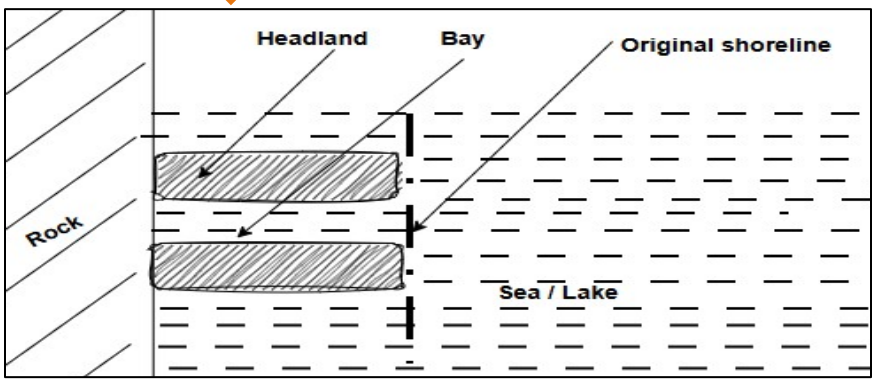
Blowhole/Gloup: Is a cavity or vertical opening in the cave with a cliff on top formed by waves eroding through a weakness in the rock.

Diagram Showing the Formation of a Blowhole



Headlands and Bays: When erosion occurs at the shoreline, softer rock erodes to form bay while resistant rock remain stable to form headlands.

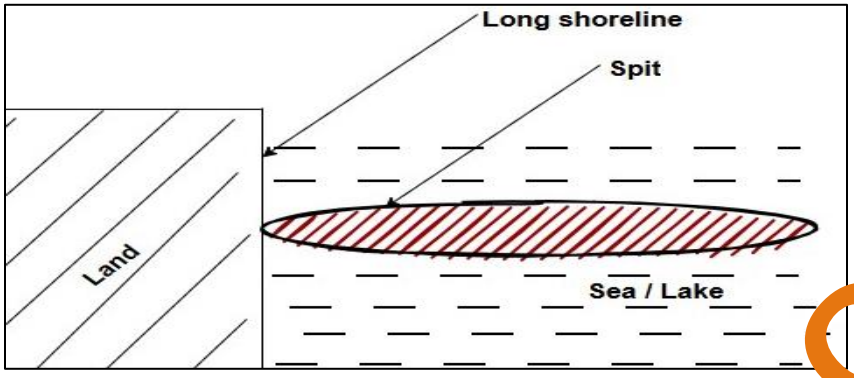
Diagram Showing the Formation of Headland and Bay



Features Formed by Lake and Sea Deposition

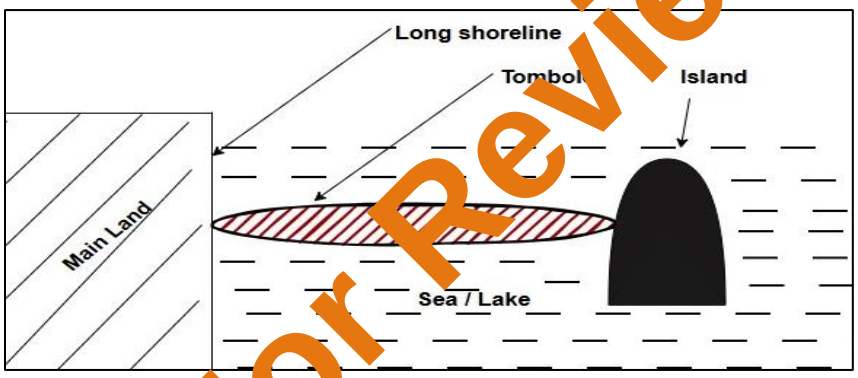
Spit: Is a long, narrow accumulation of sand or shingle (small rounded pebbles) that extend out from the mainland into the sea or lake formed by sediments deposition due to long shore drift. Longshore drift is the name of the process where materials are moved along the coastline.

Diagram Showing the Formation of a Spit



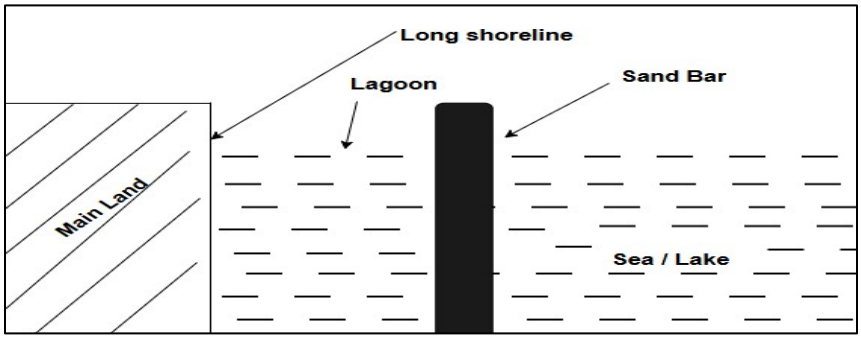
Tombolo: This is a spit that connects an island to the mainland or to another island.

Diagram Showing the Formation of a Tombolo



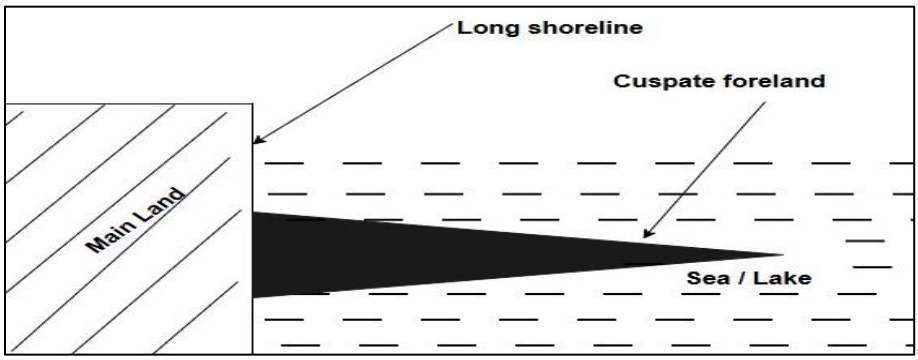
Lagoon: A shallow body of water separated from the sea by sandbar.

Diagram Showing the Formation of a Lagoon



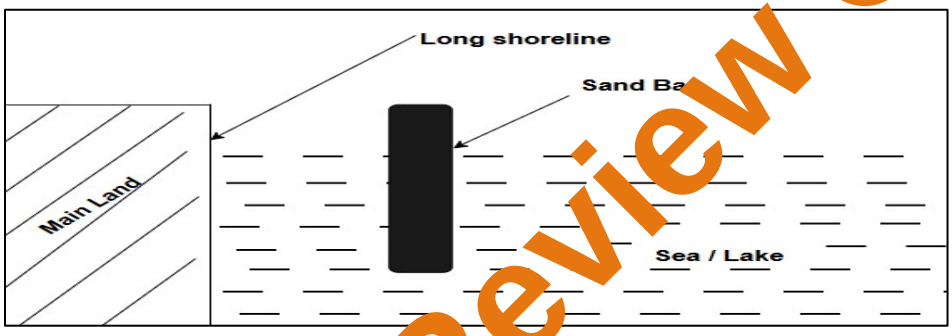
Cuspate Foreland: Is a large triangular deposit of sand and shingles projecting into the sea or lake.

Diagram Showing the Formation of a Cuspate Foreland



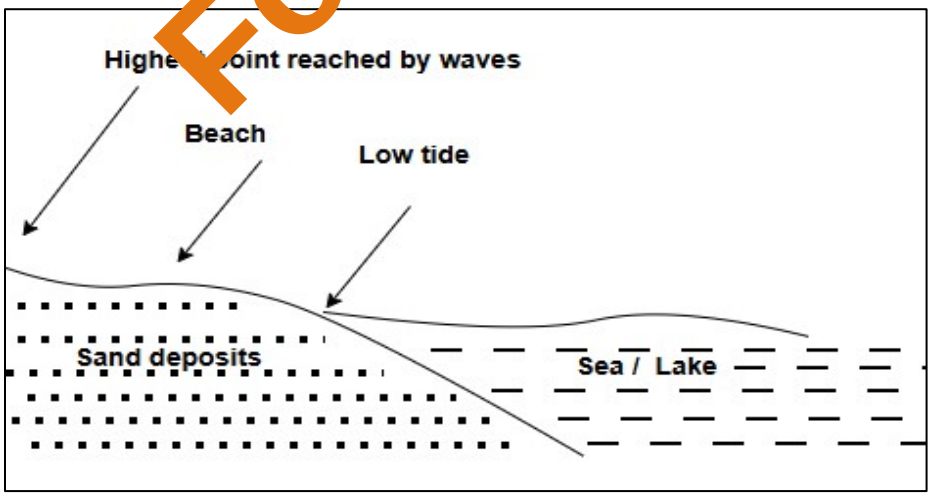
Sand Bar: Is a ridge of sand and shingles deposited parallel to the shoreline.

