CHAPTER ONE
CONCEPT OF GEOGRAPHY

DEFINITION

The term GEOGRAPHY is derived from two Greek words that is, 'geo' and 'graphy'.

Geo comes from the Greek word 'geo' which means the earth and graphy comes from 'graphein' which means to describe. Therefore geography describes the earth.

Geography is the study of physical features of the earth and human activities as it relates to these. Or Geography is the study of physical features of the earth and its atmosphere, and of human activity as affected by these including social and economic activities.

ENVIRONMENT refers to all external conditions surrounding an organism and which have influence over its behaviour or activities. The earth is the environment of humankind. There are two types of environment in Geography. These are:

(i)**PHYSICAL ENVIRONMENT** is all natural physical features on the earth. These are like land, water, climate, plant, animal life and human beings.

(ii) **HUMAN ENVIRONMENT** is all human kind activities such as farming, mining, settlement, transportation, trading and tourism.

BRANCHES OF GEOGRAPHY

There are three main branches of geography namely;

(a) Physical geography

(b) Practical geography

(c) Human and economic geography

A. Physical geography

Is the science concerned with land formation processes and pattern in natural environment. This includes mountains, valley, rivers, soils, rocks, solar system, the earth and distribution of vegetation.

B. Practical geography

is the science that is concerned with application of methods of measuring, observing, recording and interpreting geographical data. It involves field study, research, photograph interpretation, map work, statistics.

C. Human and Economic geography or Regional geography.

It deals with all human activities on the earth's surface. This includes mining, agricultures, transportation, settlement, trade, tourism and industry.

THE RELATIONSHIP BETWEEN GEOGRAPHY AND OTHER SUBJECTS

Geography has a relationship with almost every discipline as follows:

(a)**BIOLOGY**

It is called **BIOGEOGRAPHY**. Biology is the scientific study of organisms, focusing on their anatomy, physiology and behaviour. It deals with the relationships between plants and living creatures and their relation to their environment. Hence Geography applies such knowledge in the study of concepts such population and settlement, vegetation and forestry.

(b) **HISTORY**.

It is called **HISTORICAL GEOGRAPHY**. History studies and records the events of the past and the present. Also Geography attempts to explain where these events took place and analyses ways in which historical events affect current human activities.

(c) **ECONOMICS**.

It is called **ECONOMIC GEOGRAPHY**. Economics deals with the study of production, distribution and consumption of commodities. It involves money, trade, industry, agriculture and all human activities. Geography also uses such information while studying concepts such as trade, industry, and transport and land reclamation.

(d) **MATHEMATICS**.

It is called **MATHEMATICAL GEOGRAPHY**. Mathematics is the science of numbers and shapes. Also Geography uses mathematical principles and formulas in studying statistical methods and map work.

(e) **PHYSICS**.

It is called **GEOPHYSICS**. It is concerned with matter, energy, light, heat, sound, gravity, pressure and magnetism. Also deals with astronomy which is the scientific study of sun, moon, stars and planets. Geography uses such information in the study of concepts such as solar system, earth movements, the atmosphere, land forming processes and earthquake.

(f) **CHEMISTRY**.

It is called **MEDICALGEOGRAPHY** which deals with diagnosing, preventing and curing diseases in people, animals and plants. Also Geography focuses on the causes and factors influencing the spread of diseases and the impact of diseases in human activities.

THE INTERRELATIONSHIP BETWEEN GEOGRAPHICAL PHENOMENA

Geographical phenomena refer to the geographical facts or events of scientific interest such as land, plants, animals, people, climate and atmosphere. These tend to interrelate as follows;

- The land provides soil in which plants grow and these plants are food for herbivores which in turn are food for carnivores and humankind.
- Climate determines the types of plants and animals that can survive in a given region.
- Climate and plants determine the distribution of people and human activities such as farming, tourism and settlement.
- Human activities modify physical environment such as poor farming methods leads to soil erosion, drought and global warming in turn affect human life.
- Human activities such as farming, tourism and settlement are determined by the conditions of the physical environment.

GEOGRAPHICAL EMPLOYMENT OPPORTUNITIES

The following are people who perform job opportunities that can be obtained through learning geography: A diver, Forester, Surveyor, Pilot, Mountain climber, Cartographers, Land planner, Teacher, Environmentalist.

THE IMPORTANCE OF STUDYING GEOGRAPHY

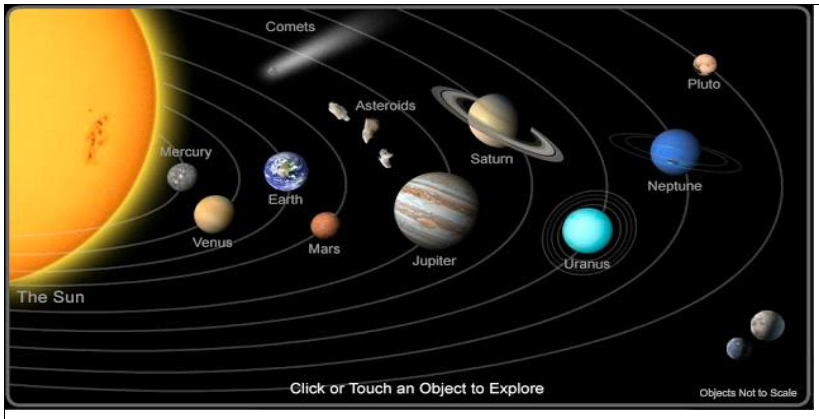
- It helps us to understand basic physical system that affects everyday life e.g water cycles, wind and ocean current.
- To gain skills of observing, measuring, recording and interpreting phenomena
- To understand the interaction between our country and other countries, and share ideas of solving problems.
- To acquire skills for combating environment problems in order to conserve and manage the environment in the sustainable way.
- To develop awareness and knowledge about natural resources (Land, natural forests, mineral deposits, water etc) wild animals climatic regions and other natural resources.
- It provide base for specialization career for example cartographer, climatology, geologist
- It helps to learn on how other countries in the world solve different problems like fire outbreak diseases, environmental problems.
- To gain knowledge of employment opportunities

CHAPTER TWO
THE SOLAR SYSTEM

DEFINITION

The Solar system is the arrangement of sun, planets and other solid objects in the space in relation to the position of the sun OR

Is the group of heavenly bodies made up of the sun, the planets, the moons, natural satellites, asteroids, comets, the stars, meteors and meteorites that surround it.



The diagram showing solar system

COMPONENTS OF THE SOLAR SYSTEM

The solar system is made up of the stars, sun, planets, asteroids, meteors, comets, interplanetary dust and gases and natural satellite (Moon).The space in the sky which contains so many stars, the sun the moons and the planets is called the UNIVERSE. The solar system is part of the universe. The scientific study of the components of the solar system is called **ASTRONOMY**.

- **A STAR**

  Is a heavenly body that possesses and transmits its own light. A group of stars is known as **galaxy**. In the sky there are millions of stars. Though the stars look so close to each other, they are very far from one another and so many that you cannot count them. These stars are actually suns because they also have light of their own.

- **THE SUN**

  The sun is a huge burning body consisting of different gases that possesses and transmits its own light. The looks like a bright yellow and red fire ball.

- The Sun is the big star. It is like one among the millions of stars that one sees at night except that it looks much bigger because it is closer to the earth than other distant stars.
- The sun is much larger than other distant stars from the earth, in fact much larger than all the planets put together.
- It is a spherical mass of hot, glowing gases consisting mainly two gases that is hydrogen and helium which are light gaseous making about 98% of the sun.
- Almost all the energy of the solar system is derived from the sun. All the light and heat on all the planets and natural satellites come from the sun.
- Its diameter is about 1.4 million km. It is more than 108 times bigger than the diameter of the Earth. And its mass is approximately 330,000 times greater than that of the Earth. The sun does not rotate or revolve in the solar system. It is a stationary object.
- The sun is very hot. Its average surface temperatures are about 6,000°C. Its hotness does not support any life in it. It is much hotter in the interior where it is about 14,000,000°C.
- It forms about 91.8% of the mass of the solar system. The elements that form the material of the sun are different proportion from those of the earth. The earth is relatively cold body but the sun is so hot that nearly all molecules are broken into their separate atoms and all are mixed together into a single hot gas.

COMPOSITION OF THE SUN

The elements which form the materials of the sun are in different proportion and from those of the Earth. The sun is composed of approximately:

- Hydrogen is 75% of the sun.
- Helium is 23% of the sun.
- Other elements are 2% of the sun.
    - Therefore the other elements of the sun include the Carbon, oxygen, silicon, iron and other chemical elements. They only make a small fraction of the material of the sun but make up most of the Earth.
    - At the Centre the sun has a density of over 1,000 times that of water. This means that it is very heavy in relation to its size.

LAYERS OF THE SUN

The sun is made up of several layers namely the corona, chromospheres, photosphere and the core

CORONA is the outer most layer of the sun in which there are series of luminous concentric rings of colours due to the diffraction of light by water drops. It is beyond chromospheres.

CHROMOSPHERE is the outer layers of the sun's atmosphere lying immediately above the photosphere, which is the ordinary visible surface of the sun. It is a hot layer of gas around the sun or another star and roughly 10,000km deep.

PHOTOSPHERE is the visible gaseous and intensely bright layer surrounding the sun and is about 400km thick below the chromospheres.

CORE is the layer of the sun which at the Centre.

The sun is the brightest celestial body in the solar system which the Earth and other planets revolve and supplies with the light and heat. The sun is the main source of light and heat that planets receive. The light is the brightness we see during day time. When it gets to evening, the sun disappears and light also disappears with it.

Heat is the hotness from the sun we feel on our body. It is stronger during day time. When the sun disappears, the heat decreases considerably; it then becomes cool, sometimes cold.

The rays of the sun are thrown onto the earth's surfaces. The rays contain light and energy which is which is transformed into heat only after falling onto the ground.

Unlike heat, a light is felt immediately. We feel the heat when the elements of which are on the ground and those which are in the atmosphere like dust particles and water vapour change the energy of the sun into heat. The heat then warms the ground and that is when we feel it.

The atmosphere above us is also heated from below. That is why areas on lower level are heated more strongly than areas on a high level.

SOLAR ENERGY

Energy refers to the power required to carry out an activity, for example to run a machine. Power is the capacity or ability to do something such as light, heat, and sound, electrical and chemical energy.

Solar energy is the energy produced by the sun. Solar energy has power that helps to perform an activity. This capacity exists in form of light and heat.

TYPES OF SOLAR ENERGY

The sun is the only source of all energies on the Earth's surface which is called solar energy. The sun provides energy by releasing electromagnetic waves which we call SUNSHINE. There are two types of solar energy

- Direct solar energy
- Indirect solar energy

Direct solar energy is the energy received from the rays of the sun which comes directly to the Earth's surface. It is changed by the dust particles and water vapour into heat.

Indirect solar energy is the energy received from the rays of the sun by the bodies of animals and plants being converted into energies after dying of those living organisms. Examples are coal, oil or petroleum.

USES OF SOLAR ENERGY

Solar energy is used in many ways:

- It is used in drying clothes, grains, fruits and meat.
- Used by plants to sun to manufacture their food through the process known as photosynthesis.
- Solar energy captured in solar panels and stored in batteries provides electricity used in generating industrial and home Appliances like television, refrigerator, Oven, electric iron and cooker.
- Many everyday items such as calculators and other low power consuming devices can be powered by solar energy effectively
- Is used as a source of vitamin D for human being
- It is used for evaporation of water from water bodies which is necessary for rain formation

USEFULNESS OF SOLAR ENERGY IN ENVIRONMENTAL CONSERVATION

- It helps to make more oxygen for use since plants take up carbon dioxide from the atmosphere and release oxygen as a result excess carbon dioxide is removed from the atmosphere.
- It is clean type of energy which does not the atmosphere because it does not release fumes or form soot.
- It protects forest and other woodland from being destroyed thus promoting environmental conservations.
- It reduces environmental pollution since it reduces reliance on fuel like kerosene and diesel.

ADVANTAGES OF SOLAR ENERGY

- It could be used in many parts of the world

- It has unlimited supply since it is renewable energy (does not get exhausted).
- It is not pollutant (it is clean). That is does not cause environmental pollution.
- It does not have to be transported.
- It is free; one only has to buy the solar equipment.
- It has low maintenance costs for solar equipment
- It can be captured in every home using solar panel.
- It can lead to development of other sectors such as tourism in the country where there is plentiful supply of sunshine. Many visitors enjoy sunshine when it is winter.

DISADVANTAGES OF SOLAR ENERGY

- It is not possible to be used on a cloud day when the stored energy is not enough to operate the device.
- It is difficult to store large quantity of solar energy, compared to electrical energy.
- It is expensive to install hence needs high capital for buying some equipment.
- The sophisticated technology required in solar energy production is lacking in developing countries.

NB: Tanzania receives plenty of solar energy. However most of this energy has not been put into much use yet. In some countries research is being carried out to find out how the solar energy can be best used for domestic, industrial and other purpose.

SOLAR ENERGY IN THE EMANCIPATION OF WOMEN

DEFINITION

Emancipation of women refers to a situation when women and girls are free from the hard labour of gathering firewood, cooking, cleaning and taking care of children in a society.

IMPORTANCE

- It helps women and girls to involve in other activities

  The use of solar powered equipment such as solar cookers and water heaters would make women have more time to get involved in money making activities such as business and farming. It also means that young girls would go to school. This would give the girls an opportunity to be at same education level as boys.

- It makes life easier for the rural women because of using solar energy for lighting, heating and cooking.
- It reduces the illegal killing of women suspected to engage in witchcraft practices due to having red eyes diseases due to use of unfavorable sources of energy like animal dung, crop residue, firewood and charcoal.
- It helps to improve the health of women and girls because women and girls will not walk long distances to the forests or bushes to gather firewood and carrying them on heads or n their backs.
- It saves the forests and woodland from destruction thus promoting environmental conservation which will enable them to get other basic needs such as water at nearby areas.
- **THE PLANETS**

DEFINITION

The word **planet** is a **Greek** word which means **wandering stars**.

Thus planets refer to the bodies which revolve around the sun in an orbit.

CHARACTERISTICS OF PLANETS

For a heavenly body to be called a planet, it has to fulfill the following conditions;

- It must move around the sun in its orbit.
- It must be big enough for its own gravitational force to pull it into the shape of a sphere.
- It has to have "Cleared neighborhood around its orbit of other bodies.

POSITION AND NATURE OF PLANETS

- According to their arrangement, starting with the nearest planets to the sun there are eight planets, these are MERCURY, VENUS, EARTH, MARS, JUPITER, SATURN, URANUS and NEPTUNE.
- Since 1930 when it was first discovered, PLUTO has been referred to as the ninth planet. However in the year 2006, the International Astronomical Union (IAU) demoted it from being a planet to a "**DWARF PLANET**". This is because does not satisfy the third condition of having clear orbital neighborhood with the KUIPER BELT OBJECTS. In the year 2003, astronomers discovered the heavenly body in our solar system which they called 2003 "VB12" and later "SEDNA"
- The distance of the planets from the Sun differs. The Mercury, Venus and the Earth are nearer to the sun. The other five are farther away from the sun. furthermore they are divided into two groups as terrestrial planets (inner planets) like the Mercury, Venus,

Earth and Mars and the Jovian planets (outer planets) which are Jupiter, Saturn, Uranus and Neptune. Pluto is not included in either category because its position at the far edge of the solar system and its small size make this planet's true nature a mystery.

- All planets revolve around the sun in an anticlockwise direction following their orbits. Each planet has its own orbit and takes a different amount of time to move around the sun. Thus as they revolve around the sun, they appear to move among the stars. That is why the Greek called them "planets" which means the wandering stars.
- All planets revolve around the sun in the same direction in ORBITS, that are ELLIPTICAL and nearly in the same plane. And each planet rotates around a central imaginary line called an AXIS.
- The time taken to complete an orbit around the sun depends on the distance of the planets from the sun.
- All the light and the heat of the planets come from the sun. Hence the temperature on the planets depends on their relative distance from the sun.
- The mercury s the nearest to the sun and also the smallest planet. Mars is the nearest to our earth and Jupiter is the biggest of all. Neptune is the farthest planet of the solar system.
- The planets that revolve around the sun are kept in their orbits (paths) by the sun's powerful force of gravity.

THE POSITIONS OF PLANETS IN THE SOLAR SYSTEM ALONG THEIR ORBITS

EARTH

The following are some general characteristics of the planet earth.

- It is the third planet from the sun in the solar system. Its distance from the sun is between 154 and 147 million km. Its average distance from the sun is 150 million km.
- It is the planet in which living things exists. It consists of air, water bodies living organisms. About three quarters (75%) of the earth's surface is covered with water.

- It takes 365¼ or 366 days (1 year) to revolve around the sun.
- It has one moon, which is called the moon or lunar.
- It s a larger than Mars and Mercury.
- Its diameter is 12,683km that is the length of the equator. It takes 24 hours to rotate (that is spinning) on its axis.
- The earth condition makes the life possible for 100% on the earth's surface.

THE COMETS

Refer to the objects with leading heads and bright tail at the sky. These comets are smaller than planets composed of many frozen gases and the fine particles of matter (rock and dust) that orbits the sun.

They revolve around the sun beyond the limits of Pluto and can be seen only when their orbits overlap that of the earth at night. It is difficult to predict when a comet will be seen because of different factors that determine its brightness. The combination of rock, ice and dust gives it a bright and shiny appearance.

