ILLUSTRATED LESSON NOTES FOR THE TEACHER AND STUDENT

GEOGRAPHY



Form Two

FORM TWO WORK MADE EASY AND INTERESTING

ALSO INCLUDES KEY KCSE TEST PAPERS FOR FORM TWO WORK

BY E. Cheloti

CONTENT

TOPIC		PAGE NO.
1.	INTERNAL LANDFORMING PROCESSES.	3
2.	VULCANICITY AND EARTHQUAKES	6
3.	MAPWORK	41
4.	PHOTOGRAPH WORK.	49
5.	CLIMATE.	60
6.	VEGETATION.	77
7.	FORESTRY.	82
8.	MODEL KCSE PAPERS COVERING F1 WORK	92
9.	ANSWERS TO MODEL PAPERS	100

INTERNAL LANDFORMING PROCESSES.

The forces, which produce physical features, are of two types: **internal forces** and **external forces.**

The processes operating inside the earth's surface are called ***endogenic-endogenetic processes***. These forces cause earth movements.

EARTH MOVEMENTS.

Definition;

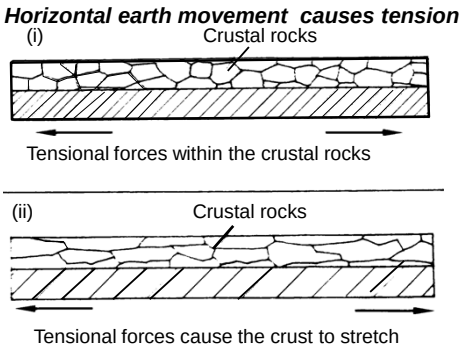
These are movements which are *lateral (orogenic)* and *vertical (Epeirogenic),* exerting great forces of tension and compression to produce features like the rift valley escarpment etc.

There are two basic types;

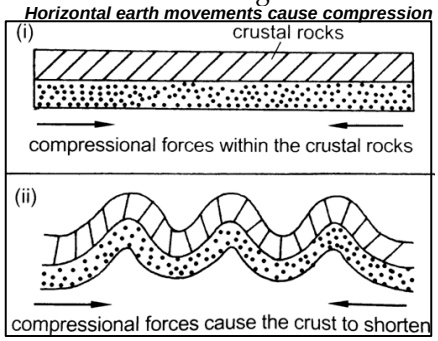
Horizontal movements. (lateral or orogenic movements)

These operate along a horizontal plane causing the earth's rocks to stretch, shorten or shear.

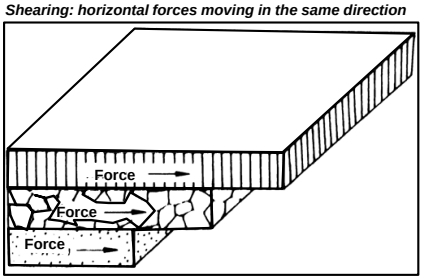
a) **Stretch;** when the crustal rocks are subjected to forces moving away from each other along a horizontal plane, it causes tension or strain within the rocks since they are being pulled apart.



b) **Shorten;** when crustal rocks become compressed due to forces pushing towards each other, this result in the shortening of the earth's rocks.

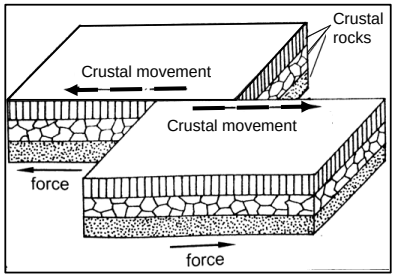


c) **Shear/tear**. When the forces are operating in the same direction and exerting strengths of different magnitudes in the rock layers, the top layers move forward more than the lower layers.



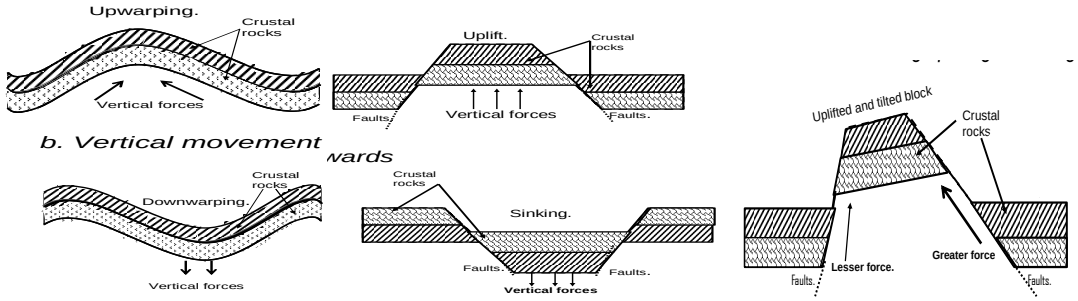
d) Or when tectonic forces are operating in opposite direction but moving past each other with unequal strength, the rocks may be displaced horizontally by slipping past each other.

Shearing: horizontal forces moving inn opposite directions



Vertical movements (epeirogenic/Epeirogetic)

These are movements operating along the radius of the earth (from the interior towards the surface *vise versa*). The effect of vertical movements is that crustal rocks are either pulled downwards (**subsidence or downwarping**) or pushed upwards (**uplifting or upwarping)**,



Or even shear in a vertical direction. The sunken or uplifted land may also be tilted.

Causes of earth movements.

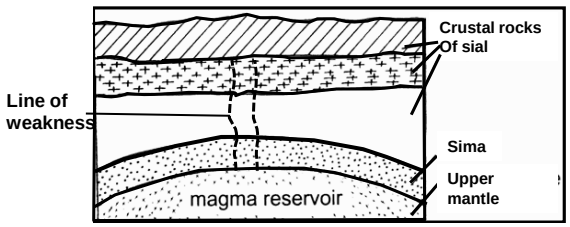
The following have been suggested as causes of earth movements;

a) **Movement of magma within the crust**.

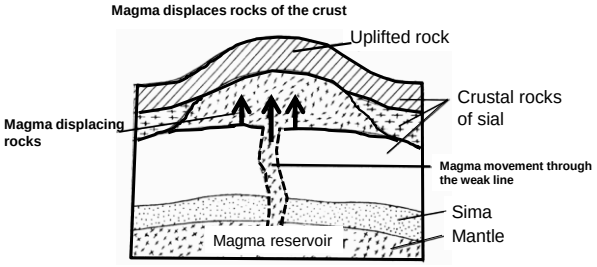
If a line of weakness occurs in the sima rocks, the magma, from the upper mantle, may move to invade the earth's crust causing vertical or horizontal displacement of crustal rocks. Vertical movement will cause land to be uplifted.

Magma movement and its effects.

Section of crust upto mantle with a line of weakness



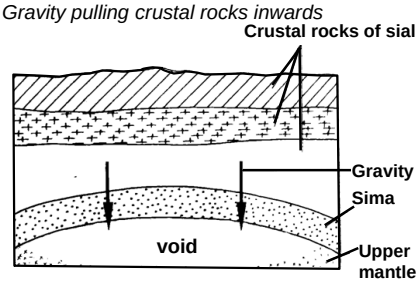
Magma displaces rocks of the crust



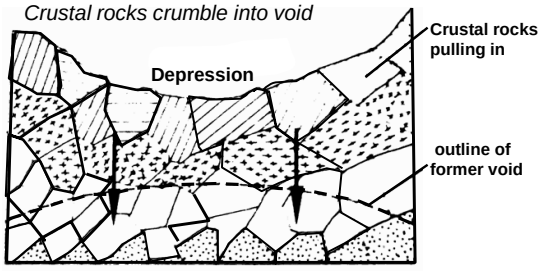
b) **Gravitative pressure.**

The escape of large quantities of magma from the upper mantle to the surface during Vulcanicity leaves behind large cavities or voids.

Gravity pulling crustal rocks inwards



Crustal rocks crumble into void

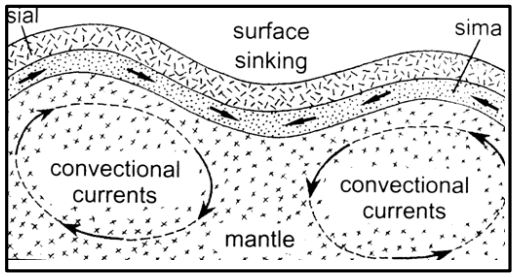


Due to Gravitative pressure, the crustal rocks which are above the cavities move inwards to fill up the voids. This movement may cause surface to form a depression.

c) **Convectional currents in the mantle.**

The currents cause the molten rocks to circulate in a cyclical manner since they move from inside the mantle, towards the upper surface of the mantle and then *horizontally,* finally *vertically* inwards.

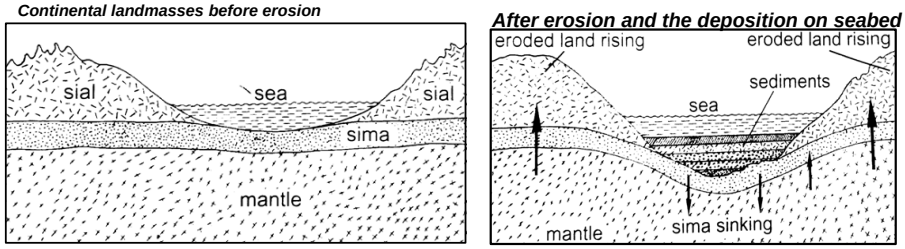
Convectional currents in the mantle



As the currents move horizontally beneath the sima, they exert a **frictional drag on the crustal rocks** causing them to also move horizontally. At a point of convergence of the currents beneath the crust, the rocks directly above the point ***move vertically inwards.***

d) **Isostatic adjustment.**

The weight of the sial layer on the sima is in a state of equilibrium known as *Isostacy.* The deposition of eroded materials on the sea bed and emptying of melt water into the sea causes the sima layers to be depressed (sink) into the mantle. This sinking disrupts the balance maintained by the sial and the sima layers. The continental masses have to rise (*vertical earth movement*) since they are lighter. This is what is called the **Isostatic adjustment**.

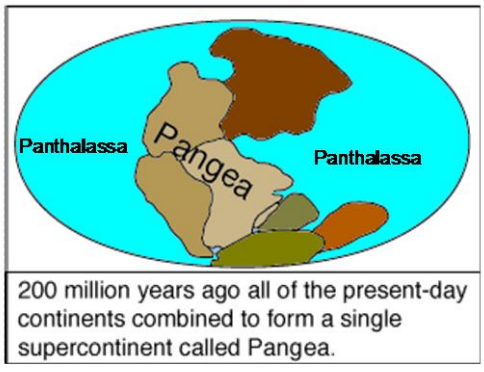


Evidence of this is found along the Scandinavian coastline with raised beaches (rising at a rate of 30cm in 30 years-) due to massive ice melt in the Pleistocene period

The following two theories are important in understanding folding, faulting and Vulcanicity.

1. The theory of continental drift.

In 1912 a German Scientist called Alfred Wegener proposed that all the continents were once stuck together as one big land mass called **Pangaea**. The landmass was surrounded by a great ocean**, panthalassa,** whose floor was mainly a mass of sima, until about 200 million years ago.



During the late pre-Cambrian period, Pangaea broke up to form two land masses, *Laurasia,* and *Gondwanaland,* separated by a fairly narrow Ocean called **Tethys** (present day Mediterranean). During the Mesozoic era, Laurasia broke up into two; the *Laurentian Shield* and *Fennoscondia.*

Gondwanaland broke into a series of continents such as **Africa, Australia, the Americas, Antarctica** and the sub continent of **India**. Africa and India later drifted northwards to their present positions.

Evidences in support of the continental drift theory.

a) The continents bordering the Atlantic Ocean seem to fit together like a giant **jigsaw puzzle**: on a map, Africa seems to snuggle nicely into the east coast of South America and the Caribbean Sea.

b) **Palaeoclimatology** reveals that the landmasses of southern Africa, eastern South America, India and Australia could have been joined and were all located near the South Pole. (Ancient glaciation is

recognizable in all).

c) The location of **major coalfields** in the southern hemisphere (about latitude 30˚S in Chile, South Africa and south-Eastern Australia) and in the northern hemisphere between 40˚N and 55˚N is an indicator that these areas were once located around the Equator before drifting apart. *Coal is only formed from large areas of tropical forests that were later buried.*

d) Similar **geological structure** could be traced from one continent to the other across stretches of oceans. Rocks of similar structure, ages and origin occur in SE Brazil and South Africa.

e) **Palaeomagnetic dating**. Rocks become magnetized in the direction of magnetic north at the time of solidifying. By examining the magnetism of very old rocks, it is possible to place the position on the earth's surface where they were formed. Palaeomagnetic studies indicate that the present continents developed from a single continent.

f) The **cape folds** of South Africa resemble those of Buenos Aires in Argentina. The folds have a similar trend and geological structure; they must have formed when the two continents were still one.

g) It has been proven that **the red sea** was formed by crustal separation/rifting. Its shores exhibit evidences of having undergone lateral displacement.

h) A study of the **mid-Atlantic ridge** reveals a chain of ocean mountain ranges made up of volcanic rocks of recent origin. This means that mountain building process is still taking place to fill the gap left when two continents moved apart.

1. The plate tectonics theory.

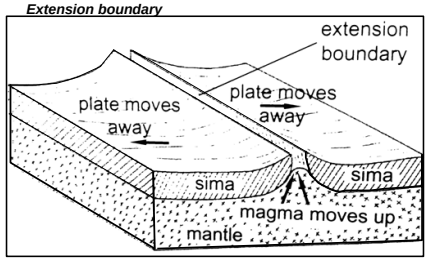
This theory was an improvement of the continental drift theory. It suggests that The Earth's surface is made up of a series of large plates called **tectonic plates**. These plates are in constant motion traveling at a few centimeters per year, caused by convectional currents beneath the plates, within the mantle.

The plates are separated from one another by the following distinct boundaries;

1. Constructive boundaries/divergent plate boundaries

These are locations where plates are moving away from one another. Convection currents push up on the bottom of the lithosphere, lifting it and flowing laterally beneath it. This lateral flow causes the plate material above to be dragged along in the direction of flow.

Illustration.



When a divergent boundary occurs beneath oceanic lithosphere, the Extensional forces stretch the lithosphere and produce a deep fissure. Pressure is reduced on the super-heated mantle material below. It responds by melting and the new magma flows into the fissure. The magma then solidifies into a ridge. A **Mid Ocean Ridge** is formed.

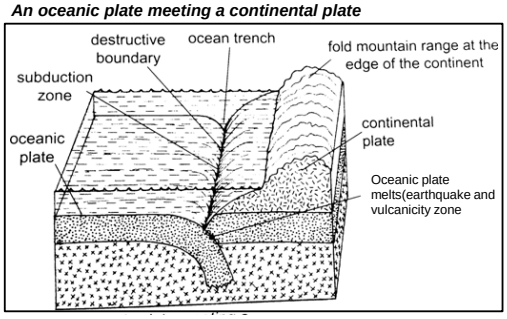
Effects include; The Mid-Atlantic Ridge; due to fissure eruptions, shallow earthquake activity and Creation of new seafloor.

When a divergent boundary occurs beneath a thick continental plate, the pull-apart is not so strong. It creates normal faults on both sides of the rift and the central blocks slide downwards to form a rift valley. E.g. ***The East Africa Rift Valley*** is in a very early stage of development. *Volcanic activity* sometimes occurs within the rift.

2. **Compressional /destructive/convergent plate boundaries**.

They are locations where lithosphere plates are moving towards one another resulting in plate collisions to produce earthquakes, volcanic activity and crustal deformation. When continental and oceanic plates collide the thinner and denser oceanic plate is forced down below the continental plate, into the mantle in a process known as ***"subduction".*** At a depth of about 100 miles (160 km), a process of partial melting of the subducting plate material begins, due to the high temperatures.

An oceanic plate meeting a continental plate

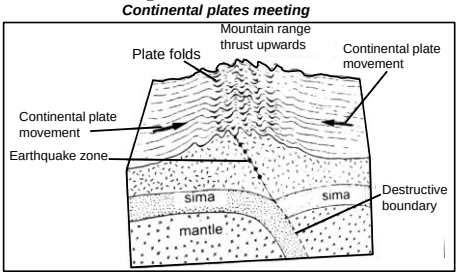


An example is the Nazca Plate is subducting beneath the South American plate eventually producing The Andes Mountain Range of western South America.

When a convergent boundary occurs between two oceanic plates, the older plate will subduct because of its higher density. The subducting plate, at a depth of about 100 miles (150 km) begins to melt to form Magma. The newly-created magma rises to the surface and forms volcanoes. The volcano may grow tall enough to reach the surface of the ocean creating an island arc or chain. With continued development the islands grow larger, merge and an elongate landmass is created.
In Japan, the Aleutian Islands and the Eastern Caribbean islands of Martinique, St. Lucia and St. Vincent and the Grenadines are examples of islands formed through this type of plate boundary. Effects that are found at this type of plate boundary include *an oceanic trench.*

Convergent Plate Boundary – Continental. In such a boundary, a powerful collision occurs since the two thick continental plates have a density that is much lower than the mantle, which prevents subduction.
The intense compression can cause extensive folding and faulting of rocks within the two colliding plates.

Continental plates meeting

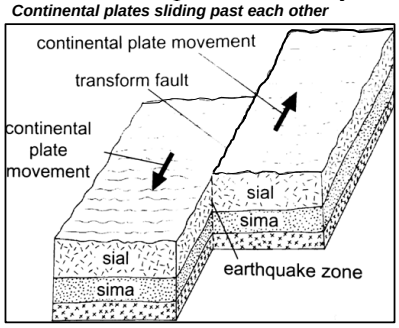


The Himalaya Mountain Range is the best active example of this type of plate boundary. The Indian and Eurasian plates are currently in collision.

3. Transform plate boundaries

Transform Plate Boundaries are locations where two plates slide past one another. The fracture zone that forms a transform plate boundary is known as **a transform fault.**

Continental plates sliding past each other



This boundary is **conservation zone/transform boundary** because plate is neither created nor destroyed.
An example of such a boundary is the San Andreas Fault in California.
Effects found at Transform faults include; Recurring earthquake activity and faulting.
NB; Volcanic activity is normally not present because the typical magma sources of an upwelling convection current or a melting subducting plate are not present.

FOLDING AND FAULTING

Introduction.

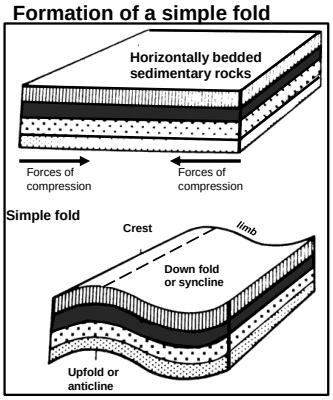
Lateral forces of compression cause folding while either lateral or vertical forces of tension or compression cause faulting.

Folding

This is the process of crustal distortion which causes the rocks to bend upwards or downwards.
The process occurs in fairly young sedimentary rocks.

A **fold** can be defined as a bend in rock that is in response to Compressional forces.

The nature of folds



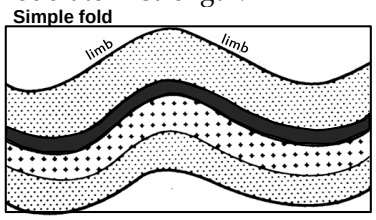
The layers of rock which bend up form an **up fold or anticline**. Those which bend down form a **down fold or syncline**. The sunken parts are called **synclines.** The uppermost part of the upfold is called a **crest.** The lowest part of the syncline is called the **trough.** A line drawn vertically through the centre of the anticline is called the **axis** of the fold. The rock layers on both sides of the axis, Dipping in opposite directions is called **limbs.**

Types of folds

A number of different **folds** have been recognized depending on the strength of the Compressional forces and the nature of sedimentary rocks involved.

1. Simple symmetrical folds.

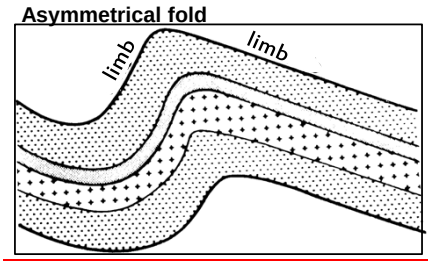
Also known as anticline folds, the folds are formed by Compressional forces of equal magnitude/ weak to moderate in strength.



An anticline is a convex up fold in rock with the rock beds (or limbs) dipping evenly away from the center of the structure. Note how the rock layers dip away from the center of the fold are roughly symmetrical.

2. Asymmetrical folds.

These fold types develop where one of the Compressional forces involved is slightly stronger than the other.

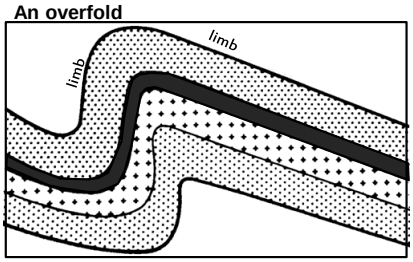


One limb steeper than the other.

*The greater pressure results in **anticlines** and **synclines** that are inclined and asymmetrical.*
One limb is steeper than the other. The limbs are asymmetrical about the axis.

3. Overfolds

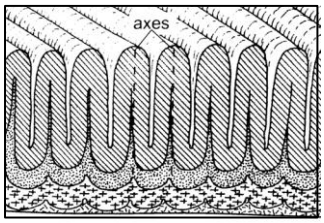
These are asymmetrical folds caused by a very strong force pushing against a very resistant rock. The anticline will be pushed over the limb of the next fold.



4. Isoclinal folds

This is a group of folds which are packed together. The limbs are in an almost parallel position and they dip in the same direction. The folds may be vertical or inclined.

Vertical Isoclinal folds



5. **Recumbent folds**.

These are Overfolds which are completely pushed over one side to a horizontal position.

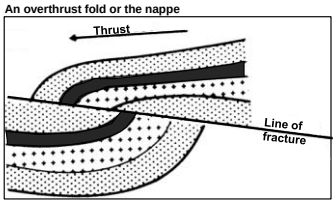
A recumbent fold develops if the center of the fold moves from being once vertical to a horizontal position.

Recumbent folds are commonly found in the core of mountain ranges and indicate that compression and/or shear forces were stronger in one direction.

6. The nappe or overthrust folds.

When pressure is very great, a fracture occurs in the fold and one limb is pushed forward over the other limb forming an overthrust fold. A combination of a **fault** and a **fold** in a rock is also called a **thrust fault.**

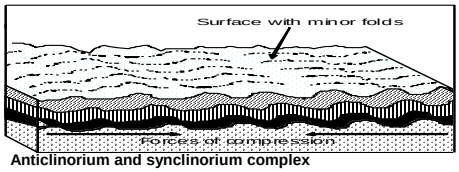
An overthrust fold or the nappe



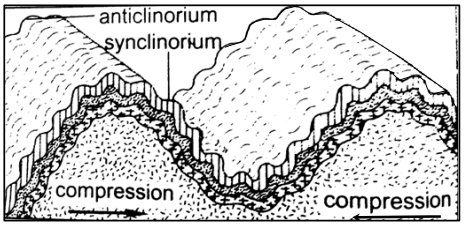
7. Anticlinorium and synclinorium complex.

A land surface may undergo initial minor folding creating a series of minor folds.

Formation of minor folds on the surface



Anticlinorium and synclinorium complex



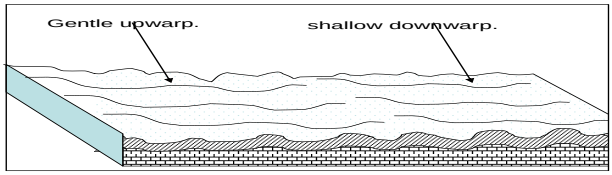
Later on, major folding may occur on the same land surface to create bigger folds.

Each of the new upfolds, characterized by minor upfolds and downfolds superimposed on it is called the *Anticlinorium* while the major downfold is called a synclinorium.

Features related to folding.

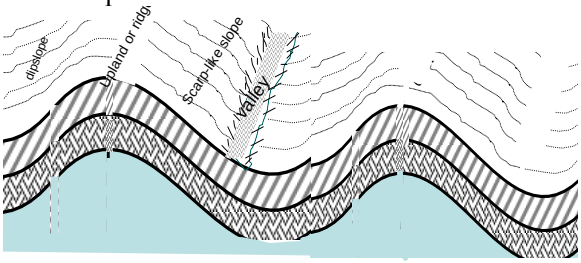
1) **Rolling plains.** If the Compressional forces are weak, the landscape may be turned into gently sloping anticlines and very wide synclines. Such a landscape is described as a rolling plain.

A rolling plain.



2) **Ridge and valley landscape**. Where the Compressional forces are stronger and uneven, the

landscape could be transformed into a series of asymmetrical folds.



The anticlines form upfolds while the synclines form valleys.

Where these surface rocks are resistant, the uplands will form ridges with a gentle back slope (dip slope) and steep scarp-like slope on the opposite side.

3) **Inter-montane plateaus.** During formation of Fold Mountains, the middle part of a region may resist folding. The two sets of fold mountains enclose an area which is unaffected by the folding process. This area is called an inter-montane plateau. E.g. the Chotts plateau between the Tell Atlas and the Sahara Atlas of Algeria.
4) **Inter-montane basins.** When inter-montane plateaus are forming, some parts of the plateaus may subside to form basins. For example, the Chotts plateau has numerous inter-montane basins with some occupied by salty lakes.
5) **Synclinal valleys.** These are broad and shallow valleys having gently sloping basins and formed as a result of folding. These valleys/basins may contain water to form lakes.
6) **Depressions.** These are depressions of the crust that have occurred over a large area due to down warping caused by vertical earth movements.
7) **Escarpments.**When folding takes place on a rock mass, the extended steep limb from the anticline forms an escarpment.
8) **Fold Mountains.** Examples of Fold Mountains are the Alps, Atlas and the Himalayas.

Fold mountain Formation.

It is explained through the following theories;

a) Plate tectonics theory.-Andes mountain formation

Fold Mountains are created by uplift and folding of two tectonic plates as they move towards each other and collide at a *Compressional plate margin*. The Andes are an example of Fold Mountains formed at a destructive plate margin through Nazca Plate (oceanic) colliding with the South American Plate (continental). The Himalayas were formed due to the collision of the Indian plate and the Eurasian plate.

b) *The continental drift theory*.-Himalayas formation.

As the continents were drifting apart, India drifted northwards against a rather static Eurasia. The crust, together with the sediments between was squeezed by the Indian subcontinent against Eurasia resulting in the formation of the Himalayas Mountains.

c) The convectional currents theory.

As the currents move horizontally beneath the sima, they exert a **frictional drag on the crustal rocks** causing them to also move horizontally along. When the continental coasts are pulled towards each other due to the effects of these currents, the sediments between the coasts are squeezed into folds.

d) The contraction theory.