Diagram Showing the Formation of a Sand Bar



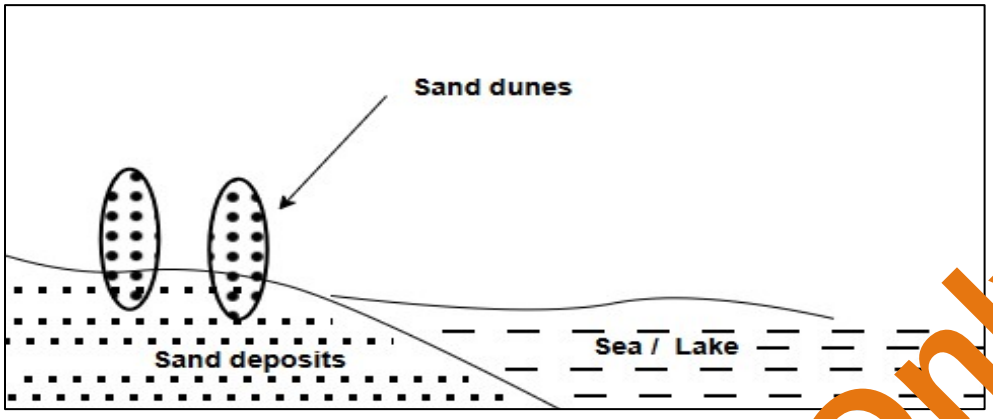
Beach: A gently sloping zone of sand, pebbles, shingle, or mud found along the shore of a sea or lake. It lies between the low tide mark and the highest point reached by storm waves.

Diagram Showing the Formation of a Beach



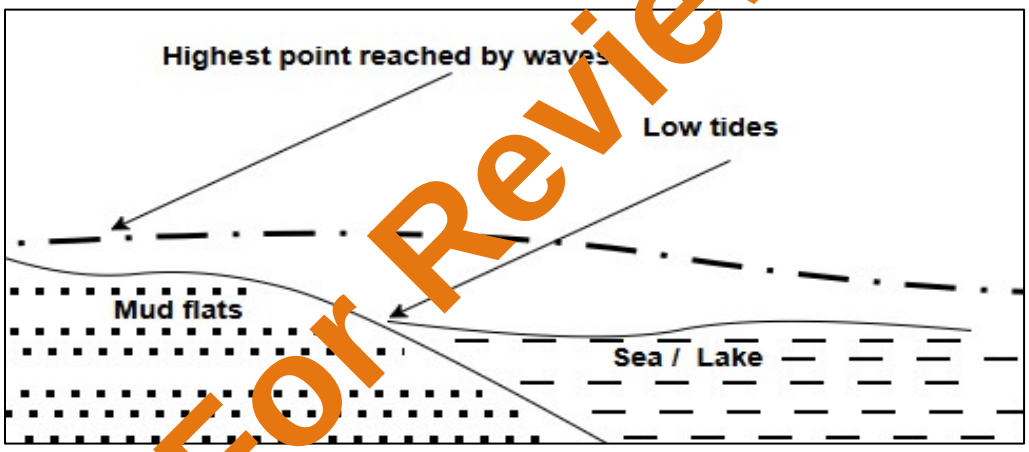
Sand Dunes: Ridges or pillars of sand formed when wind erosion blows loose sand and deposits it after losing energy.

Diagram Showing the Formation of a Sand Dune



Mudflats: Low-lying, flat areas of fine silt, clay, and mud that are left uncovered when the tide goes out and covered again when the tide comes in.

Diagram Showing the Formation of Mudflats



GLACIATION

This is the process by which large masses of ice (glaciers) form, move, and shape the landscape through erosion, transportation, and deposition.

Plucking: Is a glacial erosion process where the glacier freezes on the rocks at the valley floor or sides. As the glacier moves, it pulls pieces of rock away.

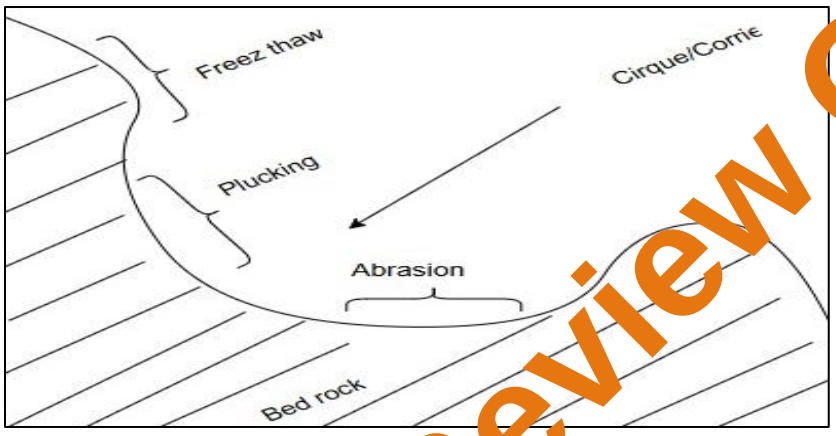
Abrasion: Here glacial erosion occurs when rocks and debris frozen into the glacier act like sandpaper. As the glacier slides over the bedrock it scratches and damages it.

Freeze-thaw/Frost shattering: Water enters cracks in rocks and when temperature drops at night, it freezes, expands and widens the cracks. Repeated freezing and thawing causes rocks to break apart, which are then picked up by the glacier.

Landforms from Glacial Erosion

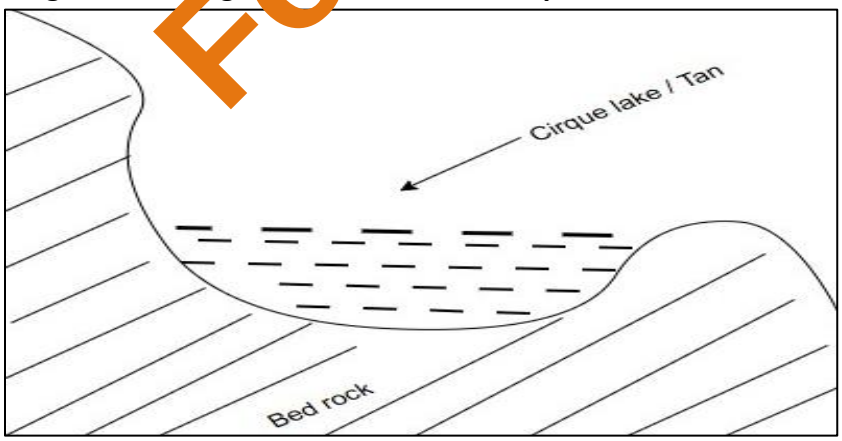
Cirque/Corrie: A cirque is a bowl-shaped, steep-walled hollow found on mountains, formed mainly by glacial erosion processes of Plucking and Abrasion. The glacier ice slowly moves, freezing onto the bedrock and pulling chunks of rock away. This process is called plucking, which steepens the back and sides of the hollow. As the glacier moves, the rocks and debris trapped in the ice grind against the bedrock, smoothing and deepening the hollow. This is abrasion, which creates a polished, bowl-shaped depression.

Diagram Showing the Formation of a a Cirque/Corrie



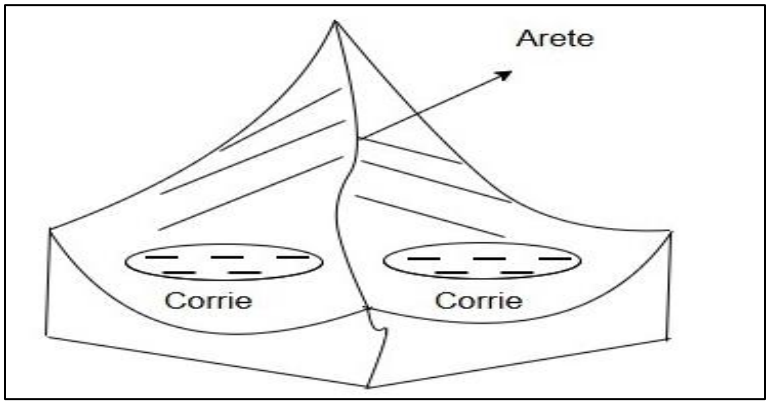
Cirque Lake: Also called a Tan, is a small lake that forms in a Cirque when ii is filled with rainwater, snowmelt, or groundwater.