ASTEROIDS

Asteroids are solid heavenly bodies revolving around the sun mostly between the orbits of Mars and Jupiter. They look like planets and this is why they are also called PLANETOIDS. The section of the solar system found is found between MARS and JPITER where asteroids are mostly likely to occur is called ASTEROID BELT. They are so many and the largest existing asteroid is called CERES with a diameter of about 930km. These bodies cannot be seen without a telescope because they are very far away.

METEORS

- Meteors refer to a piece or fragment of hard matter falling from outer space or sky at the night. It has the bright line because of a burning piece of rock in space resulting from great friction against the atmospheric gases. The tail of light that forms is called a **METEOR** or a **SHOOTING STAR.**
- The meteors can be seen and luminous between 145 and 110km above the earth's surface because gets heated through friction with the atmospheric air and usually disintegrates. When they fail to disintegrate in passing through the atmosphere, they reach the earth's surface with a great force making large holes or craters and they are known as **METEORITES**.
- Thus meteorite is the remnant rock of a meteor from outer space that has travelled through the earth's atmosphere without disintegrating. Meteors are usually made of nickel, iron or silica fragments of disintegrated meteors.
- The much bigger meteoroids can produce very brilliant meteors called **BOLLIDES**.
- There are two known meteorites in Tanzania one is found in Mbozi District (MBEYA) and the other fell at Malampaka in Kwimba District (MWANZA) in 1930. Another meteorite crater is found in Arizona in U.S.A which is 150 deep and 1km wide.

NATURAL SATELLITES

Natural satellite is anybody that moves around the planet or any other body larger than itself. There are 60 known satellite in the solar system. There sizes range between 10 and 2500km in diameter. The largest know satellite is the earth's moon. Other planets also have large moon example jupiter's Galilean moons (Io, Europa, Ganymede and Callistol). Saturn's moon (Titan); and Neptune's moon (Triton).

The moon of the earth is a solid spherical body of a diameter of 3,456km. The distance from the earth to the moon is 375,000km. Due to elliptical shape of the moon's orbit, the point when the moon on its orbit is at farthest distance from the earth is known as APOGEE. It occurs when the moon is about 407,000km from the earth.

The point in the orbit of moon when it is at its minimum distance from the earth is called PERIGEE. It occurs when the moon is about 354,000km from the earth.

The moon takes 29½ days to make a complete revolution around the earth. As the moon revolves around the earth the illuminated Part of it apparently varies in size. The moon appears to rise in the EAST and set in the WEST because the earth spins from WEST to EAST. On the moon's surface there are some features found called as CRATERS. The first man to visit and walk on the surface of the moon is called NEIL ARMSTRONG from the former U.S.S.R in year 1969, nowadays RUSSIA.

THE IMPORTANCE OF THE SUN TO THE ENVIRONMENT

The sun plays a very important role in the environment. The sun is the chief controller of all climates on the earth's surface. The following are some important aspects of the sun:

- Warming the world.

  The sun gives off heat energy which is moderate and supports the existence of life on the earth.

- Light

  The sun gives light which make the objects visible during day time. At night some light from the sun is reflected to the earth by the moon and other planets.

- Photosynthesis

  The sun provides green plants with sunlight energy which helps them to manufacture their own food through photosynthesis. The plant food is then used by other organisms and therefore the energy passes from one group of organisms to another in the food chain, therefore, the sun helps the existence of life on earth.

- Making vitamin D.

  Sunlight energy helps the skin of human beings to make vitamin D in the body. Vitamin D helps in the strengthening of bones in the human body.

- Drying of materials.

Heat energy from the sun is used to dry different materials such as grains (cereals), clothes, firewood and other food products.

- Formation of rains

  The solar energy that is heat contributes to the formation of rainfall through evaporation, followed by condensation and finally rainfall.

- Making electrical energy

  The solar energy is changed into electricity using solar cells or solar panels. Electrical energy is then used for cooking, ironing, lightning, and running machines such as radios, TV, calculators etc.

- Gravitational force.

  The sun holds all objects in the solar system. It holds planets, comets, moons, asteroids and other components of the solar system through its gravitational attraction. This holds the component of the solar system to remain in their positions and prevent them from falling onto universe

THE RELATIONSHIP BETWEEN THE SUN AND WEATHER CHANGE

The sun is very importance for the occurrence and changes of the weather as follows;

- It provides temperature of the place which is determined by the intensity of the sun's heat.

  When it is too sunny, the temperature of the place is increases and the opposite is true.

- It plays a great role in rain formation.

  These rays from the sun heat water bodies and cause water to evaporate and raises up to form clouds. When the clouds gains heat they melt to form rain droplets.

- The heat from the sun causes evaporation of water bodies and transpiration in plants hence increase the amount of moisture in air. Hence sun leads to the formation of humidity.

- Heat from the sun causes wind.

  When air is heated it expands and rises up causing colder air to move down to replace the rising air because colder air is heavier than hot air.

- It causes desertification because f excessive high temperatures which result evaporation of water bodies.

- It determines the intensity of pressure.

The areas with high temperature, the lower the pressure and the areas with low temperature the atmospheric pressure is high.

THE IMPORTANCE OF COMPONENTS OF THE SOLAR SYSTEM

- They produce heat and light eg. Sun which support all life on earth.
- They provide habitat for human being and other living organism e,g the earth is our habitat.
- They are responsible for the determination of climate and weather conditions especially the sun
- They are tourists' resorts especially when they form craters such as meteorites which form large depressions.
- They provide necessary requirements for animals and plants to survive. So the earth sustains life because it has natural resources such as water and air. The earth's atmosphere contains gases such as oxygen for use and humankind and animals, and carbon dioxide and nitrogen for use by plants.
- They affect organism's behavior or activities. The organisms can be plants, animals and human being.
- The moon leads to the rising and falling of ocean water or tides

THE EARTH

Is the third planet from the sun and the only known planet that supports life.
The Earth is made of

- the Atmosphere (air),
- Hydrosphere (water bodies),
- the crust solid (rocks)- lithosphere
- Biosphere (living things).

About ¾ of the earth's surface is covered by water. In fact no other planet in the solar system is known to have water.

THE SHAPE AND SIZE OF THE EARTH

The earth is spherical in shape. It is however not perfect sphere or round. It is slightly wider at the equator and flattened at the north and south poles. This shape is described as a **GEOID** or **OBLATE SPHEROID**.

EVIDENCES OF THE OBLATENESS OF THE EARTH (THE EARTH IS NOT PERFECTLY ROUND)

- The polar diameter is shorter than the equatorial circumference.

That is the diameter through the poles is about 12,713km and the equatorial diameter is 12,757km. Also the polar circumference is 40,008km and equatorial circumference is 40,076km.

- Also measurements of latitudes near equator and poles differ.

Near equator, a distance of 1° latitude equals 109,926km while near the North Pole, 1° latitude equals 111,005km. The difference in these measurements is a proof that the Earth is an oblate spheroid and not a perfect sphere.

- The gravitational force or pull at the equator is lower than the gravitational pull at the Poles because the points at equator are far from the centre of gravity while at the poles the points are near the center of gravity.
- Recent data from satellites suggest that the earth's southern hemisphere is little larger than the northern hemisphere. This shows that the earth is not a perfect sphere. Therefore, an oblate spheroid or geoids is still the best description of the earth's shape.

EVIDENCES TO SUPPORT THAT THE EARTH IS ROUND OR SPHERICAL NOT FLAT

There are some several evidences which are used to prove that the earth is sphere like structure, some of them are shown in the following:

- **SUNRISE AND SUNSET**

  The sunrise and sunset at different places of the earth, people in the east see the sun earlier than the people in the west due to earth's rotation from west to east. If the earth was flat the whole world would have sunrise and sunset at the same time.
- **CIRCUMNAVIGATION OF THE EARTH**

  If traveling from a certain point of the earth and you go straight around the earth you will come to the point of origin. The first traveler around the world named Magellan in 1519-1522 proved this; image did not encounter abrupt edge over the world in his voyage.
- **AERIAL PHOTOGRAPHS**

  Photographs taken by satellites at great distances from the earth all show that the earth's surface is curved or round shape.
- **SHIP'S VISIBILITY**

  The observation of two ships in the ocean provides the following information. If the earth were flat the observer would see both ships at once but is able to see only one of them. Also, if you are in the coast viewing a ship which is very far you will see the soot, then the pipe and eventually you can see the whole ship.
- **THE LUNAR ECLIPSE (THE MOON'S ECLIPSE).**

  When there is an eclipse of the moon, the shadow of the earth's thrown on the moon is always round. Only a sphere can cast a shadow which is always circular. The earth comes between the sun and the moon as

- **THE PLANETARY BODIES ARE SPHERICAL**

  The observations from telescopes show that all planetary bodies such as sun, moon and stars are spherical in shape. Hence the earth as the planet is also spherical.
- **SURVEYING WITH RANGING POLES ON THE LEVEL GROUND**

  When the poles of the same lengths are driven into the level land, at equal intervals, do not give a perfect level. The poles in the centre usually projects above the level of the

other poles either ends. This is caused by the curvature of the earth's surface. If the earth were flat, all the poles would be at the same level.

- **THE EARTH'S CURVED HORIZON**
  As the observer's altitude increases the horizon also widens and becomes more circular, seeming to be dipping down beyond the ground level. If the earth were not spherical in shape, there would be no circular horizon. The curvature of the horizon is influenced by the curvature of the earth's surface. Furthermore if we watch a ship approaching land from the horizon we see first its smoke and gradually more and more of the ship as it comes up over the horizon. If the earth were not spherical, there would be no circular horizon.

THE MOVEMENT OF THE EARTH

The earth is in motion all the time. We do not feel this motion because we like all the other objects on the earth, moves with it. Like most other planets, the earth has two motions known as:

(a) Rotation and
(b) Revolution

THE ROTATION OF THE EARTH

The word Rotation means the spinning or revolving of a body on its axis. Thus the Earth's rotation refers to the spinning of the earth on its axis.

Axis – is an imaginary line joining the north and south poles through the center of the Earth. The earth's axis makes an angle of 66½° with the plane of its orbits. In other words the axis is titled 23½° from the perpendicular. The earth rotates on its axis from **west** to **east**. It makes one complete rotation after every twenty four hours (24), one day through 360°. This means that it rotates through 15° in one hour.

=

=15°

Or through 1°in four minutes, such that

If 15°=60minutes

1°=?

=4minutes

And takes 1' (minutes) to turn 60'' (seconds).

The velocity of the rotation of the earth differs from one latitude to the next latitude this is due to the shape of the earth which is an oblate ellipsoid. The velocity of rotation at the equator is about 1700km/hour, at latitude 60° is about 850km/hour while at the poles the velocity is zero km/hour. The general principle of velocity of rotation is that the velocity is greatest at the equator and decreases as you go to the North Pole or South Pole.Thus the earth's rotation is very rapid although we do not feel the rotation

THE EVIDENCES TO SUPPORT THAT THE EARTH ROTATE FROM WEST TO EAST

The following observations illustrate the earth's rotation from west to east;

- When traveling in a fast moving vehicle.

We notice trees and other objects on both sides of the road moving in the opposite direction. This observation is similar to the movement of the earth in relation to the sun.

- The existence or occurrence of sunrise and sunset
  In the morning the sun appears to rise over the eastern horizon but due to the fact that the sun is the center of the solar system we know that it does not move in relation to the solar system. This shows that the earth is moving from west to east.
- A movement of stars at night across the sky.
  At night most of the stars appear to move across the sky from east to west. This shows that the earth is moving from west to east.

THE EFFECTS OF EARTH'S ROTATION

- Day and night

While the earth is rotating on its axis the side that faces the sun will be having its daylight. And the side that will be away from the sun will be in darkness (night).

- Different hours

As the earth rotate from west to east it takes 24 hours for the earth to make full rotation through 360°. Therefore as the earth rotate it causes a difference of 4 minutes for every 1° in turn. This is in turn means that it causes a difference of 1 hour for every 15° it turns.

- Deflection of winds and ocean currents

As the earth rotate from west to east winds are deflected because they are not flowing in their intended direction. That s it sets deflective effect (cariolis effects) on winds and ocean currents.

- Daily rising and falling of tides

The rise and fall of tides are caused by gravitational forces of the moon and the sun acting on the earth. That is the rotation produces lunar tides and tidal currents. Also these are known as environmental effects of the earth's rotation.

REVOLUTION OF THE EARTH

In geography and astronomy the word Revolution is defined as the motion of one body around another. In the solar system, the moon revolves around the earth. The earth revolves around the sun in an elliptical orbit. Due to the elliptical shape of the earth's orbit, the sun is closer to the earth at one period of the year than at another. These are called either aphelion or perihelion.

Aphelion

Refers to the time when the earth on its orbit is at the farthest position from the sun. it occurs each year on 4th July when the earth is 152 million kilometers from the sun.

Perihelion

Refers to the time when the earth on its orbit is at the nearest or closest position from the sun. it occurs each year on 3rd January when it is 147.3 million kilometers from the sun.

The earth takes 365¼ days to revolve once round the sun. Every fourth years given 366 days and this is called a leap year. All other years have 365 days. The earth's revolution seems to be slow; it takes a long time to complete on revolution. Actually this motion is very rapid. It is about 29.6km per second.

THE EFFECTS OF EARTH'S REVOLUTION

The following are the results of the revolution of the earth around the suns:

- The four seasons in the year
- The Eclipse (solar and lunar eclipses)
- Difference in the length of day and night
- Change of midday sun in the latitudes.

THE FOUR SEASONS IN THE YEAR

Since the earth is inclined in its orbit, the angle which the sun's rays reach different parts of the earth varies. This causes different parts of the earth to experience seasonal weather changes. These changes are mainly experienced the mid latitude and high latitude regions. This results in four distinct seasons, namely summer, autumn, winter and spring.

Within the tropical regions, for example in most of Africa, these seasons are non-existence the sun is almost overhead at all places throughout the year. The length of day and night is almost equal throughout the year within the equatorial regions.

The seasons are more pronounced between 23½° and 66½° of latitudes. At the equator the year is divided between hot and wet seasons while at the poles it is very cold all the year round and the season cannot be identified easily.

The differences of temperature between springs, summer, autumn and winter are largely, the result of the difference in the elevation of the sun at different times of the year, which in turn is caused by the inclination of the earth's axis.

Season is a period of the year characterized by differences of temperature between the four seasons resulting from the tilting of the earth on its axis to the perpendicular or vertical plane and the earth's revolution around the sun.

SPRING it is the season between winter and summer in temperate latitudes.

SUMMER it is the season between spring and autumn; it is the warmest season of the year.

AUTUMN it is the season between summer and winter

WINTER it is the season between autumn and spring, it is the coldest season f the year.

Because of the earth's orbit is elliptical and the orbital rate of movement changes, the seasons are of unequal length. For example in the northern hemisphere the following seasons exist for the given days in a year as follows.

Spring=93days

Summer=94 days

Autumn=90 days

Winter=89 days

CAUSE OF SEASONS

Seasons are caused by inclination of the earth's axis and the earth's revolution around the sun. The earth's axis is tilted at an angle of 66^0 to the earth's orbital plane and it is always pointing to the same direction in space. In its revolution around the sun one of the hemispheres is inclined towards the sun to one period of the year and away from it at another period of the year.

EFFECTS OF THE FOUR SEASONS ON THE EARTH'S ROTATION AND REVOLUTION

- **SPRING EQUINOX**

It occurs on 21st march each year
Seasons: northern hemisphere is spring
Southern hemisphere is autumn

- **SUMMER SOLSTICE**
  It occurs on 21st June each year
  Seasons: northern hemisphere is summer
  Southern hemisphere is winter
- **AUTUMN EQUINOX**
  It occurs on 23rd September
  Seasons: northern hemisphere is autumn
  Southern hemisphere is spring
- **WINTER SOLSTICE**
  It occurs on 22nd December
  Seasons: northern hemisphere is winter
  Southern hemisphere is summer

THE ECLIPSES

DEFINITION

An eclipse refers to the total or partial blockage of light received by one heavenly body from another when the sun, moon and the earth are in a straight line or in a near straight line. An eclipse is said to be total eclipse when the whole body is obscured i.e. completely blocked from the sun light and it is described as a partial eclipse when the only part of the body becomes obscured. At any place an eclipse will last short time, hardly seven minutes because both the earth and the moon are in motion OR

The word eclipse comes from an ancient Greek word meaning “a falling, that is a light fail”

Therefore eclipse refers to a state one heavenly body in space moves in between two other bodies one of which fails to provide light to another.

HOW AN ECLIPSE OCCURS?

It occurs when the sun or moon is hidden or blocked from view for a short period. This blockage is as a result of interference from a third heavenly body passing between the other two. This means that an eclipse can only occur when the sun, moon and the earth are in a straight line or in a near straight line.

The eclipse occurs in two states as follows:

UMBRA is a situation of eclipse when the whole body is in dark shadow (obscured). It is also known as the **TOTAL ECLIPSE**.

PENUMBRA is a situation of eclipse when only a part of sun’s disc (obscured). It is also known as the **PARTIAL ECLIPSE**.