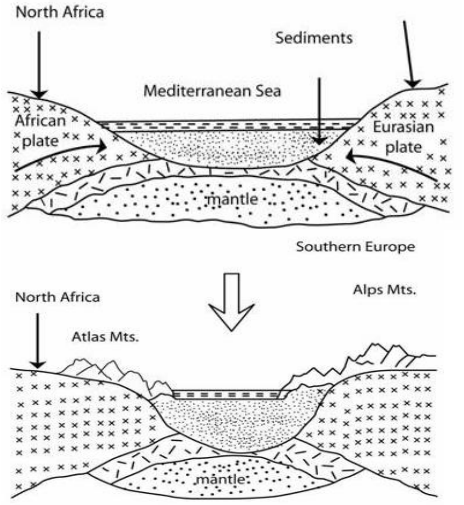
The theory presupposes that during the formation of the earth, the surface rocks cooled and contracted faster than those of the interior. Since the interior rocks were cooling slowly, the surface rocks started wrinkling in order to fit on the cooling and contracting interior rocks. The wrinkles became Fold Mountains.

Weakness of the contraction theory.

i. The amount of wrinkling that resulted in high mountains would have been more than the earth could accommodate.
ii. Fold Mountains are made of sedimentary rocks which formed many years after the earth was formed

Stages in the formation of fold mountains with reference to the Alps and the Atlas.

Initially, there was the formation of an extensive depression called a **geosyncline** on the surface of the earth. The depression was filled with water, forming a sea. The intensive erosion of the surrounding landmasses led to deposition of sediments in the geosyncline in layers.



Weight caused by sediment accumulation led to further subsidence of the geosyncline leading to more accumulation of sediments and later originating forces of compression that drew landmasses together.

The forces could also have been triggered off by convectional currents in the mantle, which pulled the continental crust towards the geosyncline.

Mountain features developed at the continental edges of the geosyncline because these parts were closer to the origin of the forces. E.g. Fold Mountains like the Alps add Atlas border large oceans and sea which were part of the ancient geosyncline.

Fold mountain formation periods.

The process of fold mountain formation is called **Orogenesis.** The fold mountain building period is called **Orogeny.** Geologists have recognized **four orogenies** that were separated by periods of calm, during which intense erosion and deposition took place;

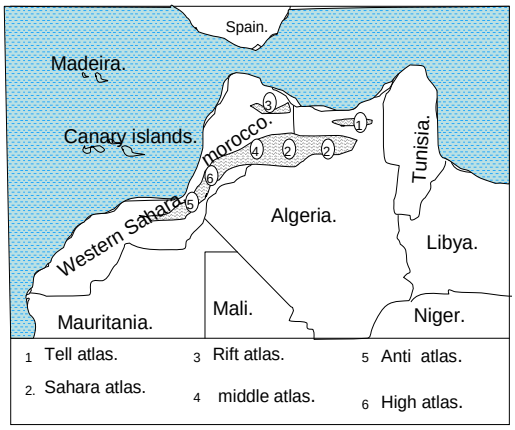
a) ***The Charnian Orogeny***. The first Orogeny, dating back to the *Precambrian period*. Mountains formed during this period no longer exist since they were eroded to form plateaus like the Deccan plateau of India, the Russian platform of Siberia, the Laurentian shield of North America and the African block.

b) ***Caledonian Orogeny***. This occurred during the late *Silurian period*. Mountains formed included the Akwapim Hills in Ghana and the Scottish highlands of Caledonia. Most of these mountains have been reduced to hills and plateaus.

c) ***Hercynian Orogeny/ the Armorican Orogeny***. Occurred during the late *carboniferous period* and early Permian period. Mountains formed included the Armorican in north western France, cape ranges of South Africa, the Appalachians of North America and Urals of Europe.

d) ***Alpine Orogeny.*** Occurred during the *Paleocene period* and is the latest. The mountains formed include the Atlas of Africa, the Alps of Europe, the Himalayas of Asia, the Rockies of North America and the Andes of South America.

The atlas mountains of North-West Africa

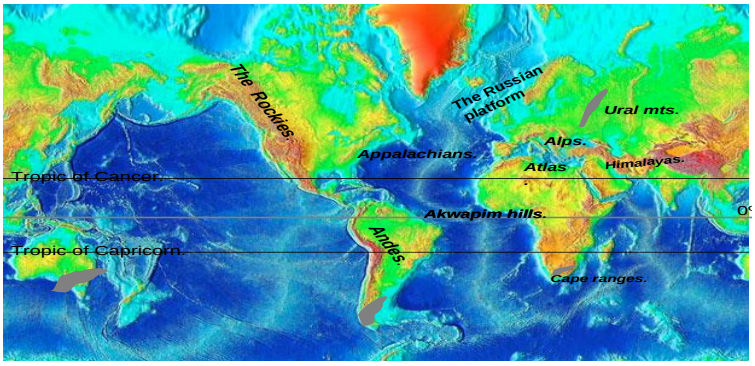


NB: *the process of folding was not significant in East Africa and therefore didn't create any significant land forms. In east Africa, the crust consists of hard basement rocks which fracture when folded. However minor folds are found at the border between Uganda and Tanzania/Karagwe where layers of mudstone were compressed into a U shape. There is also some folding in the layers of limestone on the East Africa coast. Folding is evident in Bukaba region in the North of Tanzania.*

World distribution of Fold Mountains.

The high mountain chains of the Alps, the Rockies and the Himalayas are examples of Fold Mountains. The atlas and the Alps were formed when the African plate was pushed against a rigid European plate. The Rockies and the Andes were formed as a result of the pacific and the Nazca oceanic plates meeting with respective American continental plates.

World distribution of fold mountains.



(***Source:*** *National Geophysical Data Center, National Oceanic and Atmospheric Administration).*

Significance of folding.

a) Fold Mountains generally receive heavy rainfall on the windward side. The leeward side receives little rains.
b) Windward sides also support luxuriant forests due to the heavy rains. The forests are a source of timber for furniture making and construction. Trees also improve the water catchment capacity of the soil.
c) The heavy rains together with snow on the windward give rise to rivers that provide water for industrial and domestic use and HEP generation
d) Cold winds descending to the lowlands on the mountain sides cause a lot of harm to crops such as grapes in Europe. They lead to frost formation.
e) Existence of mountains in the northern hemisphere influence human activities. The south facing slopes of the Alps are warmer and favour agriculture and settlement.
f) The process of folding could bring valuable minerals to the surface, making them easily available for mining. For example on the Appalachians (coal) and the Andes (copper and tin in Bolivia).
g) The mountainous landscape provides unique scenery, making such areas attractive to tourists. E.g. the Swiss Alps.
h) Mountains may be a barrier to transport and communication unless passes exist and are not covered with snow.
i) The ruggedness of mountain topography discourages settlement.
j) Fold Mountains sometimes cause crustal rocks to become weak because faults develop in such rocks. The weak lines created act as passages for magma, triggering off Vulcanicity. E.g. in the Appalachians and Alps

Faulting

Introduction and definitions.

This is the process by which colder and brittle crustal rocks respond to large tectonic stresses by

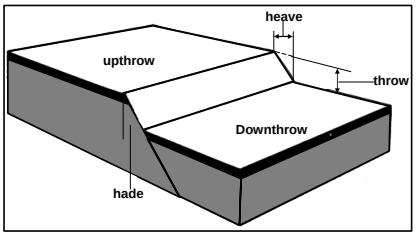
fracturing or breaking.

A **fault** is a break, crack or a fracture in the Earth crust produced by vertical and lateral movements within the earth's crust.

Tension causes **a normal fault**, compression causes **a reverse fault** and lateral movement produces **a tear fault**

Escarpments is a steep sided feature bordering a rift valley which develops when faulting is accompanied by upward or downward movement of adjoining parts of the crust.

Parts of a fault



The land on one side of the fault displaced upwards is called an **upthrow.**

The one displaced downwards is called the **Downthrow.**

A fault line is the surface trace of a fault, the line of intersection between the fault plane and the Earth's surface.

Fault plane; the surface of separation of the land which is created by the fault.

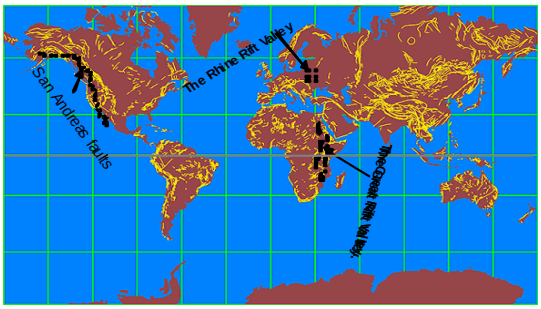
The rupture of the surface by a fault is called a **fault scarp**.

Throw; vertical displacement.

Heave; lateral displacement.

Hade; inclination of the fault to the vertical plane

location of some of the major faults located on the Earth.



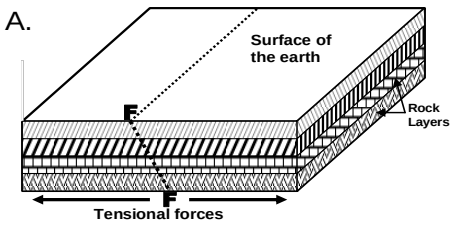
Note that many of these faults are in mountainous regions

Types of faults.

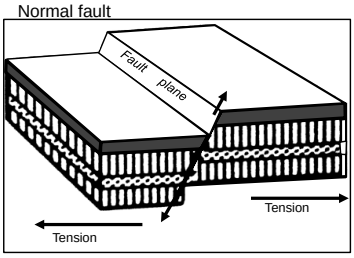
Faults are named according to the type of *stress that acts on the rock* and *the nature of the movement of the rock blocks* either side of the fault plane.

a) **Normal faults/ extensional faults**.If the rocks are under **tension**, faults will be formed and the centre block may sink down relative to its neighbors. Normal faults are common in East Africa.

Formation of a normal fault



Rocks subjected to tensional forces leading to development of normal faults

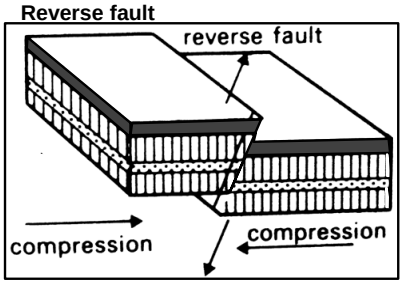


Normal faulting is indicative of a region that is stretching due to tension force.

b) **Reverse faults/*thrust faults.*** When the strata or layers are compressed or pressed together the rocks

will crack and faults will be formed. One block of rocks may override another.

Reverse fault



Such faults are common in western Uganda. The Ruwenzori Mountain is an example of a block mountain formed by thrust faults.

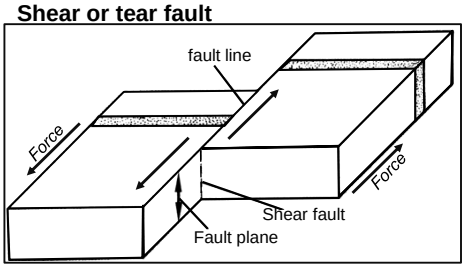
Reverse faults are also associated with "subduction" plate boundaries.

c) **Shear or tear faults/the strike-slip or transform fault/*wrench*** faults

When lateral movement is taking place particularly during an earthquake, tear faults may occur.

If a tear fault occurs across the course of a river, then the river's course may be slightly offset.

Shear or tear fault

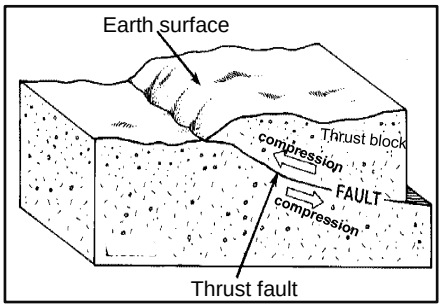


A well-known example of this type of fault is the San Andreas Fault in California. Part of coastal California is sliding to the northwest relative to the rest of North America - Los Angeles is slowly moving towards San Francisco

d) Thrust faults

They are formed when strong Compressional forces push a block of land over the other along a fault developed in a near horizontal position.

A thrust fault



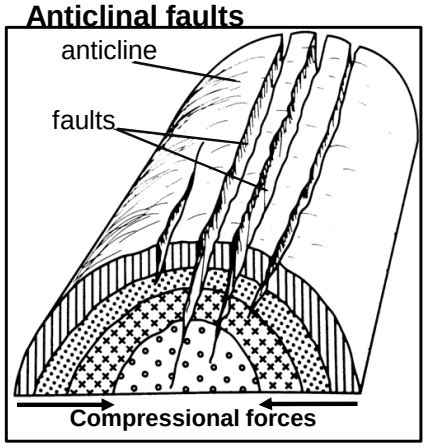
A thrust fault has the same sense of motion as a reverse fault, but with the dip of the fault plane at less than 45°.

e) Anticlinal faults

These are faults formed at the crest of an anticline due the stress exerted on the rocks.

If no displacement of land occurs, such faults can be referred to as fissures.

Anticlinal faults



An upthrow block between two normal faults dipping away from each other is called **a horst**. Low-angle normal faults with regional tectonic significance may be designated detachment faults**.**

Depending on the strength of the forces and the nature of the rocks involved, Faulting has produced a variety of physical features over the surface of the earth;

1) Escarpments/Fault scarps.

Escarpments are steep cliff-like slopes, formed mostly during the formation of the rift valleys.

When escarpments are eroded, they become ***fault scarps***.



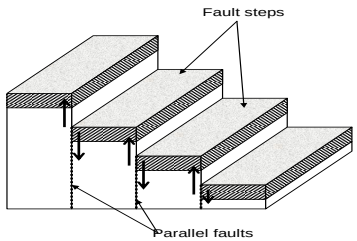
Examples of fault scarps in east Africa are Elgeyo, Nyandarua (or Aberdare) , Mau, Nandi and Nyando scarps in Kenya, Butiaba, scarp in Uganda and Lake Manyara scarp in Tanzania. The world's highest scarp is the Ethiopian scarp.

2) Fault steps.

This is a landscape with a series of fault scarps formed due to displacement of the land between a series of parallel faults to different levels.

The top part of the scarps resembles the steps of a house.

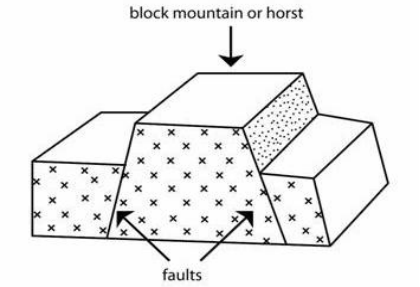
Step faulting resulting in fault steps



An example of this type of features is seen at Kijabe-west of Nairobi and on the Elgeyo escarpment at Tambach.

3) Fault blocks. /<u>Block Mountains</u>

A fault block is formed when the middle block which is bounded by more or less parallel faults is made to rise or is uplifted by the Compressional forces.



Examples are Nandi hills, Mau escarpment, Nyandarua (Arbadere) ranges in Kenya. The Danakil Alps of Ethiopia and the Karas mountains of Namibia.

A **horst** is formed where a block of land bordered by two almost parallel normal faults remains standing as the land on either side subsides.

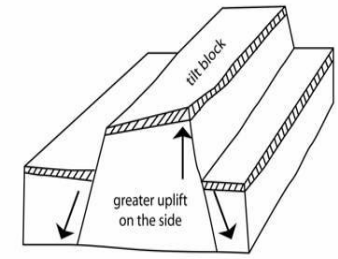
Or two reverse faults develop causing a block of rock to be pushed up.

The best example of a block mountain in East Africa is mount. Ruwenzori ranges. Others include Mathew's ranges and Nyiru Ndoto in Northern Kenya.

4) Tilt Blocks

Tilt blocks are formed when one side of the middle block is uplifted higher than the other side.

The top of the middle block will not be flat but will be tilted.



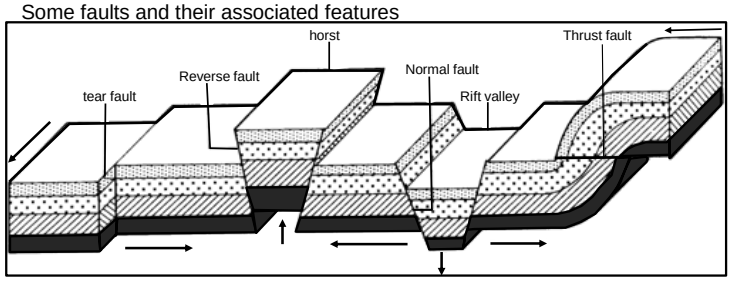
e.g. west Kenya tilt block from Nandi hills towards Lake Victoria., and the Arbadere range-tilted eastwards, The Ruwenzori Mountains is uplifted more on the western side.

5) Rift Valleys.

A rift valley is an elongated trough/valley formed between faults which are almost parallel and bound by two in-facing escarpments. It is also known as **a Graben.**

Examples. The Great Rift Valley of East Africa, the Benue Rift Valley of West Africa, the Rhine Rift Valley in Central Europe, and the Baikal Rift Valley in southern Siberia.

Some faults and their associated features



FORMATION OF RIFT VALLEYS.

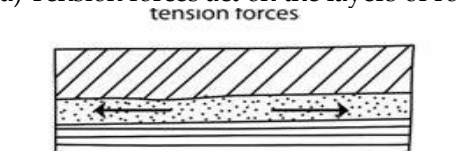
Rift valleys are thought to have been developed either from the action of tensional forces in the crust or from the action of Compressional forces.

a) ***The tension theory on rift valley formation***.

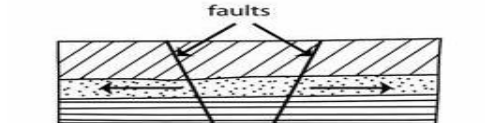
The theory suggests that forces of tension produced normal faults. The crust between the two parallel faults subsided and produced the rift valley.

Theory 1 Tensional forces-illustrated

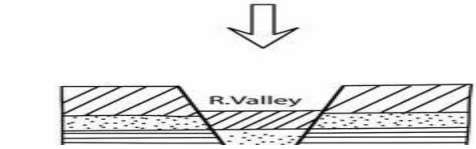
a) Tension forces act on the layers of rock.



b) Gradually two parallel faults appear and the central block begins to subside (sink).



c) Land in between sinks in forming a rift valley. The land on either sides stays in place.



After subsidence a depression with steep fault scarp sides i.e. a rift valley is formed. It is trapped in

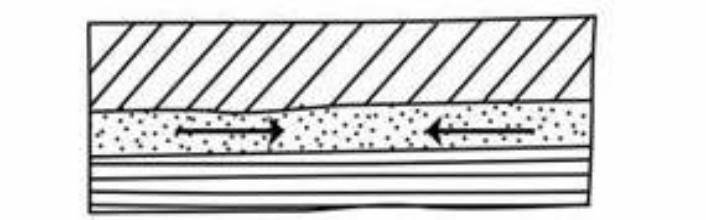
position by later pressure.

b) The compression theory on rift valley formation.

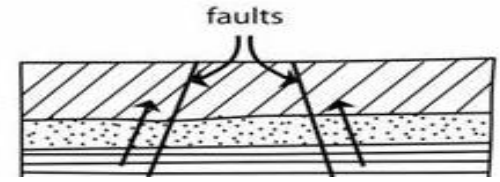
This theory suggests that the forces of compression produced almost parallel reverse faults. The crustal blocks outside the two faults rose up partially over the middle block, thus producing the rift valley.

Theory 2. Compressional forces-illustrated

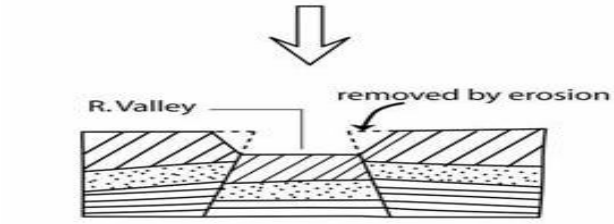
a) Layers of rocks are subjected to Compressional forces.



b) Faults develop and the outer blocks move upwards (Reverse faults are formed).



c) Central block stays in place and a rift valley is formed

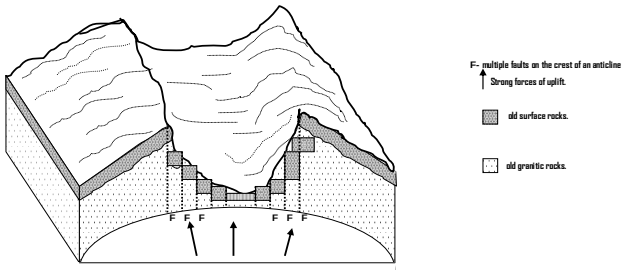


c) Formation by Anticlinal arching.

When vertical forces pushed the earth's crust upwards, the ground arched upwards.

Continued upwards pushing let to stress on the crest of the anticline which eventually cracked into a series of cracks to form a rift valley.

RIFT VALLEY FORMED DUE TO MULTIPLE FAULTING CAUSED BY ANTICLINAL ARCHING

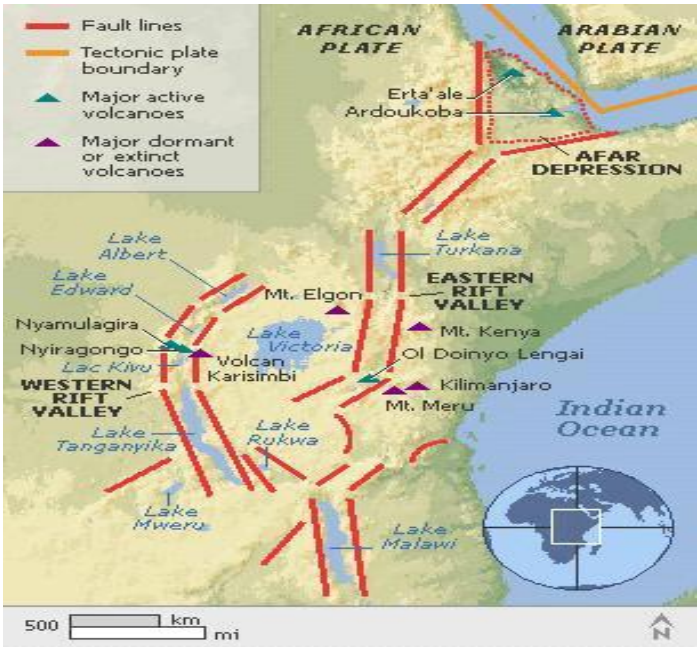


If more upward force is exerted, then the outermost blocks will be pushed much higher than the middle block.

The Rhine rift valley was formed in this manner.

THE GREAT RIFT VALLEY.

OR The Great East African Rift Valley.



It is also known as the Afro-Arabian Rift system.

Rift valleys of East Africa are grouped as follows;

a) The Lake Turkana and Stephanie section extending into Ethiopia.
b) The Eastern/ Gregory rift valley which runs through Kenya from north to the south into Tanzania.
c) The western rift valley that extends from Lake Tanganyika to north of Lake Albert. It is closely associated with uplifted Ruwenzori horsts between lakes Edward and Albert. Other lakes found in this section are Lake Kivu.
d) The Malawian section; it includes lake Rukwa, Ruaha and the Zambezi Luangwa basins. Lakes here are lake Rukwa, Malawi and Chilwa.
e) THE GREGORY RIFT VALLEY.

This is the section with the most pronounced features of the Great Rift Valley.

The section is named after a geologist J.W Gregory who carried out extensive studies on this section. The features include pronounced fault steps as high as 1000m from the valley floor.

For example; Elgeyo, Mau, Nyandarua and Ngurumani.

Step faulting can be seen at Tambach on the Elgeyo escarpment.

Width of the rift valley varies. In Lake Magadi area, it is 50km wide. To the north of Lake Baringo, it is 10km wide.

Height of the valley floor also varies. At Lake Magadi area, it is 600m above sea level. At Lake Naivasha, it is 1800m above sea level.

Depressions exist on the valley floor with some occupied by lakes. Numerous rivers flow into these lakes.

Further minor faulting on the floor has resulted in smaller escarpments within the valley.

Volcanic activity on its floor formed volcanoes like Longonot and Menengai

A series of adjacent faults here form a range and valley topography e.g. a cross section between Ngurumani Hills and Kajiado or Kikuyu escarpment and Kedong Valley.

The Winam R. Valley in which the Winam or Kavirondo Gulf is found has a North-East-South-West trend, which is a departure from the North-South trend of the Gregory Rift Valley.

It is bound by the Nyando escarpment to the south. A series of fault blocks are associated with the Winam Gulf. E.g. the West Kenya Tilt block defined by the Kakamega/Nandi and Nyando escarpments.

The Kisii/ Sotik fault blocks bound by Kendu /Sotik fault to the north and Soita-ololol fault to the south.

World distribution of features due to faulting.

Location of these features coincide with boundaries of tectonic plates particularly extension and shear boundaries.

Extension boundary Areas experienced sea floor spreading. At Shear boundaries, crust cracks forming two blocks which move laterally alongside one another. E.g. the San Andreas fault.

The Great Rift Valley exists along a split on the African continent. The split was an extension boundary that did not proceed further.

Other rift valleys in the world include the Rhine valley, the central valley in Scotland and the Jordan valley.

Block Mountains like the Ruwenzori, Danakil Alps (Ethiopia), Karas (Namibia) exist.

Tilt blocks like the ones in the Afar Triangle in Ethiopia.

Faultscarps like Butiaba in Uganda and Nandi Escarpment in Kenya.

Significance of faulting.

a) Faulting may cause disjointing of land leading to disruption of communication lines, water, and sewage and oil pipes.
b) Fault scarps can cause difficulty and extra expense in the construction of these lines.
c) Faulting may cause a river to change direction and start flowing along a fault line or even disappear into the ground.
d) Subsidence of land resulting from faulting can cause loss of life and property.
e) Subsidence of land caused by faulting may also result in the formation of depressions that may eventually fill up with water to form lakes. The lakes can be useful in fishing, irrigation, transport and mining. This is common on Lake Naivasha.
f) Faulting creates lines of weakness in the crust which become passages for hot water from the ground to the surface in form of the hot springs and geysers. These can be utilized for geothermal power production. An example is Olkaria in Kenya.
g) Fault scarp slopes may expose underground water, resulting in the formation of scarp springs which could be sources of clean water. These can encourage settlement.
h) The resultant block mountains created through faulting receive a lot of rain on their windward slopes. They therefore become sources of rivers that provide water for irrigation, domestic and industrial use, as well as generation of HEP. For example River Tana flowing from Arbadere Range.
i) The heavy rains received on the windward slopes of Block Mountains make the slopes suitable for agriculture and settlement.
j) Faulting has resulted in the exposure of minerals like Diatomite. Minerals are a source of income for the country.