Diagram Showing the Formation of a Cirque Lake or Tan



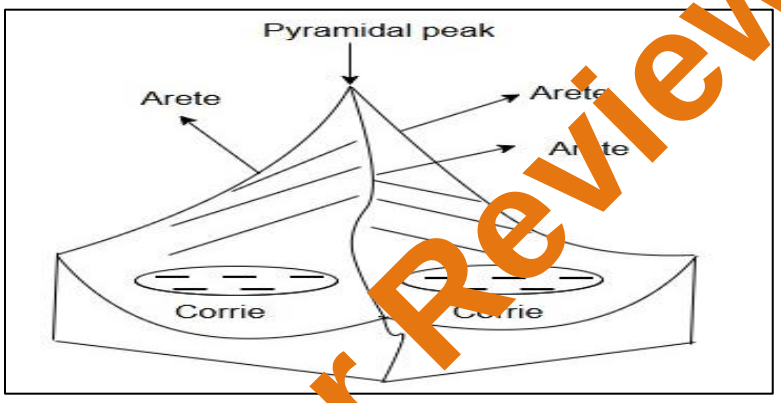
Arete: This is a narrow sharp ridge separating two Corries / Cirques. When two opposite cirques are eroded backward a sharp wall is left standing in the middle (Arete).

Diagram Showing the Formation of an Arete



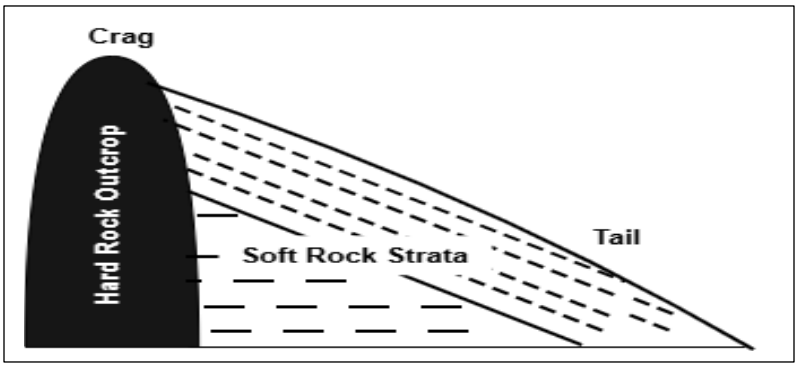
Pyramidal Peak: This is a radial pattern of many Aretes. A good example is Margherita the highest peak on mountain Rwenzori.

Diagram Showing the Formation of a Pyramidal Peak



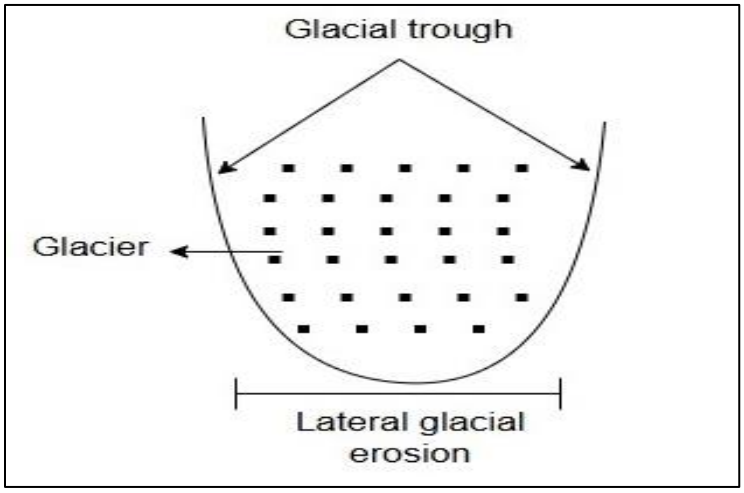
Crag and Tail: Is a feature formed by glacial erosion and deposition, where a resistant rock (crag) protects softer rock behind it, creating a tapering ridge (tail).

Diagram Showing the Formation of a Crag and Tail



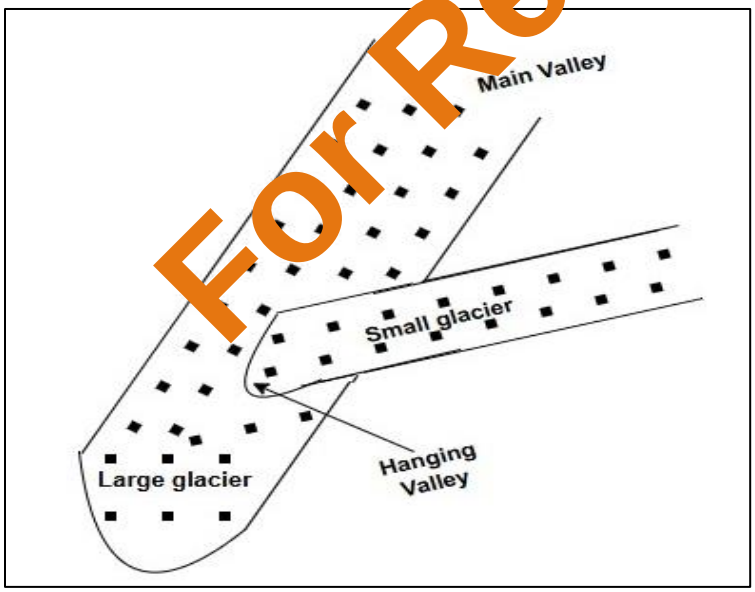
Glacial Trough: Is a U-shaped valley formed by glacial erosion, in a pre-existing V-shaped valley due to lateral or side glacial erosion.

Diagram Showing the Formation of a Glacial Trough



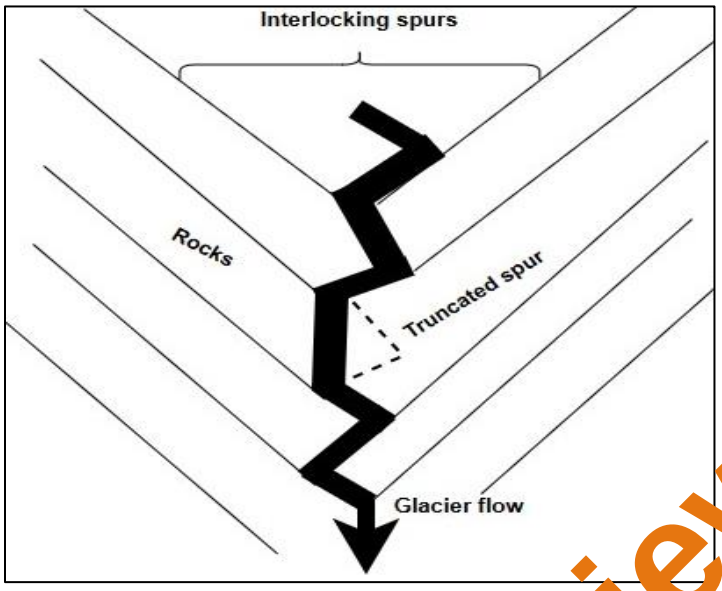
Hanging Valley: This is a smaller valley that enters a main glacial valley from the side but is left hanging above the main valley floor after glacial erosion. A smaller tributary glacier flows into a larger main glacier. The main glacier is thicker and more powerful, so it erodes its valley deeper than the tributary glacier. When the glaciers melt, the tributary valley is left high above the main valley floor.

Diagram Showing the Formation of a Hanging Valley



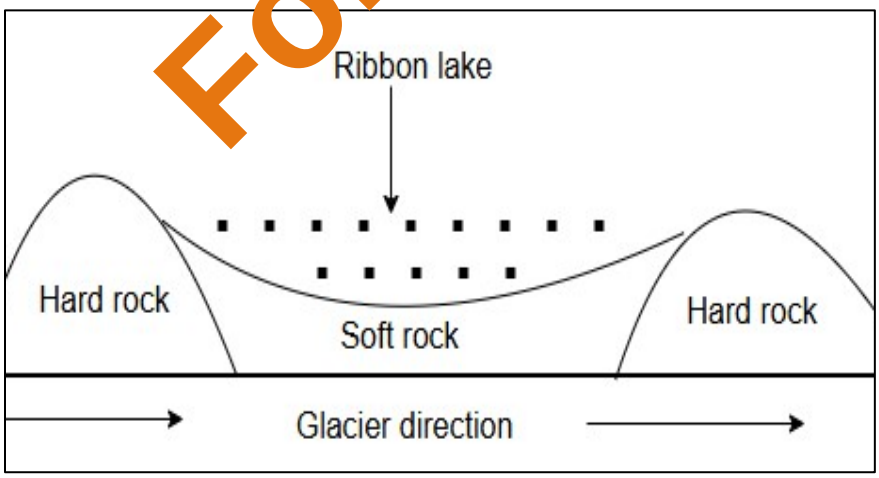
Truncated Spur is a ridge of land that has been cut off sharply from an interlocking spur by glacial erosion. When a glacier moves through the valley, its large, powerful ice mass cannot wind around the spurs like a river. Instead, it plucks and abrades the ends of the spurs, cutting them off sharply.

Diagram Showing the Formation of a Truncated Spur



Ribbon Lake: Is a long, narrow lake that forms in a glacial trough (U-shaped valley) due to glacial erosion. Glaciers erode the valley floor unevenly because some rocks are softer (more easily eroded) and some are harder. The glacier erodes soft sections more deeply, creating depressions in the valley floor. When the glacier melts, water fills these depressions, forming a long, narrow lake.