TYPES OF ECLIPSE

There are two types of eclipses

- Lunar eclipse
- Solar eclipse

- **LUNAR ECLIPSE**

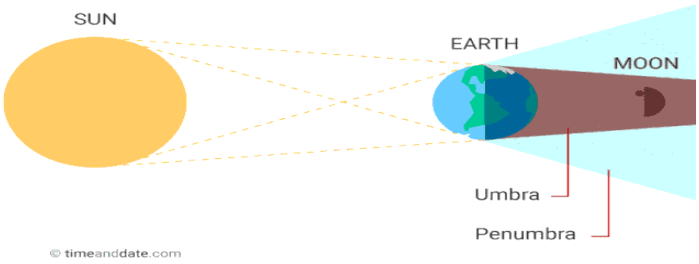
The lunar eclipse is also known as **ECLIPSE OF THE MOON**.

A lunar eclipse is a situation when light from the sun does not reach the moon because the earth's shadow is cast of the moon.

HOW LUNAR ECLIPSE OCCURS?

Lunar eclipse occurs when the moon while orbiting the earth, lies in a straight line with the earth and the sun. The earth lies between the sun and the moon. The shadow of the earth is cast onto the moon. The earth blocks sunlight from reaching the moon as a result there is no moonlight reaching the earth. This means that there is no light reflected by the moon to the earth since the sunlight has been obscured by earth.

Diagram



This makes the whole or part of the moon to look dark, black or faintly reddish-orange, depending on the intensity of the shadow cast on it. Lunar eclipses happen only on days when there is a full moon. Usually lunar eclipse is experienced at night.

This event can be contracted by using the following simple words for easy remembrance: **LUSEM** where

LU= Lunar eclipse

S= sun

E= earth

M= moon

TYPES OF LUNAR ECLIPSE

There are three types of lunar eclipses

- **Penumbral lunar eclipse**

Is when the moon passes through the earth's penumbral shadow. These eclipses are very difficult to notice.

- **Partial lunar eclipse**

Is when the whole moon passes through the earth's umbral shadow.

2. **SOLAR ECLIPSE**

DEFINITION

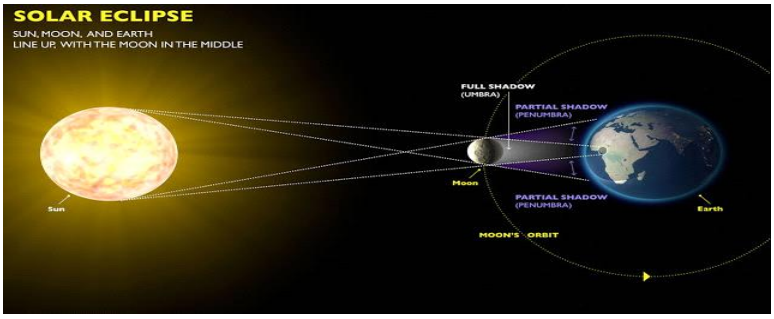
The solar eclipse also known as the sun eclipse.

A solar eclipse is a situation when light from the sun does not reach to the earth because the moon's shadow is cast of the earth.

HOW A SOLAR ECLIPSE OCCURS?

A solar eclipse occurs when the moon while orbiting the earth, comes between the earth and the sun. The three bodies lie in a straight line or in a near straight line. This can be partial solar eclipse or total solar eclipse depending on the position of the moon or the earth, in Tanzania 16th February 1980 was the total solar eclipse and partial solar eclipse in Mbeya Tanzania at Wanging'ombe was 1st September 2016. Umbra or total eclipse it occurs when whole body obscured or completely blocked from the suns light, Penumbra or partial eclipse is when the only part of the body becomes obscured.

NB; at any place eclipse last for short time up to seven minutes



The shadow of the moon is cast onto the earth, preventing sunlight from reaching that part of the earth's surface. The light obscured by the moon is reflected back to the sun. This causes the shadow of the moon onto the earth during the day time. This can be simply remembered by the

use of simple words; **SOSME** which helps to remember the arrangement of the earth, sun and moon in the eclipse. Where,
SO- solar eclipse
S= sun
M= moon
E= earth

TYPES OF SOLAR ECLIPSE

There are three types of solar eclipse

- **TOTAL SOLAR ECLIPSE**

Is when the moon blocks our view of the sun completely and the sun, moon and the earth are in a perfect line.

- **PARTIAL SOLAR ECLIPSE**

Is when the sun, the moon and the earth are not in a perfect line, only some of light from the sun is blocked.

- **ANNULAR OR RING ECLIPSE**

Is when the moon is at far distance from the earth and the moon appears too small, therefore only a small part of the sun is blocked and the shadow does not reach the earth's surface, but the light of the sun appears like a small ring.

NOTE: the shadow of the moon on the earth can be either umbra or penumbra. Umbra is dark shadow when the sun is completely blocked. Penumbra is a partial shadow when the sun is not completely blocked.
When viewing a solar eclipse during day time, it is important to wear a special eye protection. This is to protect the eyes from the harmful rays of the sun that might permanently damage the eyes.

CHANGES IN THE POSITION OF THE MIDDAY SUN

This is also known as the apparent movement of overhead sun which is related to the different positions of the earth on its movements it revolve around the sun.
The overhead sun appears to move northwards and southward in an osculating (swinging) manner. However the overhead suns northward limit is latitude 23½˚N. People beyond this latitude never see the sun vertically above their heads. The latitude of 23½˚ N is known as **Tropic of cancer**.
Similarly the overhead sun ends 23½°S is apparent southward movement. This latitude is known as **Tropic of Capricorn.** Places south of the tropic of Capricorn never experience overhead of sun at any time in the year.
The position of the earth in relation to the vertically overhead sun produces

- Solstices
- equinoxes

THE SOLSTICITES

Solstices comes from a Latin word "sol" which means sun and "sostere" which means to stand still. So the word solstice means the sun stands still.
There are two types of solstices in a year as:

- summer solstices
- winter solstices

Summer solstice occurs on 21st June each year. The sun's direct rays focus on tropic of cancer or vertically overhead on tropical of cancer.
Winter solstice occurs on 22ndDecember each year. The sun's rays focus on tropic of Capricorn or vertically overhead on Tropic of Capricorn.

THE EQUINOXES

Equinoxes comes from the Latin word "Aequus" which means "equal" and "No" which means "Night". Equinoxes so means equal nights. That is 12hours of light and 12hours of darkness over all paces of the earth's surface. At the equinoxes the sun's rays focus directly on the equator or the sun is vertically overhead at the equator. The sun is overhead at the equator twice.
There are two equinoxes in a year

- spring or vernal equinox
- autumn equinox

Spring or vernal equinox occurs on 21stmarch each year. In the northern hemisphere it is spring and to the southern hemisphere it is autumn.
Autumn equinox occurs on 23rdSeptember each year. In the northern hemisphere it is autumn and to the southern hemisphere it is spring.
Thus the following are dates on which the sun is overhead along those latitudes:

- On 21st June, the sun is overhead at midday along the tropic of cancer at 23½°N of equator. This is called the summer solstice in the northern hemisphere.
- On 22ndDecember, the sun is vertically overhead at noon on the tropic of Capricorn at 23½°S of the equator. This is termed as the winter solstice in the northern hemisphere.
- The sun is overhead twice a year at the equator on 21st march and 23rd September. These days are termed as equinoxes.

THE VARYING LENGTH OF DAY AND NIGHT

- The length of days and night are not the same across the world. Some areas experience longer hours of day light than darkness, while other parts experience longer hours of darkness than daylight.
- The length of day and night varies according to the seasons and while days and night are due to the earth's rotation, their respective duration is caused by the inclination of the earth's axis to its plane at an angle of 66½°.
- It remains permanently inclined at this angle as it rotates and revolves around the sun. If the earth's axis was vertical to its orbital plane, all parts of the earth would have the same duration of days and nights throughout the year.
- Places along the equator experience equal day and night all the year, but northwards or southwards towards the poles, the length of the day and night vary with latitudes.
- During the summer solstice, on 21st June each year in the Northern Hemisphere on tropic of cancer there is long days and short night.
- At the Arctic Circle (66½°) there are 24hours of light per day. It is known as mid night sun or arctic summer. Beyond the Arctic Circle to the North Pole, the number of days of complete darkness increase.

- In the southern hemisphere at this time there are short days and long nights. It is southern winter. At the Antarctic Circle there are 24hours of darkness per day or Antarctic winter.
- During the winter solstice, on 22nd December each year, the sun is at the tropic of Capricorn. In the Northern Hemisphere there are long days and short night. It is known as Northern winter.
- Along the Arctic Circle, there are 24hours of darkness per day or arctic winter.
- In the Southern Hemisphere there are long days and short nights. It is southern summer.
- Along the Antarctic Circle there are 24hours of light per day. It is midnight sun or arctic summer.
- During equinoxes especially the spring or vernal equinox which occurs on 21st march each year there are equal day and night hour the whole planet.
- Also during autumn equinox which occurs on 23rd December there are equal day and night hours the whole planet. In the Northern Hemisphere it is autumn and in the southern Hemisphere it is spring.

THE LOCATION OF POSITION ON THE EARTH

The determination of position on the earth's surface done by using LATITUDE and LONGITUDE which are the imaginary lines drawn on the surface.

PARALLELS OR LATITUDES

Is an imaginary line drawn on map from west to east and forms a circle. OR

Is an angular distance north and south of equator measured in degrees and parts of degree termed as minute and seconds from the centre of the earth.

The equator is latitude 0°which divides the earth into two equal hemispheres, one in the north and other in the south. These parts are called the **HEMISPHERE** (equal halves). The hemisphere north f the equator is called the **NORTHERN HEMISPHERE** and that of south of equator is called the **SOUTHERN HEMISPHERE**.

The lines f latitudes are drawn from equator are 0° to the north or south poles with 90° and parallel to each other.

A parallel can be described as a distance in any points north or south of the equator. All are determined on the basis of the equator (0°).

The earth's circumference is 40,000km. The sphere has 360°. To calculate the distance between the latitudes, the earth's circumference is divided by a number of degrees as follows:

=

=111km

Therefore the distance between one latitude and another is approximately 111km. then say if Egypt is 30°N, its distance from the equator is as:

=30°×111km

=3330km

EXAMPLES OF MAJOR LATITUDES ARE:

- Equator with 0°
- Tropic of cancer with 23½°N
- Tropic of Capricorn with 23½°S

- Arctic circle with 66½°N
- Antarctic circle with 66½°S

LONGITUDE OR MERIDIAN

Is angular distance measured in degrees east or west of the prime meridian.

Are imaginary lines drawn on the maps running from North Pole to South Pole and measured in degrees east or west of the prime meridian (0°). Meridians are numbered in degrees east or west of longitude 0°, which is known as the GREENWICH. The Greenwich line has been chosen by convention. This means that any other line could have served the same purpose. It is also known as the PRIME MERIDIAN because it is the line of line of reference from which all other meridians are numbered.

All longitudes meet at the poles, that is North Pole and South Pole

Hence are curved lines. They are therefore not parallel to one another.

Since there are 360° in a circle, 180° will lie east of the Greenwich meridian and other 180° west of Greenwich. The Greenwich meridian is 0° and is useful in determining time.

DIFFERENCES BETWEEN LATITUDES AND LONGITUDES

LATITUDES	**LONGITUDES**
• Run from west to east	Run from North to South
• Parallel to one another	Curved lines and meet at the poles
• Show how far a place is from the equator	Shows how far a place is from the prime meridian
• They are not great circles except equator (they are small circles)	All are great circles
• Ranges from 0° to 90° North and South of equator	Ranges from 0° to 180° east and west of prime meridian
• Used in determining climate	Used in determining time
• The distance between latitudes is even or uniform around the globe	The distance between longitudes is not even, is longest at the equator and decreases pole wards

Diagram to show longitudes

DETERMINING LOCATION

In determining location of a place on the earth's surface always state latitude first labeled with N or S then longitude labeled with E or W. it is usual to write the minute (') and second ('') in two figures groups. Thus write 17°04'09''N rather than 17°4'9''N

Example

Write the location of point A and B in the map provided

Solution

Location of point A- Latitudes= 30°S and longitude= 15°W
A is located at 30°S15°W
Location of point B- longitude= 45+ ()

=45°+
=45°+7.5°
=52.5°
=52°30'E

Latitudes= 0+ ()
=0°+
=15°N

B is located at =15°N52°30'E

IMPORTANCE OF PARALLELS AND MERIDIANS IN GEOGRAPHY

- Longitude (Meridian) enables us to calculate local and international times of different places on the earth's surface.
- Latitudes (Parallel) help us to explain and understand the variation in climate on the surface of the earth (used to determine climate of a given place).
- Parallel and meridian are used by pilots and sailors to guide their path as they steer the plane or ship.
- They enables us to locate places on maps, for example Tanzania is found at the latitude of 6degre and 00 south of the equator and longitude 35degree and 00 east of Greenwich meridian.
- Latitude used to calculate distance of any place.

THE GREAT CIRCLES

DEFINITION

A great circle is an imaginary circle on the earth's surface that has the same circumference and divides the earth into two hemispheres. OR
Is the line round the earth which forms a circle whose plane passes through the centre of the earth and divides the earth into two equal hemispheres.

NATURE OF GREAT CIRCLE

Among the latitudes, only the equator is a great circle while all longitudes are great circle since they divide the earth into equal parts. One group is 180°East of Greenwich and the other is 180°west of Greenwich.
More great circles can be drawn on the globe in all directions so long as their planes pass through the centre of the earth. Therefore, there is no limit to the number of great circles that can be drawn.

IMPORTANCE OF GREAT CIRCLES

- They shorten the distance between two points on the surface of the earth.
- They are useful in crossing the Polar Regions. For example from London to Vancouver or Los Angels or from Tokyo to Stokholm.
- The great circles are important for aero planes which use them as route ways to guide their path.
- Great circles are important for ship to follow routes along great circles.

LONGITUDE AND TIME:

The earth rotates on its own axis from west to east once on every twenty four hours (one day). This means that the earth turns through 360^0 in twenty four hours it turns 1°in four minutes as;

=

=4minutes

And it takes one hour to turn 15°

=

=15°

- All places along the given meridian will experience the sun at its highest elevation in the sky on any given day at the same time. When this happens it is noon for those places along the meridians.
- Thus all places which are on the same meridians have the same local time. But east of that meridians it will be AFTERNOON (POST MERIDIAN or p.m) while west of the MERIDIAN it will be BEFORE NOON (ANTE MERIDIAN or a.m)
- Time differs from one place to another. The areas which are found on the same latitude experience a difference in local mean time. However, all the places which are on the same longitude experience the same local mean time.
- **LOCAL MEAN TIME (LMT)** is the same time that is experienced by different places which are found along the same longitude.
- **STANDARD TIME** is the time which is accepted throughout the given time. Places in a belt or region share the same local mean time which is accepted throughout the given time zone. Examples of standard times are Greenwich Mean Time (GMT), for Greenwich along the 0°, East Africa Standard Time, for East Africa along 45^0 E, Central Africa Time (CAT) for central Africa along 30^0 E and West Africa Time (WAT),for west Africa along 15^0W.
- **GREENWICH MEAN TIME (GMT)** is the local time of longitude $0^{0.\text{ or is the}}$ local mean time recorded along Greenwich meridian. This prime meridian of Greenwich is used as a reference meridian in all world time calculations. The places that are located on the Eastern sides of the Greenwich meridian are always ahead of G.M.T, while all the places that are located to the west of the Greenwich meridian are always behind the G.M.T.

For example

Suppose it is 17:30hours G.M.T, what will be the time in city A which is located at 45°East, and city B which is located at 45° West of prime meridian?

Solution

The time in city A (45°E), thus difference in degrees from the prime meridians is 45°

15°=1hr

45°=?

=

=3hours

The time in city A (45°E)= difference in time is added to the time in G.M.T

17:30hours+03:00hours

20:30hours

Time in city B (45°W), thus difference in degrees from the prime meridians is 45°

15°=1hr

45°=?

=

=3hours

The time in city A (45°W) = difference in time is subtracted from the time in G.M.T

17:30hours-03:00hours

14:30hours

Time in city B (45°W) is 14:30hours

Thus the local mean time can easily be calculated at any place once the longitude is known because if the Earth completes one rotation (360°) in twenty four hours.

THE DAY LIGHT SAVING TIME is the adjusted time system which is obtained by setting the time by one hour ahead in order to utilize the hours of sunlight more fully.

This emanates from the fact that the sun rises early in the morning before people have started to work and it sets early in the evening before people have finishes work. Hence people work in the evening.

Thus the local mean time can easily be calculated at any place once the longitude is known because if the earth completes one rotation (360°) in twenty four hours.

PROCEDURES FOLLOWED IN DETERMING TIME

In order to calculate local mean time for any place, the following procedures can be employed:

- Note and identify the longitudinal position of two points.
- Find the difference in degrees if longitudes between two points.
- Find the difference in time.
- Determine the time for the asked place as:
- If the place is on the East of Greenwich meridian
  Add the time obtained to that given place. Also for places which are found in the East of given ones add the difference in time to get the asked time.
- If the asked place is on the West of Greenwich meridian or found in the west side of the asked place- subtract the time obtained from that of the given place.

Example 1

The time of Kinshasa is 20:00 noon which is 15 30^0E. Find time at Musoma in Tanzania which is 34^0E.

Solution

Difference in longitudes= 34^0 00'-15° 30'

=18° 30'

Difference in time

15°=60minutes

18°=?

=

=72minutes

1hour and 12minutes

And the earth turns 1°in four minutes

1°=6o'=4minutes

=30'=?

=

=2minutes

Total time is 01:12hours+0-00:02hours

=1:14hours

The time at Musoma will be 1:14p.m

TIME ZONES

TIME

Refers to a period that is used for event or activity. It is measured in seconds, hours, days, months or years.