Problems faced by the people living in the Rift valley areas of East Africa.

1. High temperatures lead to shortage of water.
2. Earthquakes (tremors) which destroy property
3. Little rainfall or drought in the Rain shadow areas
4. Poor means of transport and communication because of the steep escarpments
5. Salty lakes because of high temperatures and high evaporation rates
6. Soil erosion and land slides especially on the steep slopes

Vulcanicity and earthquakes

Vulcanicity

Vulcanicity is the process through which gases and molten rock are either extruded on the earth's surface or intruded into the earth's crust.

Magma is the molten rock originating from the upper plastic layer of the mantle. When it gets to the surface and loses its gases, it is known as **lava.**

Pyrocrasts are the ashes, cinders and small particles of magma during an explosive volcanic eruption.

***What causes Vulcanicity*?**

Deep inside the earth *heat and pressure exerted by the crust* cause rocks to melt forming molten rocks known as magma, which is forced to rise along the lines of weakness (fault lines).

Features formed: –

on reaching the surface the magma which becomes lava, cools and solidifies either on the earth surface forming ***extrusive volcanic features*** or magma may solidify below the earth's surface forming ***intrusive volcanic features.***

Intrusive features:

These are formed when magma solidifies underground. The magma may spread, accumulate or remain in the passage within the crustal rocks. The features are also referred to as plutonic features.

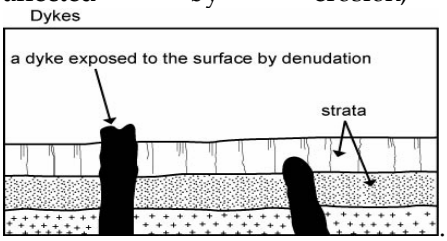
The features formed depend on the viscosity of the magma and the nature of the intruded rocks. E.g.

1) Dykes:

These are layers of igneous intrusion formed when magma solidifies into vertical cracks, cutting across rock layers.

They could be vertical or slightly slanting depending on the nature of the cracks.

Where a dyke is made up of a rock that is more resistant to erosion than the surrounding rocks, and when affected by erosion, the dyke stands as a ridge.



. Examples of this type are Devil's knuckles and Jambila in Transvaal province-S.A Along the Thyolo escarpment in Malawi, on the Jos Plateau in Nigeria.

Where the dykes are softer than the surrounding rock, erosion creates a furrow or trench across the land.

Examples of trench dykes are to the west of Lake Turkana in Kenya; at the south Africa- Swaziland border forming the channel of river Ugutugulo, at Lancer's Gap near Maseru in Lesotho.

2) Sills:

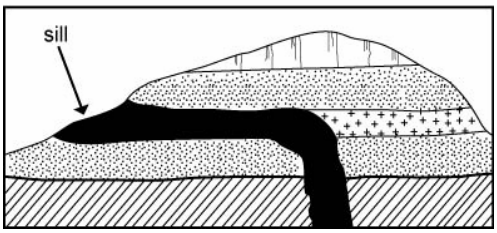
They formed when lava solidifies in between rock layers.

The layer may be horizontal or slightly dipping depending on whether the bedding planes of the intruded rocks are horizontal or are dipping.

After prolonged erosion, some Sills may be exposed as escarpments.

Where they occur across a river valley they cause water falls and rapids.

Sills



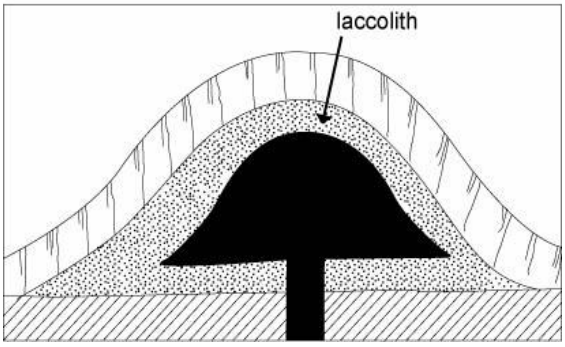
Examples are Thika and Thompson falls in Kenya, Karuma falls and Bujagali in Uganda.

3. **Laccoliths**:

Dome shaped layers of magma formed when magma encounters rock more resistant at its sides than its center.

After prolonged erosion, it may form upland.

Laccolith

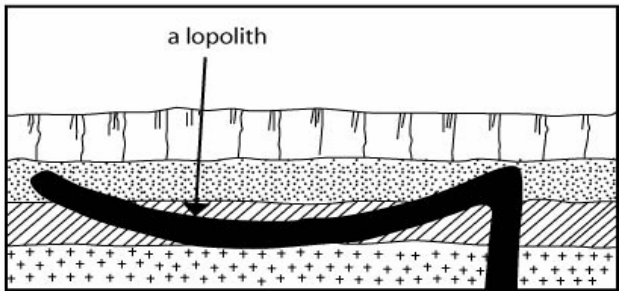


4. **Lopolith**:

Bowl shaped layers of magma formed when magma encounters rock more resistant at its center than its sides.

It can be exposed as a shallow basin. Examples are Arenas in Ankole.

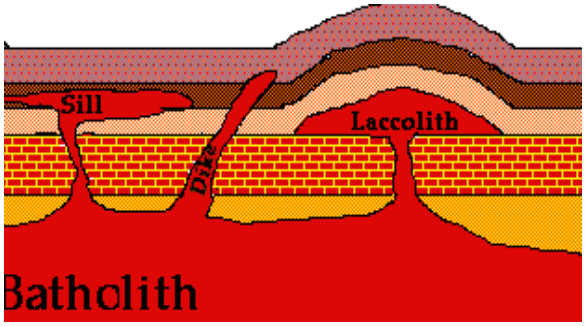
a lopolith



6. **Batholiths**:

They consist of plutonic mass of magma which intruded the country rock.

They are dome shaped, formed at great depth and at times they are exposed at the surface by denudational forces as Inselbergs.



- Examples are Maragoli and eat Bunyore batholiths in Kenya, the Chimamora batholith-north east of Harare, the Chailla Massif in Gabon and the Stone Mountain of Georgia.

Extrusive features

The following types of lava are responsible for formation of extrusive features.

Lava – material that moves to the surface differs in chemical composition. This party explain the different types or shapes of volcanoes and nature of eruption whether explosions or quite. For example:

a) **Acidic lava:** very thick, traps a lot of gas, water, rich in silica content violent eruption and lava solidifies very quickly builds up *steep cones*.
b) **Basic lava:** this is a form of fluid poor in silica content flows for a very distance before it solidifies; it builds up *gently sloping cones*, *lava plateau* and *plains*.
c) **Pyroclasts (Heated lava):** when lava is heated, it breaks down into small fragments or pieces (Pyroclasts), which usually falls to the ground and form layers of Ash/cinder. Layers of ash mix with layers of lava to form composite cones.

The features.

1) Volcanoes:

These are hills or mountains formed when magma erupts and piles up around the vent until a cone is formed.

These are basically four types of volcanic cones.

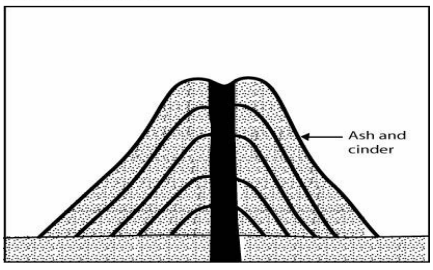
Types of volcanic cones

a) Ash/cinder cone:

These are small but steep sided hills formed when explosive eruptions throw lava high into the air, breaking it into small fragments or pieces known as pyroclastics (fire rocks).

The erupted materials build up around the vent; layer after layer forming steep sided cones.

Ash and cinder cones



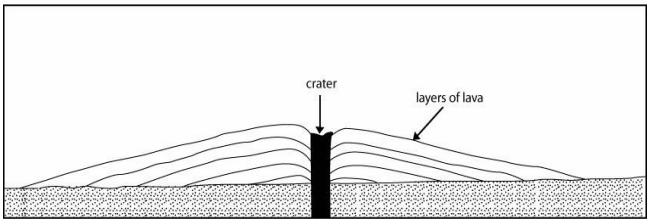
Examples in Kenya are chyulu hills to the west of Mtito Andei, Abili Agituk, Nabuyatom and Murniau ash cones to the south of Lake Turkana and Longonot. Teleki and Likaiyu to the south of Lake Turkana are cinder cones. The hills are characterized by a large crater /caldera at the top because of violet eruptions. The parasitic cones on mt. Kenya and Longonot arte ash cones.

b) Basic lava cone/basic lava domes/shield volcano.

This is a low lying hill with gently slopping sides formed when hot fluid lava, with low silica content, flows and spreads out in flat layers before solidifying.

It is shaped like a shield and hence the name shield volcano.

ash and cinder cones

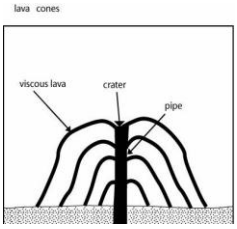


Examples include Nyamulagira ranges on Uganda- Rwanda boarder, mt. Marsabit in Kenya, Tukuyu Mountain in southern Tanzania.

c) Acid lava dome:

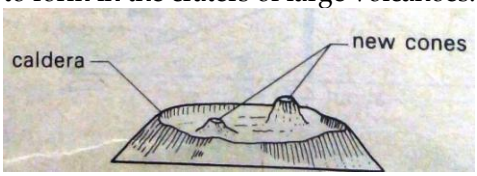
These are dome-shaped hills formed when thick lava rich in silica, solidifies quickly on reaching the surface.

lava cones



Examples – ***sernal volcano*** domes in Tsavo national park in Kenya, the itasy Massif of Madagascar, the western side of Lake Naivasha.

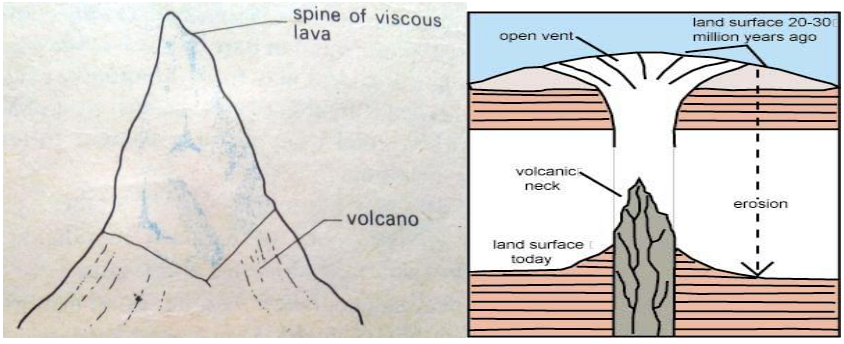
NB; Lava domes usually do not have craters (depressions) at their tops but the domes are instead known to form in the craters of large volcanoes. Such craters are called ***tholoids.***



d) Volcanic plug/volcanic neck.

The thick lava (viscous) lava, at times solidifies in the vent.

After prolonged erosion, the plug is exposed to the surface as a volcanic plug.



Spine volcano

Examples are the peaks of mt Kenya; Rangwe hills SW of Homa Bay existing as the remains of Kisingiri volcano, the Tororo rocks in Eastern Uganda.

e) A composite cone: / strato volcanoes,

These are formed by alternating layers of lava and **rock** fragments hence the name **composite**.

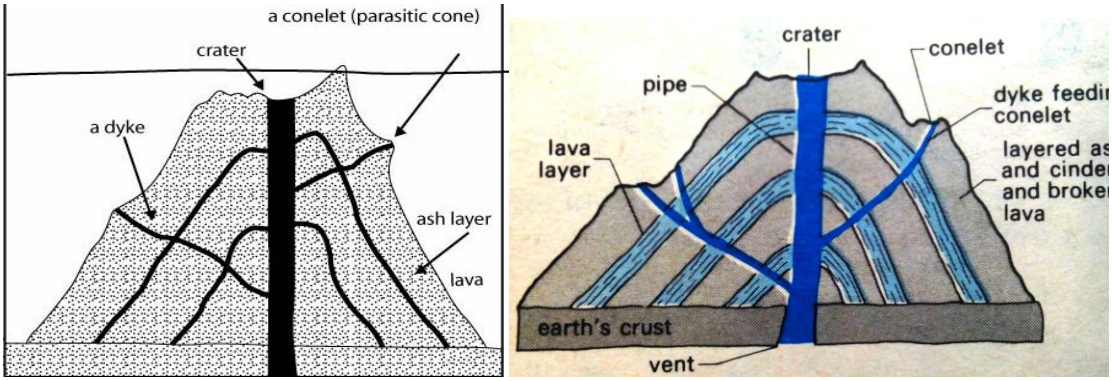
Formation.

An explosive period releases gas and ash and cinder layers.

Then the eruption changes to a quite period

Erupting lava then covers the top of ash layer.

When the cycle of ash and lave is repeated over and over in alternating layers, a composite volcano is formed.



At times lava is diverted sideways from the vent forming dykes, Corrects or **parasite cone** .Examples are Mt. Kenya, Kilimanjaro in Tanzania, Mahambura in South west Uganda, mount Cameroon in west Africa.

f) Plug domes/plug volcano/spine.

It is a column of very viscous acidic lava which sticks above the ground like a pillar when a mass of very viscous acidic magma is forced out of the ground in the shape of a rigid cylindrical column.



The Devil's tower in Wyoming State, USA.

As soon as the column of stiff magma reaches the surface, it starts to cool and harden as it vertically rises. The loose rocks in the line of weakness are thrown out due to high pressure, and they accumulate around the vent.

For example, Hyrax and Fischer's tower at Hell's Gate near Naivasha, Iharen in the Hoggar mountain of Algeria. Lassen Peak in California and the Devil's Tower in Wyoming State, USA.

g) Lava plateaus and plains.

A lava plateau is an extensive fairly level upland area which is elevated to over 500 m above sea level and covered by lava flows.

It is formed as a result of quite eruptions, when lava moves out slowly along cracks /faults.

The fluid lava flows for a very long times on the land, filling up depressions and valleys, leveling the entire surface before it solidifies, forming lava plateau.

Examples are; Uasin Gishu, Yatta, Laikipia and Turkana plateau in Kenya and Kisoro lava plain in Uganda.

NB; Lava plains do not have thick lava covering. Their original surface is covered in lava flows like lava plateaus, though not of great thickness. They are found at the foot of highlands and mountains.

Examples are the Athi-Kapiti plains, Mwea plains and the Nyando plains

h) Crater-.

A crater is a funnel-shaped/circular depression which forms at the mouth of a volcanic vent.

Craters are formed as follows

I) *During the formation of a volcano.*

When the outpouring of lava from the vent stops, the magma in the vent cools and therefore contracts at the same time.

This contraction and subsequent withdrawal of lava/magma into the vent creates a depression at the top of the volcano.

Examples are found on Mt. Marsabit, Ol Donyo Nyoike, Central Island of Lake Turkana, Kilimanjaro, Ol Donyo Lengai and Mahambura.

When rainwater or snowmelt water accumulates in the depression, a crater lake is formed.

Examples are lake paradise on Mount Marsabit, Lake Chala on the Kenya-Tanzania border and Lake Magadi in the Ngorongoro crater.

II) *Formation due to a volcanic explosion at ground level.*

Explosion craters are flat floor depressions formed when explosive eruptions of gases blow off the rocks at the surface leaving a shallow circular depression.

When explosion stops a ring crater or explosion crater is formed.

Water from rivers or underground may flow into the crater to form a crater lake that is known as **a Maar.**

Examples are found in south-*western Uganda between Lake George and Lake Albert. E.g.* Lake Katwe- *a major source of salt* in Uganda, L. Nyamuruka, Kyamwiga, Nyungu, Nyamsingire, L. Munyanyang, L. Saka, and Kyegere. Found in western Uganda, in Kasese, Kabarole and Bushenyi districts.

III) Formation of craters through non-volcanic processes.

Through the impact of a meteorite falling on the earth's surface from space, a depression may be formed as it sinks into the rocks.



Meteor Crater, Arizona

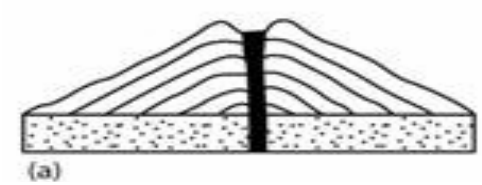
Water from the rains, rivers, and underground may accumulate in it to form a lake. E.g. the depression occupied by lake Bosumtwi-south-east of Kumasi in Ghana.

i) Caldera/basal wreck.

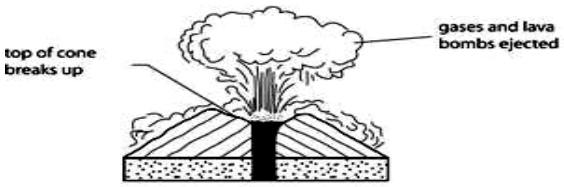
It is an enlargement of a crater on top of volcano. It is a very large basin-shaped depression surrounded by steep sides.

It may be formed in the following ways

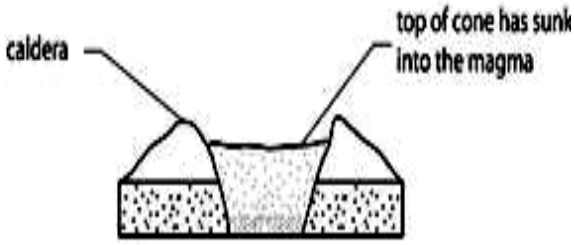
I) Due to violent eruption.



After eruptions, a volcano is formed and the magma in the vent settles and solidifies firmly sealing the vent.



a short period of dormancy may follow
Then molten magma heats the gases and steam beneath the volcano, which expand and try to escape to the earth, thus exerting a lot of pressure on the rocks above.
As the pressure piles up, the volcano explodes, blowing off its upper part (*head)*



Some fragments from the explosion fall back on the slopes to build it up.
Others fall into the vent and are melted by the magma.
Then a large depression called an explosion caldera is formed.

Examples are found on Menengai, Suswa, and Longonot in Kenya, Napaka, and Sabino in Uganda. Ngorongoro in Tanzania. Nyamulagira and Nyiragongo DRC, the caldera occupied by lake Toba on Sumatra Island in Indonesia..

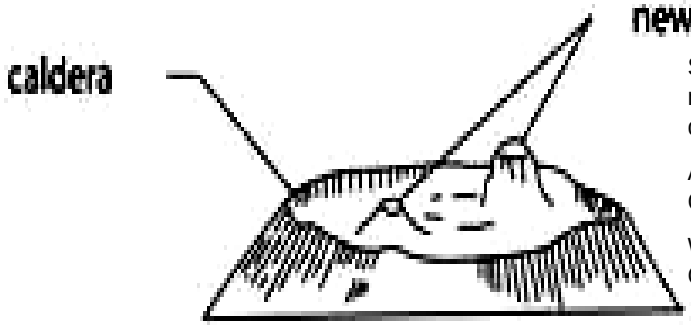
II) *By cauldron or block subsidence*.

When a volcano forms, the magma reservoir below the crust is left partly empty creating a cavity called a cauldron or void.
The rocks of the volcano will exert pressure on the crustal rocks over which they lie.
Weak lines develop in the crustal rocks making the volcano unstable.
The weight of the volcano overcomes resistance and its middle portion subsides into the cauldron. This may be triggered off by an earthquake.
A large depression is left on top of the now lower volcano. This depression is called a *collapse caldera*.
Examples of collapse calderas are Menengai near Nakuru, Embagai and Ngorongoro in northern Tanzania, lake Shala caldera in Ethiopia, Krakatoa in Sunda Straits between Java and Sumatra in Indonesia.

III). Formation by outward pouring.

- A high volcano build by ash and other Pyroclasts may become unstable in its mass due to the pressure exerted on the material beneath by the materials at the top.
- The materials at the base begin to spread outwards as the top of the volcano collapses inwards. This creates a depression which forms a caldera.
- An example is the Napak caldera in north-eastern Uganda formed due to the collapse of mount Napak.

NB; the height of the new volcano after the formation of a caldera is much lower than the original volcano.



Subsequent volcanic eruption but on a minor scale, may result in the formation of secondary cones inside the caldera**.**

An example is in Suswa, Meru Gadames and Krakatoa calderas.

Wizard island in crater lake district of Oregon is a secondary cone.

J) Lava dammed lakes.

- These are formed when lava blocks channels. Water pools behind leading to formation of lakes. Examples L.Bunyonyi and L. Mutande in southwest Uganda.

K) Fumaroles, Solfatara and Mofettes.

- A fumarole is a subsidiary vent on a volcano or a hole in the ground which mainly emits gases or steam.
- A Solfatara is a hole or subsidiary vent that emits steam and gases that are composed mainly of sulphurous compounds.
- Mofettes are vents/ holes that emit carbon dioxide gas and steam an example is found at Kereita in the uplands area of Kenya at Eburu west of Naivasha, at Ol karia in Kenya.
  NB; the source of the gases is the chemical reactions that take place within the crustal rocks when they are heated by magma. The minerals in the rocks determine the type of gases which flow out.

L) Hot springs /geyser:

These are features produced when heated water in volcanic areas flow out quietly in form of hot springs or erupt periodically shooting out water /steam in the air as geysers.

a) **Hot springs/thermal springs.**

- A hot spring is a place where hot water comes out of the ground.
- The water may not be very hot but it may be at a higher temperature than that of the normal water.

Formation.

- Rainwater/river water enters the crustal rocks through cracks and holes upto the hot rock location.
- Magma or the hot rock itself heats the water, some of it turning into vapour. Some of the water collects in chambers called sumps, within the rocks.
- The steam builds pressure causing the water in the chambers to be superheated.
- The pressure forces the steam upwards towards the earth's surface through cracks and holes in the rocks.
- As the steam is escaping to the surface, it heats the groundwater in the surrounding rocks.
- The ground water now under pressure finds its way to the surface quietly as a *hot spring*.

  Examples of hot springs are around the shores of Lake Magadi, Turkana basin and bogoria, at mahi mahiu and lower slopes of Longonot

b) A **geyser**

- This is a spring characterized by intermittent discharge of water ejected turbulently and accompanied by vapour and gases.



An erupting spring (geyser) at Haukadalur, Iceland.

- Generally the geyser effect is due to the proximity of magma. Surface water works its way down to a depth where it contacts hot rocks.
- The resultant boiling of the pressurized water results in the geyser effect of hot water and steam spraying out of the geyser's surface vent.

The formation of geysers specifically requires the following geologic conditions.

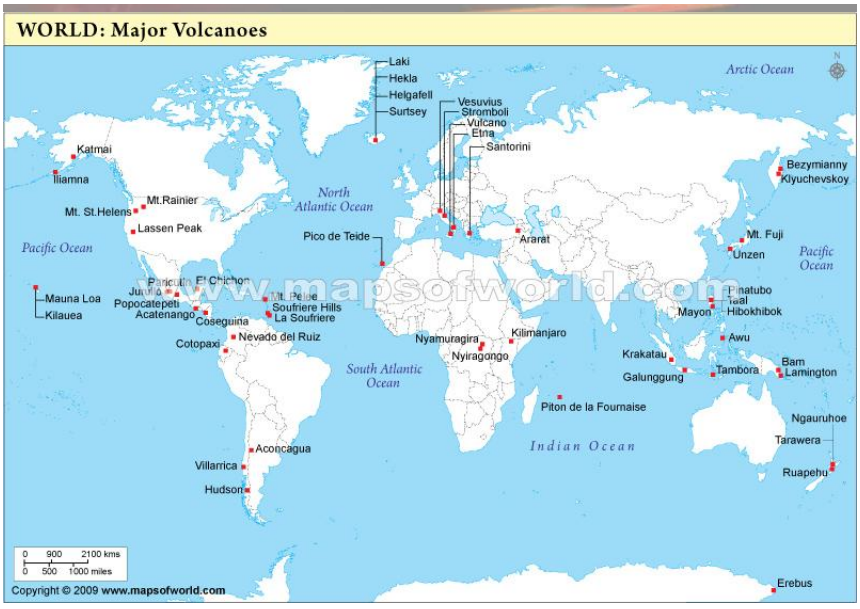
a) Intense heat. The magma needs to be near the surface of the earth to provide the heat needed for geyser formation.
b) Water. The water that is ejected from a geyser must travel underground through deep, pressurized fissures in the earth's crust.
c) A plumbing system that includes a reservoir to hold the water while being heated, fractures, fissures, porous spaces and sometimes cavities.
d) Constrictions in the system are essential to the building up of pressure before an eruption.

E.g. Geysers in Yellowstone National Park, Wyoming, United States. Examples in East Africa are Kitagata in Bushenyi, Sempaya in fort portal (Uganda), in the Rungwe mountain ranges in Tanzania, at Ol Karia, south-west of Lake Naivasha, at the western shores of Lake Bogoria.

Types of Volcanoes

1. Active: This is a volcano that has erupted within the last 500 years and still shows signs of activity.
2. Dormant: This is a volcano that has not erupted within the last 500 years but still shows signs of activity such as hot springs. An example is Mt. Kilimanjaro.
3. Extinct: This is a volcano that has not erupted within the last 500 years and shows no signs of activity. An example is Mt. Kenya, mt. Elgon.

Distribution of volcanoes and volcanic features.



Advantages of Vulcanicity

1. Volcanic mountains and lava plateau provide fertile volcanic soils which support agriculture, e.g. Arabic coffee is grown on mountain Elgon, Mufumbiro, Kenya and Kilimanjaro, coffee earns the country foreign currency and provides employment, and other crops grown include wheat, tea, pyrethrum, maize, bananas, vegetables, and Irish potatoes.