Diagram Showing the Formation of a Ribbon Lake



Glacial Deposition

Glacial deposition creates large accumulation of rocks, sand, and debris among other materials. The accumulation of unsorted glacial materials named above is called **Moraine**.

Types Moraine:

Lateral Moraine: Deposition of glacial material occurs along the sides of a glacier

Medial Moraine: Deposition of glacial material occurs in the middle of a glacier, where two lateral moraines meet

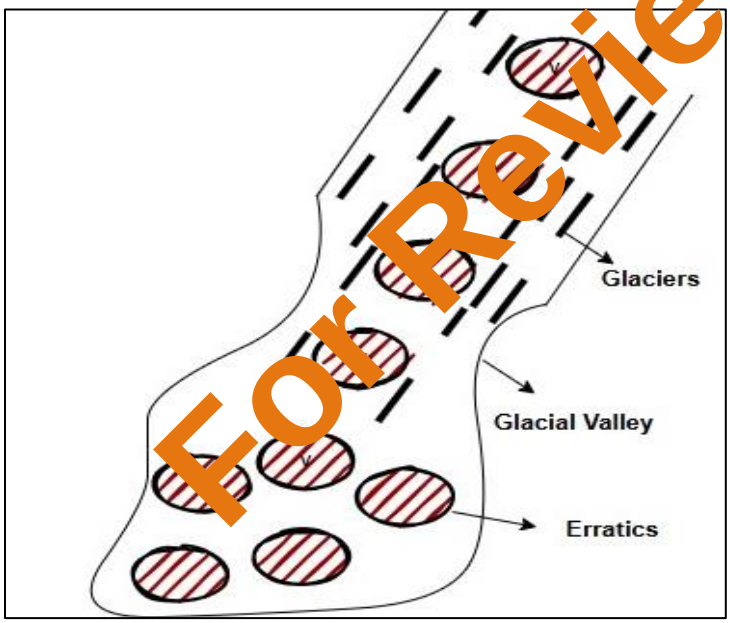
Terminal Moraine: Deposition of glacial material occurs at the end of a glacier, marking its furthest point reached.

Recessional Moraine: Forms during temporary pauses in glacier movement due to loss of ice.

Glacial Deposition Landforms

Erratics: Large boulders transported and deposited by glaciers, often different from local rocks. Examples can be traced around mountain Kilimanjaro in Tanzania.

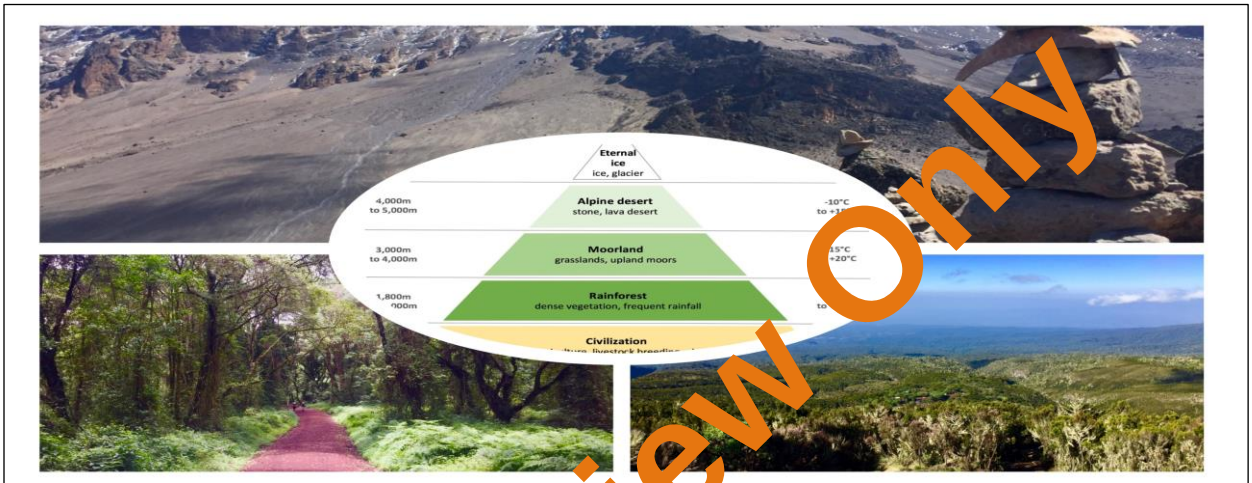
Diagram Showing the Formation of Erratics



THEME 3: Introduction to Geography

Introduction to East Africa

Topic 9: Climate and Natural Vegetation of East Africa



Topic Keywords

1. Climate
2. Vegetation
3. Rainfall
4. Temperature
5. Humidity
6. Evaporation
7. Vegetation Zonation
8. Human Activities
9. Case studies
10. Way of life

Learning Outcomes: By the end of this topic the learner will be able to;

a). Understand the characteristics of the climates of Uganda and the East African and the factors influencing them.

b). Understand through fieldwork the characteristics of vegetation and how vegetation is affected by the climates.

c). Draw graphs to show the different climates.

d). Draw a map showing the climates and vegetation of East Africa (s)

e). Recognise and describe a climate from a graph.

f). Recognise and describe types of vegetation from photographs. (s)

g). Understand through case studies how selected climates and types of vegetation affect the way of life of the people in those areas

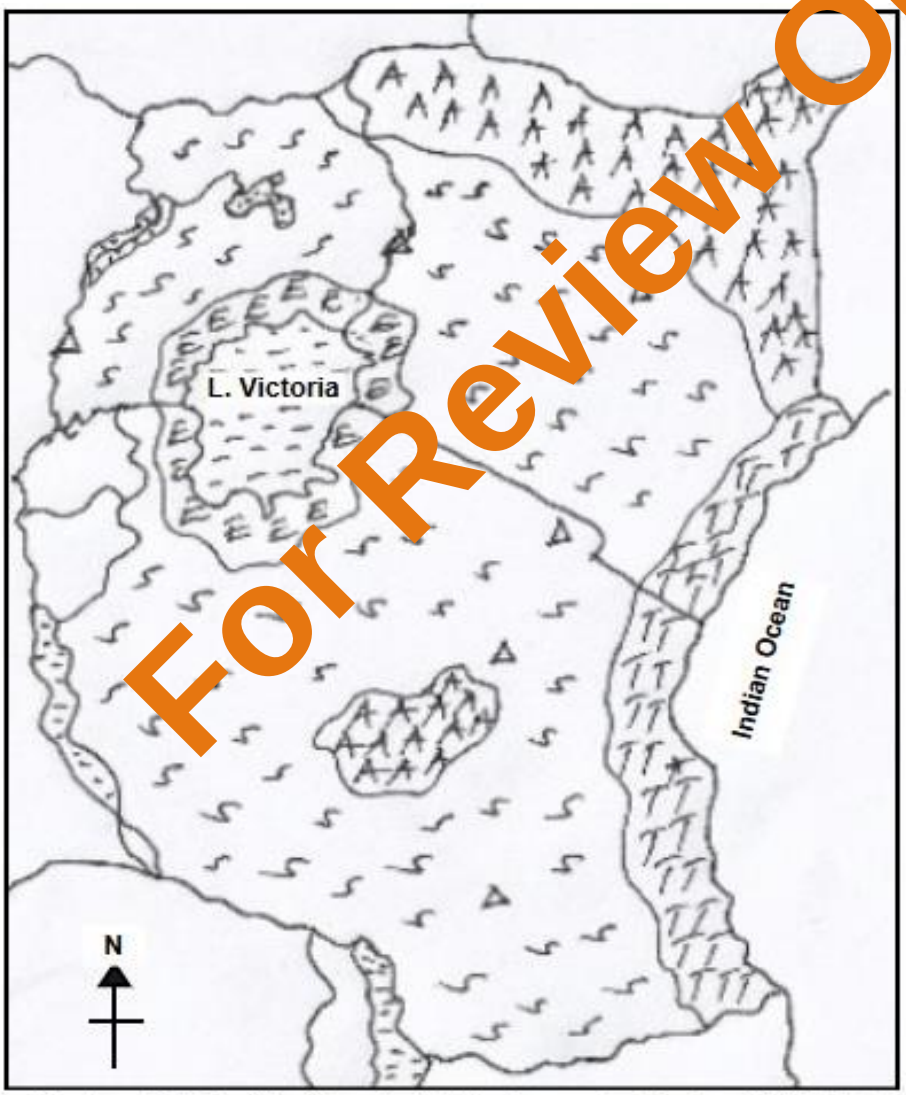
CLIMATE OF EAST AFRICA

Climate is the average weather conditions of a place recorded over a long period of time, usually above 30 years.