TIME ZONE

Is the region having the same standard time. Standard time is common on time for all countries belonging to the same time zone for example Tanzania, Kenya, Uganda, Ethiopia, Djibouti and Somalia use the same standard time. This commonly referred to the East African Standard time. There would be problems of telling time if every place had its own time set according to local mean time. For example, there would be great confusion in railway airway time table or in radio programs if they had to show difference time each one place within a small area. To avoid this problem difference stretches on earth takes their time from great meridian. The time adopted is known as **STANDARD TIME**.

In East Africa Standard time is taken from meridian of 45 degree E when a whole stretch of land keeps to the same standard time that stretches from a time zone. There for time zone refers to a stretch of land where standard time is accepted throughout a longitudinal zone 15 degree width. Countries with large stretches of land have several standard zones. There are 24 time zones in the World. The Greenwich meridian is the starting point for dividing the globe into 24 time zones, the standard time for Greenwich is known as Greenwich Mean Time (GMT).

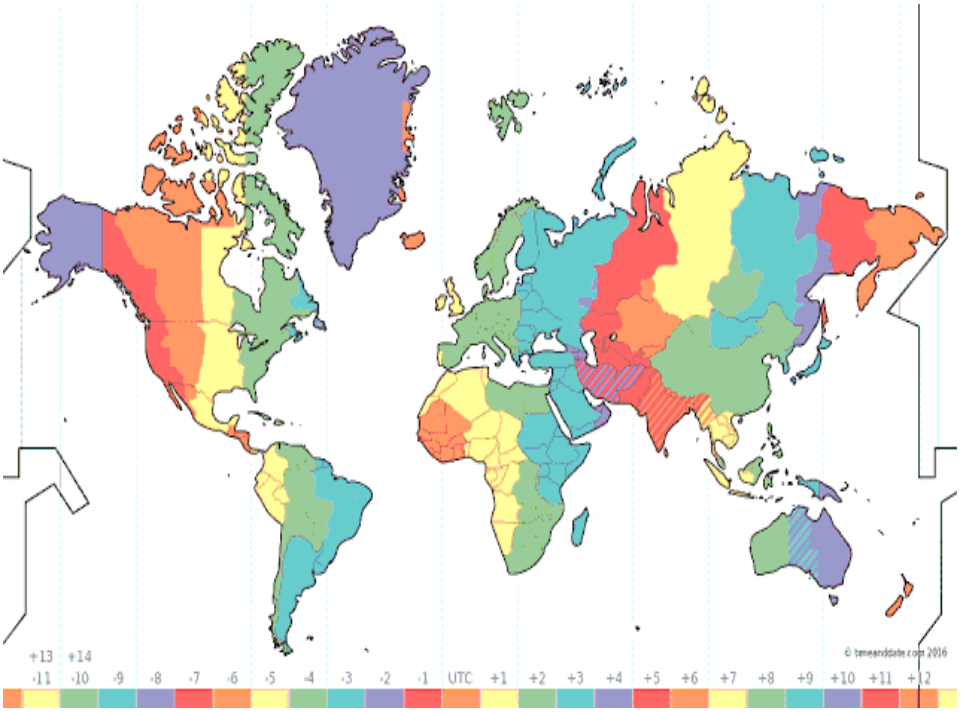
Essence of Time zone

In a certain place there could be a place on the surface using its own local time. This would bring a lot of confusion example every radio station would have to announce different times for

every region within the same country; Local time of Bukoba would be different from that of Dodoma. The above confusion was avoid when it was internationally agreed to split the World into 24 time zone according to longitudes The longitudinal division across the earth with an approximates with of 15 degree of longitude which is regular across the oceans. Each time zone has standard time which is the time of longitude (Meridian near the center of time zone. In the same way, all countries belonging to the same way, all countries belonging to the same time zone have common time. Note: Large countries like Canada, USA and Russia have different standards for different regions within them because they are crossed by many time zone. Question: 1. If it is 9:30 am at Kasse 15 degree what time is in Zanzibar 45 degree? 2. Find the time for the youncle 30 degree W if it is 12:00 noon London 3. When it is 3:30 pm at Nairobi 25 degree E what is the time for Comoro 120 E?

INTERNATIONAL DATE LINE

Is the line where date changed or where the calendar day begins. The one travel eastward across the date line will gain a day, if one travel westwards and cross the date line will lose a day, if Greenwich it is noon at Tuesday a place 90 degree W would be 10 am on Tuesday, at a place 180 degree it would be midnight Monday .On other hand a place 90 degree E would be 6:00 pm on Tuesday and at a place 180 degree E would be midnight on Tuesday



CHAPTER THREE
: MAJOR FEATURES OF THE EARTH'S SURFACE

INTRODUCTION

Earth is the fifth largest planet in the solar system. Its surface is approximately 510 millions square kilometers. This means that earth is very large. The surface of the earth is made up of two main features LAND and WATER BODIES. The land's surface area is estimated at 29.2% of the total area of the earth's surface, while water covers the remaining 70.8%. Most of the land exists in large blocks called ***Continents***. Likewise, most of the water is contained in large water bodies called ***seas and oceans***.

THE CONTINENT

Continent is a major landmass rising from the ocean floor. It includes island adjacent to the continent. This land surface forms the seven continents. These are Asia, Africa, North America, South America, Antarctica, Europe and Australia.

These continents surround by oceans.

There is more land surfaces in the Northern Hemisphere than in the southern hemisphere.

The boundaries of the continents with the exception of Asia and Europe were filled with water. Ural Mountains separated Europe and Asia. While other continents are separated by water bodies called seas and oceans. For instance African continent and Asia to the north are separated by Mediterranean Sea and Red sea. Africa and South America are separated by Atlantic Ocean. The land surface occupies 29% of the surface of the earth, it forms seven continents. It includes Islands adjacent to the continents. The seven continents are Asia, Africa, South America, North America, Australia, Europe and Antarctica.

The table below shows Size of continents.

Continents	Area (km2)
Asia	43 608 000
Africa	30 335 000
North America	25 349 000
South America	17 611 000
Antarctica	13 340 000
Europe	10 498 000

Australia	7 682 000

SIZE OF THE CONTINENTS

The largest continent in the world is ASIA covering more than one third () of the land surface of the earth. It is about 45.6 million square km.

The smallest continent in the world is AUSTRALIA which is about a quarter of the size of AFRICA. Its size is about 8.5 million square km.

The second continent is AFRICA with an area of about 30.6million square km. the greater part of AFRICA about ¾ of the whole area lies in the tropics

The third largest continent is NORTH AMERICA and is about two-thirds the size of Africa. It is about 24.3 million square km.

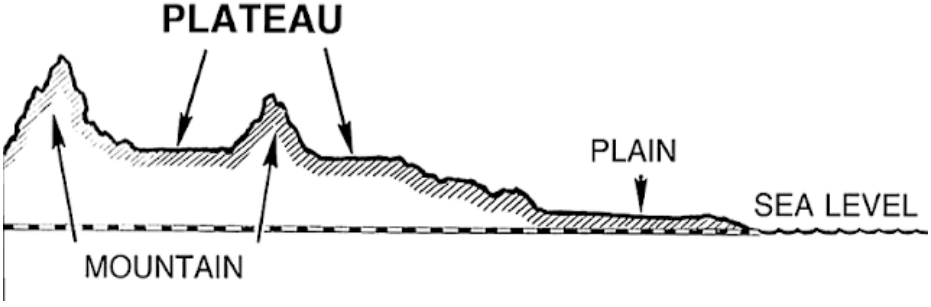
The fourth largest continent in size is SOUTH AMERICA with an area of about 17.9 million square km.

The fifth largest continent is ANTARCTICA which is about one third of the size of Africa. Its size is about 11.2 million square km.

The sixth largest continent is EUROPE with about two-fifth the size of Africa. It is about 9.8 million square km.

THE MAIN OR MAJOR RELIEF FEATURES OF CONTINENTS

The surface of any continent is not smooth. It has mountains, hills, plain and plateaus, river valleys, lakes, basins and rift valleys. Altitude and slope give rise to the different relief features. Plain, plateaus and mountains form the major relief features of continent.



PLAINS

Plains are large and continuous stretches of comparatively flat land and not raising much above

the sea level. Plains may have been formed through agents of erosion worn down higher land; layers of underground rocks did not fold, but remains almost horizontal forming wide and extensive plains or the gradual accumulation of silt brought by the agents of erosion. **PLATEAUS** these are extensive high altitude areas with more or less uniform summit levels bounded by one or more shapes steeply away. They are formed when forces formed within the earth uplift a plain region. Major plateaus regions include the central plateau of Africa, the Brazilian Highlands and the Arabian plateau. The African plateau is higher in the South and East of the continent than it is in the north and west. In some areas, the outflow and spread of lava have formed plateaus over an extensive area, for instance the Deccan plateau in the India sub-continent and Colombia plateaus in the United States.

MOUNTAIN
is a large and elevated part of the earth's surface rising to greater height than ordinary hills OR

Refers to the landforms having high relief, generally over three hundred meters (300m) above the sea level.

TYPES OF MOUNTAINS

There are four major types of Mountains depending on how they are formed. These are;
a] Fold mountains

b] Block mountains

c] Volcanic mountains

d] Residual mountains

A] FOLD MOUNTAIN

They are formed by wrinkling of the earth's crust. Fold Mountains usually consist of high ranges that extend for hundreds of kilometers across the continent. Thus Fold Mountains form the most extensive ranges in the world.

The folding of rocks layers are compressed to form the ups and downs as shown below

Where

x- Stands for UPFOLD OR UPRAISED which are also known as ANTICLINES

y- Stands for DOWNFOLDS (TROUGH) which are also known as SYNCLINES

Examples of Fold Mountains are

- The Andes-in South America
- The Alps in Europe
- The Atlas in North Africa
- The Cap Rangers in South Africa
- The Appalachians in U.S.A
- The Great Divide Range in Australia

b] BLOCK MOUNTAINS

Block Mountains are formed when a movement in the earth's crust forces the rocks to break. As a result, enormous cracks or faults are formed when sets of faults run parallel to each other and the ground between is forced up, a block mountain (horst) is formed. Usually Block Mountains do not extend over wide areas as Fold Mountains.

Examples of Block Mountains are:

- the Usambara and Uruguru in Tanzania
- Ruwenzori mountains in Uganda
- The Vosges and Black forest mountains in Europe
- Mount Sinai in Asia.

OTHER FEATURES ASSOCIATED WITH FAULTING AND BLOCK MOUNTAINS

The Rift valleys (grabens)

Rift valleys are formed when the land is between two sets of faults sink down.

Examples of rift valley

- The Great East African Rift valley is the longest in the world. It stretches from the Baka's valley east of the Lebanon Mountains, through the Red sea, Ethiopia, East Africa to the lower Zambezi Area. A branch of the valley runs along Lake Tanganyika in Tanzania to Lake Albert in Uganda.
- Another less extensive rift valley is the middle Rhine Rift valley between the Vosges and black forest mountains. The walls of a rift valley form fault lines or escarpments. Trenches formed by rift valley are sometimes filled with water to form Lakes like Lake Nyasa, Lake Albert, Lake Eyasi, and Lake Turkana all of which are in East Africa and the Dead Sea in Jordan.

c] VOLCANIC MOUNTAIN

Volcanic mountains are formed from the accumulation or pilling up and cooling of hot molten lava and ashes that are thrown out from the earth's interior after a volcanic eruption. The volcanic mountains existing today some were formed by a single eruption, others by several eruptions. The volcanic mountains generally are conical in shape and mostly with craters at ther

summit. Sometimes the craters may be filled with water to form CRATER LAKES for example Lake Duluti and Ngorongoro in Tanzania.

TYPES OF VOLCANIC MOUNTAIN

- Active volcanic mountain
- Dormant volcanic mountain
- Extinct (dead) volcanic mountain

ACTIVE VOLCANIC MOUNTAINS

These are still experiencing frequent eruption.
Examples are;

- Vesuvius in Italy
- The Krakatoa in Indonesia
- The Mfumbiro in Uganda
- The Oldonyo Lengai in Tanzania
- The Cameroons in Equatorial Africa

EXTINCT VOLCANOES OR DEAD VOLCANOES

These have not erupted for a very long time and have not shown any signs of erupting again
Examples are

- Kenya mt in Kenya
- Elgon mt in Uganda
- Ngorongoro and Rungwe ranges in Tanzania
- Demavend in iran

DORMANT VOLCANOES

Are those volcanoes which erupted only once in historical time and are no longer active
Examples are Kilimanjaro and Meru mountains in Tanzania.

RESIDUAL MOUNTAINS

Are those Mountains which are formed when an area of high land remains standing above the general level after rivers and other natural agents have lowered the surface of the surrounding area. Sometimes these mountains are called mountains of denudation.
In some parts these mountains appear as along ridges generally steep on one side (the SCARPSLOPE) and gentle on the other side (DIPSLOPE)
Examples of residual mountains include the Ahaggar Mountains of central Sahara, the Sekenke hills of Singida in Tanzania, the Adamawa Mountains of Eastern Niger, the Highlands of Scotland, the sierras of central Spain, and the Mesas and Buttes of the western plateau of the United States of America.

SIGNIFICANCE OF MOUNTAINS

- Tourism
  The presence of high mountains with snow encourages tourists to visits.

- Providing building materials
  That is mountains provide rocks, gravels and other materials for building purposes.
- Sources of minerals
  Mountains provide precious or valuable minerals such as gold and diamond which encourage mining, hence providing employment.
- They are sacred places
  These provide places which people think are sacred so be used by some people for worshipping.
- Provide favourable climate
  That is mountains receive high amount of rainfall per year. This makes it to be covered with forests and wild animals.
- They are source of water
  The mountains have forests and good climate that makes them a good source of rains, rivers and streams.
- Provide conducive weather
  Mountains and hills provide good and conducive weather for recreation and refreshment.
- They provide fertile soil
  Low land areas near mountains are usually fertile and therefore good for agriculture. Volcanic soil is very fertile hence promoting agriculture.
- They promote growth of town centre
  Mountains provide favourable conditions for economic activities which attract settlements and therefore growth of town centre.
- They provide employment opportunities from being centre of tourists and mining centre.
- They are source of government revenues
  The activities conducted around the mountain such as tourism contribute to the growth of national and individual economy.

DISADVANTAGES OF MOUNTAINS

In spite of the all advantages of mountains, the following are some of the disadvantages of mountains:

- They are barriers to rain formation
  It occurs when one part of a mountain receives rain winds and sufficient rains and the other part receives dry winds and therefore becomes a desert or a semi desert.
- They limit some development
  Mountains form barriers to some development such as construction of roads, railways and airports.
- Occurrence of disasters such as eruption of volcanoes, land flow and mass flow cause destruction of properties.
- They are habitat of dangerous wild animals
  Some wild animals that live around the mountain forests may cause damage to people and their properties.
- They cause death of people and other living organisms.

- They cause displacement of people from their settlement such as occurrence of volcanic eruption which spread over the nearby areas.

HILLS

Refers to the land with a moderate relief or altitude generally between 150m and 300m above the surrounding area

BASINS

A basin is a form of natural or artificial depression (hollow) varying in size in the earth's surface. OR

Refers to the large scale depression enclosed by higher land without an outlet to the sea on the earth's surface.

Basins are formed when vertical earth movement causes the crust to down warp to form a depressed area known as basin.

Examples of basins are Lake Victoria basin which covers the area around Lake Victoria. It extends and joins the basin of Lake Kyoga. Lake Victoria is formed due to down warping of the land mass and then the land is covered with water.

DRAINAGE OF CONTINENTS

Drainage is the removal of water from any area through a system of natural streams and rivers. Rain water that does not evaporate into the air either flows on the ground surface (overland flows) is called SURFACE FLOW or is that sinks into the ground where it may find its way to the surface is called the UNDERGROUND FLOW. The flow of water over or under the ground is known as RUN-OFF.

RIVERS

is a large natural stream or mass of water flowing in a valley. OR

Is water flowing in a definite channel towards the sea, lake, a desert basin. A river has a source and mouth. A source is the starting point of a river while mouth is the endpoint of a river.

RIVER CHANNEL

Is a groove or furrow through which river water flows. It is made up of upstream and downstream sides. The upstream is the side towards the source of the river and downstream is the side towards the mouth of the river.

RIVER SYSTEM

Is the collection of tributary and the main rivers together. The river system consists of permanent rivers and seasonal or intermittent rivers.

- Permanent River is a river that flows throughout the year. It is Also Known As Perennial River.
- Seasonal or non-perennial or periodic rivers are those rivers which do not have a constant flow throughout the year. They flow into part of the year but have no water flowing during other parts of the year.

STREAM

Are rivers that are small in size

TRIBUTARIES
Are small rivers that flow into bigger ones.
These are the streams that join together to form main streams

DISTRIBUTARIES
Are small streams which are formed when the main river branches off before it enters the sea or lake.

CONFLUENCE
- Is a point at which a tributary joins the main river or any other river

INTERFLUVE
- Is area of high ground between tributaries

RIVER BASIN
- Is the area from which a river system collects its rain water OR
- Is a unit area f land that is drained by a river system.
- It is also known as a drainage basin or river catchment. The boundary of one drainage basin to the next is known as WATER DIVIDE or WATER SHED or BASIN PERIMETER.

A BASIN
- Is a form of natural or artificial depression (hollow) varying in size in the earth's surface.

WATER DIVIDE OR WATER SHED
- Is the boundary separating other neighbouring drainage basins.
- It is also known as basin perimeter or water divide.