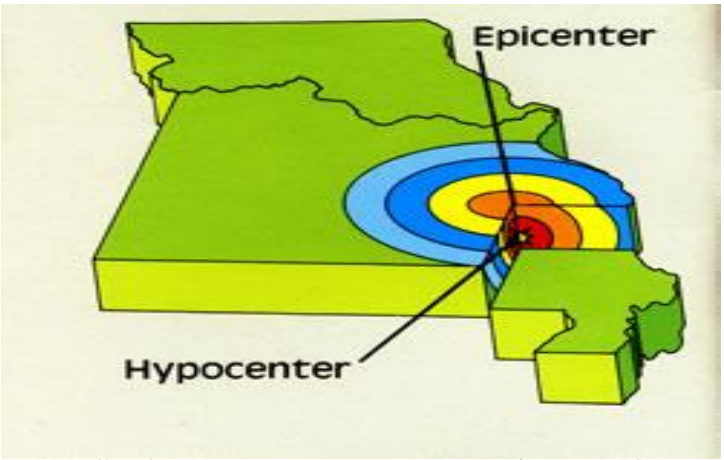
2. The highland areas are densely settled. This is due to the fertile soils and cool climate, e.g. Bugishu, Kigezi, Kenya and Kilimanjaro highlands. In addition some of these areas have large towns like Kabale, Mbale, Moshi, and Nairobi. This has led to development of commercial activities.
3. The volcanic features especially mountains are tourist attractions. They provide sporting activities like mountain climbing. They generate income in form of foreign exchange and provide employment to local people.
4. Volcanic mountains influence climate, lead to formation of geographic or relief rainfall which is important for agriculture. Some mountains are ice capped. They are a source of many rivers, which provide water for domestic use and generate hydroelectric power.
5. There are forest reserves on the slopes of mountains like Elgon, Mufumbiro Kenya, and Kilimanjaro which are valuable source of timber and firewood. The forests also act as wildlife conservation areas e.g. Bwindi impenetrable forests, has the largest population of gorillas, which promote tourism.
6. Lava or magma is rich in minerals e.g. Tororo rock volcanic plug is a source of limestone for the cement industry. Iron, tin and uranium are found in the Mufumbiro ranges. Lake Katwe which is an explosion crater is a centre for salt mining. The Kimberlitic rock in Tanzania is centre for gold mining. Minerals provide revenue and employment.
7. Hot springs or Geysers are potential source of geothermal power (electricity).in Kenya, the Olkaria Geothermal Power Station near Lake Naivasha in Kenya, generates electricity.
8. There is fishing in lava-damned lakes, which provides food and employment.
9. The intrusive features Batholiths, dyke, sills, laccoliths and Lappolith once exposed to the surface as Inselbergs have the following advantages;
    a) Good sites for quarrying. They are sources of stones used for construction.
    b) Sills and Dykes once crossed by rivers create waterfalls which are good for hydro power generation.
    c) They are tourist attractions.

Disadvantages of Vulcanicity

1. Volcanic features especially mountains are communication barriers due to steepness.
2. It is very expensive and risky to construct roads and railways in the hilly areas.
3. Volcanic eruption leads to loss of lives and property.
4. Heavy rainfall and steepness lead to soil erosion, mass wasting and landslides which are common in Kigezi and Elgon areas.
5. Mountains act as barriers to rainfall especially on the leeward side (rain shadow areas) this causes aridity.
6. Intrusive features like sills and dykes form waterfalls and rapids which hinder navigation of rivers.
7. Where there are Inselbergs and Batholiths make agriculture practicing difficult.

Earthquakes

- An **earthquake** is the shaking of the earth caused by the sudden release of energy from rocks under tectonic stress.
- The scientific study and interpretation of earthquakes is called **seismology.** Scientists who study earthquakes are called **seismologists.**
- We call the "point" (or region) inside the earth where an earthquake originates the **hypocenter** or **seismic focus**. The point on Earth's surface directly above the hypocenter is called the **epicenter**.



Practically, the epicenter is most important for societal impact, as it marks the position where energy release, and thus shaking, is largest. The position of *maximum* energy release is actually the focus, but if this region lies deep in the Earth, the effect at the surface may be minor.

- Earthquakes that are less violent are referred to as **earth tremors.**
- An earthquake beneath the ocean results in huge waves called seismic sea waves (**tsunamis**) that devastate coastlines.

CAUSES OF EARTHQUAKES.

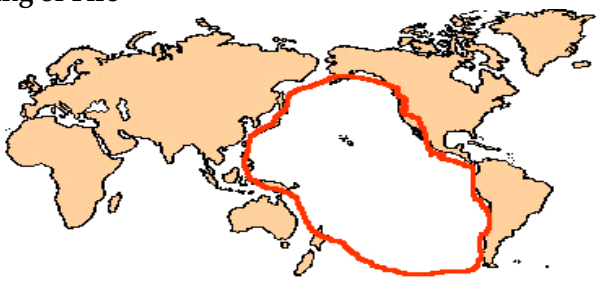
The causes are categorized as natural and human causes.

Natural causes.

a) *Tectonic movements*. The boundaries between moving plates are called faults. When plates in motion lock temporarily and release energy as the rocks fracture, this generates an earthquake. Such earthquakes are called **tectonic earthquake**s. This are common in Japan (the pacific plate is moving towards the Eurasian plate)

b) Vulcanicity. Magma movements within the earth's crust causes sudden displacement of crustal rocks. Violent volcanic explosions and emission of gases can also shake or shatter rocks. Suck earthquakes are common in Kenya in the Great Rift Valley and in the ring of fire in Japan.

Ring of Fire



This is the area in the Pacific where subduction is occurring. As the plates of North and South America move west and the Asia moves east, they are overriding the Pacific Ocean Plate.

Also sudden eruption of molten magma under the oceans can cause earth tremors as the water on the ocean floor expands violently.

c) Gravitative pressure. Due to Gravitative pressure the crustal rocks which are above the voids left by escaping magma move inwards to fill the cavities. As the crustal rocks sink due to this pressure, the ground shakes.

d) Isostatic adjustment. When erosion and melting of large masses of ice takes place on

the continental masses, the continents become lighter and therefore rise. The deposition on the sea bed causes the sima layers to be depressed (sink) into the mantle. This sinking disrupts the balance maintained by the sial and the sima layers. This triggers off earthquakes. E.*g.* in the mid-west and east coast of USA, and parts of Canada.

e) *Radioactivity in the mantle.* Where the activity is localized in parts of the mantle, it results in excessive energy release, sometimes explosively, sending shock waves outwards into the crustal rocks resulting in earthquakes.

Human causes..

a) *Underground nuclear test.* When nuclear bombs are detonated underground, they trigger off immense vibration of the earth in the region where they go off.

b) *Movement of trains.* A passing train generates vibrations as it rolls on its rails. These shockwaves can be felt in the neighbourhood of the railway.

c) *Use of explosives.* During quarrying or construction, explosives are sometimes used to blast the rocks. The explosives trigger off vibrations which are felt in the area surrounding the explosion site.

d) *Construction of large reservoirs*. Weight of water in man-made lakes (reservoirs) can reactivate dormant faults, triggering off tremors. For example around Lake Mead, behind Hoover dam on River Colorado in the USA. Also Lake Kariba, behind Kariba Dam on river Zambezi has caused earthquakes of up to 5.8 magnitudes.

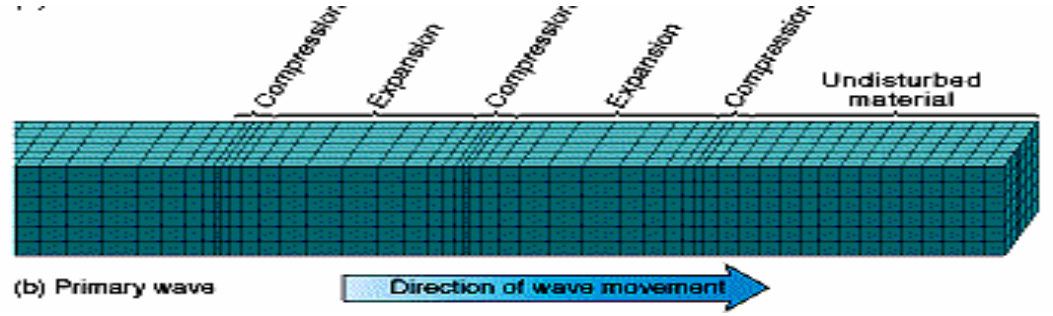
TYPES OF EARTHQUAKES.

- The shockwaves originating from the focus are also called **seismic waves**
- There are three types of seismic waves: P and S body waves and surface waves**.**

Body waves radiate outward from the focus in all directions and travel through solid rock.

a) **Primary waves**.

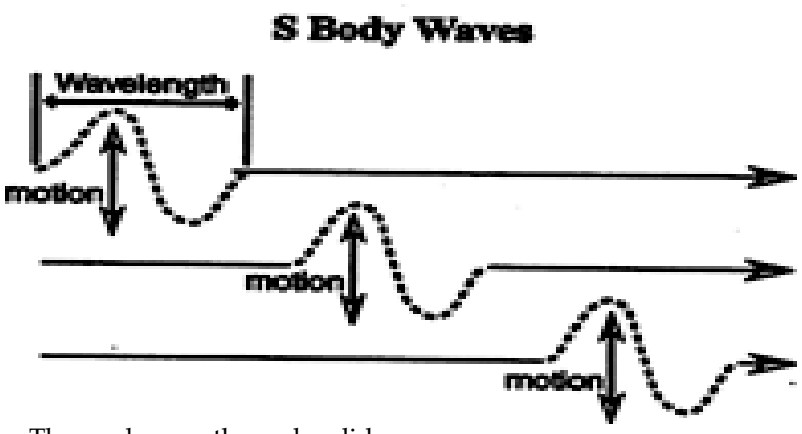
- A **P body wave (primary body wave)** is a Compressional (longitudinal) wave that induces the particles in the rock to vibrate back and forth in the same direction the wave moves.
- These are the fastest waves which are recorded first



- These waves can pass through gases, liquids and solids.

b) **Secondary waves.**

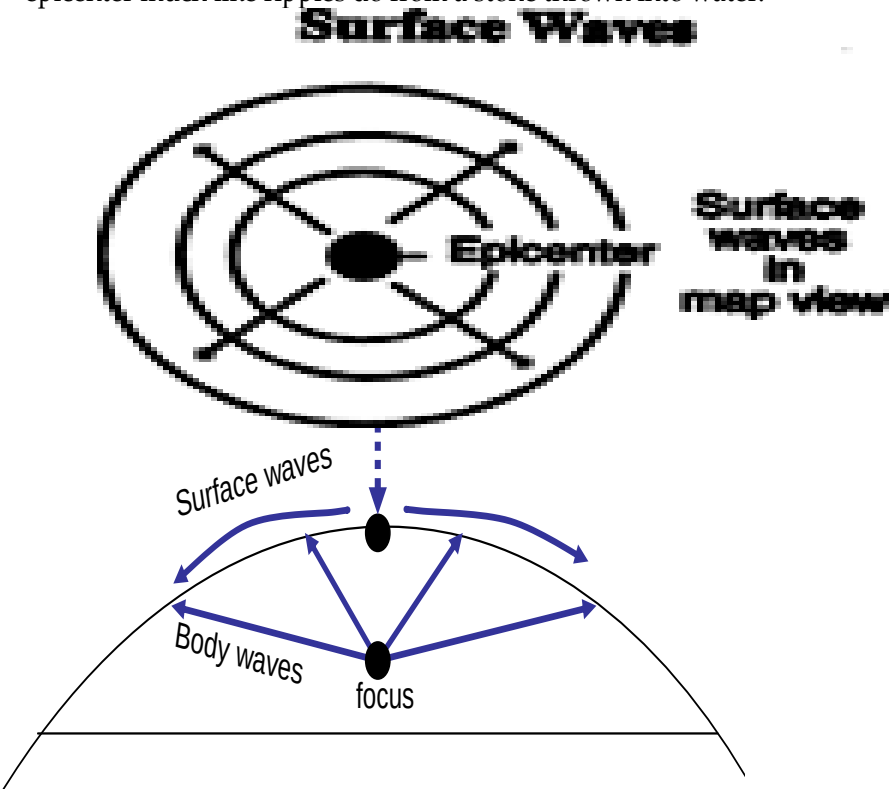
- S-waves represent a brief shear motion between atoms, which relax and are passed on.
- They cause the rock to vibrate at right angles to the direction of wave travel. They move like loops in a taut robe shaken at one end.



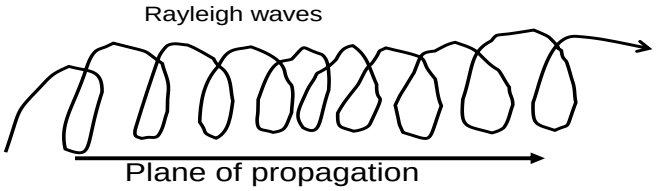
- They only pass through solids.

c) **Surface longitudinal waves.**

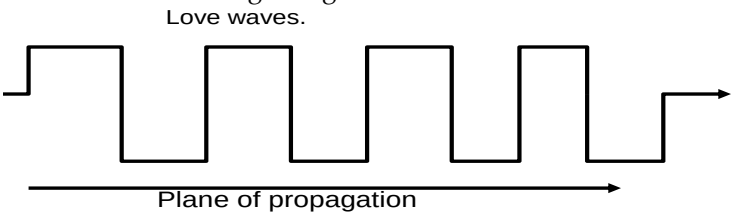
- These are the slowest seismic waves and travel outward on the earth's surface from the epicenter much like ripples do from a stone thrown into water.



- These are the waves responsible for most of the damages due to earthquakes. They cause the surface rock particles to shake, even causing buildings to collapse.
- They exist in two types;
    a) *Rayleigh waves.* Named after the person who first predicted them in 1887 (Lord Rayleigh III), they cause the surface rock particles to move in elliptical orbits.



b) *Love waves.* Also named after an oxford mathematician A.E.H. Love who first recognized them, the waves cause surface rock particles to move in a horizontal manner and at right angles to the direction of the wave.



Important points to note about earthquakes.

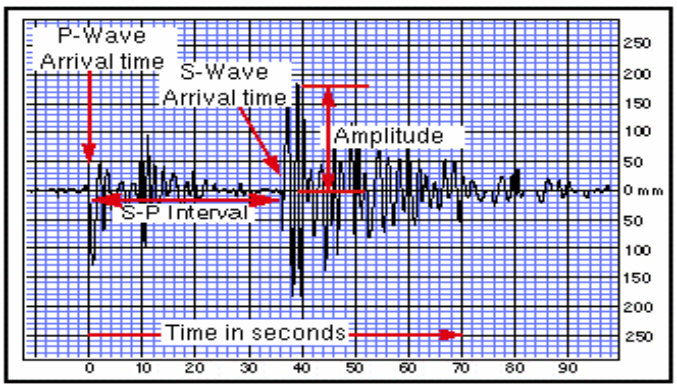
- Earthquakes can occur anywhere between the Earth's surface and about 700 kilometers below the surface. Based on their depth, earthquakes can be described as shallow, intermediate, and deep focus.
- **Shallow earthquakes** are between 0 and 70 km deep; **intermediate earthquakes**, 70 - 300 km **deep**; and **deep earthquakes**, 300 - 700 km deep. In general, the term "deep-focus earthquakes" is applied to earthquakes deeper than 70 km.
- Areas with deep focus earthquakes record higher earthquake magnitudes and are more disastrous.
- The velocity of all waves increase with depth to the Gutenberg discontinuity. Earthquakes travel faster in denser materials.

Measurement of earthquakes.

Seismometers.

- Seismic waves are detected with a **seismometer**, which contains a suspended pendulum-like mass that is kept as motionless as possible.
- The seismometer is connected to a **seismograph**, which records the motion of the mass during an earthquake as a series of squiggly lines called a **seismogram** (a graph-like record on which the impulses are recorded)
- Reading and interpretation of seismic waves are made from the seismogram.
- The location, depth, and strength of an earthquake can easily be calculated from the seismograph data.

A typical seismogram (Figure).



•There are times of wide swings of the recorder against a background of small amplitude. ***Amplitude*** is the technical term for the distance between the average background and the maximum swing of the needle. The pattern falls into two components: an initial series of swings followed by slowly diminishing activity, then a second wave of greater amplitude. If the station is sufficiently close to the earthquake source region, the needle continues to move even after this second wave of activity. These pulses of activity record different types of waves that emanate from an earthquake.

• Those arriving first are called P-waves, for Primary waves, whereas the second pulse of waves are predictably called S-waves.

The strength of an earthquake is measured by its intensity and magnitude.

Intensity

- Intensity refers to the effect of an earthquake on the Earth's surface. The **modified Mercalli scale**

ranks intensity from 1 to 12 according to the amount of resulting damage.

- The maximum observed intensity generally occurs near the epicenter.
- *This system is not however totally accurate because;*
    - **a.** The amount of damage is often proportional to the type of design and construction of buildings, and the bedrock on which the buildings sit.
    - **b.** Intensities cannot be assigned to earthquakes in uninhabited areas because there is little physical damage that can be quantified.

Magnitude

- Magnitude is the measure of the amount of energy given off by an earthquake.
- By analyzing the seismic waves, the magnitude, or the amount of energy released by the earthquake, can be determined.
- The **Richter scale** is a numerical scale that lists earthquake magnitudes in logarithmic increments from about 2 to 8.6—the highest value ever recorded on the scale.
- For example, an earthquake that is a 3 on the Richter scale has a vibration ten times bigger than that for a 2. The difference in energy released is even larger: a Richter 3 is about thirty times more powerful than a Richter 2.

Effects of earthquakes.

a) **Structural damage and fire.** Surface trembling from seismic waves often damages buildings. Depending on the severity of the earthquake, gas mains may break, starting numerous fires.
b) **Mass-wasting events.** Ground motion may trigger landslides and other rapid mass-wasting events that result in loss of life and damage to buildings. This happened in the Loess county of China in 1920 and 1927.
c) **Rocks can be permanently displaced during an earthquake**. Fault blocks may move vertically, forming a new scarp along the fault plane. Horizontal movement can tear apart roads, pipelines, and any other structures that are built across the fault zone.
d) **Seismic sea waves/ tsunamis.** If the sea floor suddenly shifts upward or downward, the sudden displacement of water results in **seismic sea waves**, or **tsunamis**, resulting in widespread coastal damage.
e) Earthquakes can cause violent motions of the earth's surface.
f) Parts of the sea floor can be raised or lowered. E.g. in 1923, a part of Sagami Bay in Japan was raised by as much as 213m. In 1899, parts of the coastal rocks in Alaska were uplifted by 15m by an earthquake.

WORLD DISTRIBUTION OF EARTHQUAKES

- Earthquakes mostly occur in **seismic zones.**
- Areas which are not prone to earthquakes are called **aseismic zones.**
- Earthquakes occur in well-defined belts that correspond to active plate tectonic zones.
- The main seismic zones of the world include;
    a) The **circum-Pacific belt** (also called the **Rim of Fire**) hosts over 80 percent of the world's shallow and medium-depth earthquakes and 100 percent of the deep earthquakes.
    b) Other earthquake zones are the **Mediterranean-Himalayan belt** and the **mid-oceanic ridges** that split the crust at the bottom of the world's oceans.
    c) **Plate boundaries and associated earthquakes.** Distribution plots reveal that many earthquakes are associated with andesitic volcanic action and oceanic trenches that occur over subduction zones in the circum-Pacific belt.
    d) A belt across southern Europe and south-east Asia including the Himalayas.
    e) Along the boundaries of tectonic plates.

Some Destructive Earthquakes

Date	Location	Deaths	Magn.	Comments

December 26, 2004	Sumatra	280,000	9.1	tsunami (NOAA); about dozen countries affected
May 22, 1927	China, near Xining	200,000	8.3	Large fractures
December 16, 1920	China,Gansu	200,000	8.6	Major fractures, landslides
September 1, 1923	Japan, Kwanto	143,000	8.3	Great Tokyo fire
December 28, 1908	Italy, Messina	70,000	7.5	Deaths from 70,000 to 100,000 (estimated); earthquake and tsunami
November 1, 1755	Portugal, Lisbon	70,000	8.7	Great tsunami

MAPWORK

DIRECTION AND BEARING

Direction;

This a line along which something is moving, pointing or facing.

Ways of finding direction.

Traditional methods.

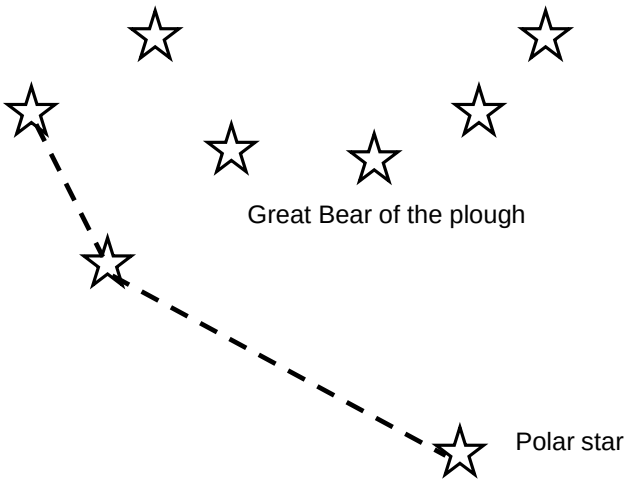
a) Use of landmarks

These are familiar features on the surface of the earth that can help give a clue to travelers' direction.
This helps the traveler to find the way from one place to another e.g rivers, hills, roads, buildings, etc. for example; "go down the road, turn tight and go uphill" etc.
The method however has a limitation in areas where there are no landmarks.
For example in deserts and large water bodies.

b) Use of heavenly bodies.

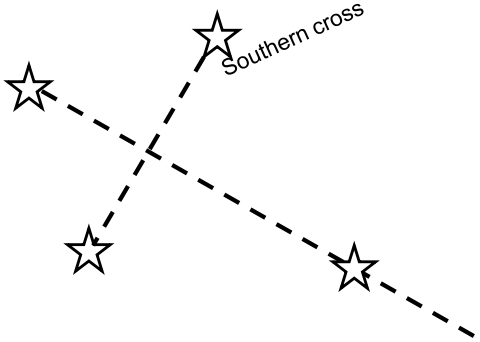
i) The North Star (polar star)

It always appears in the same position in the sky.
The star indicates the North Pole and can be viewed from any place in the northern hemisphere.



ii) The Southern Cross

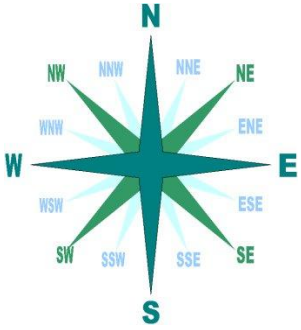
The Southern Cross is a group of bright stars used to indicate South Pole in the southern hemisphere. They a pattern like a cross hence the name 'southern cross'



Modern methods

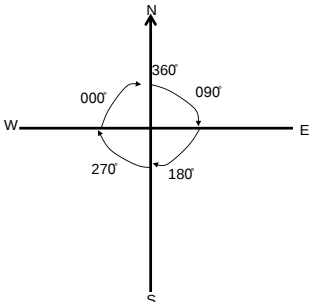
(i) The compass.

This a scientific instrument whose needle always points to the north. It has a total of 32 points but only 16 are commonly used. The cardinal points are N, S, W and E. The method is more accurate than the traditional methods.



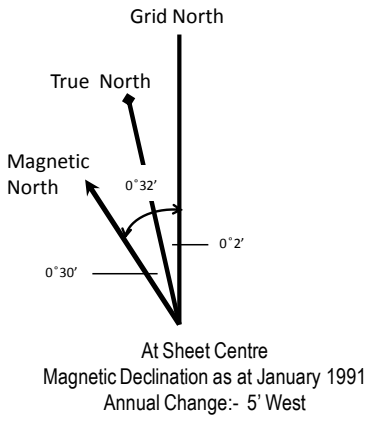
Bearing.

This is the direction measured as an angle and given in degrees read in a clockwise direction from the North line.



All places to the East of the North-south line have bearings of between 0˚and 180˚ and to the west of the same line have the bearing s of between 180˚ and 360°.
The bearings are stated in three figures e.g North is stated as 360° or 000˚ and East as 090˚.
Movement in a clockwise direction from north to north covers a complete circle of 360°.

Types of bearing.
The expressions of the north are;
Geographical North
This is the position of the North Pole as shown on the globe (point where longitudes meet.)
Magnetic North.
This is the earth's magnetic North as determined by the earth's magnetic field. This is the direction to which the needle of a compass points when it comes to rest. The position varies in different parts of the world and with time
The Angular difference between the True North and the magnetic North is called Magnetic Variation (Declination)
Grid North.
It is in the same alignment as the North-South map Grid lines on topographical maps. It is based on the national Grid system but each map and set has its own grid north.
It is usually as close to the true north as possible and sometimes coincides with it.



When the map was drawn, magnetic variation was 0 ˚32′ west of the true North. the position of the grid North was 2 minutes of a degree east of the True North and 0 ˚32′ east of the magnetic north.
Magnetic variation (Declination)
This is the angle between the magnetic North and the True North, at any point on the earth's surface. It is expressed in degrees east or west of true north. This angle changes because the position of the magnetic North changes with time.

HOW TO DETERMINE THE POSITION OF A PLACE ON A MAP.

The position of a place can be expressed in any of the following ways;

a) By use of bearing and distance from one place to another.
b) By use of place names.
c) By use of Grid References.
d) By use of Latitudes and Longitudes.
e)

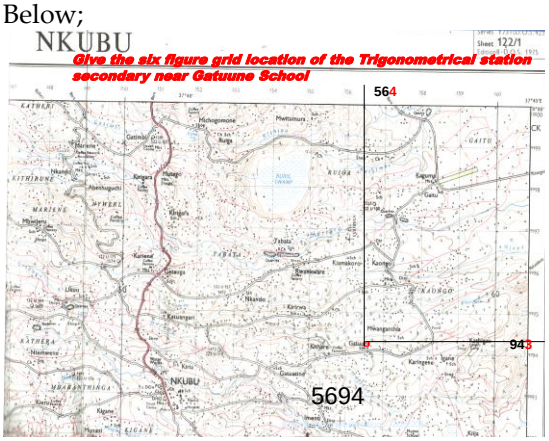
Grid References.

A grid is a network of imaginary horizontal lines and vertical lines drawn on a map forming equal squares.
The vertical lines are called Eastings because they are numbered eastwards.
The Horizontal lines are called Northings because they are numbered northwards.
Each grid line is given a number starting from the south-western corner which is known as the Grid Origin.
The most common grid on Kenyan maps is based on printed squares of 1km.

How to give a grid reference

Read and give the figure for the Easting first.
Follow this figure with the Northing.
When giving a Grid Reference, both decimal points and Commas are eliminated in the coordinates. And a single continuous figure is given.
Grid values are given in plain figures i.e. units of length are not expressed.
When giving grid reference, read the bold numbers only.
For example

*Give the **six** figure grid location of the Trigonometrical station secondary near Gatuune School*
Below;

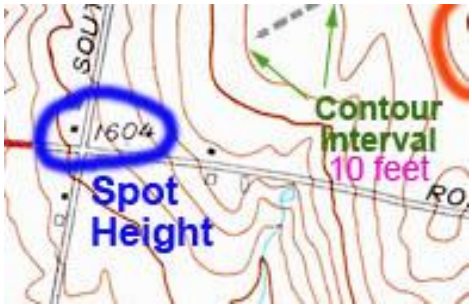


Write down the Easting first then the Northing.
Four figure references are approximation and only refer to the Grid Squares in which the points lie.

Methods of representing relief on topographical maps.

Spot heights.
They are points on a map whose positions and heights have been determined by surveyors.
They are shown on a map by a dot and a figure. For example; ·1604.
Units of height are quoted in the key on a map. E.g if units are in metres then that place is 1604 metres

above sea level.