Types of Climate in East Africa

- Modified Equatorial Climate found around Lake Victoria basin.
- Tropical / Savannah Climate common in most of Kenya, Tanzania, and Uganda.
- Semi–Desert /Arid found in Northeastern Kenya and Uganda.
- Montane Climate found around mountains such as Mt. Kenya, Kilimanjaro and Rwenzori.
- Tropical Monsoon / Coastal climate found along the coast of East Africa

Sketch Map of East Africa Showing Climate Zones



△: **Montane** **EE:** Modified Equatorial **SS**: Savannah **AA**: Semi-Arid **TT**: Coastal

Factors Influencing the Climate of East Africa

Influence of latitude: East Africa lies near the Equator, so most areas experience high temperatures throughout the year. Areas far North of the Equator e.g. Sudan borderlands and far South of the Equator e.g., Tanzania have slightly cooler temperature.

Altitude: Highlands such as Mount Kenya, Kilimanjaro and Rwenzori are much cooler and wetter than the surrounding lowlands because as you go higher, the air becomes thinner and cannot hold much heat. Lowlands e.g., Coastal Plains, Turkana are hot and dry because the dense air holds more heat, making the areas much hotter.

Distance from the Sea: Coastal areas e.g., Mombasa, Dar es Salaam have high humidity and heavy rainfall influenced by the Indian Ocean. Inland areas e.g., Ankole- Masaka corridor experience more continental conditions (climate influenced by land rather than sea), less humidity which is why rainfall is seasonal.

Prevailing Winds: Monsoon winds from the Indian Ocean bring moisture and rainfall during certain months along the East African coast just like the Westerlies from Congo forest cause heavy rain in Kasese region of South Western Uganda. Dry northeast Trade Winds from Arabia desert cause arid conditions in Northeastern Kenya (Marsabit) and Northeastern Uganda (Karamoja region).

Ocean Currents: The warm Mozambique Current from Indian Ocean increases rainfall in the area they blow towards e.g along the Tanzanian coast. Cold Somali currents which originate from Arabian Sea reduce rainfall in Northern Coastal Kenya and Northeastern Uganda.

Vegetation Cover: Forested areas such as Mabira in Buikwe district of central Uganda create higher convectional rainfall through evapo-transpiration and retain humidity. Semi-Arid regions with little or no vegetation cover such as Karamoja and Northeastern Kenya experience hot, dry conditions.

Relief/Topography/Aspect: Also called the rain shadow effect makes the Windward slopes of mountains receive heavy rainfall. However, Leeward Sides of Mountains e.g. Mount Kenya, Kilimanjaro are dry because of dry air masses that continue their way.

Influence of Inter Tropical Convergence Zone (ITCZ): Is a region in the tropics where winds from North and Southern Hemisphere meet. Because the tropical zone receives more sun light, the temperature in this region is high which makes it low pressure zone.

Wind from the North and Southern Hemisphere (high pressure zones due to limited sun light), periodically move to this region to cool down. Moist winds generate seasonal convectional rainfall.

Human Activities: Deforestation reduces rainfall and increases temperatures because trees absorb excess carbon and reduce heat. Also, evapo-transpiration is disabled which reduces rainfall. Urbanization creates heat waves from industrial gases and burning fuel in cars. However, some human activities influence humidity and generate rainfall e.g. afforestation and irrigation.

Characteristics of Modified Equatorial Climate

1. High temperatures throughout the year (average 21°C–25°C) because the area lies near the equator where the sun's rays strike almost overhead all year.

2. Small annual temperature range since the sun is overhead throughout the year, there's little difference between the hottest and coolest months.

3. High rainfall totals (over 1500 mm annually). Due to the large water body of Lake Victoria which provides continuous evaporation.

4. Rainfall is received almost throughout the year, with double maxima (March–May and September–November) because the Inter-Tropical Convergence Zone (ITCZ) passes overhead twice a year (March–May and September–November).

5. High humidity due to evaporation from Lake Victoria because of high temperatures evaporation increase and makes the air very humid.

6. Supports dense population and intensive crop farming e.g. coffee, tea, sugarcane due to reliable rainfall and fertile soils.

Influence Modified Equatorial Climate on Human Activities

1. Reliable and abundant rainfall and fertile soils support intensive growing of cash crops such as coffee, tea, sugarcane.

2. Lake Victoria provides abundant fish especially Nile Perch and Tilapia. Fishing is a source of food rich in protein.

3. Favourable climate with water availability and fertile land attracts dense population hence development of towns like Kampala, Kisumu, and Mwanza.

4. Lake Victoria provides water transport routes connecting Uganda, Kenya, and Tanzania leading to development of trade between these countries.

5. Natural scenery and wildlife around the basin attract tourists earning East Africa foreign exchange through taxes.

6. Availability of raw materials from crop growing such as sugarcane and tea supports agro-based industries which provide jobs to the high population in the region.

Problems Facing People Living in Modified Equatorial Climate and Solutions

High rainfall leads to floods and waterlogging hence destruction of crops, houses and roads.	Building drainage channels, dams, proper town planning etc.
Outbreak of diseases e.g. malaria, bilharzia, cholera, due to high temperatures and stagnant water.	Using mosquito nets, spraying, clean water supply and good sanitation.
Soil leaching due to continuous heavy rainfall which washes away soil nutrients hence low fertility.	Use of crop rotation, fertilizers and terracing on slopes.
Roads become muddy and impassable during rainy seasons which makes Transport difficulties.	Tarmacking roads, raising road embankments and constructing bridges.
Fertile soils and favorable climate attract many people leading to land fragmentation, deforestation.	Using birth controls e.g. condoms and resettlement schemes to decongest places.
Crop pests and diseases like coffee wilt, banana bacterial wilt, maize streak virus which thrive in warm, humid conditions.	Investing in agricultural research and extension services.
High humidity leads to uncomfortable living conditions and rapid spoilage of stored food.	Use of fans, refrigeration, drying during rainy days.
Landslides in highland areas due to heavy rainfall on steep slopes.	Afforestation, contour farming, banning settlement in landslide-prone areas.

Characteristics of Tropical / Savannah Climate

1. High temperatures but with greater annual range compared to equatorial areas because it is slightly farther from the equator, the angle of the sun changes more during the year.

2. Annual rainfall between 500–1500 mm because savannah is under the influence of **ITCZ** but only for part of the year. Unlike modified equatorial where the effect is twice a year leading to (1000–2000 mm).

3. Distinct wet and dry seasons because when the ITCZ shifts overhead, there is a wet season and when the ITCZ moves away, dry winds such as the trade winds dominate hence dry season.

4. Vegetation mainly savannah grassland with scattered trees because moderate rainfall cannot support dense forests like in modified equatorial areas.

5. High evaporation rates due to high temperatures and prolonged dry seasons, which often lead to water scarcity and seasonal rivers.

6. Clear skies and intense sunshine during the dry season because of the dominance of dry tropical air masses that suppress cloud formation.

Possible Economic Activities in Savannah Climate Region of East Africa

1. The alternating wet and dry seasons support cultivation of crops such as maize, millet, sorghum, groundnuts, cotton, and sunflower. Allowing both growth in wet and harvesting in dry season.

2. Livestock rearing due to presence of grassland vegetation provides grazing for cattle, goats, sheep etc.

3. The savannah supports a rich variety of wildlife animals like lions, elephants, zebras, giraffes, buffaloes ideal for national parks and game reserves such as Serengeti (Tanzania), Maasai Mara (Kenya), and Queen Elizabeth (Uganda).

4. Moderate rainfall and fertile soils in wetter savannah areas attract dens[illegible]ent and farming communities.

5. Collection of wild fruits for food and herbs for medicine from [illegible] and grasslands.

6. Savannah woodland support bee keeping since trees can be [illegible] raise bee hives

Problems Faced by People Living in Savannah and Solutions

Problem	Solution
Unreliable and low rainfall leads to frequent droughts, crop failure, and famine.	Use of irrigation farming to reduce reliance on seasonal.
Prolonged dry seasons cause water scarcity for people, animals, and crops.	Water harvesting by building dams, boreholes, and rainwater tanks for use in dry seasons.
Overgrazing by livestock results in land degradation and desertification.	Controlled or rotational grazing to prevent overgrazing and allow vegetation to regenerate.
Outbreaks of pests and diseases e.g., locusts destroy crops; tsetse flies spread sleeping sickness.	Afforestation and reforestation to improve rainfall reliability and reduce desertification.
Soil infertility in some areas hence poor crop yields.	Use of drought-resistant crops e.g., millet, sorghum, and cassava.
Bushfires in dry season destroy pasture and property.	Pest and disease control e.g spraying against locusts, tsetse flies or vaccinating livestock.
Wildlife and human conflicts where animals raid crops and threaten lives near game reserves.	Wildlife management e.g. fencing farms, creating buffer zones around national parks.

Characteristics of Semi–Desert / Arid Climate

1. Low and unreliable rainfall, often below 500 mm annually because semi–arid areas are usually far from the ITCZ or only briefly influenced by it.

2. Large diurnal temperature range since during the day, intense solar heating makes it very hot but at night, heat escapes quickly into the atmosphere thus becoming very cold.

3. Long dry season, short wet season (if any) because the ITCZ passes for a very short time or misses the area completely following this the rainy season is very short.