The ultimate end of running water (run-off) is the sea. Normally water flow down a slope by force of gravity. When it is flowing it carries minerals in solution, rock fragments and organic matter.
For example in Africa the following rivers end in the following oceans:
- The Congo river pours it's water into ATLANTIC OCEAN
- The Niger river pours it's water into ATLANTIC OCEAN
- The Orange river pours it's water into ATLANTIC OCEAN
- The River Nile flows into MEDITERRANEAN SEA
- The Zambezi and Limpopo river flows into the INDIAN OCEAN
- The Volta river and Senegal river pours their water into ATLANTIC OCEAN

Some rivers however are help up in depression or hollow on the surface of the continent to form lakes and swamps where they are held temporary before they are let out to the sea. These lakes have outlets to the sea. Examples are Lake NYASA, VICTORIA and KYOGA.
Those lakes that do not find an outlet to the sea is known as INLAND DRAINAGE include Lake RUKWA, EYASI, TURKANA or RUDOLF and CHAD.

THE MAIN RIVERS IN AFRICA

These are: The Congo River, The Niger River, The Orange River, The Nile River, The Zambezi River and the Limpopo River.

WHY MOST OF RIVERS IN TANZANIA NOT USED FOR NAVIGATION PURPOSES?

Reasons

- They are short distance runners such as Pangani, Rufiji and Ruvuma.
- They are seasonal rivers
- They face the silting problem
- They pass in dry climate
- They have dangerous animals like hippoportumus and crockdile.
- They are full of water weeds
- They are shallow

THE IMPORTANCE OF RIVERS AND RIVER VALLEYS

POSITIVE IMPORTANCE

- They provide water which is used for domestic purposes such as drinking.
- They provide water which is used for industrial uses such as cooling engines and washing raw materials.
- They provide fertile soil for agriculture development and water for irrigation farming to supplement rainfall in those areas where rainfall is seasonal.
- They are used for transportation or navigation purposes. Some parts of the valley are used as a passage for constructing roads and railways others are used as transport routes.
- They are port facilities- some river mouths are deep so suitable for port development.
- They are fishing grounds- they are a source of fish for both domestic and commercial purposes.
- They are used to produce hydroelectric power.
- They provide building materials such as sand, gravels and pebbles.
- They provide various minerals. Water in the valley is either fresh or salty. The salty water contains some minerals such as salt and soda. Also there are deposited minerals such as alluvial gold.
- They are tourist attractions- the valleys and many features formed by rivers attract tourists as they are among the wonders of the world.
- They are natural boundaries between countries as well as internal administrative units within a country.
- They have supported the growth of towns and settlements due tto the presence of various economic activities

NEGATIVE IMPORTANCE

- They destroy properties such as buildings, farms and other structures due to river flooding.
- They cause loss of human life and being displaced.

- They are source of waterborne diseases such as amoebiasis (amoebic-dysentry) and malaria.
- They create barriers between areas when rivers are so wide so people fail to cross them.
- They contain dangerous animals. Some rivers are a habitat for animals that are dangerous to people. Examples are hippoportumus and crockdile- they attack and kill people who cross the river.

SOURCES OF RIVERS

- Rainfall
  Water from rainfall may run-off or sinks into the ground and flows slowly into the river and flow downstream. e.g the Amazon in South America.
- Spring
  Rain water soaks to the ground forming underground water which flows slowly into streams. Many rivers start from the natural spring.
- Lakes
  Lakes are natural reservoir that may supply rivers with water. e.g Lake Victoria supplies the Nile river in Africa.
- Glaciers
  Heads of glaciers supply river water from melting ice e.g Rhone River in France.
- Marsh
  Permanent inland marshes may be sources of rivers e.g Mississippi river in U.S.A starts from marshes.

Some of the world's longest rivers are;

Name	**Continent**	**Length in km**
• Nile	Africa	6670
• Amazon	South America	6500
• Mississippi	North America	6030
• Yang-tze	Asia (china)	4820
• Volga	Asia (USSR)	3700

WATER BODIES

Water body is a mass of water occupying a sizeable depression on the surface of the earth. There are three major water bodies namely lakes, seas and oceans.

- **LAKES**

Lake is a body of water contained within a basin or hollow on the earth's surface.

Most lakes have natural outlet in the form of river or stream but others do not. They loose water through evaporation and thus most have salt water. Some lakes are very big, occupying a surface area of thousands of square kilometers. Others are very small with a surface area less than a square kilometer. Such small lakes include volcanic lakes and human made lakes.

The largest lakes in the world are:

Name	Continent	Area (km^2)	Depth (m)
• Caspian sea		394,299	946
• Lake superior	North America	82,414	

• Lake Victoria	Africa	69,485	82
• Lake Tanganyika	Africa	32,893	1,436
• Lake Baikal	Asia (Siberia)		1,637

- **SEAS**

A sea is a large body of salty or saline water on the margins of the continents. Some parts of the oceans that border continents are considered seas. Other seas are surrounded by land but are connected to oceans for example the red sea, Mediterranean Sea and Baltic Sea.

Some examples of sea resulting from the ocean bordering the continents are the Arabian sea, java sea, south china sea, east china sea, sea of Japan, Caribbean sea and north sea.

Some seas are not connected to any ocean such as the Caspian, Aral and the dead seas.

The Mediterranean Sea occupies an area of approximately 2.509 million km^2 and is the biggest sea on earth.

- **OCEANS**

Ocean is a very large body of salt water that occupies a vast basin between continents.

All continents in the world are surrounded by oceans in which in general water occupies about 71 % of the earth's surface. There is more water surface in the Southern hemisphere than in the North Hemisphere. The earth has the following Oceans;

The Pacific Ocean is the largest with about 165.3 million square km and an average depth of 4028m,

The Atlantic Ocean is the second largest ocean with about 82.2 million square km and an average depth of 3926m,

Indian Ocean which is about 73.4 million square km is the third largest ocean an average depth of 3936m

The Southern Ocean is the fourth largest ocean it is also known as ANTARCTICA R AUSTRAL OCEAN which completely surrounds ANTARCTICA with an area of 20.3 million square km and an average depth between 4000 and 5000m

The fifth one is Arctic which is about 14.0 million square km with an average depth of 1205m. In the southern hemisphere, the Atlantic Ocean merges with the pacific ocean. The pacific in turn merges with the Atlantic Ocean. The waters of these three oceans surround the continent of ANTARCTICA

NATURE OF OCEAN WATER

Naturally the ocean water is composed of minerals and gases. Thus Ocean water contains a number of dissolved mineral salts. They include sodium Chloride (common salts) which makes up about 78% of all salt in the ocean water. Ocean water also contains compounds of magnesium, potassium, and calcium.

Most minerals come from the land have been dissolved by water and brought into the ocean by rivers, wind and ice.

Another source has been volcanic activity that takes place in the oceans.

DISTRIBUTION OF SALTS IN THE OCEAN WATER

Saltiness of the ocean water is not the same everywhere in the ocean. Saltiness of ocean water depends mainly on:

- Temperature
  This affects capacity of water to dissolve salt, the amount of fresh water brought into the ocean by rivers and rainfall and the amount of evaporation taking place from surface. Generally temperature of ocean water decreases from the equator where surface temperature is about 250C, to the Polar Regions where water is very cold temperature drops to 2.20 C.
- The amount of fresh water brought into the ocean by rivers and rainfall
- The amount of evaporation taking place from the surface.

THE MOTION OF OCEAN WATER

Ocean water is constantly in motion. There are two types of movement as:

- Horizontal movement, refers to the motion of ocean water in the form of ocean current and tides
- Vertical movement refers to the motion of ocean water which involves the rising of sub-surface water and the sinking of surface water.

The movement of ocean water as a result of density variations in the water which is particularly important in vertical movements and winds which are particularly important in horizontal movement.

THE OCEAN CURRENTS

An ocean current is the movement of surface water in the ocean.

TYPES OF OCEAN CURRENTS

There are two types of ocean currents. These are

The warm currents

These are surface movement of water often raise the temperature of land surface when the winds are on-shore. They cause heavy rain on the coastal lands. Examples are like; north equatorial, south equatorial, gulf stream, Brazil, guinea, canaries, Mozambique (Agulhas) and Kurosiwo.

The cold currents

These are surface movement of water often lower the temperature of land surface when the winds are off-shore. Examples of cold currents are California, Kamchatka, Peruvian, benguella, Labrador, Greenland and west Australia.

THE CAUSES OF THE OCEAN CURRENTS

The flow of ocean currents is due to a combination of the following:

- Prevailing winds;
  Prevailing wind blowing over ocean surface can push the water surface and form a current.
- differences of density
  The more salt the water contains, the denser is the water. Dense water tends to sink when it is in water that has low density.
- temperature of the ocean water

Cold water is denser than warm water. Cold water placed in warm water tends to sink to the bottom of the warm water, hence this cause a current.

- the rotation of the earth
  Ocean currents like air are turned from their straight courses by the rotation of the earth.
- The shape of landmass or continent
  Ocean currents are turned from their straight courses by the shape of the adjacent landmasses.
  The ocean currents to be either warm or cold depend on the place of origin and direction. For instance the ocean currents moving Northward in the Northern hemisphere will be warm because they are originating from warm tropics to cold Polar Regions. While the ocean currents moving Southward will be cold because they are moving from cold polar regions to warm tropics and the opposite is true in the southern hemisphere.

Through various observations, all warm ocean currents are formed in the EASTERN sides of the continents while all cold currents are found in the WESTERN sides of the continents.

Examples of ocean currents of the world

Name	Type	Ocean
Gulf stream	Warm	Atlantic
North Atlantic drift	Warm	Atlantic
North equatorial	Warm	Atlantic
Guinea	Warm	Atlantic
Brazillian	Warm	Atlantic
Mozambique	Warm	Indian
North equatorial	Warm	Pacific
South	Warm	Pacific
Kurosiwo	Warm	Pacific
East Australian	Warm	Pacific
Greenland	Warm	Atlantic
Labrador	Cold	Atlantic
Benguela	Cold	Atlantic
West Australia	Cold	Indian
Kamchatka	Cold	Pacific
Peruvian	Cold	Pacific
California	Cold	Pacific
West wind drift	Cold	Pacific

THE OCEAN TIDES

Tides

Tides are the rising and falling in the level of water in the ocean and seas. OR

Tides are the rising and falling of the ocean water levels caused by the gravitation attraction between earth, moon and sun.

WHY IT OCCURS

The tides occur twice a day (in 24 hours). The level of which tides rise and fall varies slightly. On the days when it rises to its highest level it also falls to its lowest level. The difference between high water level and the low water level is known as tidal range. This rising and falling is caused by:

- The pull of gravity of the moon
- The pull of gravity of the sun

The change of their relative positions tends to affect also gravitational force as causing three types of tides.

- High tides or Spring tides
- Normal tides
- Low tides or Neap tides

HIGH TIDES OR SPRING TIDES

In high tide the water rises much higher. High tides occur twice a month. This occurs when Earth, sun and moon are in line with each other at full moon and new moon. Here the gravitational force is greatest and its range is also greatest because the sun and moon are pulling together.

NORMAL TIDES

They occur twice a day in 24 hours. The water daily rises to its highest level and falls to its lowest level. Normal tides are caused by the gravitational pull of the moon.

LOW TIDES OR NEAP TIDES

In low tide the water rises to lower level, but the water is more than in normal tides. Low tides occur twice a month. This occurs when the sun and moon are at right angles to each other. That is the sun, earth and moon are in a straight line then the moon and sun are not pulling together. The sun and moon are at right angles to each other. Their gravitational force is pulling in different directions. They have less gravitational force.

Low tides occur during first and last quarter moon. At half moon when the sun and moon are pulling at right angles, there is no difference between low and high tides.

Thus tidal range varies considerably from one place to another. Therefore the varying position of the moon with respect to the earth is the main factor accounting for the differences in the tides.

THE WATER WAVES

Waves

Waves are the up and down movement of the surface water.

WAVE MECHANISM

Wave gets their energy from wind that blows across bodies of standing water. The energy from the wind is transferred to the water surface. The waves then move forward and will continue to move even if the wind has long stopped blowing. Waves travel in a definite direction and give the impression that they move forward but in reality only the shapes moves forward while the

water moves up and down. For example a cork thrown into the water does not travel with waves, it moves up and down and to and fro but not forward.
The shape is driven on the shore by wind and its height and force are determined by the strength of the wind (wind speed), the distance of open water over which it has blown (size of water body) and length of time the wind blows.

PARTS OF A WAVE
A wave has the following parts
THE CREST
The highest part or point of a wave
TROUGH
The lowest part or point of a wave
THE WAVE LENGTH
The distances from one crest to the next or from trough to trough. OR
Is a horizontal distance between crests or troughs.
WAVE HEIGHT
Is a vertical distance between crests and trough

WAVE PERIOD
Is the length of time it takes two successive crest to pass a given point.
Wave period can be calculated to find how fast the wave travels.
For example,
Wave speed =
Given the following data, wave length is 100metres; speed of wave is 10metres per second. What is wave period?
Solution
Wave speed =
Wave period =
Wave period =
Wave period= 10 seconds

RELIEF OF OCEAN FLOOR OR PHYSICAL OCEANOGRAPHY
The ocean floor is the bottom of the surface of the ocean. The floor of the ocean is irregular.
The major relief features of the ocean floor are:

- The continental shelf
- The continental slope
- Oceanic Deep or Trenches
- Ocean ridges
- The Deep sea plains or abyssal plain;
- Islands
- Submarine plateau
- Sea level

- Volcanic peaks

The continental shelf

The continental shelf is a gently sloping margin of a continent. OR
Is the shallow part of the ocean or sea that stretches out from the coast to where the ocean floor is suddenly slopes steeply into the deep sea.
Continental shelf is occupied by shallow water that extends from the coast to the depth of about 200 meters towards the ocean basin and usually ends suddenly. Its width varies from continent to continent. Sun light reaches the seabed because the continental shelf is relatively shallow suitable for fish breeding.

The continental Slope

Is the steep sloping surface between the edge of the continental shelf and the ocean basin. It begins at the depth of about 200m where the shelf ends and thereafter a slope drops steeply down to the real ocean floor.

Oceanic Deep or Trenches

Ocean Deep or trenches are long narrow depressions or trough found on the ocean plain to great depth I the ocean floor. They are narrow and steep sided valley that form on the seabed of the deep sea plain. They run across the ocean floor for long distances, they are not of uniform depth but they are the deepest parts of oceans. The deepest is the MINDANAO deep Marianas Trench with 11911m below sea level.

Ocean ridges

An ocean ridge is a long and fairly narrow raised part of the ocean floor or seabed. In some laces there are very high mountain ridges which rise from the seabed. They may appear single or in chains. Some of the ridges extend above ocean level to form islands; example is the mid Atlantic ridge and the mid pacific ridge.

The Deep sea plains or abyssal plain;

Deep sea planes are the most extensive area of the ocean floor about 200 to 300m wide and almost level comprising the greater part of the ocean floor. They lie at an average depth of 4,572m. They cover with varieties of materials both organic and inorganic (fine mud). In some places the surface is interrupted by other relief features which rise from it. These incudes island, plateaus, ridges and volcanic mountains. These seamounts are the isolated volcanic mountain peaks rise from the ocean plain floor but do not reach the surface while the guyots are the flat topped seamounts which resembles submarine plateaus.

Islands

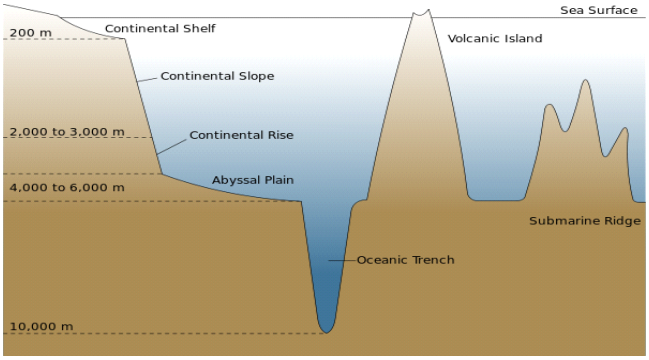
An island is a piece of land that is completely surrounded by water. Very small island are called ISLETS or KEYS. Islands of the world fall into three categories as follows;

- Continental islands
  Are bodies of land that lie on a continental shelf with rocks resembling those of the neighbouring continental land. Are the largest island in the world such as lama, mafia Sri Lanka, Pemba and Zanzibar.
- Oceanic islands

Are islands that rise from the ocean plain due to volcanic activity; examples are canary, Cape Verde, Seychelles and Iceland.

- Coral islands
  Are islands formed from coral rocks both on the continental shelf as well as on the deep plain. Examples are Maldives and Aldabara in the Indian ocean

The diagram below shows the ocean floor. The major relief features of the ocean floor are;



CHAPTER FOUR
WEATHER

DEFINITION

Weather refers to conditions of the atmosphere which occur at a place at specific time period from hour to hour or day to day.

Therefore when we say it is hot, or wet, or cloudy we are saying something about weather, which is the condition of the atmosphere at a place at a specific time periods (from hour to hour or day to day). It is never be static, and thus cannot be generalized. In the same country, even over a small area weather can vary tremendously. It may be sunny in one part of district but raining heavily in few kilometers.

Elements of weather

Weather is determined by a number of elements which can be measured and recorded. These are temperature, precipitation, cloud cover, humidity, atmospheric pressure, sunshine and wind. These elements can be measured and recorded and on the day can be stated as suuny, rainy, windy and cloudy.