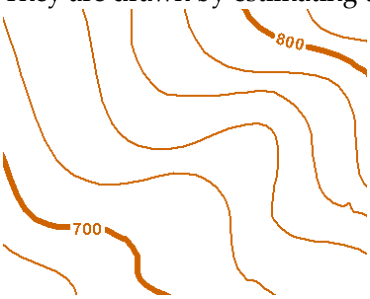


Spot heights show the actual height of a point on a map.

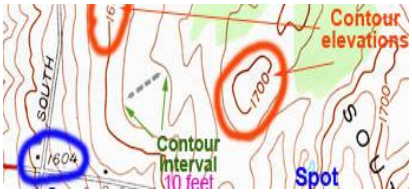
Trigonometrical Stations (points)
They are corners or intersections of carefully measured triangles which form the basis of surveying an area.
They are marked on the ground by a concrete pillar, slab or stone in locations that offer maximum view of an area. E.g hills and mountains are usually chosen.
They are indicated on a map by use of special symbols and their height above sea level written beside them.
They show actual heights of places on a map.
Disadvantage; they don't give the trend of relief of an area on their own
It is impossible to use them to identify landforms.

Trigonometrical stations (illustrations)

Contours and form lines
Contours are lines on a map joining all points of the same height above sea level. They are also known as Isohypes.
Such points are accurately determined
Formlines are lines drawn on a map joining points of approximately the same height above sea level.
They are drawn by estimating the height of the land with the help of spot heights.



Contours are drawn in darker colour and their values are shown while form lines are faint and sometimes doted and may not have values written on them.
For practical purposes, Formlines are generally regarded as contours.
Contour interval;
This is the difference e in height between any two successive contours. It is also known as vertical interval. This interval is constant throughout a given map.



Advantages

It is easy to identify variety of landforms using contours.

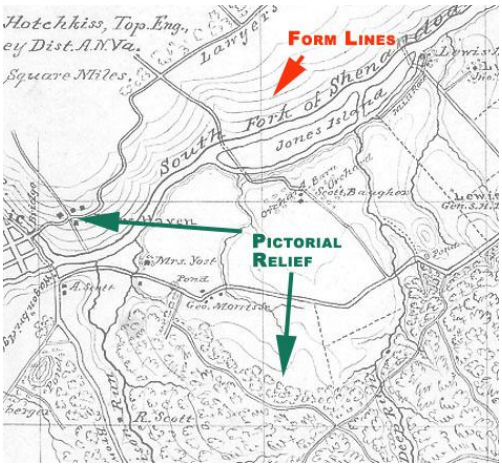
Slope of the land can easily be determined from contours e.g when drawn closely together; it shows that the land is steep while widely spaced contours indicate gently sloping land.

It is possible to estimate heights of places using contours.

Pictorials

This is a method of showing relief using drawings of landforms

Pictures of landforms like hills, mountains and valleys are drawn on a map in the approximate positions where the landforms are to be found.



Such maps are not common today

Advantages;

They are easy to interpret because the type and shape of the landforms can easily be determined.

Disadvantages

Symbols are viewed from an angle which is contrary to the idea that a map is supposed to be viewed vertically from above.

Pictures may obscure the details behind them.

They do not give heights of land above sea level as it is difficult to draw the symbols in proportion to their various heights or depths.

A limited variety of landforms can be shown.

Hachures.

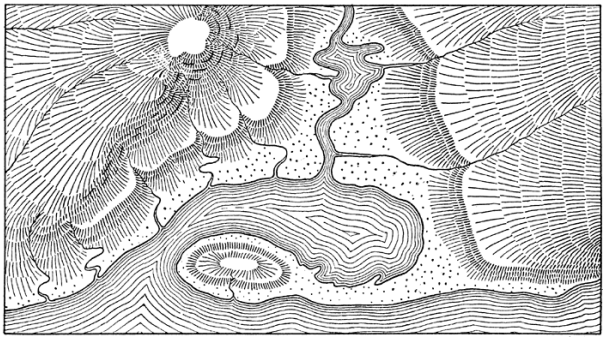
These are short lines drawn to represent the direction of the slope of land.

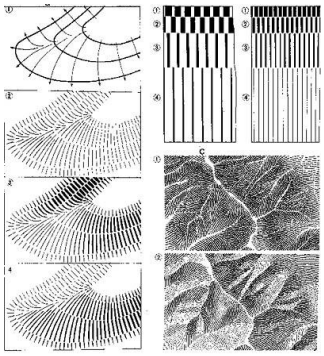
Where the slope is steep, the lines are thick and close together.

Where the slope is gentle, the lines are thin and wide apart.

Where the land is flat, there are no hachures.

They are sometimes used alongside contours to show minor features like road cuttings or small craters





Advantages

They give an idea about the general relief of an area. Steep slopes can be distinguished from gentle slopes.

These lines together with contours show minor but important details on maps.

Disadvantages;

If used alone, the map would lack definite information about height of land above sea level.

It would be difficult to determine the steepness of land.

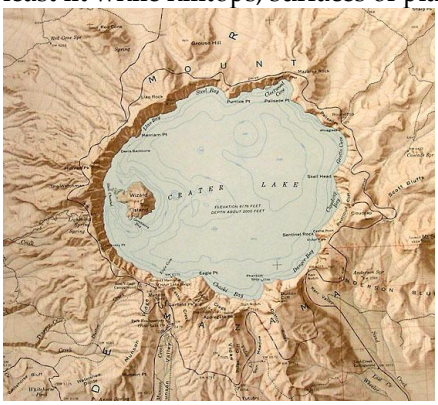
It requires a lot of time to draw.

It is difficult to show other features. E.g area under vegetation / crops either in writing or drawing without interfering with hachures

Hill shading.

The method uses light to illuminate some parts of the map while casting shadows on others.

The first technique assumes that light is shinning vertically above land. Therefore the steepest slopes are least lit while hilltops, surfaces of plateaus and valley bottoms are well lit.



The least lit areas have a darker shade while the well lit areas have a light shade.

The second technique assumes that light is shinning over the land from N-W direction, slopes facing N-W and West appear well lit and are not coloured while slopes facing East and south have darker colour.

Varying shades of colour are used.

The method is commonly used on atlas maps showing relief.

Advantage.

It gives an idea about the general relief of the region.

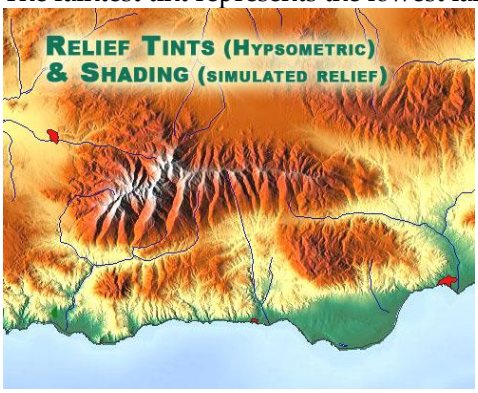
Disadvantage.

It does not show accurate heights above sea level.

Insertion of more details is difficult in darkly shaded areas.

It is difficult to determine direction of slope and types of landforms on the map.

Layer tinting.
This involves some use of colour or some form of shade (hypsometric shading)
Land within a certain range of altitude is given a particular colour or shade.
A single colour with varying tones is used e.g Brown.
The faintest tint represents the lowest land and it becomes progressively darker with increasing altitude.



A set of carefully chosen colours can be used to represent land within each range of altitude.

colour	**height**
White	Over 5500m
Purple	3600-5500m
Brownish- purple	2700-3600 m
Dark- brown	1800- 2700m
Light- brown	1400- 1800m
Brownish- yellow	900-1400m
yellow	400- 900m
Light green	180- 400m
Green	0- 180m

Each tint merges into the next tint to show continuity of relief.
Hypsometric (line) shading can also depict relief.
Lines used are of uniform colour and only vary in concentration.

PHOTOGRAPH WORK.

PHOTOGRAPH

It is an image or likeness of an object, person or scene in form of a print or slide recorded in a camera on a film (photosensitive material).
Photographs are printed on paper and are available in books, newspapers, posters and calendars
Motion pictures are found in video tapes, television, cinema, computer Discs etc.

Types of photographs
Photographs are classified according to the position they are taken from.
The main types are;

a) Ground photographs
b) Aerial photographs

a) Ground photographs

These are taken from the ground with the camera held level to the object.
The photographer stands in a position where he can see the object directly in front of him.
Objects near the camera appear big and clear.
An area hidden from the eye of the caner by an object is called the ***Dead Ground.***

Types of ground photographs

i. Ground horizontals.

They are photographs taken with the camera held at the same level as the object.
They show clearly what immediately infront o the camera is.
There are two types of Ground Horizontals;
Ground Close-ups (particular view)
The camera is focused on one main item. This item obscures other things behind it.
Ground general-view.
Objects become progressively smaller from the foreground to the background.
They give a general view of the scene.

ii. **Ground Oblique**.

These are taken while the photographer is holding the camera at an angle but while standing on the ground. E.g on top of a building or a hill overlooking the lower ground.
The camera is tilted towards the object/scenary.
Images appear to reduce in size from foreground to the background.

b) Aerial View Photographs.

They are taken from the air. It is mainly done from aircrafts, hot-air balloons and satellites.
There are two types of aerial view photographs;

Aerial oblique

These are taken while the camera is tilted towards the ground.
They cover a large area and may include the horizon.
Objects near the camera appear slightly larger than those away.

Vertical aerial photographs

They are taken with the camera directly above the object or scenary.
They focus on specific features on the ground.
They also show the area surrounding the feature/ scenary.

PARTS OF A PHOTOGRAPH.

A photograph can be divided horizontally into
Foreground: - the area at the front or nearest to the camera.
Middle ground: - the area in the middle distance away from the camera.
Background: - the area farthest away from the camera upto and including the horizon.
Vertical divisions of a photograph are left, Right and centre.
When both horizontal and vertical divisions are combined, we get 9 parts. i.e.

LEFT BACKGROUND	CENTRE BACKGROUND	RIGHT BACKGROUND

LEFT MIDDLEGROUND	CENTRE MIDDLEGROUND	RIGHT MIDDLEGROUND
LEFT FOREGROUND	CENTRE FORGROUND	RIGHT FOREGROUND

The divisions are used to describe location of features in a photograph.

Uses of photographs.

a) They show acute objects as they appear.
b) They show physical features on a photograph. E.g, vegetation drainage etc.
c) They show human and economic activities e.g. transport and communication, agricultural activities.
d) They are used to describe/deduce the climate of an area.

Limitations.

a) They are expensive to produce.
b) Black and white photographs do not give the real colours of objects or scenary.
c) Photographs obscure a lot of details.
d) Some objects especially in aerial photographs and those that are far away from the camera may not be clear, leading to wrong interpretation.
e) They have no scale and so it is difficult to work on distance accurately.
f) Vertical aerial photographs are difficult to interpret without special instruments like stereoscopes.
g) If the camera is not well focused, the details in the photograph will be blurred.
h) It becomes difficult to distinguish features that look similar e.g wheat and barley.

INTERPRETATION OF PHOTOGRAPHS.

This involves the following;

Determining the title.

~ When deciding on the title, examine the information in the foreground, middle and background carefully.
~ Study all activities shown on the landscape to determine a suitable title.

Estimating time and season.

~ It is possible to estimate time if we know where the photograph was taken.
~ If the photograph was taken I the tropics, and shadows of objects appear short, then the time was around noon.
~ Shadows are shortest around midday and longest early in the morning or late in the afternoon.
~ If the photograph was taken in the northern hemisphere and the camera was facing north, then the time would be morning if the shadows are on the left side of the object.
~ If on the right, it would be in the afternoon.
~ The reverse is true if the photograph was taken in the southern hemisphere.
~ It is also possible to determine the hemisphere in which the photograph was taken or the direction the camera was facing.
~ Beyond the tropic, the sun never gets overhead but the shadows behave similarly to those in the tropics. They are shortest at midday and points pole wards.
~ Bright clear skies with dry vegetation could indicate a dry period or season.
~ Luxuriant vegetation, young crops in the fields, flowering plants and rain clouds in the sky could indicate a rainy season.
~ Winter could be indicated by presence of snow on the ground
~ Type of clothing can indicate the prevailing temperatures at the time the photograph was taken.
~ Activities shown determine the time of the year when the photograph was taken especially if the area

is known.

Estimating direction.

~ Compass direction can be determined from the photograph. E.g;
~ If a photograph shows a flagpole whose shadow is on the right and it is indicated it was taken within the tropics in the morning, the photographer was facing south.
~ Therefore the sun is on the left and the shadows of objects will be on the right i.e. west.
~ If the shadows are pointing towards you and the photograph was taken in the afternoon, meaning the sun was in the west, then the camera was facing west.

Estimating the sizes of features.

~ Size of a familiar object can be estimated e.g a hammer can be placed against a rock formation. The size of the hammer being known can then be used to determine the size of the rock.
~ Heights of trees, house etc could be estimated using familiar features in the photograph taken on the same level and at the same distance from the camera. E.g objects appear smaller the farther away from the camera.

STUDYING PHYSICAL FEATURES ON A PHOTOGRAPH.

Relief.

a) Flat landscape

~ It occurs in lowlands and uplands or in areas with a meandering river.
~ A *plain* is a landscape found in lowland areas normally less than 500m above sea level.
~ *Plateaus* are flat areas above 500m above sea level.
~ *Undulating ground* is a relatively flat area with low-lying hills.
~ Types of crops grown can give a clue on the relief of an area. E.g rice growing is a likely indication that the area is flat.
~ Activities such as irrigation indicate that the land is relatively flat.
~ If hills are prominent and isolated on the flat land, then they are called *Inselberg*.

b) Hilly and mountainous landscape.

~ An area of more than 2000m above sea level is reffered to as mountainous.
~ It is characterized by steep slopes either on an individual block of land or extended mountain range e.g Aberdere range.
~ Crops grown can deduce the altitude of the area e.g. Tea and wheat grow in high altitude areas in Kenya.

Drainage

~ Drainage features include swamps, rivers, waterholes, ponds and reservoirs.
~ Presence of waterfalls and rapids indicates that a river is flowing in a steep region.
~ Meanders show that a river is in its middle stage or old stage.
~ A river delta can be identified by the presence of many channels or distributaries before the river enters into the ocean or lake.

Vegetation.

~ It is the plant cover which develops under natural conditions in a particular climate, relief and soil.
~ When describing vegetation of a given area, consider the following;
~ Identify the type of vegetation e.g. forest, thicket, scrub grass etc.
~ Describe the height and shape of vegetation e.g tall or short trees, broad leaves or needle or thorny leaves
~ Try to identify some species of trees which are easily identifiable e.g. Acacia trees.
~ Relate vegetation types to climatic regions e.g desert vegetation, savanna grasslands and tropical rainforests.
~ Distinguish between planted and natural vegetation e.g. planted trees appear in rows, are same

species and have no undergrowths.

NB: Apply knowledge from other subjects like biology when studying vegetation.

Climate

~ It is expressed in terms of temperature and rainfall.
~ The type of clothes worn by people can indicate the type of weather at the time.
~ Human features e.g. activities being undertaken, types of houses and their style of building are indicators of the climatic conditions.
~ Types of crops grown and animals kept also give a clue. E.g sugar plantations would mean relatively high temperatures while tea would suggest cool temperatures.
~ Crops such as tea and coffee would suggest that the area receives relatively high rainfall.
~ Types of vegetation e.g. dense forests with tall trees close to one another suggest that the area receives heavy and reliable rainfall.
~ Predominant sisal or grass plantations indicate a dry climate with very low and unreliable rainfall.

Soils

~ Types of soils can be determined by studying the crops grown.
~ Some crops grow only in certain soils. E.g coffee trees suggest acidic and volcanic soils.
~ Coconut and cashew nuts suggest that the area has sandy soils while horticultural crops mainly do well in loamy soils.

HUMAN ACTIVITIES

These include farming, settlement, mining, transport and communication, fishing and lumbering.

Transport and communication.

There are various forms of transport.

The following are the indicators;

~ *Motor transport*:- shown by roads or motor vehicles
~ *Rail transport*: - indicated by a railway line with or without a train.
~ *Air transport*: - indicated by a large flat tarmac piece of ground with buildings on side and a control tower. An aircraft may be packed on the runway near the airport buildings.
~ *Water transport*: - indicated by presence of boats, ships and large water vessels.
~ Presence of communication services is indicated by facilities like telephone lines, booths, satellite masts, TV and Radio stations, post offices, newspapers etc.

Industrial and mining activities are indicated by the presence of;

~ Facing buildings with tall chimneys, nucleated settlements for workers oil refineries with chimneys emitting flames of fires.
~ Large open pits, large excavators and Lorries carrying loads of rocks eg open-cast mining.

Lumbering

It can be indicated by;

~ People cutting trees with power saw.
~ People loading timber into Lorries.
~ Rafts of logs floating down a river.
~ Logs piled near a sawmill
~ Large forest clearings with tree stumps and piles of logs.

Settlements.

These are groups of dwellings where people live and interact with one another. Rural settlements are indicated by;

~ Simple architectural designs of semi-permanent buildings.
~ Farming or fishing activities.

- ~ Uneven and unplanned distribution of dwellings/ the presence of villages.

Urban settlement can be indicated by;

- ~ Dominant permanent buildings.
- ~ Regular street patterns.
- ~ Buildings with several storeys'.
- ~ An industrial part of the town which has many large buildings and warehouses.
- ~ High population densities.
- ~ Heavy motor traffic.
- ~ Port facilities e.g cranes, warehouses and containers.
- ~ Well developed communication network.

Farming

This may be in form of Crop farming and livestock keeping
It also includes subsistence and commercial farming.
Factors favouring farming are;

- ~ Reliable rainfall.
- ~ Well drained landscape.
- ~ Good transport facilities.
- ~ Markets.
- ~ Grazing land.

Bear in mind the following Aspects of economic geography relating to various types of farming when interpreting a photograph.

- ~ Main characteristic of each type of farming.
- ~ Areas where such farming is carried out.
- ~ Benefits and problems associated with each type of farming.
- ~ Effects of the farming on environment e.g. soil erosion.
- ~ Government policy on the type of farming.

Identification of various types of farming on a photograph.

Subsistence farming:-

- ~ Fields may b separated by hedges.
- ~ Local and exotic breeds are kept.
- ~ Use of simple farm implements.

Mixed cropping.

- ~ Land divided into small portions.
- ~ Both permanent and temporary houses.

Livestock farming*;*

Traditional livestock farming.

- ~ Cattle grazing in a grassland /semi arid region.
- ~ Large herds of traditional cows and goats e.g Zebu cattle.

Ranching.

- ~ Large fields divided into paddocks.
- ~ Presence of cattle shades near farm houses.
- ~ Presence of Windmills for water supply.
- ~ Presence of water tanks, ponds or reservoirs in dry areas.
- ~ Presence of Cattle dips on farms.

Dairy farming;

- ~ High grade cows with big udders.
- ~ Milk processing plants.
- ~ Zero grazing.

Sketching diagrams from photographs.

Follow the following steps:-

a) Draw a rectangle or a square of the same size as the photograph. If the photograph is too large, the rectangle or square can be made smaller, but it should be proportional to the size of the photograph.
b) Subdivide the photograph you want to sketch into three equal sections by faintly drawing horizontal lines across the photograph using a pencil. You will therefore have foreground, middle and background.
c) Draw faint vertical lines on the photograph, which are at the same distance apart as the horizontal lines to form a network of squares. You have now divided the photograph into left, centre and right.
d) Starting with the background, draw the skyline on your framework just as it appears on the photograph.
e) Fill in the main features in the photograph. Do not draw animals. Do not shade or draw fine details.
f) Complete the details in the middle ground and finally put in the important features in the foreground.
g) The squares drawn will guide you in placing the various features in their right positions.
h) Complete the sketch by drawing and labeling all important features e.g vegetation land use, permanent buildings etc.

STATISTICAL METHODS

Comparative Line graphs (group line graphs or multiple line graphs)

These are a series of line graphs that are drawn on the same chart to show the relationship between sets of similar statistics for two or more items.

Steps followed in constructing comparative line graphs.

a) Decide on a suitable scale for both the horizontal and vertical axis.
   Label values on the X and Y axis. E.g values for crop production on Y axis and year (duration) on the

X axis.

b) Draw line graphs for the commodities in question on the same frame with each line starting from a common base.
   Each commodity /item should be presented using a separate/different line. E.g. lines can be of different shade or colour.
   The item that each line represents should be written alongside it- only if the lines are well spread out or items are fewer.
   If lines are not labeled because of congestion, use the key.
   Minimize congestion of lines.
c) Write the title for your graph, scale and key.

Advantages.

a) It is simple to construct and make decisions from it.
b) It is easy to read exact values from each graph since they a common base-zero.
c) It is easy to make comparison of items since they are drawn on the same chart.
d) It enables one to save time by combining several graphs representing each dependable variable..
e) It does not involve lengthy calculations.

Disadvantages.

a) The numbers of items that can be represented are limited. More than five lines would make the graph difficult to interpret due to congestion.
b) Crossing of lines is inevitable in some cases. This can make interpretation and comparison difficult and confusing.
c) It is difficult to choose a suitable scale when the values for each variable differ by great magnitude.
d) Parallel graphs close to each other pose difficulties related to estimating the trend of the relationships that may be present.

ASSIGNMENT

The table below shows Exports and imports of a country X by value. (Values in k.£).
Use it to answer question a and b.

Commodity	2000	2001	2002	2003
Exports	1119764	121434	131394	136709
Imports	247804	290108	257710	281844

(a) (i) Using a vertical scale of 1cm rep: 100,000k£, draw a comparative line graph using the data above. (8mks)

(ii) Calculate the total grand value for the exports (2mks)

(iii) Calculate the balance of trade for country X in 2002. (2mks)

(b) Explain two reasons why there was an increase in the value of exports in country X between 2001 to 2003. (4mks)

(c) State three advantages .of comparative line graphs. (3mks)

ANSWERS

The table below shows Exports and Imports a country X by value (values in k.) . Use it to answer question a and b

Commodity	2000	2001	2002	2002
Exports	1119764	121434	131394	136709
Imports	247804	290108	290108	281844

(a) i Using a vertical scale of 1cm rep 100,000 kf a comparative line graph using the data above (8mks)

(ii) Calculate the total grand value for the exports (2mks)

T.G.V : 1119764 + 121434 + 131394 + 136 709

Kf 150 9301 (2x1=2mks)
Or Kshs 301 86020

(iii) Calculate the balance of trade for country X in 2002 (2mks)

B.O.T : Exports – Imports
131394 – 257710 (2x1=2mks)
Kf – 126316 Ksh -252 6320

c) State three advantages of comparative line graphs (3mks)

- Has a good visual impression of the commodities/variables represented.
- It is quick to make comparison of the variables
- It is easy to read
- It is easy to draw (3x1=3mks)

Comparative bar graphs (Group bar graphs/ multiple bar graphs)

These are the most suitable method for representing quantities which are solid or tangible.
Multiple bar graphs representing different variables can be plotted together to facilitate easy comparison.
Comparative bar Graphs are made of bars which are grouped together for the purpose of comparison.
Data that can be presented using this technique include crop/mineral production, countries or regions producing the same commodity over a number of years.
The total length of a bar indicates the total quantity of the variable that it represents.

Steps in construction a comparative bar graph.

a) Choose a suitable scale for both the X and Y axis.
b) Quantities of fish are represented on the y axis.
c) The length of the X axis is determined by the number of bars be drawn and years involved.
d) The width of the bar will be determined by the space available along the X-axis. But all bars must be of the same width.
e) A gap should be left between different sets of bars.
f) Vertical scale for the dependent variable is determined by considering the largest and smallest values.
g) Starting with the first group of bars e.g year 2000 draw bars staring with the one representing the largest single component followed by the next in length until the shortest is drawn.(l. Victoria, L. Baringo, L. Turkana and fish farming in that order.)
h) If there is data for others, it is drawn last even if it represents a bigger value than some of the already drawn.
i) Bars in one group are drawn touching each other and drawn upright.
j) Same procedure is done for other groups of bars until the last set is drawn.
k) Choose suitable shade or colours for the different bars in a group. (Shading adopted in the first group should be adopted for the respective bars in all other groups.
l) Add a key and a suitable title which should be informative as to what the graph represents.

Example

Quantity of fresh water fish landed in the years 2000 to 2002(Quantities in tonnes)

6 a) i) Draw a group/comparative bar graph using the data above. (8mks)

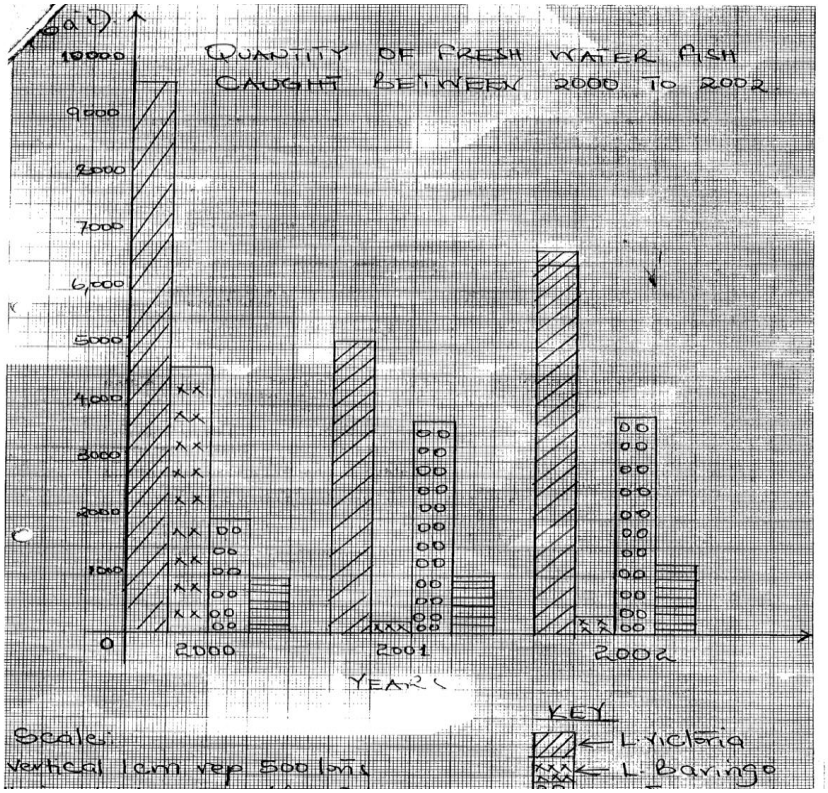
LAKE	2000	2001	2002
L.Victoria	9,200	5,100	6,700
L.Baringo	4,600	200	300
L.Turkana	2,000	3,700	3,800
Fish farming	980	1,000	1,200

ii) Which year had the highest total number of fish landed? (1mark)

iii) State a possible reason as to why there has been a decline of fish in L. Baringo (2mks)

SECTION B.