4. Vegetation consists of thorn bushes, shrubs, and sparse grasses because limited and unreliable rainfall cannot support dense vegetation.

5. Frequent droughts and unreliable crop growing due to rainfall being scarce and irregular, crop farming often fails.

6. High evaporation rates because of intense heat and low humidity, causing water from soil and open surfaces to evaporate quickly.

7. Dust storms and strong winds are common during the dry season since there is little vegetation to hold the loose, dry soil in place.

8. Poorly developed soils that are often sandy or stony due to limited organic matter and minimal weathering caused by scarce rainfall.

Land Use in Semi–Desert / Arid Climate

1. Nomadic and Semi-nomadic pastoralism since rainfall is too low for crops e.g. in Turkana land.

2. Irrigation farming in some areas is carried out along rivers, oases, and underground water sources e.g. irrigation schemes along River Tana and Turkwel in Kenya.

3. Some Semi–Arid areas are gazetted as game reserves and national parks e.g. Samburu, Kora, Tsavo East in Kenya. These attract tourists, providing income.

4. Some arid regions have deposits of minerals e.g Soda Ash in Lake Magadi and Gemstones in Northern Tanzania.

5. Some Semi=Arid areas support charcoal burning and gum Arabic collection from Arid trees.

6. Settlement cluster around water sources e.g. rivers, boreholes, oases and irrigation schemes.

7. Solar and wind energy generation because the regions receive abundant sunshine and strong winds throughout the year, making them suitable for renewable energy projects.

8. Crafts and trade in animal products such as hides, skins, and wool, which are by-products of pastoralism and provide alternative sources of income.

Problems Facing People Who Live in Semi-Arid Climate and Solutions

Problem	Solution
Water scarcity due to limited water sources like rivers, wells, and rainfall.	Irrigation farming using rivers, wells, or small dams to grow crops despite low rainfall.
Droughts due to unreliable rainfall leading to frequent crop failure and livestock deaths.	Water harvesting and storage e.g building dams, pans, boreholes and rainwater tanks.
Overgrazing leading to land degradation and desertification.	Controlled grazing / rotational grazing to prevent overgrazing and allow pasture recovery.
Soil infertility since dry soils limit crop production.	Planting drought-resistant crops like millet, sorghum, cassava
Bushfires destroy pasture and trees.	Emergency relief programs to reduce losses during droughts.
Deforestation / tree damage and overharvesting of firewood can harm trees.	Afforestation / tree planting to replace lost trees.
Human and wildlife conflict where animals compete with livestock for scarce pastures.	Wildlife management through fencing farms and creating buffer zones around national parks.

Characteristics of Montane Climate

1. Temperature decreases with altitude (about 6.5°C per 1000m) because as altitude increases, the air becomes thinner and holds less heat.

2. Rainfall increases on windward slopes and decreases on leeward slopes because descending air on the leeward side becomes dry and little rain occurs due to rain shadow effect.

3. Cool to cold conditions at higher elevations (can have snow at mountain tops) because of low air pressure and reduced heat retention.

4. Dense forests at mid-altitudes and less vegetation at higher altitudes because mid-altitudes receive heavy rainfall and moderate temperatures.

5. Important catchment areas for rivers since mountains intercept moist winds and generate rain which is the largest source of water for drainage features including rivers.

6. Dryland farming using drought-resistant crops such as millet, sorghum, and cassava, practiced in areas that receive slightly higher rainfall or benefit from water conservation techniques.

7. Wildlife conservation and eco-tourism in semi-desert landscapes that host unique plant and animal species adapted to arid conditions, attracting tourists and researchers.

Land Use in Montane Climate Region of East Africa

1. Fertile volcanic soils and reliable rainfall support both cash crops like coffee, tea, pyrethrum, wheat, and barley and food crops like maize, beans, Irish potatoes, vegetables, bananas etc.

2. Montane areas support dense forests e.g. Mau Forest, Mt. Elgon forests are timber, fuelwood and bamboo sources. Forests also provide water catchment areas.

3. In some highland plateaus, people keep dairy cattle and sheep due to abundant pasture for example large dairy farms on slopes of mountain Kenya.

4. Cool climate and scenic landscapes attract tourists for hiking e.g. Kilimanjaro expeditions and Rwenzori and trekking.

5. National parks and forest reserves promote wildlife conversation thus leading to foreign exchange from taxing the tourism businesses.

6. Favorable climate and fertile soils attract dense population to carry out crop cultivation. Highland regions of Kenya are among the most populated parts of East Africa.

Problems Faced in Montane Climate Regions of East Africa and Solutions

Soil erosion due to steep slopes and heavy rainfall wash away fertile topsoil.	Use soil conservation methods e.g terracing, contour ploughing, planting cover crops
Deforestation due to logging, farming, and settlement pressure.	Afforestation and reforestation to restore forests and protect water catchments.
Montane regions e.g. central Kenya are densely settled, leading to land shortage.	Use of birth controls e.g. condoms to reduce pressure on land.
Over cultivation and continuous farming reduces soil fertility.	Use of crop rotation and organic manure to maintain soil fertility.
Heavy rains trigger landslides on steep slopes causing heavy damages to crops and human life.	Relocation and resettlement schemes to reduce congestion in highland areas.
Wildlife human conflict: people farming near forest reserves face destruction from wild animals.	Zoning land for farming, settlement, forestry, and conservation.
Climate change due to retreat of glaciers e.g. on mountain Kilimanjaro, and Rwenzori reduces water sources.	Protecting water sources, promoting drought-tolerant crops, and conserving glaciers.
Soil leaching due to heavy rainfall, which washes away vital minerals and nutrients, leaving the soils less fertile for agriculture.	Apply soil conservation and fertility management.

Characteristics of Tropical Monsoon / Coastal Climate

1. High temperatures throughout the year because coastal areas lie near the equator hence receiving direct overhead sun most of the year.

2. High rainfall (1000–1500 mm annually) because the coast is influenced by moist monsoon winds from the Indian Ocean.

3. Distinct wet and dry seasons because when the ITCZ shifts overhead, there is a wet season and when the ITCZ moves away, dry winds such as the trade winds dominate hence dry season.

4. High humidity influenced by sea breezes which regulate daytime heat, making the coast less extremely hot than inland. A sea breeze is a local wind that blows from the sea towards the land during the day.

5. Vegetation due to high rainfall which support tropical coastal vegetation. Mangroves grow in tidal swampy areas.

Land Use in Tropical Monsoon / Coastal Climate

1. Agriculture due to fertile soils and high rainfall supporting both subsistence and commercial farming. Crops grown include coconuts, cashew nuts, sisal, rice, and tropical fruits.

2. Fishing due to abundant fish in the Indian Ocean e.g. tuna, prawns, lobsters which provide food and income.

3. Coastal towns e.g. Mombasa, Dar es Salaam and Zanzibar are major ports for international trade.

4. Sandy beaches e.g. Diani, Malindi, Zanzibar attract many tourists bringing to the region lots of foreign exchange.

5. Coral reefs, marine parks, and cultural heritage e.g. Swahili coast, Zanzibar Stone Town also support tourism.

6. The coast has dense population due to fertile soils, water availability, and trade opportunities. Cities like Mombasa and Dar es Salaam developed as major urban and economic centers due coastal location factor.

7. Mangrove forests along the coast provide wood for fuel, building, and export.

8. Salt pans are common in hot coastal areas where seawater is evaporated.

Problems Facing Coastal Climate Regions of East Africa and Solutions.

Problems	Solutions
High humidity and heat make the coast uncomfortable for settlement and can spread diseases like malaria.	Use of mosquito nets, spraying, and drainage to reduce malaria and waterborne diseases.
Flooding due to heavy rainfall and cyclones cause destruction of homes and farms.	Flood control measures e.g. building dykes, drainage channels, and proper urban planning.
Soil salinity when sea water intrudes in land and evaporates making the soils saline and infertile.	Soil management through planting salt-tolerant crops and improving irrigation to reduce salinity.
Pests and diseases attack crops like coconuts and cashew nuts humans also suffer from malaria, bilharzia, etc.	Pest and disease control e.g. spraying, crop rotation, and use of resistant seed varieties.
Overfishing reduces fish stocks in the sea and threatens livelihoods.	Sustainable fishing e.g. enforcing fishing quotas, protecting breeding grounds, and promoting aquaculture.
Deforestation of mangroves for firewood, poles, and building materials leads to coastal erosion.	Mangrove forest conservation through replanting and protecting mangrove forests.
Pollution of water and land from oil spills, urban waste, and port activities.	Pollution control e.g. enforcing laws on waste disposal and controlling oil spills.
Coastal towns like Mombasa and Dar es Salaam are overcrowded, straining social services provision.	Expanding infrastructure and services in rural areas to reduce overcrowding.