WEATHER FORECASTING

Weather forecasting is defined as a prediction of weather condition of a place at a given time approximately 24 to 48hrs.

A synoptic chart is a special chart drawn by experts in weather stations for reporting and indicating weather conditions in various parts of a country or region.

METHODS AND INSTRUMENTS USED FOR WEATHER FORECASTING

The following are the the methods and instruments used for weather forecasting:

- Radiosonde
- Satellites
- Persistence method
- Statistical forecasting

- **Radiosonde**

This is an instrument used to register pressure and temperature from the ground to roughly 12km above the ground. it is fixed to balloons filled with helium gas and are released into the atmosphere every day at a particular time from different weather stations. The radiosonde transmits radio signals to computers on the ground station where they are analyzed. The signal transmitted give pressure, temperature and humidity readings at different altitude. These balloons are made in such a way that they burst when they reach a certain altitude.

- **satellites**

Are large electronic devices human made which are sent to space and move around the earth so that they can provide various types of information on weather conditions on a daily basis. They transmit photographs taken on weather conditions on a daily basis. They are also used in radio, television and telephone communication. The movement of clouds can be predicted from an analysis of the movement of winds force period of 24hours.

- **Persistence method**

This is simplest way of making a weather forecast. It assumes that the atmospheric conditions of a place at the time of forecast will not change. For example, if it is 28°C in Dodoma today the persistence method predicts that it will still be 28°C in Dodoma tomorrow. If two inches of rain fell in Arusha yesterday, this method predicts that two inches of rain will fall in Arusha today.

- **Statistical forecasting**

It is when the meteorologists collect records of of average temperatures and rainfall over the last five years. This gives forecasters an idea of what the weather is supposed to be like at the certain time of year

- **Other methods**

Other modern methods are like electronic computers, radar and aircrafts. The tradition ways of predicting weather are also known as ANCIENT METHODS. They are the ones in which weather is predicted by observing the behavour of stars, crocking of frogs, rainbow, migration of butterflies, changes of wind direction, position of the moon and general body feeling. These methods were based on astrological, traditional and religious theories.

Weather forecasting is useful to people in the following ways;

- It helps to plan the calendar of activities of various groups of people including farmers. That is farmers tend to adjust their farming activities to suit the expected weather conditions.
- It helps to determine the nature of dressing of people according to the expected weather. That is people can be in a position to select suitable clothes for the day.
- Weather broadcasting greatly influence transport since it helps sailors and air travelers to know condition of the winds.
- It helps to arrange place and time for sporting activities.
- It is useful to fishermen to determine the movement and migration of fishes.
- Helps contractors to plan for suitable houses for a given area.
- It helps guide tourist activities. It attracts tourists especially good weather condition which made tourists from their countries escape with winter to warmer countries.
- Military personnel benefit from weather broadcasting as they can plan their military activities depending on weather conditions.
- It provide information to people on the kind of weather to be expected for example floods, hurricanes and other calamities, s that precautions may be taken either to prevent or keep away from them.

Importance of weather

Weather is important in the following ways:

- Good weather improves people's lives. When it rains, livestock get water to drink, people get water for domestic use.
- Weather determines the kind of clothing to be worn by people in an area. For instance in hot areas, will put on light clothing and in cold areas they will put on heavy clothing.

- Knowledge of the weather of a place enables people to carry out economic activities which can be sustained by the weather in that place. E.g. dairy cattle do well in a cool and wet place.
- It helps to establish a type of climate of a place after taking records of weather elements over a long time.

MEASURING AND RECORDING ELEMENTS OF WEATHER

All the elements of weather are measured and recorded at a weather station

A weather station is a place specially constructed for observing, measuring and recording weather elements accurately.

Weather stations are often found at meteorological centre, government institutions, schools, colleges, universities and agricultural centre.

GUIDELINES ON ESTABLISHMENT OF A WEATHER STATION

The suitable site for establishing weather station should have the following characteristics:

- It must be established on a flat or gently sloping ground.
- The area should be free from floods
- It should be sited in an open space and a place where there is free flow of air
- It should be away from any shadow or any objects or structure which might obstruct wind and rain or retain water after rains.
- The area should be fenced with a lockable gate to keep the instruments safe from the intruders
- It should have a wide view of the surrounding landscape and the sky
- It should consists of compass direction

INSTRUMENTS FOUND AT A WEATHER STATION

Common equipment found at a weather station includes the following:

- Six's thermometer for measuring maximum and minimum temperatures.
- A hygrometer (wet and dry bulb thermometer) for measuring humidity.
- A rain gauge for measuring rainfall.
- A wind vane for measuring direction of wind.
- An anemometer for recording wind speed.

- A sunshine recorder for measuring the number of hours and minutes of sunshine that a place receives each day.

REASONS FOR INACCURATE MEASURING AND RECORDING WEATHER ELEMENTS AT WEATHER STATION

- The weather station site may be in an inappropriate place. For example when a rain gauge or a thermometer are located under trees or building.
- Some of the instruments used may be defective. That is poorly maintained instruments may give wrong data.
- The weather observer may make errors in their observation and take readings from the instrument wrongly.
- The existence of natural calamities can cause damage to some instruments.
- Extreme weather conditions may result in inaccurate reading, like too much rain, such that the rain gauge overflows.
- When there is miscalculation of the recorded data.

INSTRUMENTS USED TO MEASURE THE ELEMENTS OF WEATHER

Element of weather	Instrument used to measure
Temperature	Thermometer
Rainfall	Rain gauge
Pressure	Barometer
Humidity	Hygrometer
Wind speed	Anemometer
Wind direction	Wind vane
Sunshine	Campbell stokes recorder
Weather forecasting	Weather satellites
Maximum and mnimum temperature	Six's thermometer
Cloud height	Cloud search light
Cloud cover	Oktas
Direction and velocity of cloud	Nephoscope
Amount and rate of evaporation	Evaporimeter
Direction the wind is blowing to	Wind sock
Direction the wind is blowing from	Wind vane

- ## Temperature:

Temperature is the degree of hotness or coldness of a substance or place or a body.

MEASURING AND RECORDING TEMPERATURE

Temperature is measured by an instrument known as thermometer and expressed in degrees of centigrade (°C) or Fahrenheit scales (°F).

- **CENTIGRADE SCALE (°C)**

It is a scale of temperature in which 0° is the freezing point of water and 100° is the boiling point. The scale is also known as the CELSIUS SCALE.

- **FAHENHEIT SCALE (°F)**

It is a scale of temperature derived by G. Fahrenheit in the early 18^{th} century on which the freezing point of water is 32° and the boiling point of water is 212°. This scale is widely used in English speaking countries, but is replaced by the CELSIUS or CENTIGRADE SCALE which have a more convenient decimal scale of temperature.

To change centigrade degrees into Fahrenheit degrees use

°F=C+32°

To change Fahrenheit degrees into centigrade degrees use

°C=(°F -32°)

Example

Convert 80°C into degree Fahrenheit

Solution

Formula °F=C+32°

°F= (80°) +32°

°F =144°+32°

176°°F

Convert 140°F into degree centigrade

Solution

°C= (°F -32°)

°C= (140° -32°)

°C= (108°)

°C= 60°

Thus on the centigrade thermometer the scale is divided into 100 equal parts (0 to 100) degrees. So one degree is of the distance between the freezing and the boiling point of water. On the Fahrenheit thermometer the scale is divided into 180 of equal parts (32 to 212) degrees. So one degree is , the same distance as in centigrade.

Therefore, 180°F are equivalent to 100°C. the ratio of 100 to 180 is the same as 5 to 9 or . Therefore one Fahrenheit degree is of a centigrade scale. One centigrade degree is of a Fahrenheit degree.

Temperature readings are taken everyday either at regular and fixed intervals of time (example after every four or six hours) or once in twenty four hours.

In some meteorological stations, temperatures are recorded continuously by a self recording instrument called a **THERMOGRAPH**.

TYPES OF THEMOMETERS

A STEVENSON SCREEN is a standardized meteorological screen which was designed by an engineer known as THOMAS STEVENSON.

It is a white wooden box, which is mounted 1.2 on four legs with louvered sides to house four types of thermometers. The cupboard containing meteorological instruments such as the wet and dry bulb thermometers and the minimum and maximum thermometers enable temperature readings to be taken in the shade protected from sunlight and wind.

- In order to prevent sun's heat to reach inside, the roof is double bodied. Also have a sloping roof to allow rain water to drain off.
- The screen is painted white to improve insulation or it can reflect direct heat from the sun.
- The legs of the Stevenson screen are made of metal to reduce the possibility of rodents or termites destroying them if they were made of wood.
- The sides are made up of double wooden louvers to allow free flow of air in and out of it, in order to obtain room temperature one side is hinged and acts as a door.

Each weather station has the Stevenson screen which contains four types of thermometers which are hanging from a frame in the centre of screen. They are:

- wet bulb thermometers
- dry bulb thermometers
- the minimum thermometers
- maximum thermometers

THE PURPOSES OF THE STEVENSON SCREEN

- to ensure the safety of the delicate instruments which could easily be damaged if kept in the open space.
- To provide the conditions necessary for accurate temperature readings.
- To protect instruments against precipitation and direct heat from outside sources while still allowing air to circulate freely around them.

WET BULB THERMOMETER

This is a thermometer with a moist muslin bag around its bulb to lower the temperature by loss of the latent heat of evaporation.

A wet bulb thermometer uses evaporation to add humidity to the air around the bulb. As water evaporates, it cools the surrounding air.

A wet bulb thermometer may use a cloth or wick soaked in water and wrapped around the bulb to provide 100% humidity.

Because wet bulb thermometers measure the temperature as moisture evaporates from a surface, they are useful in preparing smoked foods such as jerky and monitoring the humidity and temperature levels in small incubators when hatching poultry eggs. Chicken eggs require temperature maintained at 97°F to 102°F with a dry bulb thermometer and 80°F to 90°F with a wet bulb thermometer to successfully incubate the eggs.

DRY BULB THERMOMETER

This is a thermometer which indicates current air temperature, it can be used together with a WE BULB THERMOMETER to obtain the dew point from tables or from the humidity slide ruler.

Maximum thermometer

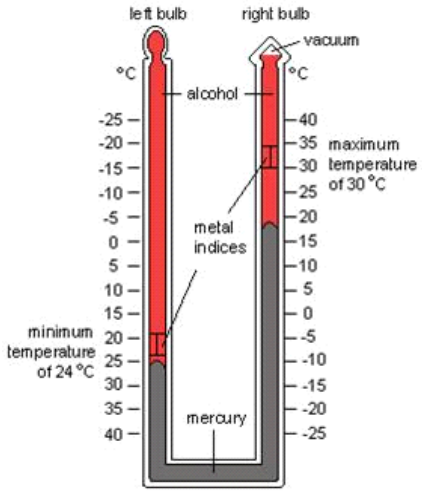
Is the thermometer made of glass and uses mercury to measure and record the highest temperature reached in a day. The maximum temperature is read from the side of the metal index nearest to the mercury. When the temperature falls the mercury falls, leaving behind the metal index still indicating the maximum temperature reached. A magnet is used to bring back the metal index into contact with the mercury.

Minimum thermometer

Is the thermometer used to measure and record the lowest temperature reached in a day. Alcohol is used because it has lower freezing point than mercury. Any fall in temperature will cause the alcohol column to contract and the **meniscus** (the curved upper surface of the alcohol column) will pull the index back along the tube whenever temperature rises, the alcohol will expand and flow freely past the metal index without pushing it up. Therefore the metal index is always left as a record of the lowest temperature reached between the readings. The part of the metal index away from the bulb will indicate the lowest temperature reached.

Six's thermometer

This thermometer used for measuring and recording maximum and minimum temperature reached in a day. The thermometer consists of a "U" shaped glass tube. When temperature rises, the alcohol on the left hand side expands, pushing the mercury underneath downward and up the right hand side. While the mercury on the right hand side rises, it pushes the metal index upwards, until the highest temperature is reached for the day. This temperature is read from the scale on the right hand side, when temperature falls the alcohol on the left hand side contracts. This pushes the mercury downward and up by the mercury.



The maximum and minimum temperature which are recorded for the day are used to calculate

- **THE DAIRY RANGE OF TEMPERATURE (D.R.T)**

  This is the different between the maximum and the minimum temperatures in a day. It is also known as DIURNAL RANGE OF TEMPERATURE.

  D.R.T=maximum temperature-minimum temperature

- **THE DAIRY MEAN TEMPERATURE (D.M.T)**

  Is the average of the maximum and minimum temperature s in a day.

  D.M.T=

- **THE MONTHLY RANGE OF TEMPERATURE (M.R.T)**

  Is the difference between the highest mean daily temperature and the lowest mean daily temperature in a month.

  M.R.T= Highest D.M.T -lowest D.M.T

- **THE MEAN MONTLY TEMPERATURE (M.M.T)**

  Is the sum of the mean daily temperature in a month divided by the total number of days in that month OR

  Is the average temperature for th month.

  M.M.T=

- **THE ANNUAL RANGE OF TEMPERATURE (A.R.T)**

Is the difference between the highest mean monthly temperature and the lowest mean monthly temperature.

A.R.T=highest M.R.T-lowest M.R.T

- **THE MEAN ANNUAL TEMPERATURE (M.A.T)**

  Is the sum of the mean monthly temperature in a year divided by the total number of months (12) in a year.

  M.A.T=

- **THE TOTAL ANNUAL TEMPERATURE (T.A.T)**

  Is the sum of the mean monthly temperature in a year

  Example

Read carefully the data of station X given below then answer the questions that follow:

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. (°C)	23.3	22.8	21.1	18.9	15.6	13.3	12.8	15.6	18.9	20.6	22.2	23.3
Rainfall (mm)	68.6	68.6	81.3	43.2	10.1	0.0	0.0	0.0	2.5	10.1	25	45.7

- Calculate the annual total temperature

  =() °C

  =°C

- Calculate the mean annual temperature

  M.A.T=

M.A.T=

M.A.T=°C

M.A.T=19.03°C

- Find the annual range of temperature

  A.R.T=highest M.R.T-lowest M.R.T

  = 23.3°C-12.8°C

  =10.5°C

- List the hottest months

  These are January and December

- Name the coldest months

  This is July

Importance of Temperature

- Temperature is one of the factor s that determine soil formation
- High temperature causes sun-burn and also increases the risks of skin cancer.
- Temperature determines the types of shelter, clothing and even the type of food people eat. For example inuets (Eskimos), have snow and ice houses (gloos).
- Warm is essential for plant and animal survival Plants need warm in order to manufacture their food
- Facilitates formation of clouds
- It determines the growth of plants. In desert regions, there is scant or no vegetation because temperatures are very high. In the Tundra areas, vegetation grows during summer only because winters are too cold for their growth.

THE PRESENTATION OF TEMPERATURE DAA

When mean monthly temperatures for a given month are obtained for many places, they can be shown on a map.

The lines are drawn to connect places with the same mean monthly temperature. For all places with a mean monthly temperature of 23.3°C will be connected by one line. These lines are known as isotherms.

Also you can present the temperature data for a certain station or place by using a GRAPH. Here the mean monthly temperature figures for a year are plotted on the graph and points are joined by a smooth line.

Example:

Study the following table and then answer the questions that follow:

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. (°C)	15.4	14.3	17.2	21.1	25	26.1	26.7	26.7	26.1	24.4	20.6	17.2
Rainfall	35.6	27.9	66	139.7	259	383.5	289.6	355.6	292.1	114.3	40.6	33

(mm)												

Draw a line graph to present the temperature data given.

Solution

Factors affecting temperature

the temperature of a place is dependent on some or all of these factors:

- Altitude
- ocean currents
- distance from the sea
- latitude
- prevailing winds
- aspect of slope
- cloud cover
- length of day and night
- Amount of dust and other impurities in the atmosphere

Altitude

This refers as a height above sea level. Temperature decreases with an increase in altitude at the rate of 0.6 0 c for every 100 meters. So the higher you go the cooler it becomes, therefore land of higher altitudes experience low temperature than areas of low altitude. That is why the summit of Mount Kilimanjaro with 5895 meters above sea level permanently covered with ice.

Ocean currents

Ocean currents are either warm or cold. Warm currents raise the temperature of wind blowing across them while cold currents lower temperature of such winds. Some winds blowing on shore will influence the temperature of such winds in some of coastal areas with the temperature of the ocean currents.

Distance from the sea

Land surface heats and cool more quickly than sea surface. That is water heats more slowly but it retains its heat for longer periods than the land. Thus large area of land masses lying at great distance from the sea does not get the moderating influence of the oceans. Lack of these moderating effects makes the land masses experience very low temperature in winter and very high temperature in summer. This extremely results in high annual range of temperature. The interior of the continent of Asia is a typical example.

Aspect of slope

The influence of aspects on temperature is only noticeable in temperate latitudes. In tropics the mid day sun is always high in the sky and aspect is of little significance. The south facing slopes enjoy longer period of daylight and therefore experience higher temperature than the northern facing slopes in the northern hemisphere.

Wind

When winds onshore they bring rainfall and the wind blowing from hot area to cold areas they raise, the temperature of cold areas and vice versa. In temperature latitudes winds transported from the land lower the winter temperature but raise the summer temperature. Prevailing winds from the sea raise the winter temperatures but lower the summer temperatures. In tropical latitudes on shore winds modify the temperature of the cooler ocean surface. Local winds sometimes produce rapid upwards on downward temperature changes.