6ai). A comparative bar graph showing the quantities in tones of fresh water fish landed in the year 2000 to 2002 in different lakes.



ii). The year with the highest fish landed was 2000 with a total of 16,780

- Tons of fish.

iii) Reason; why there is a decline of fish in Lake Baringo.

- Over fishing

Advantages

a) It enables one to make easy comparisons across the different sets of bars.
b) The bars when drawn are easy to interpret.
c) They are easy to construct since all the bars start from the same base line.
d) Group bars give a better impression of totality and of the individual contributions made by each of the component parts.

Limitations.

a) Their construction is time a consuming exercise.
b) Erroneous conclusion can easily be made depending on the scale used.
c) Bars tend to emphasize too much on the quantities while fluctuations are ignored.
d) The general movement or trend of any component is difficult to follow.

Divided rectangles.

In this case, a rectangle is divided to present statistical data.. a rectangle is subdivided into potions each representing an item , commodity, region etc.

Steps followed in construction.

A rectangle is drawn.

Its length is assumed to represent the grand total of the variables being illustrated.

The rectangle is then divided into segments representing the components of the variables being represented.
Identical divided rectangle can be used for comparison purposes.

Example,
The following Table shows Kenya's leading imports. By value (Ksh million) for the year 2004.
Use the data to answer question A.

Kenya; leading imports by value (Ksh. Millions)

Crude petroleum	45,954
Petroleum products	43,056
Medicine and Pharmaceuticals	11,607
Chemical fertilizers	11,079
Plastics	15,420
Iron and steel	21,265
Industrial machinery	43,516
Road motor vehicles	24,361
Others	147,947
Grand total	364,205

a) (i) Calculate the percentage of the item with the least imports bill for 2004 (2mks)
(ii)Draw a divided rectangle to show the proportion by percentage of the leading imports for 2004.Use a scale of 1cm to represent 10% , and width of 2cm (10mks)

Convert the import values into percentage of the total.
Choose a suitable length of the rectangle to represent Kenya's total imports by value (***KSH 364,205 000,000=100%).*** E.g. 10cm is the length of the rectangle.
Thus each centmetre represents 10% of the total value.
Calculate the percentage of the items and convert them into centimetres.

Crude petroleum: $\frac{45,954 \times 100\%}{364,205} = 12.0\%$ (1.26cm)

Industrial machinery: $\frac{43,516 \times 100\%}{364,205} = 12.0\%$ (1.2cm)

Petroleum products: $\frac{43,056 \times 100\%}{364,205} = 11.8\%$ (1.18cm)

Road motor vehicles: $\frac{24,361 \times 100\%}{364,205} = 6.7\%$ (0.6cm)

Iron and steel: $\frac{21,265 \times 100\%}{364,205} = 5.8\%$ (0.58cm)

Plastics: $\frac{15,420 \times 100\%}{364,205} = 4.2\%$ (0.4cm)

Med and pharmaceuticals: $\frac{11,607 \times 100\%}{} = 3.2\%$ (0.3cm)

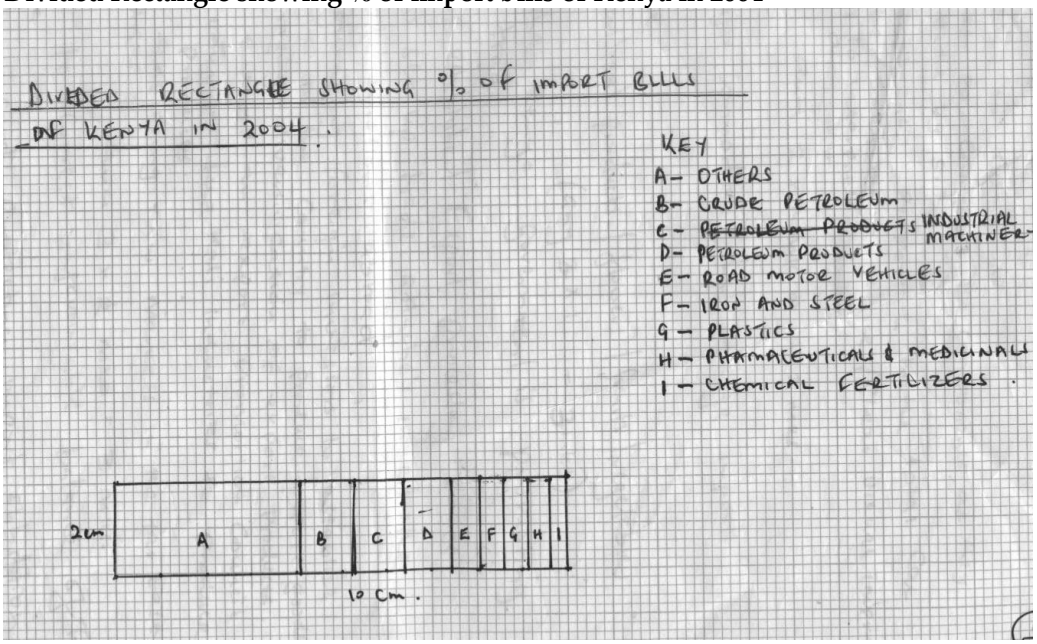
364,205

Chemical fertilizers: $\frac{11,079 \times 100\%}{364,205} = 3.0\%$ (0.3cm)

Others: $\frac{147,947 \times 100\%}{364,205.} = 40.7\%$ (4.1cm)

The percentages represent the length of respective segments of the divided rectangle.
Arrange the segments in an ascending order.

Divided Rectangle showing % of import bills of Kenya in 2004



(i) Percentage of least imports bill item in 2004.

Chemical fertilizers have the least bill which is Ksh. 11, 079 million
As a percentage of the grand total is;
$\frac{11,079}{363,205} \times 100\% = 3.04\%$

(ii) Advantages of using divided rectangle

a) It is easy to construct
b) It is easy to compare the components as they lie side by side and are arranged in ascending order.
c) It takes up less space than if the same data was drawn using comparative bars.
d) Each component's proportion to the total can easily be seen at a glance/ clear visual impression.
e) It's easy to interpret.

Disadvantages of divided rectangles

a) It is difficult to assess the value of the individual components except for the one since it begins from a common base.
b) The shape of the rectangle is not as appealing as of e.g a pie chart.
c) Only one unit of measurement can be used.

NB;

~ Each strip could be differentiated by giving it a specific colour or shade. In this case use a key for interpretation.

- An informative title must accompany the rectangle.
- The rectangle can be drawn horizontally or vertically depending on the available space or choice.
- If there is a component for 'others', it should occupy the uppermost position.
- Indicate the scale used.

CLIMATE.

Introduction to Kenya's Climatic regions

DEFINITIONS

Weather.

It is the state of the atmosphere surrounding the earth at a certain area for a short period of time. Elements of weather include; Temperature, Humidity and Precipitation etc.

Climate.

It is the general weather conditions of a place or a region observed over a long period of time.

The average Weather data such as temperature variations and precipitation rates for the past 30 years and over.

Factors influencing Climate.

a) Latitude:

Latitude influences temperature on the earth's surface. Highest temperatures are generally at the equator and the lowest at the poles. This is because the Sun shines all the year round for 12 hours out of 24 hours at the Equator.

Latitude influences the seasonal variation of rainfall. Some areas receive maximum rainfall when the position of the sun is overhead. For example, northern tropical areas receive rainfall from March to July coinciding with the overhead position of the sun in the northern hemisphere. In the southern hemisphere, it is between October and February.

Latitudes also influence the intensity of sunshine, pressure systems and wind systems.

b) Altitude or Height above Sea Level

This is the height above sea level

Lowlands are usually warmer than highlands because the atmosphere becomes thinner as altitude increases where the ground losses heat faster.

Atmospheric pressure decreases with increase in altitude. This is due to the weight of atmospheric air above highlands being less than in lowlands

c) Distance from the sea/effect of Continentality/nearness to the sea

During hot seasons, coastal lands are relatively hotter than inland areas on the same latitude due to the existing effects of the sea breezes. By the time the sea breezes reach inland areas they have adapted to the temperature of the land over which they are passing.

Regions where temperature s is greatly influenced by the sea are said to have maritime /oceanic/insular climate. They are found in coastal regions where winds are onshore and heavy rainfall is received throughout the year.

Regions whose temperatures are influenced by remoteness from sea have a continental climate. Such areas receive less rainfall than expected mainly in summer.

d) Aspect.

It is the direction in which a slope faces in relation to the sun's insolation. The effect is greater at higher latitudes than in tropical regions where slopes receive more or less equal hours of the day and night.

In northern hemisphere, the south facing slopes are warmer than the slopes facing the north because they are warmed by the sun's insolation.

Slopes facing north in the southern hemisphere are warmer than the ones facing south.

Windward slopes of highlands and mountains generally receive more rainfall than the leeward sides.

e) Ocean currents:

Ocean currents may be warm or cold. When moist onshore winds blow over warm ocean currents, they get t warm from below and hold onto the moisture which they release on reaching land leading to increased rainfall in coastal regions.

The winds also raise the temperatures of coastal areas.

For example, the warm Mozambique current flows along the coast of Natal, warming the onshore S.E trade winds that bring rainfall to the coast throughout the year.

Cold ocean currents cool onshore winds from below thus lowering their temeratues.such winds if moist would cause rainfall over the ocean waters and cool the coastal land while causing drying effect. This effect is witnessed on the south western coast of Africa due to the effect of the cold Benguela current. (The Kalahari Desert).

f) Winds:

Winds are a medium of transfer of heat from one place to another.

Winds carrying warm air from warm regions bring a warming effect to a place. If cool, they bring a cooling effect.

Some places have higher temperatures than expected because of the effect of such winds. E.g the Harmattan Winds blow from the Sahara Desert, warming West African countries.

Moisture-laden winds cause heavy rainfall while persistent dry winds cause desert like conditions in some places.

Land and sea breezes modify the climate in some coastal regions and around water bodies like Lake Victoria.

Katabatic winds are responsible for low temperatures at night in valleys and lowlands at the foot of mountains.

Anabatic winds are partly responsible for the formation of Cumulus clouds which cause afternoon showers in highland areas.

The Föhn and Chinook winds are descending warm dry winds which contribute to the dryness on the leeward side of Alps and Rockies.

g) Forests.

Forested areas tend to have low temperatures due to the shade of trees. Trees reduce solar insolation reaching the lower grounds.

The areas have high humidity because of high evapotranspiration rate.

There is heavy rainfall because of the high evapotranspiration rate and friction between trees and ran-bearing winds.

Weaker winds are experienced because trees act as wind-breakers.

Forest areas experience Micro-climates.

h) Configuration of the coastline.

The alignment, appearance or nature of the coastline.

Straight coastlines tend to receive less rainfall especially when they lie parallel to the path of onshore winds. For example, the areas to the North coast towards Somalia.

In Ghana, the coast of Axim being indented receives heavy rainfall of over 2200mm per annum because it receives moist onshore SW Monsoon winds directly. But the rest of the coast of Ghana receives only 768mm annually because these winds blow parallel to this regular coast.

i) Inter-Tropical Convergence Zone(ITCZ)

It is a low pressure zone which shifts its position north and south of the equator according to the position of the overhead sun. Rain bearing trade winds converge in this zone.

Places near the Equator experience two distinct rain seasons coinciding with the two periods when the ITCZ is experienced here.

j) Human activities

Many activities like Agriculture, settlement and construction of dams have effects on local climate.

Clearing forests can make an area semi Arid. Intensive and sustained reafforestation can convert a Semiarid to a wetland.

Emission of CFCs and other gases from burning plastics, factory emissions and motor vehicle emissions alters the composition of the atmosphere which may eventually lead to global warming.

DESCRIPTION OF CLIMATE.

Temperature and rainfall are the main elements used I climatic description. Other elements are like humidity, wind cloud cover and atmospheric pressure are only mentioned depending on their significance.

First outline the temperature of a place stating the mean annual temperature and months with the highest and lowest temperature. Mention the annual range of temperature if large, moderate or small giving the statistical figures to support your mention.

Use general terms to describe precipitating then follow with actual statistical data of the mean annual totals. Describe rainfall distribution in the year mentioning the number of wet and dry months.

Relate the rainfall to temperature.

When describing the climates of areas beyond the tropics, the seasons should be identified.

Use the conjunction 'and' when describing temperature and rainfall eg 'hot and wet'

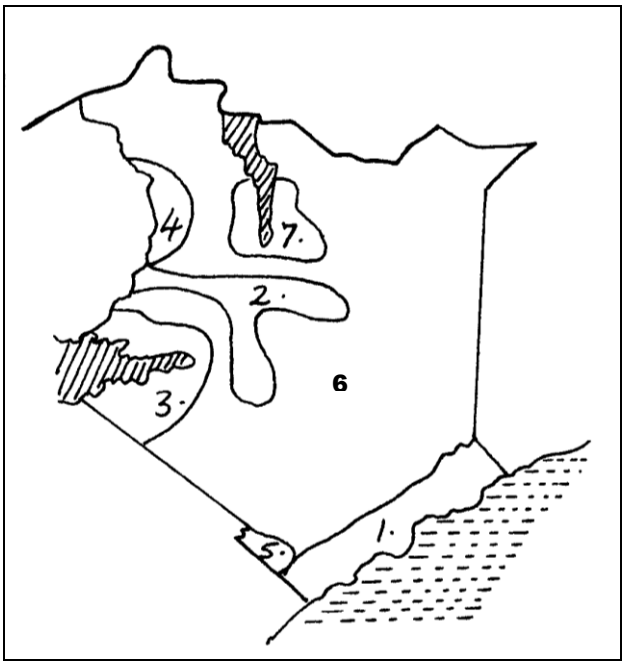
TEMPERATURE	**RANGE OF DESCRIPTION.**

THE CLIMATIC REGIONS OF KENYA.

Kenya's climate can be described as hot with an equatorial coastal belt. The rest of the country experiences a tropical continental climate.

The climate is modified considerably due to the general variation in relief, localized influence of Lake Victoria and Continentality.

The regions



1. Modified Equatorial climate of the coastal region
2. Modified tropical climate.
3. Modified Equatorial climate of Lake Victoria region.
4. Tropical Northern Climate.
5. Tropical climate.
6. Tropical continental or semi-desert climate.
7. Desert climate.

1. Modified equatorial climate.

This type of climate is experienced in two regions;

- ~ Along the coast.
- ~ The Lake Victoria basin.

Modified equatorial climate of the Lake Victoria Basin

Temperature range is between 6^0c and 10^0c ranging from 22^0c to 22^0c and generally lower than those of true equatorial climate.

This is due to the moderating effect of Lake Victoria and the area's altitude.

For example Kisumu is hot with a mean annual temperature of 23^0c and a small annual range of about 2^0c

Rainfall is received throughout the year but varying from one place to another Rainfall total varies between 750mm and 1500mm from one place to another. E.g Kisumu's annual rainfall is 1300mm.

the rainfall peak is between March and May and the lowest amount is in January and February.

To the south of Winam Gulf, rainfall is in two seasons and the amounts are much lower varying from 570mm to 875mm.

Rainfalls mainly in the afternoons and is accompanied by thunder

There is high humidity.

Modified equatorial climate of the coastal region.

This climate is experienced from the Somali border to the Tanzania border.

Mean annual range of temperature is small. For example in Mombasa it is 4^0c.

The Area generally receives rainfall throughout the year with a double maxima rainfall in May and October. Mombasa's annual rainfall is about 1100mm while Lamu is about 930mm.

There is High humidity due to proximity to the sea and the High temperatures due to high rates of evaporation

2. Modified tropical climate of the Kenya highlands.

The climate is mainly experienced in the central highlands to the East and west of the rift valley.

The temperatures range between 17°c and 24°c varying according to the altitude of the place. The lower slopes are warmer than the higher slopes due to altitudinal modification.

The mean annual range of temperature is small between 3°c and 5°c. for example; Nairobi's temperature is 18°c with a small annual range of only 4°c.

The region receives rainfall of between 1000mm and 1500mm on average throughout the year. Mountains receive higher rainfall of over 2000mm.

However the amount of rainfall varies according to the position of a place in respect to the rain-bearing winds (aspect). It is mainly orographic rainfall caused by the S.E Trade winds.

The rainfall regime is double maxima in the highlands east of the Rift valley and single maxima in the highlands west of the Rift Valley (in Kericho)

The long rains are received between March and May and short rains between Sept and Dec in the east. In the highland west of the Rift valley the peak between May and August.

The rainfall is mainly orographic type. It is caused by the south East trade winds.

Humidity can be described as moderate.

Tropical continental or semi-desert climate

About ½ of Kenya experiences this type of climate. (The North Eastern and most of Eastern Kenya, Southern and a large part of Northern Kenya).

Temperatures are high throughout the year ranging between 22°c- 27°c.

The mean annual range is small upto 5°c. In areas of high relief, it may be slightly lower.

Rainfall is low and unreliable and generally not exceeding 500mm annually. For example, Voi receives 536mm, Garissa- 350mm and Magadi- 409mm.

Tropical climate.

This climate is experienced in Narok, Southern Taita and Kwale regions. It is a continuation of the tropical climate of central Tanzania.

Temperatures are as high as those of the tropical continental climate but in areas of high relief, they are lower thus making the regions more suitable for human habitation

Rain falls in one season and is generally low. The amounts are slightly higher than those received in the semi-desert areas. There is a definite dry season that lasts upto 6months. Narok receives 672mm of rainfall between November and May.

Tropical Northern Climate.

This type of climate is experienced in a small area in the North-Western part of Kenya which borders Uganda.

It is a continuation of the tropical continental climate of Northern and Eastern Uganda.

Average temperatures are high but slightly modified in some places because of a higher altitude.

Mean annual rainfall is 850mm falling between June and September. There is a long dry season which lasts upto 6 months.

7. Desert climate of the central and northern areas.

The regions experience High temperature of about 29°c. (Lodwar 29°c).

Day temperatures are high sometimes going beyond 35°c and dropping to below 15°c at night. There is a High diurnal range of temperature range.

Annual rainfall is usually less than 250mm. Wajir's mean annual rainfall is about 237mm while Lodwar

receives 190mm.
The little rain received is associated with the passing I.T.C.Z.
The area is characterized by descending or diverging winds which do not bring rain
The sky is usually cloudless resulting in intense solar radiation during day and high terrestrial radiation during night.
Sandstorms are common in this region.
Between Marsabit and Turkana, there are two areas that are pure deserts; Chalbi and Karoli Deserts and Kaisut Desert to the South of Chalbi Desert.

World Climatic Regions

On the basis of temperature, 5 world climatic types are identified;
HOT.
WARM
COOL
COLD
VERY COLD
Each of these climatic types can further be sub-divided on the basis of rainfall and its seasonal variation and also according to the position of the region in the continental.

HOT CLIMATES.
This type is experienced within the tropical latitudes with mean annual temperature of over 21˚c
They include;

a) Equatorial climate.
b) Equatorial Monsoon Climate.
c) Tropical Monsoon climate.
d) Tropical Maritime/Marine climate.
e) Tropical Continental Climate.
f) Tropical Desert Climate.

a) Equatorial climate.
This climate type occurs in the lowlands mainly between 5˚N and 5˚S of the Equator. In some regions, it extends upto 10˚N and S.
It is experienced along the west coast of Africa from Guinea through Cote D'Ivoire, in south western and central Ghana, Southern Nigeria, Cameroon, Central African Republic, Gabon, Congo and DRC.
In South America, it is experienced in the Amazon Basin and the West-Coast of Ecuador and Columbia.
Characteristics of equatorial climate.
The region experiences High temperatures throughout the year (average- 27^{o}c). This is because of location within the doldrums.
Annual range of temperature is small (3^{o}c-5^{o}c).
There is a Low diurnal range of temperature of 6^{o}c – 8^{o}c due to the thick cloud cover and high humidity that prevents temperature rising too high in the day or dropping too low in the night.
High rainfall is experienced throughout the year exceeding 1500mm and mainly convectional rainfall.

In the highland areas, rainfall is heavier for example, the Ruwenzori receives 2700mm, and the Cameroon Mountains has once recorded annual totals of 10,000mm. (The wettest place in the world)
There is low atmospheric pressure with an average of 1014millibars throughout the year.

Equatorial Monsoon.

This climate is experienced in South-Eastern Nigeria and extends into western Cameroon.

In South East Asia, it is experienced in the Malaysian and Indonesian islands of Sumatra, Java, Borneo, Salawesi, Mindanao, New Guinea and all the small islands in the regions.

The whole Malayan Peninsula experience the same climate.

*Characteristics of Equatorial Monsoon climate***.**

Temperatures are high throughout the year with a mean monthly temperature of about 26℃.

Annual range of temperature is small about 3˚c.

The diurnal range of temperature rarely exceeds 8˚c.

Relative humidity is very high throughout the year because of constantly high temperatures and high rates of evaporation from rainwater and nearby oceans.

Rainfall is heavy and falls throughout the year.

In these regions, the monsoon winds in the coastal regions and mountain ranges influence the convectional rainfall. This results in an increase in the amount of rainfall making it heavier than normal.

Calabar, a coastal plain in S.E Nigeria has a mean annual temperature of 26˚c and mean annual rainfall of 3033mm. on the slopes of Mt. Cameroon; the mean annual rainfall reaches 10,000mm.

High rainfall is experienced throughout the year in South East Asia. Since the region comprises islands, the monsoon winds are always onshore even though the direction of the wind reverses.

The SE and Easterly Monsoon winds originate from Australia and reach these islands after crossing a relatively shorter stretch of ocean. They bring less rainfall during the May to August season.

The North West and Westerly monsoon winds on the other hand bring more rain during the season of November to February.

Tropical Monsoon climate

Large parts of South East Asia, Indian sub-continent southern china and northern Australia experience seasonal reversal in wind direction giving marked wet and dry seasons. In Africa, it is also experienced in southern Senegal, Guinea Bissau, Guinea, Sierra Leone and Liberia but on a small scale.

Characteristics of tropical monsoon climate.

Temperature varies from 25^0C to 32^0C in the hot season.

The area has a moderate temperature range of about 7 ℃. but this is not uniform for all places in the climatic belt.

The main characteristic of the climate is seasonal reversal of winds, blowing onshore in summer and offshore in winter.

Amount of rainfall varies with relief and aspect with some areas rainy as high as 2000mm per y ear while others 620 mm per year. Rainfall is high in summer when it is hot and very little in winter.

Humidity is also high throughout the year because of the coastal location and influence of the monsoon winds that blow all year round.

There are Cloudy skies in summer and clear in winter.

The region also experiences tropical cyclones towards the end of the hot season which is in August and September in the northern hemisphere and February and March in the southern hemisphere.

Tropical continental climate

Location.

It is mainly experienced between 5˚and 15˚N and S of the equator bordering areas of equatorial climate such as N.W and S.E of the Amazon Basin, Senegal to Eastern Africa and Northern part of South Africa and the interior parts of Australia.

Characteristics of the Savanna climate.

Temperatures rise as high as 32˚c during the hot season and drop to about 21˚c in the coolest months.

The annual range of temperature is moderate about 11˚c.

The highest temperatures are experienced before the beginning of the rain season around April in the Northern hemisphere and october in the southern hemisphere.- the time when the ITCZ is lying over the region.

Rainfall is moderate and decreases from the areas close to the equator towards the desert areas.

Heavy convectional rains occur in the hot season while the cool season is generally dry.

Tropical desert/Hot desert climate

They occur on the west of continents though in North Africa they extend across the continent Due to the dry prevailing winds blowing from land.

Desert areas of the world.

MAP

Characteristics of desert climate.

The area experiences High temperatures during the day and relatively low temperatures during the night. This is caused by general absence of cloud cover.

There is High mean monthly temperatures all year (26^0C-29^0C) with a small annual range of 3^0C. Mid-afternoon temperatures may reach 80 ˚c on sand, rock and metal surfaces. Minimum temperatures sometimes drops to as low as 15˚c

Low annual rainfall of less than 250mm is experienced. It is a dry climate. The rainfall is sporadic and short accompanied with heavy storms leading to Occasional flash floods.

The area is characterized by Strong winds onshore but crossing cold ocean currents to cause a drying effect on the land.

Sandstorms are common and may last several hours during which visibility is impaired.

There is Low humidity and High evaporation rate throughout the year.

WARM CLIMATES

These are climates that border the tropical climates and ly in regions affected by diverging winds between latitude 30˚and 40˚north or south of the equator.

They experience moderate temperatures which are lower than those of the hot climates. They include the following;

Warm Temperate Western margin (Mediterranean Climate)

The climate lies in a region where the trade winds blow offshore in summer while the westerlies blow on shore in winter bring rain.

The areas of occurrence include

- Central California in North America.

- Around the Mediterranean Sea on the coast of Africa and southern Europe.
- Central Chile.
- SW and Southern Australia around Perth and Adelaide respectively.

Characteristics of Mediterranean climate

The climate experiences moderate temperature in summer-21^{o}C and low winter temperature are of 10^{o} C.
There is a Moderate annual temperature range of 11^{o}C
There is Moderate annual rainfall of 500mm-800mm much of which falls in winter due to the effect of the onshore westerlies. Rainfall varies with altitude and location.
Summers are dry or with little rainfall and dominated by Strong winds such as sirocco in Algeria and Khamsin in Egypt.

Warm temperate continental climate (warm temperate interior climate)

It is experienced in the interior of continents in the mid-latitudes between 30˚ and 50˚ north and south of the equator.

The main areas of location include;

- Prairies of Canada and USA.
- Pampas of Argentina and South America.
- The Veldts of South Africa.
- The Downs of New South Wales and Victoria in Australia.

Characteristics of the warm temperate continental climate.

Temperature range between 26˚c in summer and 10˚c in winter. Extreme temperature are experienced due to contnentality.
Annual rang of temperature is moderate ranging from 2˚c to 6˚c .
Mean annual rainfall varies between 380mm to 780mm according to location and is received all year round mostly in summer.
Summer rains are caused by convection and low pressure systems.
Humudity is hugh in summer.
Warm temperate Deserts- Mid –Latitude Deserts.
Areas Experienced;

Characteristics.

Summer temperatures can be described as high ranging between 25 ˚c to 37 ˚ . winters are cold with temperatures dropping as low as -7˚c . this causes the diurnal range to be very large (35˚c)
Annual range of temperature is 40˚c .
Rainfall is low and unreliable because of the great distance from the sea.
The total annual rainfall is about 250mm with most of it falling in late winter and early spring.

Warm temperate Eastern Margin Climate / china Type/ humid sub-tropical climate.

Main areas experienced;

Characteristics.

Summers are hot at 26˚c and winters are mild at 13˚c.