VEGETATION IN EAST AFRICA

Vegetation refers to the total plant life or plant cover found in a particular area. It includes all types of plant growth, ranging from grasses and shrubs to trees and forests. Vegetation can be natural, such as tropical rainforests and savannah grasslands that develop without human interference, or man-made, such as plantations of tea, coffee, and eucalyptus established by people. In East Africa, the type and distribution of vegetation are mainly influenced by climate especially rainfall and temperature and soil characteristics such as fertility, drainage, and texture. Other factors like altitude, human activities (deforestation, agriculture, and settlement), and relief also play an important role in determining the nature of vegetation in different areas.

Equatorial/Tropical Rainforest

It found very close to the Equator (0°–5° North and South) e.g around Lake Victoria basin Uganda, western Kenya, northwestern Tanzania.

Characteristics Equatorial/Tropical Rainforest

1. Very tall, evergreen trees due intense competition for sunlight.
2. Dense canopy caused by continuous plant growth and competition for sunlight.
3. High rainfall throughout the year (over 1500 mm) due to abundant warm air frequent rising.
4. High temperatures all year about 25–30 °C due to constant equatorial sunshine.
5. High humidity due to abundant rainfall and evaporation keep the air moist.
6. Broad-leaved trees to capture more sunlight for photosynthesis in shaded conditions.
7. Poor soils due to heavy leaching as constant rain washes away nutrients from the soil.
8. Presence of climbing plants (lianas) growing on taller trees to reach sunlight.
9. Little sunlight reaches the forest floor because canopy blocks most sunlight.
10. Rich biodiversity due to presence of many plant and animal species.

Land Use in Equatorial/Tropical Rainforest

1. Logging (timber and hardwoods)
2. Farming (e.g. cocoa, rubber, oil palm) after clearing
3. Settlement (though limited due to dense forest)
4. Hydroelectric power (HEP) dams built on Rainforest Rivers for energy generation.
5. Establishing national parks and reserves to protect biodiversity.
6. Construction of roads and pipelines to access forest resources.
7. Extracting minerals like gold, bauxite, and iron ore, often leading to deforestation.
8. Shifting cultivation where forest is cleared, farmed for a few years, then left to regenerate.

Problems Faced in Equatorial/Tropical Rainforest and Possible Solutions

Problems	Solutions
- Deforestation and loss of biodiversity - Poor transport due to dense vegetation - Diseases like malaria - Soil infertility after clearing - Flooding and soil erosion - Climate change and reduced rainfall - Conflict over land use - Loss of livelihood for forest-dependent communities	- Enforcing forest conservation laws - Developing transport routes carefully – Sleeping under treated mosquito nets - Practicing fertilizer application - Afforestation and reforestation programs - Promotion of sustainable logging and farming practices - Development of alternative sources of income for forest communities - Environmental education and awareness campaigns

Savannah Vegetation

It is found between 8°–20° North and South of the Equator and covers the most part of East Africa e.g. Central and Northern Tanzania, Southern Uganda, Western and Coastal Kenya. It is divided into two types i.e. Grassland and Woodland.

Savannah Woodland: More of scattered trees e.g. Miombo woodland in Central Tanzania.

Savannah Grassland: Dominated by tall grass and fewer trees, e.g. Serengeti in Tanzania and Maasai Mara in Kenya.

Characteristics of Savannah Vegetation

1. Presence of tall grasses during the wet season when rainfall is available.
2. Scattered trees and shrubs limited rainfall cannot support dense forests.
3. Seasonal rainfall as climate alternates between wet and dry season.
4. Drought-resistant plants adapted to survive long dry periods e.g shedding leaves.
5. Trees have small leaves to reduce water loss and protect from frequent bushfires.
6. Grass dries up during dry season due to lack of rainfall.
7. Mixed woodland and grassland appearance giving a park-like look.
8. Deep-rooted vegetation to reach underground water during dry months.
9. Abundant grasses in wet season provide food for animals like zebras, antelopes, and buffalo.
10. Presence of fire-resistant plants that can survive frequent bushfires.
11. Vegetation shows clear zonation, with different plant types dominating lowlands and uplands.
12. Seasonal flowering and fruiting patterns that coincide with the wet season to take advantage of water availability.

Land Use in the Savannah Vegetation Region

1. Pastoral farming (livestock rearing) e.g keeping cattle, goats etc due to the abundance of grass.

2. Crop cultivation of drought-resistant crops such as millet, sorghum, maize, and groundnuts.

3. Settlements in villages and towns often established near water sources.

4. Wildlife conservation in reserves and national parks e.g Serengeti, Queen Elizabeth.

5. Charcoal burning due to sparse tree cover and reliance on wood fuel.

6. Irrigation farming in drier areas or near rivers to support crops during dry seasons.

7. Road construction and transport routes are easier to build due to open grassland terrain.

8. Seasonal fishing done in rivers and temporary swamps formed during rainy seasons.

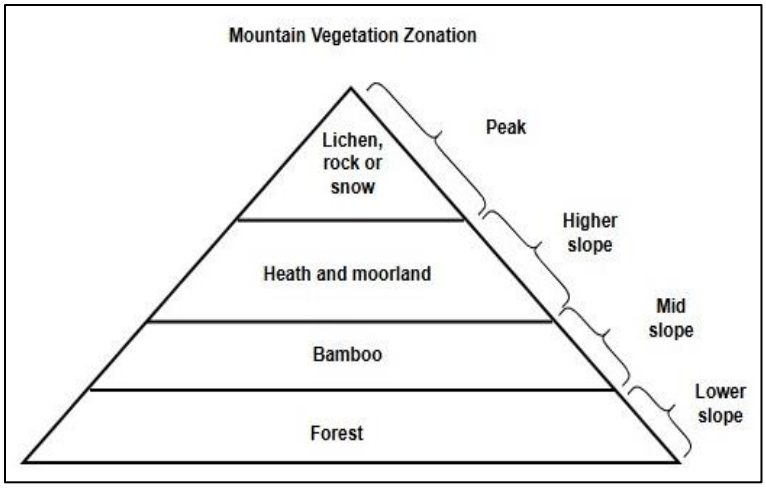
9. Mining activities like extraction of minerals like gold, or limestone where deposits exist.

Problems Faced in Savannah Vegetation and Possible Solutions

Problems	Solutions
- Frequent droughts	- Practicing controlled grazing
- Bush fires	- Tree planting and fire control measures
- Overgrazing leading to soil erosion	- Drilling boreholes and water harvesting
- Human-wildlife conflicts	- Start wildlife management programs
- Loss of biodiversity due to habitat destruction	- Implement rational grazing systems
- Poaching of wild animals for bushmeat	- Controlled burns to prevent bushfires
- Invasive plant species affecting native vegetation	- Anti-poaching law enforcement
- Soil infertility from over-cultivation	- Promote irrigation schemes
- Water scarcity during long dry seasons	- Reforestation and tree planting
- Over-harvesting of firewood and timber	- sustainable land and education program
- Crop destruction by wild animals	- Harvesting water like in dams and pans
- Climate change causing unpredictable rainfall	- Enforce laws against illegal logging

Montane Vegetation

Found in high mountains like Mt. Kilimanjaro, Mt. Kenya, Rwenzori, Mt. Elgon. The characteristics of montane vegetation changes with altitude.



Characteristics of Montane Vegetation:

1. Found on high mountains and highlands.
2. Vegetation changes with altitude different plants adapt to varying temperatures.
3. Presence of evergreen forests since steady rainfall allows trees to retain leaves year-round.
4. Cool temperatures throughout the year due to less heat from the sun.
5. High rainfall and humidity due to heavy orographic rainfall hence high moisture levels.
6. Trees with thick leaves to reduce water loss in cool, humid conditions.
7. Presence of ferns, lichens which flourish in the humid conditions common in montane forests.
8. Stunted trees at higher altitudes low temperatures, and shallow soils restrict tree growth
9. Dense undergrowth in lower zones due to warmth and abundant moisture in lower zones.
10. Supports both temperate and tropical plant species due to variable conditions with height.

Land Use in Montane (Highland) Vegetation Regions

1. Terrace farming practiced on the slopes to prevent soil erosion and grow crops e.g coffee.
2. Dairy farming common in cooler highlands where pasture and climate favor livestock.
3. Forestry e.g harvesting of softwood trees like pine, eucalyptus for timber and paper industries.
4. Settlement in towns and villages located on gentler slopes with favorable climate.
5. Tourism due to mountain scenery, waterfalls, and cool climate attract tourists for hiking.
6. Hydroelectric power (HEP) generation on rivers from highlands used for energy production.
7. Research centers established in highland zones due to the rich biodiversity.

Problems Faced in Montane Vegetation and Possible Solutions

Problems	Solutions
- Soil erosion on steep slopes	- Terracing and contour farming
- Landslides	- Reforestation and afforestation
- Deforestation	- Controlled settlement and land use plans
- Limited land for farming and settlement	- Promoting eco-tourism
- Loss of biodiversity due to habitat destruction	- Enforce forest conservation laws
- Human-wildlife conflicts with animals	- Establish wildlife corridors
- Soil infertility from over-cultivation	- Practice terrace farming

Semi-Desert / Arid Vegetation

It is found between 10°–35° North and South of the Equator. In East Africa, it is found in Northeastern Kenya, parts of Northeastern Uganda (Karamoja), Eastern and Northern Tanzania.