Latitude

The amount of heat received at any place depends on the angle at which the sun's rays strike the surface of the earth and the duration of sunshine. At the equator the sun's rays reached the earth's surface at almost right angles. Throughout the year but the angle decreases as one move towards the pole. Therefore temperature decreases with increase in latitude because the sun rays spread over a larger area and its heating effect decreases.

Cloud cover and humidity

The clouds reduce the amount of solar radiation reaching the earth's surface. And when there are no clouds both types of radiation are at maximum. For example the heavy clouds cover the equatorial region explains why the day temperature rarely exceeds 30°C and why the night temperatures are not much lower. In hot deserts the absence of clouds and the presence of dry air result in very high temperature over 38°C and much lower night temperature of 21°C or below. The very humidity air absorbs heat during the day and retains it at night and prevents

the loss of heat from the lower layers of the air. Thus in the humidity tropics, the air retains warm at night even on days when there is little or no cloud.

- **Humidity**

Is the amount of water vapour or moisture present in the atmosphere.

Types of humidity

The humidity is expressed in either absolute or relative humidity.

- **Absolute humidity**

is the actual amount of water vapor or moisture in a given volume of air at a particular temperature. It is expressed in grams per cubic metre.

- **Relative humidity**

is the ratio of the actual amount of water vapor or moisture in a given volume of air (i.e. absolute humidity) to the maximum amount of water vapor that the same volume of air can hold at the same temperature.

It is expressed as a percentage of the total amount of water vapour that would be present when that air is saturated at the temperature. Air is saturated when the atmosphere cannot hold any more water vapour. This condition depends on the temperature and pressure of the air.

MEASUREMENT OF HUMIDITY

- Humidity is measured by a **hygrometer** which consists of wet and dry bulb thermometers and is kept in the Stevenson screen.
- The wet bulb thermometer is kept moist (wet) by wrapping it in Muslin which is then dipped in a container of distilled water. When the air is not saturated water evaporates from the muslin and cools the wet bulb. The cooling effect causes the mercury to contract.
- The dry bulb is not affected in the same way as wet bulb because it does have a Muslin wrapping. It is affected by the surrounding air.
- So when the air is not saturated the two thermometers show different readings, when the air is saturated the two thermometers show the same readings.
- Therefore when there is a big difference in reading between the two thermometers humidity is low and when there is small difference humidity is high.

- **PRESSURE**

The air surrounding the earth's surface forms the atmosphere. The atmosphere has weight. The force with which it presses down on a unit area is called atmospheric pressure. The pressure is exerted equally in all directions. Pressure varies with temperature and altitude. Atmospheric pressure is measured by an instrument called a barometer.

There are two types of barometer, mercury barometer and aneroid barometer.

A mercury barometer

Is a simple apparatus consisting of a glass of about 92 centimeters long and bowl filled with mercury. The glass tube is filled with mercury and being put upside down in the bowl of mercury. At sea level the mercury will fall until the column is about 76 centimeters above the surface of the mercury in the bowl. A vacuum is left at the top of the tube. To read the pressure centimeter rule is placed besides the glass tube and the change in height of the mercury column gives the reading of the atmospheric pressure. Mercury barometers are not portable.

The aneroid barometer

It consists of an air fight box of thin metal containing very little air. The top of this box moves inwards and outwards with changes in atmospheric pressure. This movement is transmitted by a system of levers to a circular seal with a pointer which shows the reading of atmospheric pressure.

MEASURING AND RECORDING PRESSURE

Pressure is expressed in millimeters with reference to the height of mercury column or in millibars. A bar is the standard unit of pressure measurement. It is divided into one thousand units called millibars. At sea level pressure is one thousand millimeters of mercury or 1.5 kilograms of force per square centimeters. This is equivalent to 1013.2 millibars approximately one bar. Lines joining places with the same pressure are called **isobars** and the pressure is greater at sea level where the whole thickness of the atmosphere exert its weight. Pressure decreases at the rate of 10 millibars for every 100 meters increase in height because the thickness of the atmosphere decreases

Examples

- When the pressure of Mbeya (3000m) is 650mb. What will be the pressure of kilwa which is 500m above sea level?

  Solution

  Different in height = 3000m-500m

  =2500m

  If 100m=10mb

  2500m=?

=

=250mb

Thus the pressure of Kilwa= pressure of Mbeya+difference in pressure

=650mb+250mb

=900mb

- Calculate the pressure of Iringa which is 2000m above sea level when the pressure of Usangu at 300m above sea level is 850mb.

  Solution

  Different in height = 2000m-300m

  =1700m

  If 100m=10mb

  1700m=?

  =

  =170mb

  Thus the pressure of Iringa= pressure of Usangu-difference in pressure

  =850mb-170mb

  =680mb

- When the pressure of station x which is 3000m above sea level is 650mb.what will be the pressure of station y which is located at 5000m above sea level

Solution

Different in height = 5000m-3000m

=2000m

If 100m=10mb

2000m=?

=

=200mb

Pressure of station y= pressure of station x-difference in pressure

=650mb-200mb

=450mb

- **PRECIPITATION**

Precipitation refers to the deposition of moisture from the atmosphere on the earth's surface.

Forms of precipitation

It includes dew, frost, snow, mist and hail, sleet and rain.

Dew:

Is the water vapor that condenses on solid objects when the dew is reached. The droplets formed after condensation of water vapor which is then deposited on the cool surface such as building, leaves, grass and stones.

Frost:

Frost is a tiny ice crystals deposited on objects on the ground; frost is formed when temperature falls below freezing point.

Snow:

Snow is the frozen droplets of water; snow formed when water vapor in the atmosphere turns into crystals of ice and reaches the ground before melting.

Mist:

Refers to tiny water droplets suspended immediately above the ground. Frost is similar to mist but it is denser with less visibility.

Hail:

Hail is the form of precipitation falling with small ice blocks Sleet: is a mixture of snow and rain. It forms when the temperature of the ground is lower than the temperature above.

Rain:

Rain is the droplets of water falling from the atmosphere after condensation. When water vapor rises, it cools at high altitude until dew point is reached. Dew point is the temperature rate at which the atmosphere is saturated with water vapors. Condensation takes place after dew point has been reached to form water droplets. These droplets combine to form larger drops which fall as rain.

Conditions necessary for precipitation to occur

- The air must be saturated with water vapor to reach dew point.
- The air must contain small particle matters called hydroscopic nuclei around which the droplets form by condensation, and then droplets combine to form larger droplets.
- The saturated air must be cooled below its dew point. If the air is cooled becometoo heavy and unable to remain in the atmosphere as a result fall with its droplets or ice crystals as precipitation.

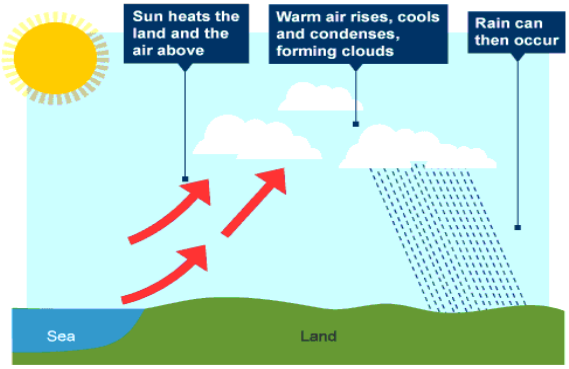
PROCESSES OF RAIN FORMATION

- The whole process of precipitation formation is known as water cycle or hydrological cycle which refers to the continuous movement or circulation of water from the earth's surface to air and back again to the earth's surface to such a way the process has no beginning or end.
- Thus rain formation process pass through the following stages: evaporation, cooling, condensation and then rain.
- When water vapour rises, it cools at high altitude until dew point is reached. Condensation takes place after dew point has been reached to form water droplets.
- These droplets combine to form larger drops which are then too heavy to remain in the air, so they fall down as rain.

TYPES OF RAINFALL

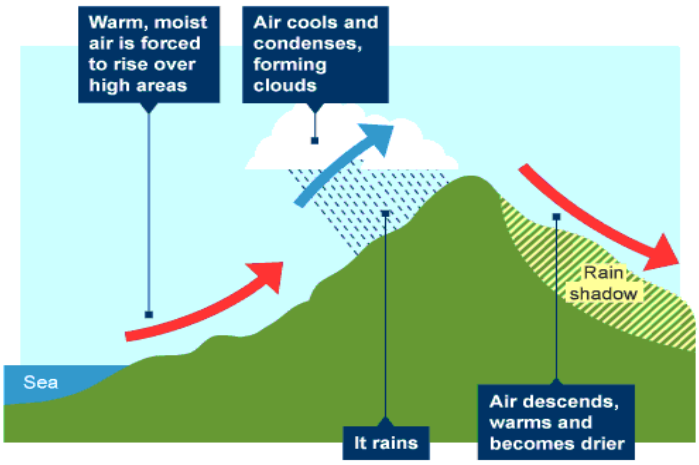
- **Convectional rainfall**

When rain is formed through vertical rising of moist air currents it is called convectional rain Convectional currents arise due to differential heating of the earth's surface. Convectional rains are common in the tropical areas.



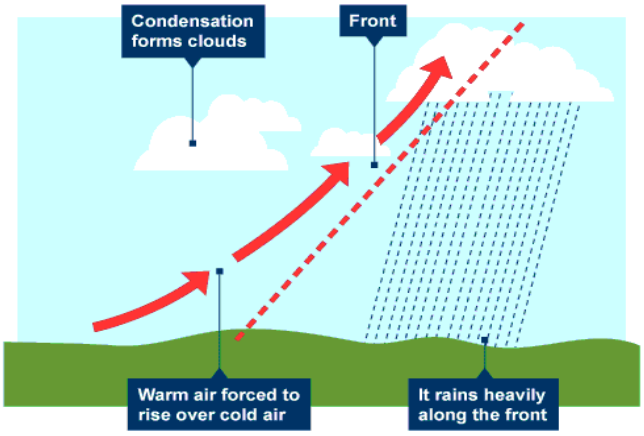
b) **Relief rain**

Sometimes moist winds are forced by a high mountain to rise and when they reach high altitude the moisture in them condenses to form droplets, which fall as rain. Rain formed in this way is called relief or orthographical rain. The sides of the mountain facing the direction of the winds is known as the wind ward side while that which faces away from the direction of the wind is known as the lee wards side or the rain shadow, the lee ward side gets very little rain . A typical example of rain shadow in Tanzania is found in the western side of mountain Kilimanjaro, winds blow from the Indian Ocean in the east and are forced by this mountain to rise and drop most of their moisture on the eastern and south eastern slopes. When these winds blow to the western side of the mountain they already relatively dry.



- **Cyclonic rain**

It occurs when large masses of air with different characteristics of temperature and moisture. As the warm and moist air is forced up over the cool and dry air, it expands. At higher altitude the warm air cools and water vapor condenses to form clouds and rain. On the other hand tropical cyclones are formed over oceans is the tropical between latitude 8 0 N and 8 0 S. They usually bring very heavy rainfall and are associated with thunderstorms and very fast moving wind, which often causes destruction along coastal settlements. In the Caribbean and U.S.A tropical cyclones are called hurricanes in Africa they are known as cyclones and in China and Japan they are called typhoons. Rainfall is measured by using a rain gauge. The rain gauge consist of an outer case , a copper-receiving vessel, a funnel whose diameter is normally 13 centimeters, a clear glass jar or bottle and a graduated measuring cylinder.



MEASURING AND RECORDING RAINFALL DATA

Rainfall is measured by using a RAIN GAUGE. The rain Gauge consists of a cylindrical copper container in which there is a copper collecting can containing a collecting a glass jar, and a copper funnel that fits onto the top of the container.

Rain gauge

The gauge is sunk into the ground so that the top of the funnel is about 30cm above ground level. Rain falling over the funnel collects in the glass jar. This is emptied usually every 24hours

months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	29	27	27	26	28	27	28	28	28	229	26	28
Rainfall (mm)	140	140	130	110	160	180	130	140	150	130	180	160

- Calculate the total annual rainfall

=1750mm

- Calculate the mean annual rainfall

=

145.8mm

c. Name the month in which this station receives highest amount of rainfall

=these are June and November

- What is the annual range of rainfall?

=highest-lowest

=180mm-110mm

=70mm

- What is the relationship between temperature and rainfall?

Ans. There is high temperature and high rainfall throughout the year.

months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	23.3	22.8	21.1	18.9	15.6	13.3	12.8	15.6	18.9	20.6	22.2	23.3
Rainfall (mm)	68.6	68.0	81.3	43.2	10.1	0.0	0.0	0.0	2.5	10.1	25	45.7

- Calculate the total annual rainfall

=356.1mm

- Calculate the mean annual rainfall

  =

  =29.7mm

- Name the month in which this station receives highest amount of rainfall

=March

The station experience dry season when the sun is at what tropics?

=at the tropic of cancer towards the equator since the dry season is in June, July and August.

- What is the relationship between temperature and rainfall in this station?
  - There is direct relationship between temperature and rainfall. That is as temperature rises is how the amount of rainfall received increases and as temperature falls also the amount of rainfall received decreases.

REPRESENTATION OF RAINFALL DATA

The figures obtained can be represented in the form of graphs known as HISTOGRAMS.

For example

months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	17.3	17.2	17.8	17.2	17	16.5	16.5	17	17	17	16.6	16.8
Rainfall (mm)	61	92	108	136	96	26	20	58	98	95	106	92

- **What is** the mean annual rainfall

=

=82.3mm

- **When the station receives heavy rainfall?**

  =April

- **Calculate the total annual rainfall**

  =988mm

- Draw a histogram or bar graph to show rainfall

Rainfall Variation

Rainfall variation is a normal phenomenon on the earth which is caused by a number of factors. Some of them include Ocean currents, distance from the equator, prevailing winds, water bodies, nature and shape of the coast, distance from the sea, altitude and human activities.

Ocean Currents

There are two types of Ocean Currents.

The warms and the cold currents

The warm Ocean Currents yield rainfall over the adjustment land. This is because the winds cross over them do carry large amounts of moisture for example Mozambique current. Much rainfall is experienced along the East Coast of Africa. Cold ocean currents are crossed by wind which have no moisture, hence brings very little or no rain in the adjacent land. For example banguera currents in South-West Africa coast and the canary current in the north-west coast of Africa.

Distance from the equator.

Areas along the equator receive more rain than areas away from it. This is because of high amount of solar radiation, which result into evaporation and raising of air moisture hence condensation takes place resulting into convectional rainfall. Congo basin and Brazil are few examples which receive much rainfall due to their position.

Prevailing winds

Winds blowing from the land towards the sea (off-shore) are carrying moist air from the land and yield no rainfall except in the sea. These winds usually lead to dryness of the land with very low rains in the coast. Effects of these winds are development of deserts for example the Sahara Dessert in the Northern Africa.

Nature and shape of the coast

The coastal areas, which align parallel to the prevailing wind such as the N.E trade winds move parallel with the North Eastern Coast of Kenya, yield no rainfall. As result a dry climate is experienced along the coast.

Distance from the sea.

The areas near the sea or ocean experience high rainfall due to winds blowing moisture from the sea which would cause rainfall to the coastal areas. Areas that are very far from the sea receive very little or no rainfall for example, Dar es Salaam in Tanzania and Mombasa in Kenya receive heavier rains than Dodoma, Singida and Tabora, which have long distance from the Indian Ocean.

Altitude

Altitude is also a factor for uneven distribution of rainfall, highlands force the warm air to rise over them. When they condense, they cause rain to fall on the wind ward side. The other side of the highland (leeward) may receive very little or no rainfall at all. People of such areas includes the eastern part of South Africa receives heavy rain (orographic) while the Western part experiences prolonged droughts due to effects of Drankensburg mountains. The eastern part of East Africa also receives heavier rainfall than the western side due to warm moist winds blowing from the Indian Ocean.

Human activity

Besides other environmental benefit plants or trees intercept precipitation and return moisture to the air through transpiration and evaporation. This process becomes balanced when there is no destruction of the vegetation. Human activity such as settlement, animal rearing, farming and transportation however can cause rainfall variations on the earth's surface through land degradation. When people cut trees or clear the bushes, land is naturally destroyed. The destruction of vegetation disturbs evaporation, condensation and precipitation process, which are necessary elements of rainfall. In turn the amount of precipitation in the air is interrupted either by causing floods or droughts. The California desert in U.S.A and the Sahel in Africa are the results of droughts caused by human activities, which have led to the expansion of the deserts in the 1980s.

RAINFALL EFFECTS

Too much rainfall for example, the case of El Nino (1998) results into negative impacts on life and properties

- Heavy rainfall may cause destruction of houses, roads and bridges, crop and loss of life for both human and animals.
- In addition to the loss of life and property, floods, which are the results of heavy rainfall results into eruption of diseases such as malaria, cholera, and dysentery.
- On the other hand, too little rainfall leads to little yield of food and cash crops. Famine and hunger in the parts of the world is a result of lack of rainfall. Prolonged dry seasons in some parts of the world have resulted into the loss of lives of both animals and the people. North Eastern Kenya, Somalia, Sudan, and Ethiopia are some of the areas where people and animals have lost their lives because of long droughts.
- Rainfall reliability leads to continuous crops production and animal keeping hence improves standard of living and the industrial development of a nation may be realized. Sustainable agriculture is made possible and people are assured of enough food and cash crops.