Some regions experience extreme low winter temperatures due to the effect of local winds caused by the local depressions e.g. the Pampero of Argentina.
Coastal regions have cool winters due to the effect of warm ocean currents.
Rain is experienced in summer due to onshore trade winds at the coastal lowlands and highlands in the interior.
Westerlies are associated wit depressions and bring very little rain.
Mean annual rainfall on average is 1000mm.
In some areas like China, Japan and North Islands of New Zealand, there is influence of Monsoon winds that reverse with season.
Tropical Cyclones are common in S.E USA and in China.

COOL CLIMATES

These climates are found between latitudes 35 ° and 60 ° north and south of the Equator. The climates experience seasonal variations in temperature making them different from the warm temperate types. They have well defined summer and winter seasons with distinct changes from one season to another.
They include;

Cool temperate western margin (cool temperate west coast/European type or British type.)

They are experienced on the western sides of continents between latitudes 45 ° and 60 ° North and south of the equator.

- ~ The main areas of location include.
- ~ British Isles, Southern Scandinavia, Central and Western Europe.
- ~ The coastal parts of British Columbia in Canada.
- ~ The coastal parts of Chile.
- ~ Tasmania in Australia and south islands of New Zealand.

Characteristics.

The climate experiences warm summers with temperatures between 13 °c and 15 °c and cool winters of 2°c to 7 °c temperature.
There is a small moderate mean annual range of temperature (3 °c-11 °c) mainly due to marine influence.
Onshore prevailing winds that have crossed warm ocean currents are strongest and most frequent in winter, raising the winter temperatures beyond the expected normal.
Rainfall is well-distributed throughout the year ranging from 750mm to 2000mm.
In coastal lowlands, cyclonic rainfall associated with eastward advancing depressions occurs while mountain areas experience relief rainfall.
Rainfall peak is in winter due to strong onshore winds.
Humidity is high in winter.
Summer days are long and generally warm.
Sub-tropical and polar air masses converge giving rise to depressions and cyclones.
Winters are mild, although at times temperatures fall below freezing points.

Cool temperate continental climate (Siberian type/cool temperate interior type)

The climate extends from 35˚N to 60˚north of equator.
The main areas of location are;
Alaska and most of Canada (provinces of Alberta, Saskatchewan and Manitoba)
Eurasia covering Sweden, Finland, Poland, Germany and across Russia upto Kamchatka Peninsula in the East.
Characteristics
The climate experiences warm summers with temperature of upto 19˚c in July (short summers).
Winter temperatures are extremely low falling to below -19 ˚c. for example in the interior areas like Siberia, and Winnipeg in Canada
Cold polar winds and long winter nights are experienced.
Annual temperature range is high especially in the interior going upto 37˚c. this is due to lack of influence from the sea due to Continentality.
Precipitation is mainly in form of snow, which falls during winter due to convergence of cold polar and warm moist maritime air masses.
In summer, rainfall is mainly caused but convection, and is accompanied by thunderstorms.
Annual rainfall range from 400mm to 550mm.
Cyclonic rains also fall in summer when depressions advance inland from oceans.
Rainfall decreases pole wards as air becomes too cold to hold any moisture.

Cool temperate Eastern margin climate (Laurantian type)
It is found on the Eastern margin of continents of North America and Asia between 35˚N to 50˚north of equator.
The main areas include;
Southern Canada (maritime provinces) and north Eastern USA in New England.
North Korea , North China, Central and Eastern Siberia.
Central and northern Japan.

Characterstics.
They experience very cold winters with temperature ranging from -40˚c to 0˚c.
Temperatures are slightly higher in summer than those in the western margin.
There is a large annual range of temperature of between 26˚c – 30˚c .
The cold westerly winds from the interior are responsible for the low winter temperatures.
Humidity is high during summer.
Winds are onshore in summer.
There is precipitation all year round with the maximum received in summer and exceeding 1000mm in Eastern Canada and Northern Japan.
Winter precipitation is in form of snow.
Rainfall type is cyclonic .
Destructive typhoons occur in September .
The convergence of the cold Labrador current flowing southwards and the warm Gulf Stream Drift Current flowing northwards produces fog and mist.

COLD CLIMATES.

These climates border the cool temperate climates from 60°N to about 68°N.

Cold temperate western margin climate

This climate occurs in part of the inerior of the stae of Alaska in NORTH America, Central and Northern Norway and Sweden upto the Arctic coast.

Characteristics.

They experience short cool summers with temperature average being 12 °c and long cold winters (temperature between -2 °c and 4 °c.

Temperature are below 0 °c for upto 4 months .

The winter temperatures are higher than expected in the coastal regions due to the influence of the onshore Westerly winds that cross warm ocean currents.

Rainfall is received in most months of the year but during winter it is replaced by snowfall.

Rainfall is mainly Orographic in highland areas reaching a mean annual of 750mm.

Cold Temperate continental Climate.

It occurs between 55 °N and 68 °N in the interior of North America from the Alaskan Border in the west to Labrador in the East. Also from Finland in the west through Siberia in Russia to Verkhoyansk Range in the East.

Characteristics.

The climate experiences warm and short summers (temperatures upto 21 °c), lasting for three months.

Winters are long with temperatures dropping below -34 °c in Canada and -45 °c in Russia.

Annual temperature range is large (44 °c – 64 °c)

Annual precipitation is about 380mm and mainly falling in summer as convectional rainfall. Snowfall dominates the winters.

Cold Temperate Eastern Margin Climate.(Eastern Margin Monsoonal Winters)

The climate exists in North-Eastern Pacific coast of Russia.

Characteristics

There are short and hot summers with mean temperatures of 21 °c .

There are long and cold winters with temperatures dropping to -20 °c caused by the high pressure systems over Siberia (Strong Cold winds blow out from NW section of Siberian lowlands during winter.)

In summer moist SE winds blow towards Siberia and bring rain of upto 1000mm at the coast and 500mm inland.

VERY COLD CLIMATES

Polar climate/tundra climate/ice cap.

The climate is found beyond 661/2 ˚ N and S of the equator in northern parts of America from Alaska through Northern Canada to GREENland .
Also in Eurasia from Norway , Finland, Greenland and Northern parts of Russia and Antarctica.

Characteristics.
They experience very cold winters lasring for 8 months with temperatures ranging from -58 ̊c to 0 ̊c
Summers are cool though short (less than 3 months) with mean monthly temperatures of 10 ˚ c to 15 ̊c .
There is a large annual range of temperature sometimes upto 73 ̊c .
There is permanent snow cover (permafrost).
At the arctic and Antarctic circles, the night lasts for six months with the exception of the equinoxes . Summer day lasts six months.
The area is generally dry with low annual precipitation of 100mm- 250mm occurring during summer.
Storms (blizzards) are frequent.
During the cold winters, polar winds dominate.

MOUNTAIN CLIMATES.
These are found in the great mountain ranges of the world like the Alps, Himalayas, Rockies, and Cameroon Ranges, Drakensberg, Ethiopian and East African highlands.

Map

Characteristics
Temperature decreases with altitudinal increase at a rate of 2 ̊c for every 300m rise.
The climate ranges from cool to cold with some peaks being ice capped.
Rainfall is mainly Orographic and its intensity depends on aspect. However the top slopes receive less rainfall than the lower slopes.
Pressure on mountain tops is low due to refraction of air.
Local winds (Föhn/Chinook) are common in these regions.

MICROCLIMATES.
These refer to the climate of the immediate surroundings of some phenomena around the earth. For example, a forest, built up areas, industrial plants and water masses.
This may arise out of differences in aspect, slope, and nature of surface, colour/soil texture and vegetation cover.
Most of these climates are caused by human activities e.g. urban climates in large cities, climates around large dams like Aswan High Dam, Kariba Dam and Masinga Dam, Forested areas like Kakamega forest.

ARIDITY AND DESERTIFICATION.

Aridity -This is the Process through which the soil experiences insufficient moisture leading to scanty vegetation or barren land.

Arid area – a place where evaporation exceeds the actual amount of precipitation received**.**

Desertification: The process of land turning into desert.

Land degradation: The reduction in the quality and quantity of soil**.**

Physical Causes of Desertification

a) *Rising Temperatures*: As global temperatures increase it leads to excessive evaporation. It is becoming increasingly hard for vegetation to grow thus reducing vegetation cover and increasing the risk of wind and water erosion. Also extreme low temperatures reduce capacity of air to hold moisture causing cold areas to become Arid.

b) *Falling Rainfall*: As the amount of rainfall reduces in some areas like the Sahel, then it is increasingly hard for vegetation to grow again making the ground more vulnerable to wind and water erosion.

c) *Influence of cold ocean currents and Wind*: onshore winds crossing cold currents transfer dry conditions to the land since they would have dropped all the moisture over the sea. Such coastal areas become dry and arid. E.g Kalahari Desert. Also If a region is particularly windy then the amount of wind erosion is likely to increase**.**

d) *Relief Barriers*. Location of an area on the leeward side of a mountain will create the rain shadow effect. Kalahari and Namib Deserts are found on the rain shadow of Drakensberg.

e) *Continentality*. An area so much in the interior is removed from the effect of onshore moist winds. For example, Gobi Desert of Asia, the central part of Sahara, Nevada desert in USA.

f) *Pressure systems*. Areas of large stable high pressure systems with cold descending air currents experience aridity since there is no rising moisture to result in precipitation.. for example in the mid-latitude continental interiors.

g) *Wind systems*. Effects of dry winds like the Harmattan causes drying effects on the land. This is the cause of aridity in the Sahel region.

h) *Flash floods*: Intense periods of rainfall can also cause erosion of topsoil which leads to land degradation and eventual desertification.

Human Causes of Desertification

a) *Overgrazing:* Allowing too much livestock to graze on a piece of land which means all the vegetation is eaten making the ground susceptible to wind and water erosion.

b) *Over cultivation*: If you farm land to intensively and don't have fallow periods then all the nutrients in the soil get used.

c) *Deforestation*: Cutting down trees which not only means the land will be receiving less nutrients, but it also means it is more vulnerable to erosion because there is no interception and less stability because the root systems have been removed.

d) O*verpopulatio*n: As the world population continues to grow the demand for agricultural products (crops and meat) is increasing, causing more land to be deforested, over cultivated and overgrazed.

e) *Fertilizer and Pesticide Use*: By using fertilizers and pesticides you can artificially increase yields of crops. However, the process is unnatural and prolonged periods of use can all naturally produced nutrients to be used and local water sources to become polluted reducing the ability of land to cultivate crops and therefore making it vulnerable to chemical degradation as well as wind and water erosion.

f) Unsustainable Water Use (aquifer depletion, unsustainable irrigation): If aquifers or rivers are used

unsustainably then areas can become increasingly arid as water resources are used up. A classic example of unsustainable irrigation happened in the Aral Sea.

Problems Caused by Desertification

a) Dust Storms: As soil become less stable because of the lack of vegetation it become much more vulnerable to wind erosion which can create large scale dust storms. Northern China is suffering from an increased frequency of dust storms as desertification takes place south of the Gobi Desert.
b) Reduced Crop Yields: As the soil becomes less fertile the amount of crops that it can support will reduce. The falling crop yields can lead to famine and starvation.
c) Conflict: With increasing soil degradation and reduction in agricultural output and available agricultural land conflict can arise over diminishing resources.
d) Famine: If the soil become degraded and cops begin to fail or the yields reduce in quantity then famine can happen. Famine is normally caused by a combination of factors, soil degradation, drought and possibly a natural disaster or conflict, so if soil degrades it increases the potential of famine.

Solutions to Desertification

a) *Crop Rotation and Fallow Periods:* Growing different crops each year, so different nutrients are used and to allow periods of rest (fallow periods) so that soil can regain its fertility.
b) *Shelter Belts*: Shelter belts (sometimes called wind breaks) are areas of forest or hedge that are left untouched to protect farmland from the affects of water and wind erosion. Shelter belts will often appear around the outside of fields.
c) *Reforestation and Afforestation:* By reforesting or afforesting areas you can help return land to its natural state, making it more fertile and stable, thus reducing wind and water erosion and ultimately land degradation.
d) *Irrigation:* It is possible to water areas of land that have become arid to try and improve the productivity of the soil. However, if water is not used sustainably then irrigation can cause water shortages and land degradation elsewhere.
e) *Grazing Quotas:* Placing limits on the number and types of animals that can graze on land, reducing the destruction of vegetation and eventual desertification.
f) *Population Control:* The main reason we are putting more pressure on the earth's resources (including soil) is because the world's population has reached 7 billion and is still growing rapidly. If we can control population growth then we can limit the amount of agricultural land we need and the intensity of our farming.

Climate change.

This refers to the establishment of a new climate state/ Is the continuous changes/ establishment of new climatic state such that temperatures and precipitation changes causing droughts, floods, frost and heat waves.

An increase in surface temperature is an important aspect of climate change

Natural causes of climate change.

1. *Dust and ash from volcanoes and meteorites blocking incoming solar radiation*. For example Tambora Volcanic eruption in Indonesia in 1815 and Mt. Pinatubo eruption in Philippines in june 1995. Gases (sulphur dioxide) released from volcanoes may remain in the atmosphere for over 3 years reflecting back the solar radiation.
2. *Changes in the earth's orbit/axis, making earth close to or further from the sun*. There is the greater variation in the earth's orbital structure during the Perihelion on Jan 3rd (position of the earth in its orbit when it is closest to the sun) and aphelion on July 4th (when earth is farthest). During perihelion, the earth receives maximum solar energy.
3. *Changes in sunspot activity*. A sun spot is a dark area on the surface of the sun. changes in sunspot (occurs during revolution) leads to increase or decrease in the solar constant (insolation recived per

unit area).

4. *Variation in the atmospheric carbon dioxide*. The higher the concentration of CO2 , the higher the temperatures.

Human causes of climate change

1. Burning of fossil fuels in industry, transport e.t.c. leading to an increase in the atmosphere hence temperature increase
2. Industrial development releases gases such as methane into the atmosphere. The gases destroy the ozone layer and sets in the penetration of ultraviolet rays causing rapid rise in temperature
3. Deforestation and land use changes reduces the natural disposed system for carbon dioxide hence increase in temperature
4. Use of C.F.C's – Industrial chemicals used as propellants in aerosols, refrigeration and solvents damage the ozone layers hence temperature increase

Greenhouse Effect and Global Warming

The greenhouse effect is the absorption of outgoing terrestrial radiation by greenhouse gases

Greenhouse gasses (GHG): Any gas that absorbs and emits radiation in the thermal infrared range. The gases include: Carbon monoxide, carbon dioxide, methane, sulphur dioxide, Nitrous Oxide, water vapour and ozone.

Sources of greenhouse gases include:

- Transport (cars and planes)
- Burning fossils fuels (especially oil and coal)releasing carbon dioxide
- Melting Permafrost (methane is released when permafrost melts)
- Industrial and agricultural developments leading to release of gases like methane, nitrous oxide and chlorine, fluorine and bromine –based gases.
- Domestic use (wood fires)
- Deforestation for farming purposes reduces the main disposal system of carbon dioxide.
- Chlorofluorocarbons used in refrigerators and electronics.

Without the greenhouse effect the earth will be significantly colder and unable to support large scale life. The greenhouse effect acts as a kind of blanket. As energy is reflected or released by the earth it moves into the atmosphere where it is trapped and reflected back by a layer of greenhouses gases. The reflected energy returns to earth and is absorbed warming global temperatures.

The problem of global warming is caused by humans enhancing the greenhouse effect. We are releasing more greenhouse gases into the atmosphere which is trapping an ever increasing amount of reflected or released energy which returns to earth and warms us further.

Effects of global warming

1. Shortage Fresh Water. One estimate is that for a temperature rise of 2°C, 1 - 4 billion people will experience water shortage, predominantly in Africa and the Middle East
2. Loss of glaciers. Many millions of people rely on the summer flow of rivers from glaciers. In China 23% of the population depend on glacier melt water.
3. *Sea level rise*. This would lead to more coastal flooding and erosion. in low lying areas the loss of fertile land would affect agriculture.
4. *Longer growing seasons*. This would possibly increase crop production.
5. *Increase in atmospheric CO2*. This would increase food output by perhaps 17%.
6. *Loss of natural ecosystems.* Particularly the polar ones where change would be the greatest. One study estimates that around 15 - 40% of species face extinction with a 2°C rise. Strong drying over the Amazon would result in dieback of forest..
7. *Heat Waves.* The summer of 2003 was the hottest in Europe for 500 years killing over 35,000 people. By 2050, these temperatures could represent the average summer.

8. *Increase in diseases*. Malaria and insect spread infection, which is a real threat to human health. Also the increase in the rat population could be serious. Climate change will amplify health disparities between rich and poor nations.

Are there any Positive Impacts of Global Warming?

a) Improved Arctic Navigation: Global warming will mean that the amount of Arctic ice steadily decreases. As the ice melts navigation across the North Pole will become safer and quicker. Trade between Scandinavia, Russia, Canada and US will all be a lot easier.
b) Increased Agricultural Land: As permafrost melts and temperatures start to rise it will be possible to grow more crops on more land. With a rising global population this might be vital in the fight to reduce global famine.
c) Reduction in Cold Deaths: Old, young and sick people are very vulnerable to the cold. If global temperatures start to rise then latitudes further north and south will become more hospitable and less people will die from the cold.
d) Release of Freshwater: Currently a lot the world's freshwater is held in glaciers or as permafrost. As global temperatures rise, we might be able to capture and use some of this freshwater to reduce the effects of drought.
e) Accessibility of Resources: It is believed that places like Greenland, Alaska, Siberia and Antarctica contain a lot of resources (oil, gas, etc.). As global warming causes large areas of ice to melt they will become more accessible for human exploitation.
f) Reduced Heating: If global temperatures rise people will have to heat their properties less. Not only will this save money but it will also reduce the demand for gas and electricity and therefore reduce the amount of greenhouse gases being released.

Possible evidence of effects of climate change.

1. The heat waves in Greece due to increased temperatures which led to the death of many people.
2. The receding ice-cap on mt. Kilimanjaro and the disappearing Glaciers on Mount Ruwenzori.
3. The melting of polar glaciers resulting into rise in sea levels.
4. Increase in rainfall causing flooding in some parts of SE Asia and Central Europe.

#END#

VEGETATION.

Vegetation refers to a community of plants such as trees, shrubs, herbs and grasses that cover a place.
Plant community- this is the plants that grow together in a particular habitat
There are three categories of vegetation

1. *Natural vegetation*. Natural vegetation is the plant cover which is growing wildly on its own without the interference of external influences. It can be found in areas of protected plant life. World climate types are based on the remnant of natural vegetation in the world. It is also known as *climax vegetation*.
2. *Semi*-natural vegetation. Also know as derived vegetation or secondary vegetation, it comprises natural vegetation on a place interfered with by man but which is in the process of recovering.
3. *Planted vegetation*. It comprises of plants grown in a place by people e.g. agro forestry.

Factors that influence vegetation distribution

a) **Variation of rainfall.** Areas that receive high rainfall are forested while those receiving low rainfall have grassland vegetation.
b) **Variation of altitude/relief.** Vegetation varies with height above sea level (e.g. montane in high altitude) as altitude influence climate and soil.
c) **Aspect.** Areas on leeward slopes of Mountains have different vegetation from thick growth of vegetation in the windward side because they receive different amounts of sunshine and rainfall.
d) **Soil.** Sandy soil/swamp soil/saline soil influence growth of different types of vegetation. Vegetation on slopes is determined by soil catena.
e) **Drainage.** Vegetation is as luxuriant along water courses/along coastal flats because surface water supply is reliable/waterlogged areas support swamp vegetation.
f) **Human activities.** Settlement/mining/ farming interferes with the original vegetation leading to growth of secondary / derived vegetation/desertification.
g) **Wild animals.** They Destroy vegetation leading to secondary type/desertification. They aid in seed dispersal.

Vegetation in Kenya

Map

<u>Factors influencing vegetation distribution in Kenya</u>

a) Rainfall – areas that receive high rainfall support dense forests while areas that receive low and unreliable rainfall have grass and scrubs.
b) Temperature – forests in cool areas have fewer species – warm areas have more species
c) Altitude/relief – vegetation varies with height as relief influences soil an d climate
d) Pressure influences temperature
e) Soil type – different soil type support different types of plants – coastal sandy soils support palms
f) Aspect – leeward sides/windward side support different vegetation. South facing slopes/North facing
g) Drainage – waterlogged support swamp vegetation, mudflats at the coast support mangrove trees
h) Wild animals – elephants destroy vegetation leading to derived vegetation
i) Human activities – deforestation pave way for farming/settlement leads to derived vegetation

<u>Major vegetation zones in Kenya</u>

1. **Forest vegetation.** 7% of Kenya is the area under forest. This includes

a) Plateau and lowland forests in Lake Victoria regions, at the coast around river Sabaki and Arabuko sokoke. For example, the mangrove forests. Plateau forests are found on Gwasi hills of Suba.
b) Mountain forests for example the podo, cedar and camphor in the areas between 1800-3000m and bamboo forests at altitude above 3000m. They exist on Nyandarua ranges, Mt. Elgon, Ngurumani escarpment, loita hills mau escarpment, kaptagat and Cherangani hills, on Mt. Elgon and Mt. Marsabit. Other forests are closed forests like Kakamega and Aberdere, woodland forest like Nyika woodlands

2. **Savannah vegetation**. They cover 65% of the total Kenyan area. the sub-types are;
   a) Savanna woodlands/wooded grasslands/tree grasslands composed of grass of 4m height in wetter areas mixed with thorny acacia, baobab. the acacia form umbrella like canopies and have adapted to the Nyika conditions;
   b) Savanna grasslands (Bush land and Thicket) scattered tree grassland. More open grassland with fewer trees dotted over the landscape. Covers 48% of grasslands. E.g the coastal strip upto Machakos, extending to Turkana area. The common trees are Shea Butternut, baobab, acacia, silk cotton tree, boras palm and locust bean tree.
3. **Arid and semi arid vegetation**. It covers 27% of Kenya in the Northern region in Areas like Turkana and Marsabit(areas of little rain and high temps) the vegetation is mainly scrub types especially in areas with rain below 375mm. there is wider spaces of bare ground. Pure desert areas are to the S.E of L. Turkana.
4. **Hearth and moorland**. It is found on mountains beyond 3000m. It is composed of tussock grasses, flowering plants and alchemilla shrubs. It is adapted to cold conditions. Areas of poor drainage have mountain swamp vegetation forming bog. In lowland altitudes with more moisture and sunshine, there are gigantic plants like the grand sel, Lobelia and hearth.
5. **Swamp vegetation**. Along the water courses in dry areas and areas of periodic flooding. For example, shores of Lake Victoria, along river Tana from Bura to the Delta, the Lorian swamp across Wajir, Isiolo and Garissa counties, the Mangrove belt at the coast. The plant types include the papyrus variety, the marshes and grasses with smooth surface and long blades.

Major vegetation zones of the world.

1. Forests.

1. Tropical rainforests/(Equatorial forests/selva vegetation).

What is the tropical rainforest?

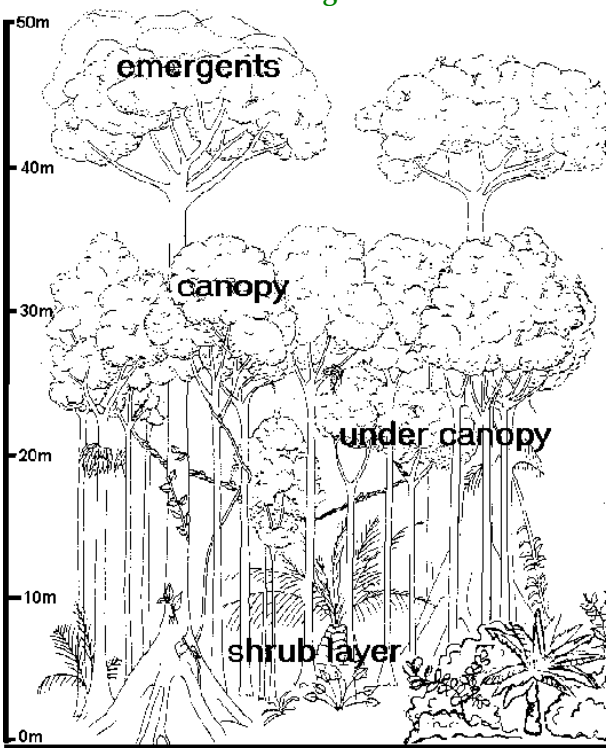
The Tropical Rainforest is a forest occurring in tropical areas of heavy rainfall, abundant with many species of wildlife and vegetation.

Distribution of Tropical Rainforests

Tropical rainforests are found on or near the Equator (roughly between 28 degrees north and south). The main concentrations of tropical rainforests are:

- The Congo Basin in central and west Africa
- The Amazon in Brazil, Peru, Bolivia and Ecuador
- SE Asia (Malaysia, Thailand, Vietnam, Indonesia and the Philippines)
- Madagascar
- North east Australia
- Southern India and Sri Lanka
- Central America

What is the structure of vegetation in the rainforest?



The image above shows a typical cross section in the rainforest.

1. **Emergents** are the tallest trees and are usually over 50 metres tall. The Kapok tree is an example of an emergent.
2. **Canopy.** The sea of leaves blocking out the sun from the lower layers is called the **canopy**. The canopy contains over 50% of the rainforest wildlife. Lianas (vines) climb to the canopy to reach this sun light. The continuous layer of canopy prevents sunlight to lower layers restricting growth on the floor.

   Middle Canopy The under canopy mainly contains bare tree trunks and lianas.
   The **lower canopy/shrub layer** has the densest plant growth. It contains shrubs and ferns and other plants needing less light. Saplings of emergents and canopy trees can also be found here.
3. The **forest floor** is usually dark and damp. It contains a layer of rotting leaves and dead animals called litter. This decomposes rapidly (within 6 weeks) to form thin humus, rich in nutrients.

Tropical Rainforest Adaptations.

- **Buttress Roots**: Very long roots that are designed to support tall trees and to suck up the maximum amount of nutrients in fairly nutrient poor soil.
- **Evergreen:** Most vegetation in rainforests does shed its leaves once a year. However, because the climate of rainforests is similar all year, they shed their leaves at different times providing a constant source of biological matter and keeping the rainforest green.
- **Drip tip leaves**: A lot of vegetation have leaves designed for rainfall to travel over them and drip to the ground. This is because the vegetation does not wanted to be damaged by large quantities of water.
- Other plants, like orchids, bromeliads and ferns, grow as **epiphytes** high up in the canopy where there is more sunlight.
- **Lianas:** These are woody vines that climb up other trees to try and get into the canopy and capture sunlight.

- **Strangler Figs**: Strangler figs grow around the outside of other trees taking their light and nutrients and slowly killing the host tree. However, when the host tree collapses so does the strangler fig.