Characteristics of Semi-Arid Vegetation:

1. Sparse or scattered vegetation due to low and unreliable rainfall.
2. Dominated by thorny bushes and short grasses plants adapt to conserve water.
3. Plants with small or needle-like leaves to reduces water loss through transpiration.
4. Presence of drought-resistant species (xerophytes) to survive long periods without rainfall.
5. Many plants have deep roots to reach water stored deep in the soil during dry periods.
6. Vegetation adapted to conserve water (e.g waxy leaves).
7. Few trees, mostly acacias and shrubs.
9. Seasonal growth since plants grow when water is available and stay dormant in dry seasons.
10. Bare ground is common limited rainfall and sparse vegetation leave soil exposed.
11. Grass dries up quickly during dry season little rainfall cause rapid drying of grass.

Land Use in Semi-Desert Vegetation Regions

1. Pastoral nomadism, keeping hardy animals such as camels, goats, and sheep that can survive on sparse vegetation.

2. Irrigation farming in oases or along rivers to grow crops like dates, vegetables, and millet.

3. Mining of minerals such as copper, salt, and uranium where deposits exist.

4. Trade and transport routes (caravan routes) connecting desert towns and border markets.

5. Tourism e.g desert safaris, cultural tourism, and sightseeing of dunes and unique landscapes.

6. Settlement often concentrated near water sources like wells or oases.

7. Wind and solar energy production due to abundant sunshine and wind for renewable power.

8. Military training and testing grounds due to open and sparsely populated terrain.

Problems Faced in Semi-Arid Vegetation and Possible Solutions

Problems	Solutions
- Acute water shortage - Poor soils and low crop yields - Desertification - Food insecurity	- Promoting irrigation and water harvesting - Planting drought-resistant crops - Afforestation and soil conservation - Food aid and agriculture extension services

Coastal Vegetation

Found along the Indian Ocean Coast (Kenya and Tanzania).

Characteristics of coastal vegetation:

1. Found along sea and ocean shores.
2. Includes mangroves, coconut palms, and salt-tolerant plants.
3. Plants adapted to salty and sandy soils.
4. Flexible stem vegetation to withstand strong winds and tides.
5. Presence of creepers and grasses on sand dunes.
6. High humidity and moderate temperatures due to moisture air and stable temperatures.
7. Dense growth in sheltered areas.
8. Roots of mangroves often grow above ground (prop roots) provide support in soft soils.
9. Evergreen appearance throughout the year due to warm temperatures and high moisture.
10. Supports water and land wildlife with its habitat and food for fish, birds, and land animals.

Land Use in Coastal Vegetation Regions

1. Fishing is a major livelihood due to rich marine and estuarine fish resources.
2. Tourism since beaches, coral reefs, and mangrove forests attract many visitors.
3. Port development and trade e.g harbors building for international trade and transport.
4. Salt extraction through evaporation of seawater.
5. Cultivation of crops such as coconuts, rice, sugarcane, and cashew nuts in fertile coastal soils.
6. Mangrove harvesting for poles and fuelwood, and protected to prevent coastal erosion.
7. Settlement and urban development in towns and cities along the coast e.g Mombasa.
8. Oil and gas exploration e.g drilling of offshore petroleum and natural gas deposits.
9. Small-scale making of fishing boats and processing fish and salt.
10. Construction of coastal roads, railways, and airports to support trade and tourism.

Problems Faced in Coastal Vegetation and Possible Solutions

Problems	Solutions
- Coastal erosion and flooding - Saltwater intrusion in farms - Destruction of mangroves - Pollution from industries and tourism	- Protecting and replanting mangroves - Building seawalls and dykes - Regulating coastal development - Promoting sustainable fishing and tourism

Swamp and Wetland Vegetation

Found along shores of Lake Victoria, Lake Kyoga, Lake Tanganyika, Lake Albert, and in river valleys such as Nile and Rufiji. Papyrus, reeds, water lilies are some of the common tree species.

Characteristics of Swamp and Wetland Vegetation

1. Found in low-lying, waterlogged areas.
2. Soils are covered with water most of the year waterlogging prevents air from entering the soils.
3. Presence of water-loving (hydrophytic) plants since they can survive in such wet environments.
4. Dominated by reeds, papyrus, and grasses since these plants thrive in shallow, stagnant water
5. Trees such as palms and mangroves in some areas because are adapted to salty or waterlogged soils.
6. Vegetation has shallow roots or floating roots for gas exchange, waterlogged soil has less oxygen.
7. Plants adapted to low oxygen in the soil they wear air channels in roots or stems to take in oxygen.
8. High humidity and moisture levels since continuous presence of water keeps the air damp
9. Supports a wide variety of aquatic animals and birds e.g fish, amphibians, insects, and birds.
10. Vegetation growth varies with water depth as different crops grow at different water levels.

Land Use in Swamp and Wetland Vegetation

1. Crop farming (e.g. rice, yam, sugarcane)
2. Fishing and fish farming
3. Papyrus harvesting for mats and crafts
4. Grazing during dry seasons
5. Water supply and tourism (bird watching)

Problems Faced in Swamp and Wetland Vegetation and Possible Solutions

Problems	Solutions
- Waterborne diseases (e.g. malaria, bilharzia) - Flooding during rainy seasons - Drainage for farming destroys wetlands - Pollution from human waste and factories - Overfishing and destruction of habitats	- Promote proper waste disposal - Drainage channels only in selected areas - Control flooding through dykes - Educate public on wetland conservation - Fish farming and eco-tourism

Sketch Map of East Africa Showing Vegetation Distribution

●: Swamp △: Montane MM: Equatorial Rainforest CC: Coastal DD: Semi-Arid TT: Savannah

Glossary

Altitude: The height of a place above sea level.

Axis: An imaginary line through the Earth from the North to the South Pole.

Climate: The average weather conditions of a place over a long period.

Desert: A dry region with very little rainfall and sparse vegetation.

Drainage: The system by which water flows across or under the land, including rivers and lakes.

Environment: The surroundings in which people, animals, and plants live.

Equator: The line dividing the Earth into the Northern and Southern Hemispheres (0° latitude).

Fieldwork: The practical study of geography outside the classroom.

Forest: A large area covered mainly by trees and other plants.

Grid Reference: A method of locating places on a map using numbers or letters.

Key: A list of symbols used on a map and what they represent.

Latitude: Imaginary horizontal lines measuring distance North or South the Equator.

Longitude: Imaginary vertical lines measuring distance East or West of the Prime Meridian.

Map: A drawing of the Earth or part of it on a flat surface.

Plateau: A raised flat-topped area of land.

Rainfall: The amount of rain that falls in a place over a given time.

Relief: The shape and height of the land's surface (mountains, valleys, plains).

Rift Valley: A long, narrow depression formed by the sinking of the Earth's crust.

Savannah: A grassland region with scattered trees, found in tropical areas.

Scale: The ratio showing the relationship between distance on a map and real ground distance.

Temperature: The degree of hotness or coldness of the atmosphere.

Vegetation: The plant life that grows naturally in an area.

Weather: The condition of the atmosphere at a specific time and place.

Reference Books

1. The Encyclopedia of Human Geography (Editor: Barney Warf) a comprehensive reference work covering many aspects of human geography.

2. Handbook of Geography Education (Springer) covers methods, teaching, and theoretical perspectives in geography.

3. Geography Foundations (Waugh & Bushell) used in school systems and covers general geography concepts such as maps, location, climate etc.

4. Introducing Physical Geography by Alan H. Strahler (6th ed): Covers earth-systems, landforms, climate, biogeography. ISBN 978-1118396209.

5. Fundamentals of Physical Geography by James Petersen et al. (2nd ed): A concise yet complete introduction to physical geography, including human interaction. ISBN 978-1133606536.

6. An Introduction to Physical Geography and the Environment by Joseph Holden (4th ed): Comprehensive, global-examples, strong on processes & environment. ISBN 978-1292083575.

7. Physical Geography: The Earth & Humanity by Michael W. Pesses: Emphasises connections between physical geography and human society, modern/recent (2019). ISBN 978-1680759525.

8. Physical Geography of Africa by Roland Baumhauer: Focused on Africa's physical geography—great when you later specialise in East Africa. Published 2025.

Patrick Ssendagi is a dedicated Geography teacher at Gayaza High School. With years of experience in teaching and content development, he is passionate about helping students understand the world around them through practical, relatable, and engaging lessons. Patrick's approach combines classroom theory with real-life examples from the environment, making Geography both meaningful and enjoyable to learners. This book was written to simplify key topics such as map reading, photographic interpretation, earth movement, weather and climate, landform formation, and vegetation for new lower secondary curriculum students.

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