Other Characteristics of tropical rain forest

-Broad leaves – to provide large surface area for transpiration
- Shiny (glossy leaves to reflect the high intensity of light/insololation
- Trees at different stages of development due to absence of seasons
- trees tall, straight, smooth trunks due to competition for sunlight
- There is little or no undergrowth because little light reaches the ground
- Most trees have shallow and extensive roots which tap nutrients lying near the surface
- contain wide variety of species which are closed together in mixed stands
- Most trees are hardwood and take long to mature.

Uses of tropical rainforests.

a) Source of timber for furniture, building and construction.
b) Crops like oil palm and cocoa are now grown in plantations in Congo and West Africa for palm oil and cocoa production.
c) The milky Juice from the bark of Zabote tree in Central America is used as a raw material for making chewing gum.
d) Nuts like the Brazil Nuts are used to make vegetable oils and Buttons (ivory nuts).
e) Fibres obtained from trees like torguilla palm in Ecuador is used to make panama hats, mats, containers, baskets and thatching materials.
f) Some forest species contain medicinal plants like Cinchona tree whose bark yields Quinine used in the treatment of Malaria.

2. Mangrove Forests.

Mangrove swamp exists in the shallow and salty waters. It is made up of tree species which can survive in waterlogged salty sea shores.

Location.

1. Africa. Along the East Coast of the continent from East Africa to Mozambique. N.W of Madagascar coast of the Gulf of Guinea in W. Africa.
2. Along the South American Coast, river estuary of the Amazon River.
3. Along the East Coast of Sumatra and Borneo in S.E Asia.

Characteristics.

a) There are made up of close to thirty different species sharing common characteristics.
b) They grow in the shallow bays, estuaries and lagoons at the coast.
c) The trees are in constant contact with water and roots are partially aerial (growing horizontally before turning vertically down)
d) The roots provide the trees with breathing mechanism.
e) The stem and branches appear to be floating on water during high tide but are supported by a network of aerial roots.

Uses

a) In East Africa and W. Africa, the barks are used to provide tannin for tanning leather.
b) Mangrove poles are used for building and construction.

3. Tropical monsoon forests.

Located in areas that experience a tropical monsoon climate with seasonal variations in temperature and rainfall. The areas include;

a) Monsoon coast of south west and southern coast of Mexico.

b) Parts of Bangladesh, Burma, Vietnam and Indonesia.
c) Southern Guinea and Monsoon Lands of Northern Australia.

Characteristics.

a) They are adapted to the seasonal variations in climate by being deciduous.
b) In rain season, they resemble the tropical evergreens.
c) They have a variety of tree species just like the equatorial forests but are less dense (fewer number of tree species
d) The dominant types are camphor, Ebony, Sapele, Pynicado, Teak, Bamboo, and acacia. Other species are Eucalyptus in Queensland
e) Tall trees rise upto 30m but do not form a canopy. The trees have more branches in the lower sections since they are scattered.
f) There is dense undergrowth since more light reaches the forest floor than in the tropical rainforest.

Uses.

a) Teak is a hard wood used in boat building, furniture and building and construction.
b) Bamboo shoots are used as vegetables in China, S.E Asia and Japan.

4. Mediterranean Forests.

The Mediterranean woodlands are remnants of the original forests destroyed by people.

Location.

They are found on the western sides of continents in regions of warm temperate western margin climate. E.g;

a) In the lands bordering the Mediterranean sea in Southern Europe and N. Africa.
b) In SW end of Africa around Cape Town.
c) In the central coast of California and in southern Chile.
d) Perth in SW Australia as well as to the South around Adelaide.

Characteristics.

a) The trees are adapted to the ling dry summers by having long taproots to reach the deep water below surface.
b) Some are evergreen like the oak. Other are deciduous like Olive, Sweet Chestnut, Beech, Cedar and Pine.
c) Areas that are dry with poor soils have woody scrubs. In France it is called *Marquis,* in Italy- *Macchia*, in California- *Chaparral* and in Australia- *Mallea.*

5. Temperate evergreen forests (warm temperate rainforests.)

Temperate rainforests are mainly found along the Pacific coast of the USA, Canada and Alaska, northern Scandinavia and Siberia. Smaller temperate rainforests can be found on the southeast coast of Chile in South America, Norway, Japan, coast of Natal, New Zealand, and southern Australia.

The main characteristics of the temperate rainforest are:

a) They have evergreen trees due to abundant rainfall and warm temperatures.
b) The increasing seasonal effects of winter in some areas make some species deciduous like inn south Eastern USA.
c) Examples are the evergreen Oak, hemlock, walnut, dogwood, maple, hickory, wattle, Chestnut, Bamboo and mulberry. On the tropical sides, the varieties are palm, tulips, camphor, camellia, and magnolia. Some confers like Cedar and Pine exist in areas of poor soils.

6. Coniferous forests/ Boreal forests/ Taiga Vegetation.

They occur between 45° -75° North and South of the Equator. In North America, the extend from the west coast of Canada to Hudson Bay in the East.

In Eurasian shield, they extend from Scandinavia, across euripi to pacific coast.

In the southern hemisphere, they exist in the Andes and in New Zealand and Tasmania.
The coniferous tree species are however common in many other vegetation regions of the world.
Characteristics.

a) The trees have a conical shape and flexible branches to allow snow to slide off easily thus minimizing damage to the trees
b) Most trees are evergreen so as to have maximum utilization of sunlight during the short summer season
c) Needle like leaves help to reduce the loss of water from the trees in winter when there is no moisture to be absorbed from the soil
d) The tree trunks are flexible to enable them sway without breaking during the strong winter winds.
e) The leaves have a tough waxy skin which protects them from the winter cold
f) The trees have a widely spread root system for utilizing moisture from the top soil since most of the time the subsoil is frozen
g) The trees occur in pure/ uniform stands with major species being Spruce, fir, pine and Larch. The forest species are generally few. Large tracts of forest land may contain only one or two tree species.
h) The forests have little undergrowth since the dead leaves make the soil acidic preventing growth of other plants apart from the mosses, lichens and crowberries.
i) Trees have thick barks which have a lot of resin to protect the trunks and branches from frost

Uses.

Deciduous forests/ the summer greens.

Mixed forests.

Grasslands.

Theer are four types of grasslands;
Tropical grasslands
Temperate
Arid
Montane grasslands.

Tropical (Savanna) grasslands
savana

- Savanna vegetation consists of trees and grass
- Wetter areas/near forests the vegetation consists of tall trees similar to those found in forests and woodlands
- Wetter areas have tall thick grass.
- Gradually away from the forest, the trees become fewer and shorter
- Grass is shorter in drier areas
- In drier areas the trees are short and more scattered.
- Some trees are deciduous type
- Most trees are umbrella shaped
- Most common trees are acacia and other thorny trees.
- Where the rainfall is lowest grass is tufted and coarse/trees scrub
- There are scattered baobab trees and other drought resistant trees.

- Along river valleys there is riverine vegetation and thick bush.

ii) Uses of savanna vegetation.

- Grazing – the plenty tall and short grasses are used for grazing domestic animals/wild animals.
- Reduces soil erosion – savanna vegetation acts as soil cover hence reduces soil erosion.
- Habitat for bees and wild animals- trees in savanna are habitat for bees which provide horney and home for wild animals e.g. Gazelles, giraffe.
- Some shrubs and herbs growing in the savanna are used as medicine.
- Fuel – trees provide wood fuel and fuel wood for the people in the tropics.
- Grass increases humus in the soil making areas suitable for cereals farming e.g. wheat and maize.

Temperate grasslands

Characteristics of temperate grasslands

- Treeless except along water courses
- Grass is short and tough in the drier areas
- Grass is tall in the moist areas
- Grass withers in Autumn and dies in Winter
- Grass sprout in springs
- Grass is nutritious

Desert vegetation

Hot Desert vegetation.

The vegetation is located in:

- Sahara in Northern Africa
- Kalahari in Southern Africa
- Atacama in South America
- Gobi in Central Asia
- Arabian in the Middle East
- Great Victoria and Great Sandy in Australia
- Mojave and Chihuahuan of North America

Characteristics of desert vegetation.

Because of the very arid conditions found in deserts, both plants and animals have had to adapt to survive. Adaptations include:

a) Succulents e.g. cacti: Succulents tend to be fairly fat fleshy plants that are able to store water in their leaves, trunks and roots.
b) Ephemeral: These are plants with very short life cycles - typically 6-8 weeks. This means that they can take advantage of very short wet seasons in order to pollinate.
c) Long and wide roots: Plants in deserts have very long roots so that they are able to absorb the maximum amount of rainfall during periods of rainfall. It also makes them more stable in very lose soil.
d) Spiky and waxy surface: Many plants like cacti protect themselves with spikes and wax so that they are not eaten or damaged by animals.

Cold desert vegetation. / Tundra vegetation.

The vegetation is found in Polar Regions and extremely high mountains where water availability to plants is scarce due to freezing.

Areas of this type of vegetation include;

a) In Eurasia and North America between 66.5° to 90°N
b) Patagonian desert of Argentina.
c) In Northern China.

Characteristics.

a) Cold deserts have more vegetation than hot deserts due to considerably higher amount of moisture available.
b) The vegetation is mainly composed of grasses like sage-brush and drought resistant woody spiny plants.
c) The plants are generally Xerophytes and halophytes.
d) Flowering plants and grasses are common in sheltered slopes.
e) The poorly drained areas have the tundra bog and moors.
f) Winter frost and blizzards limit growth of trees.

Uses.

a) The bilberries bear edible fruits.
b) Small trees are a source of fuel for the Eskimos.
c) Valuable food for animals for the pastoral nomads.

Mountain vegetation.

On high mountains , the following is the vegetation zoning;
D*iagram*.

1. **Savanna.** In tropical lands, there exists savanna vegetation at low levels graduating into woodlands at a height of 2000m **ASL.**
2. **Rainforest.** They are zoned from 1800m on windward slopes and from 2000m on leeward slopes and beyond the Savanna belt. Trees become shorter with increasing g altitude. Ferns, lichens and mosses are conspicuous undergrowth in this zone.
3. **Temperate forests.** Starts at upper limit of rainforests and is characterized by coniferous trees that are much shorter than the ones in true temperate regions. The belt extends upto 3500 m on the leeward sides.
4. **Bamboo forests.** The zone starts at about 3000m and 2700m on windward and leeward respectively. The bamboo forms a dense thicket as altitude increases.
5. **Heath and moorland.** The zone starts at about 3500m, with tussock grasses, tough shrubs and short flowering alpine plants dominating. The grass thins to give away to bare rock at higher levels.

Factors that determine zoning of mountain vegetation

a) *Altitude.* It influences temperature and rainfall. Grasslands exist at low altitude with little rainfall and higher temperatures. Heath and moorland exist at higher levels with minimal moisture and extreme low temperatures. Mid-altitudes have dense forests due to high rainfall.
b) *Aspect.* Windward slopes have richer vegetation than leeward slopes because of the rain shadow effect. Also south facing slopes in the NH (on alpines) have denser vegetation.
c) *Slope.* Steepness of slope affects rate of infiltration and drainage. Very Steep slopes usually have poor vegetation because of inability of infiltration. Moderate to gentle slopes would have dense vegetation. Poorly drained areas in the summit of mountains would have mountain bog.
d) *Temperature.* Plant species drop with increased elevation on a mountain slope due to falling temperatures.
e) *Moisture availability.* There is an increase in precipitation on the windward slope for the first 3000m ASL due to Orographic influence. This explains why there is dense forest cover in the zone between

1800m and 3000m that receive high rainfall.

Uses of mountain vegetation.

a) Mountain forests are habitat for wildlife/wild animals like elephants and mountain monkeys.
b) The mountain forests provide timber and building materials such as poles and fibres.
c) Grasslands on the lower levels of mountains are used for grazing. There is transhumance in alpine regions
d) the vegetation in mountainous forests is used for scientific research
e) The forests attract rainfall.
f) The mountain forests help in balancing the ecosystem as trees help remove carbon dioxide from the atmosphere and they also release moisture into the atmosphere.

Significance of vegetation.

- Vegetation is of aesthetic value as it adds beauty to landscape.
- Vegetations roots binds soil together protecting soil against erosion
- Plant decay to form humus adding fertility to soil

Add more points

Forestry.

A forest is a continuous growth of trees and undergrowth covering a large tract of land **.**

Forestry is the science of planting caring and using trees/forests and their associated resources or the practice of managing and using trees/ forests and their associated resources.

Types of forests.

Natural forests. Natural forests are the trees which are growing wildly on its own without the interference of external influences. They establish themselves through natural means of seed dispersal. Such forests include the *derived* or *secondary* forests that comprise natural forests on a place interfered with by man but which re-established itself naturally without the assistance of human beings.

Planted forests. They comprise trees grown in a place by people. Sometimes they are reffered to as *cultivated forests* and form what is referred to as tree plantations.

Indigenous forests. They are composed of trees which are natural or native to a country or region.

Exotic forests. They are made of trees that are alien to a country/introduced to a country from other parts of the world.

Many planted forests in Kenya are exotic. The natural forests mainly have indigenous trees.

Natural forests are further classified on the basis of climatic regions as follows;

1. Tropical hardwood forests

. These are forests characterized by a majority of trees whose timber is extremely hard. They include the equatorial and monsoon forests.

The tropical hardwoods have the following characteristics;

a) Most o the trees are Evergreen as they shed leaves at different times throughout the year while growing new ones. Monsoon forests have some deciduous species.
b) Some trees are tall growing beyond 46m, straight, with smooth trunks due to competition for sunlight.
c) The trees are very heavy and some would not float on water.
d) Most of the Trees have large trunks thick buttress roots making their exploitation difficult.
e) The trees take a long time to mature, with some taking between sixty-five and a hundred years.

Hardwoods in W. Africa include Mahogany, Iroko, Sapele, okuome, Ironwood, Rose wood and Ebony. In Kenya, they include the Meru Oak, Elgon Olive, Elgon teak, camphor, and mvuli and mangrove species.

2. Temperate hardwood forests

They grow in the mid latitude areas which experience warn=m and cool temperate climate

They are mainly found along the Pacific coast of the USA, Canada and Alaska, northern Scandinavia and Siberia. Smaller temperate rainforests can be found on the southeast coast of Chile in South America, Norway, Japan, coast of Natal, New Zealand, and southern Australia.

The main characteristics of the temperate hardwood forests are:

a) Trees are mainly deciduas, shedding their leaves in autumn and remain bare in winter.
b) The trees have broad leaves.
c) The individual tree species are scattered and density per unit area is small.
d) The trees are smaller in size than those of the tropical hardwood forests.
e) They have durable wood (very hard) but are easier to exploit than tropical hardwoods.

Varieties that are of commercial value include Oak, silver oak (*grevillea Robusta),* eucalyptus (blue gum) hemlock, walnut, Blackwood, ironwood, olive, hickory, wattle, Chestnut, elm and ash.

3. **Coniferous forests.**

They are classified as temperate softwoods and exist. They are called coniferous because they bear cone-shaped seeds

They occur between 45° -75° north and south of the Equator mainly In North America and Eurasian shield. They also exist in the Andes and in New Zealand.

The coniferous forests have the following characteristics;

a) The trees have a conical shape and flexible branches to allow snow to slide off easily thus minimizing damage to the trees
b) Most trees are evergreen with Needle like leaves help to reduce the loss of water
c) The tree trunks are flexible to enable them sway without breaking during the strong winter winds.
d) The trees have a widely spread root system for utilizing moisture from the top soil since most of the time the subsoil is frozen
e) The trees occur in pure/ uniform stands. Large tracts of forest land may contain only one or two tree species.
f) With major species being Spruce, fir, pine and Larch. The forest species are generally few.
g) The forests have little undergrowth.
h) In areas of heavy rainfall and high humidity, the trees grow gigantic. In British Columbia and California, the redwoods, the big tree *(sequoias)* and Sitka pruce can grow to a height of 100m and a trunk circumference of upto 15m.
i) Trees have thick barks which have a lot of resin to protect the trunks and branches from frost.
j) The trees take long to mature (50-70 years) because of the cold climate

Montane forests.

Mountain forests exist on many mountains in the world under the influence of altitude and latitude. The tree species are generally natural and semi – natural where people have harvested through intensive logging. Others are planted

Planted forests.

There are countries which did not have forests but have established some by planting (Afforestation). For example, in Egypt and some parts of Kenya. in kenya , there is also a programme of establishing forests where the original forests have been destroyed (reafforestation)

Factors influencing the distribution and types of natural forests

a) *Variation of rainfall***.** Areas that receive high rainfall are forested while those receiving low rainfall have little tree cover.
b) *Variation of altitude/relief***.** Forest density and vegetation zonation on mountains varies with height above sea level (e.g. montane forests in high altitude) as altitude influence climate and soil.
c) *Aspect.* Areas on leeward slopes of Mountains have lesser forest cover than the thick growth of trees in the windward side because they receive different amounts of sunshine and rainfall. South facing slopes in the alpine also have luxuriant forest cover.
d) *Soil.* Sandy soil/swamp soil/saline soil does not support forest vegetation. Rich fertile soil areas can support dense forests with other conducive conditions. Vegetation on slopes is determined by soil catena.
e) *Human activities***.** Settlement/mining/ farming interferes with the original natural forests leading to growth of secondary / derived forests.

Importance of forests in Kenya.

a) Forests Provide utility products e.g. timber which is used in construction, wood fuel and honey.
b) Forests are a habitat for a wide range of animals and micro-organisms hence help in conserving and maintaining bio-diversity and maintaining ecological balance,

c) Forests are rich reservoirs of research material e.g. scientists carry research studies on medicinal plants which helps cure certain diseases.
d) Forests create micro-climates hence regulates climate of the surrounding areas. Forested areas and their neighbourhoods tend to have frequent rainfall.
e) Forests support agriculture and HEP production by being water catchments areas, regulating water flow, preventing soil erosion and preventing siltation of rivers and therefore controlling floods.
f) Forests regulate carbon dioxide hence helps reduce global warming.
g) Presence of forests and forest activities has led to development of infrastructure which opens up remote areas.
h) Forestry as an industry provides more employment opportunities e.g. as forest guards and carpenters, this raises the standards of living.
i) Flora and Fauna of the forests have an aesthetic appeal hence attracts tourists who bring foreign exchange.
j) Forests and its products have medicinal value which helps treat a variety of diseases.

Importance of forest products.

Problems facing forestry in Kenya.

a) Encroachment of the adjacent forest because of the need for more land for agriculture, settlement and grazing of animals
b) Wild animals cause damage to forests especially when overgrazing occurs due to increased population.
c) Pests e.g. outbreak of aphides in the early 1990's resulted in the destruction of large areas of cypress forests.
d) Overexploitation through charcoal burning, logging and extraction of medicinal plants lead to scarcity of forest products
e) .Forest fires caused by poachers/ charcoal burners/ honey harvesters have threatened the forest ecosystem.
f) Excision of some parts of forests for either public or private use.
g) Poor management like delay in replanting trees once felling has been done leads to shortage of forest products and harvesting of immature tree in future.
h) Prolonged drought conditions, strain the water in the soil and this lead to death of trees in the forests.
i) Drug growing- Large portion of forest have been illegally been cleaned to grow bhang especially in Mt. Kenya forest reserve. This reduces the size.
j) Degazettement of government forest e.g. in 2002 led to large forest being cleaned for settlement.

Management and conservation of forests.

Forest management Refers to the effective planning and control of forests and forest resources.
In Kenya the government is taking the following measures to effectively manage the existing forests and the resources.

a) Research is being carried out on soil requirements for different species of trees to enable foresters' plant trees in suitable areas.
b) Public campaigns on importance of forests are always being carried out through mass media to educate people on the importance of forests.
c) People are being encouraged to use alternative sources of energy/energy saving jikos.
d) People are required to seek permits if they have to cut trees. This reduces the rate of trees felling/unlicensed people do not cut down trees.
e) The forest reserves are patrolled by guards to ensure that fires are reported promptly and also to ensure unlicensed people do not cut down trees.

f) Forest reserves have been set aside to conserve indigenous species.
g) Forestry department of the ministry of natural resources carry out research to produce and distribute seedlings to ensure the extension of forests.
h) Registering/ recognizing the efforts of NGOs like the green Belt Movement which have mounted campaigns on planting of trees.
i) Gazetting forested areas to reduce encroachment of the public.
j) Creating public awareness through mass media/ public bazaars on the importance of conserving forest resources.
k) Enacting laws to prohibit the cutting of trees without a license/ protecting indigenous tree species.
l) Establishing NEMA/ ministry of environment and natural resources to coordinate environmental management and conservation activities.
m) Setting aside national tree planting day to encourage people to plant more trees.
n) Advising people to practice agro- forestry so as to avoid cutting trees from the forests.
o) Employing forest guards to protect forests form fires/ other illegal human activities.
p) Encouraging recycling of papers/ wood based products/ use of other sources of energy to reduce demand of trees.
q) Carrying out research through KEFRI and ICRAF in order to come up with ways of controlling diseases/ pests/ develop species suitable for different ecological regions

Forest conservation measures

- Tree planting/ re- afforestation/ -NGO's planting of indigenous species is being encouraged to preserve the endangered species.

Agrofoestry.

Agro forestry is a land use system, which enables the production of trees, crops and livestock on a given unit of land either in spatial arrangement or/over time to maximize productivity and sustainability of the land.

Importance of agro forestry

- To ensure continuous supply of wood fuel/timber/herbal/medicine/raw material for paper making.
- To protect the soil from erosion.
- To protect the water catchment areas/create microclimates/maintain hydrological cycle.
- To create scenic beauty.
- To expand the habitat for wildlife/conservation of wildlife.
- To create employment opportunities.
- To reduce importation of forest products/save foreign exchange.

Soft wood forests in Kenya and Canada.

Kenya.

Softwood forests are found in the central highlands at altitude 2000m ASL. Planted forest also exists in Londiani, Kitale, Kisumu, Nyahururu, Kiambu and Nyeri. Total forest area is estimated today at 169,000 hectares with planting programme of 7000 hectares per annum.

The common indigenous softwoods are juniper (Kenya cedar and podo while the exotic ones are mainly cypress and pines. Kenyan confers grow faster.

Canada

75% of Canada's productive forests consist of softwoods. The forests are coniferous with the most valuable tree species being Douglas fir, spruce and white pine. The regions where forests are most intensively exploited are British Columbia.

Canada's softwoods are mainly natural while in Kenya they are mostly planted

Factors favoring forestry in Kenya and Canada

Kenya

a) Cool climate especially in the Kenya highlands which enable coniferous trees flourish.
b) Fertile soils-Volcanic soils within the Kenya highlands and Rift valley.
c) Varied altitude which favours growth of different types of trees due to varied temperatures and rainfall.
d) Heavy rainfall / about 1000mm and low evaporation rate which favours growth of trees.
e) Rugged and steep highlands in some areas which discourages settlements and agriculture leaving growing of trees as the only alternative
f) Creation of forests reserves which enables forests to develop without interference from humans
g) High demand for timber and wood products in the country and COMESA region.
h) Afforestation and reafforestation programs

Canada

a) Low temperature experienced discouraging settlement and other forms of land use.
b) Ruggedness of the landscape and thin soil, do not favour agriculture.
c) High precipitation throughout the year promotes forest growth.
d) Valley bottoms along the coast provide good sites for the paper mills and there is clay, which used in smoothing the paper surface.
e) Many rivers with waterfalls e.g River Ottawa, provides water used to generate HEP for use in industries such as pulp and paper industries.

Mode of exploitation

In Canada, harvesting is done through clear cutting while in Kenya it is selective logging.
In Canada logging is done in winter while in Kenya cutting takes place throughout the year.
In both countries, commercial logging is mechanized.
In Canada, logs are transported using melt water/rivers while in Kenya transportation is by road. In Kenya, transportation is expensive while in Canada it is cheap.
In Kenya, softwood forests are found mainly in the highlands while in Canada they are found both in highland and lowland areas.
In Kenya, softwood forests cover a small percentage of the total land area while in Canada they cover large tracts of land.
In Kenya, transportation is expensive while in Canada it is cheap.
Severe winters in Canada slow down growth of trees hence take long to mature while in Kenya trees mature faster due to cool climates in highlands.
Most of Canada is wood products are exported to U.S.A. / Britain /Europe while wood products in Kenya are sold locally with few being exported to and U.S.A Europe.

Factors that favour exploitation of softwood forest in Kenya and Canada

Kenya.

a) Logging can go on all year because Kenya does not experience any winter which would interrupt the activity.
b) Hydroelectric power is readily available to the relatively few sawmills and the paper mills at Webuye.
c) Availability of cheap and ample labour for cutting and processing of timber.
d) Availability of water from river Nzoia.
e) Timber and wood products are in high demand within Kenya and the COMESA region. This guarantees a ready market for these products.

Canada.

a) Mild winters with ice-free water in British Columbia make it possible to transport logs throughout the year
b) Many rivers in Canada provide adequate and cheap hydro –electric power (H.E.P) for factories and

water for processing in pulp industries

c) Cheap and efficient transport system both land and water is available to ferry logs to the factories and finished products to the market.
d) Availability of ports e.g. Vancouver , prince Rupert Montreal and Quebec enable sawn timber and timber products to be easily exported to USA, Europe and Japan
e) High demand for forest products within Canada and neighbouring countries
f) Availability of clay in processing of pulp and paper

Problems of forestry in Canada.

a) Accidental fires which consume large tracts of the forests reduce the area under the forests.
b) The cold climate leads to trees taking too long to mature which delays harvesting time.
c) Rugged landscape especially in the mountainous areas hinders smooth exploitation of the forests.
d) Northern parts are inaccessible in winter due to very cold climate conditions.
e) Overexploitation in some areas has created a shortage in some of the true species while taking a long time to mature.

Why softwoods forests in Canada is make developed than in Kenya

a) There is a high demand for the various processed forest products in Canada than in Kenya where the demand is very low. Kenya concentrates mainly hardwoods.
b) Canada has many rivers that provide cheat transport of the logs white Kenya's road and railway transport is very expensive.
c) Canada has a variety of species which can be chemically or mechanically processed to greater utilities white Kenya has very few species, mainly pine and cypress.
d) Forestry is the main economic activity in Canada since the land is rugged and unsuitable for cultivation. In Keya, Agriculture is the main economic activity / 60% of the land in Canada is under forestry white in Kenya, it is only 5%.
e) Advanced technology in Canada facilitates faster processing and marketing of the forest products in Canada while in Kenya, there is low technology making the timber produced les competitive on the world market.
f) The low population density in Canada has provided enough room for the establishment of softwood forests thus making it more developed than in Kenya where the high population is encroaching on the forest resources.

NB

THIS WORK IS ALSO AVAILABLE IN POWERPOINT SLIDES

CONTACT 0208002451 OR +254722402641