WEATHER AND HUMAN ACTIVITIES

Most human activities affected by weather that is experienced at a place. For example, when the rains are heavy, flooding occurs and causes damage to crops, animals and infrastructure like roads. This means that few economic activities can take place. When there is no rain, plants and animals die, rivers and streams dry up, and irrigation and other economic activities like fishing cannot be carried out. Therefore weather affects the social economic activities of a place.

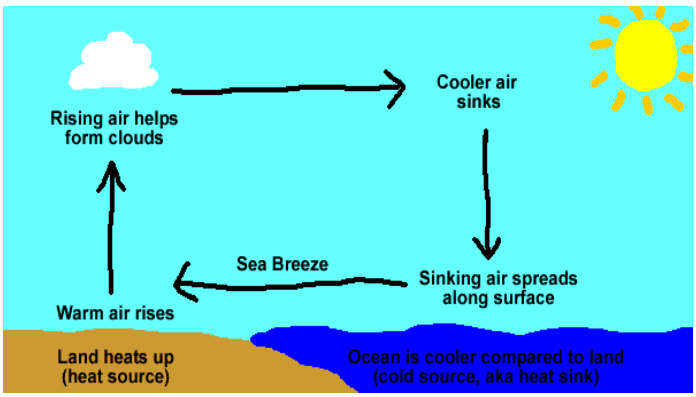
- ## Humidity

Humidity is the amount of water vapor in air. Or Humidity is the state of the atmosphere in relation to the amount of water vapour it contains. Humidity indicates the degree of dampness of the air and it is one of the main influences on weather. It is expressed in either absolute or relative terms. Absolute humidity, expressed in grams per cubic meter, is the actual amount of water vapour present in a certain volume of air at a given temperature.

5. Winds

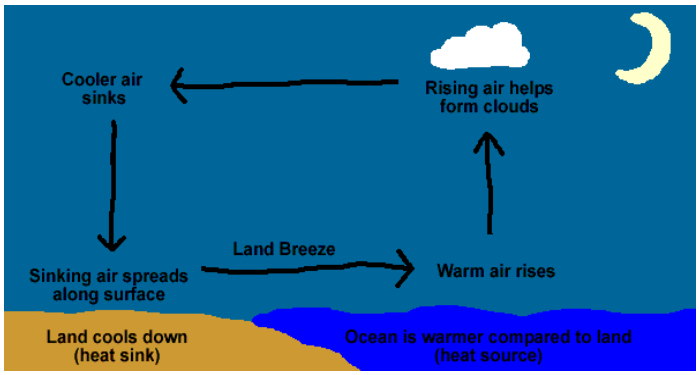
Wind is air in motion from high pressure to low pressure area.

SEA BREEZE (DAY) Is when winds blow from sea to land during a day.



LAND BREEZE (NIGHT)

This occurs during night when winds blow from land to sea.



During the day the land is usually warmer than the sea, and the air pressure on the land is lower than that over the sea. Therefore winds blow from sea to land. These winds are known as sea breezes. During the night the land is cooler than the sea and there is low pressure on the sea. Therefore winds blow from land to sea, these are called land breezes.

There are great variations in the general patterns of wind systems in areas of the earth's surface where there are large land masses adjacent to large water bodies. During summer, intense low pressure develops in central Asia in the Northern hemisphere and winds blow inform of high pressure over the Indian and pacific oceans. Wind belts of the world occasionally in the westerly wind system depressions and anticyclones develop. A depression is an area of low pressure in which winds blow a circular motion. This motion is anti-clockwise in the Northern hemisphere but clockwise in the southern hemisphere. A depression develops when cold heavy air comes into contact with warm moisture. A depression is usually associated with cyclonic rains. Anticyclones are areas of high pressure in which winds blow in a clockwise circular motion in the Northern hemisphere. They normally follow a depression and are associated with cool fine weather with no rain.

MEASURING AND RECORDING WIND

Wind direction is measured by a ***wind-vane.***

A wind-vane consists of a freely rotating arrow fitted to a central rod. The arrow of the wind-vane always points to the direction from which winds blows, and the wind is named after this direction. Four arms marking the directions of the cardinal points are fixed to the stationary central rod.

Wind speed is measured by an instrument called an ***anemometer.*** This instrument consists of three or four horizontal arms that when there is wind the arms rotate. This movement operates a meter which records the speed of the wind in kilometers per hour.

SUMMARY

The names of the lines joining different places having the same amount of the following items on a map

temperature	isotherms
pressure	isobars
rainfall	Isohyets
sunshine	Isohels
cloudiness	Isonephs
salinity	Isohaline
magnetic variation	Isogons or isogonics line
Values of items	Isolines

CHAPTER FIVE

CLIMATE AND NATURAL REGIONS

Climate is the average weather conditions of an area observed and recoded over a long period of time normally over 30 years. This involves systematic observation, recording and processing of the various elements of climate such as rainfall, temperature, humidity, air pressure, winds, clouds and sunshine before any standardization of the climatic means or average can be arrived at.

Weather: The conditions of the atmosphere which occur at a place at specific time period from hour to hour or day to day.

The weather should not be equated with climate, though they are very closely related to each other in the study of meteorology and climatology. For example when we say climate of Tanzania is hot wet equatorial climate that is the summing up of the average everyday weather conditions of the country throughout the year.

ELEMENTS OF CLIMATE

The longer period of observation, the more accurate the climatic estimates. This is because during such a period varied aspects of weather will have repeatedly occurred. The average values obtained are then used to make generalized conclusions about the climate of a place.

The elements of climate are the same as the elements of weather. So when we say it is cool and dry for a long period or is hot and rainy throughout the year we describe climate, it deals with all weather elements such as sunshine, precipitation, humidity, temperature, cloud cover, wind and atmospheric pressure.

WEATHER SND CLIMATE

Weather and climate differs in the following ways:

WEATHER	CLIMATE
Is a day to day conditions of the atmosphere of a place	Is the average conditions of the atmosphere of a place
Weather conditions are over a short time	Climate conditions are over many or long period of time
It changes abruptly within a short period	Climate changes is slow, gradual and occurs over many years

Weather elements are measured and recorded by weather instruments	Climate elements are not measured but calculated from the weather measurements
Weather determines the survival of the growing vegetation within that particular period	Climate determines the type of vegetation of an area.
Weather has no distinct seasons	Climate has distinct seasons for example in savanna regions there are hot and rainy or cool and dry seasons
Weather can be forecasted	Climate cannot be forecasted because changes take years to be known
Wether varies from one place to another within a region	Climate remains uniform over a large region
Weather is a function f state of the atmosphere which keeps changing from time to time	Climate is influenced by factors such as latitude, altitude, distance from water masses, wind and ocean current
Plants and animals do not necessarily adapt to the weather conditions for example a fall in temperature in one day in the dry season does not cause trees to shed their leaves	Plants and animals adapt to the climatic conditions of the place they live in, for example trees in temperature regions shed their leaves the dry season

FACTORS INFLUENCING CLIMATE

The factors that affect elements of weather also influence climate as follows

- **Latitude**

Latitude influences temperatures on the surface of the earth whereby the areas nearer to the Equator experience higher temperature than those far away.

- **Altitude**

It influences temperature and pressure of a region. Low altitude regions are warmer and experience high atmospheric pressure while high altitude areas are cooler and have low pressure.

- **Distance from the sea**

Places near the sea or ocean have higher temperatures and receive more rainfall than places that are inland due to high rates of evaporation

- **Aspect**.

Aspect refers to the direction in which a slope faces e.g. in The Northern Hemisphere; the Southern ward slopes are warmer than the North ward facing slopes. This is because the North slopes never receive direct sunshine as the sun in this region never gets overhead. -Windward slopes of highlands receive much higher rainfall than the Leeward slopes.

- **Ocean Currents**

Current flowing along the Coasts tends to modify the climate of the Coastal regions. Where onshore wind blow over a cold ocean current are cooled from the below and the moisture they are carrying is condensed and dropped over the sea as rain.

- **Prevailing Winds**

Wind is a medium of transfer of heat and moisture over the land. If wind is blowing from a warm region, it has the warming effects over the region it is blowing across and if wind will blow from cold region it will be cold and will cool the land over which it is blowing. Thus moist winds cause rain over their destination regions while dry winds enhance drought.

- **Human Activities**

Like development of settlements, agriculture and construction of dams and creation of manmade lakes have influence on climate. In recent times we are realizing the effects of human activities in causing climate change, caused by clearing of forests, draining and cultivating swamp areas, emission of Chlorofluorocarbons and other gases from factories and motor vehicles.

CLIMATE AND HUMAN ACTIVITIES

Human activities are all legal activities carried by people in order to meet their basic needs and make wealth. All basic needs and wealth are obtained after doing various activities without breaking the laws and the rules of the country. They are also known as economic activities which include farming, pastorals' or herding, fishing, lumbering, trade, industrial work, tourism and transport and communication. These are mostly affected by the climate of a given region.

CLIMATE AND NATURAL REGIONS OF THE WORLD

Climate is not uniform across the World; climate varies from one place to another. Mainly Variation of temperature and rainfall influences different climatic characteristics. This gives rise to various climatic regions around the globe. Natural Regions are geographical areas with uniform physical characteristics that distinguish it from other natural regions.

The world has the following climatic region

EQUATORIAL CLIMATE

Location: The region is found between 0° and 5° north and south of the equator but in some regions it may extend up to 10° north or south of the equator. Examples of areas found within this region include the Amazon basin, Congo basin, the southern Ivory Coast, south Ghana, western coastal Nigeria, and eastern coastal Malagasy Republic.

Climatic characteristics

1. There are no marked seasons of the year

2. High temperature with annual average of about 27°C throughout the year

3. The annual temperature range is about 3°C.

4. The daily mean temperatures are about 26°C all the year round.

5. The daily temperature range is rarely more than 8°C because of the thick cloud cover.

6. Rainfall is heavy and is usually convection rain.

7. Rainfalls usually occur in the afternoons and they are accompanied by lightning and thunder.

8. The annual mean rainfall is about 1500mm

9. High humidity and intensive cloud cover throughout the year.

10. Crops grown are cassava, groundnuts, maize, millet, beans, bananas.

11. Human activities: Plantation agriculture, fishing, cultivation, peasantry sedentary agriculture.

12. Common animals found: Monkey, gorillas, crocodiles, and hippopotamus.

NB: But areas located in highlands within the equatorial region have their temperatures modified by altitude. The temperature of some of these highland areas, e.g., the East African Highlands, is lowered to about 15°C. These regions are said to have a modified equatorial climate. Variations on the basic type of climate occur in the highland regions of equatorial Africa. The climate of most of these regions has an equatorial rainfall pattern.

Therefore this climate can generally be described as hot and wet throughout the year with a small annual temperature range.

TROPICAL CLIMATE

This climate is also known as Sudan type or Savannah climate. In the interior of the continents it is referred to as tropical continental climate.

Location: the region is found between 5° - 15° north and south though it may extends to 25° north or south of the equator.

Area found: East and Central Africa, Brazilian plateau, Venezuela, Africa and N. Australia.

Climate: hot wet summer season, warm dry winter

Climatic characteristics

- High temperature, in hot summers (32°C) and cooler winters (21°C).
- The annual temperature range is about 11° C.
- The highest temperatures occur just before the rainy season begins.
- It receives moderate rainfall with rainy and dry seasons
- Total annual rainfall is around 765mm, though this increases in the areas lying close to the equatorial climate region. Similarly, rainfall decreases towards the tropical deserts.
- Humidity is high during the hot, wet season.
- This climate is characterized by tall grass and trees which are more numerous near the equatorial forest region. The savannah region is suitable for herbivores animals such as giraffes, elephants, buffaloes, rhino, zebras, antelopes, wildebeests and many other animals. There are also carnivorous animals such as lions, leopards, hyenas, etc. The region also supports a variety of species of birds, reptiles and insects. People living in this region mainly engage in livestock keeping, cultivation and tourism. Also lumbering is practiced. Many tourists come from foreign countries to view the wildlife that live in the vast grassland. Numerous national parks have been established in this region. In Tanzania, for example, there are established national parks such as Serengeti, Mikumi, Selous, Tarangire, Ruaha, Saadani, Ngorongoro, Katavi and Manyara. The major crops grown in this region are maize, millet, groundnuts, beans, onions, cotton, tobacco, sugarcane, sisal, rice and coffee.

Desert climate

- It has high day time temperature up to 47°c and during night temperature can drop to as low as 5°c
- It receives less or no rainfall throughout the year usually less than 250mm a year.

Mountain climate

- It receives heavy rainfall throughout the year
- It has low temperature and pressure
- It consists of distinct vegetation zones such as cedar and camphor.

Mediterranean climate

- In summer the area is hot and dry because it is under the influence of trade winds. In winter the temperature is about 10°c

- It receives relatively light and the annual total varies from 500mm to 760mm during winter.
- There is little annual vegetation left because of too much cultivation

AGRICULTURE

The climate determines the types of crops to be grown. Thus the areas where rainfall is sufficient tend to support variety of crops to be grown. Even when crops are grown under irrigation, the region which is the source of the irrigation water must receive a lot of rainfall t ensure constant availability of water.

This can be found in the equatorial climate where yams, cassava, bananas, cocoa and palm oil are grown while those in the savanna climate grow maize and millets. The areas which receive little rainfall are agriculturally unproductive.

Livestock rearing does well in region that receive high rainfall in the tropics because plenty of rain allows growth of pasture for animals and therefore an increase in the population and productivity of livestock.

In areas with inadequate rainfall and high temperatures, hot desert conditions prevail discourage crop growing and animal rearing.

In cooler climates support crops which do well under cool conditions especially where rainfall amounts are sufficient for crop growth such as wheat, barley, oats and fruits such as apples and peaches. Likewise, very cold climates are not conducive to crop growing and animal rearing.

SETTLEMENT

People tend to build homes and settle where they can engage in suitable economic activities. Where the climate is suitable agricultural activities, settlement grow because people can grow food and cash crops. Very hot and dry areas do not attract settlements because of the unsuitable climate. Cool areas are more comfortable to live in and attract a lot of settlement as opposed to very hot areas.

FORESTRY

Forests and woodland are supported by favourable climate. In tropical regions, high temperatures together with high rainfall allow tropical forests to thrive. In temperate climate where rainfall is sufficient coniferous forests are common. This stimulates lumbering and establishment of industries like paper mills, boat building and furniture manufacturing.

FISHING

Most of largest fishing ground in the world is located in the cooler climate due to presence of cooler water which supports growth of plankton which is the main food for fish. In tropical area fishing is not productive as in those areas of middle and higher latitudes.

TRADE

Trade is influenced by the types of climate. Climatic differences influence resource distribution. Crop grown in the equatorial regions such as palm oil and cocoa do not do well in cold regions. In cold countries manufacturing industries produce goods needed in other parts of the world. These differences in what are available in one country and lacking in another has necessitated the need for trade.

TOURISM

Tourism activities are directly influenced by climate. The hot and sunny climate of the tropics attracts tourists from the cooler parts of the world who come to enjoy the warmth of the tropical areas where they can swim in the warm ocean and spend some time in the sun. some tourists come to countries in the tropics to avoid the severe cold winter in their own countries at that time.

INDUSTRY

The climate supports individual activities especially those processing raw agricultural materials like tea and coffee located in areas where the crops are grown. Likewise, meet processing and fish processing industries are found in climatic regions where livestock is reared and where there are large fishing grounds respectively.

TRANSPORT

The areas which receive heavy rainfall throughout the year have poor inland roads because they become muddy and slippery when it rains. Floods cover sections of the roads or wash away bridges, making such routes impassable.

In desert like the Sahara, strong winds blow sand onto the roads covering them and rendering them unusable because they cannot be easily traced. Very cold regions receive precipitation in the form of snow which covers roads making them unusable.

CLIMATE CHANGE

Is the slow change of the earth's overall climate over a long time

EVIDENCES WHICH SHOW EXISTANCE OF CLIMATE CHANGE

- Global warming

It is unusual increase in temperature condition globally since the world is warmer than 100years ago.

- Desertification

  Many areas are turned into desert.

- El-Niño

  Occurrence of abnormal heavy rainfall in the tropics

- La Nina

  Occurrence of unusual drought as cold condition, in the equatorial and tropical area

- Melting of ice on mountains like Kilimanjaro
- Occurrence of acid rain in industrial areas like Ruhr region in German.
- Flooding from rising sea level
- Ozone layer depletion or destruction of News Zealand

CAUSES OF CLIMATE CHANGE

These changes in climate may be caused by the following

- Industrial activities
  The industries burn fossil fuels which emit greenhouse gases such as carbon dioxide. The burning fuels like diesel, petrol and firewood release dangerous gases and chemicals which destruct the ozone layer.
- Population explosion
  This cause's high concentration of people respires out carbon dioxide giving to a problem of green house effects. Also more people means more industrial goods are to be produced as a result is many industries which automatically produce green house gases
- Deforestation and land use change
  When people clear large tracks of forests and grasslands for farming, industrial or settlement they reduce the main disposal system for carbon dioxide from atmosphere by photosynthesis hence result in a buildup of excess carbon dioxide and other gases in the atmosphere. This will increase the temperatures of the lower atmosphere.
- Agricultural malpractices
  These include shifting cultivation, bush fires, overgrazing and over cropping which lead to the depletion of natural vegetation and thus disturbing the hydrological cycle. Burning vegetation adds carbon dioxide into the atmosphere.
- Transport machines
  The by-products of transport machines such as cars, airplanes, sea vessels emit the common green house gases (carbon dioxide and methane) contribute to the global ozone layer depletion and cause the global warming.

- Large volcanic eruptions
  They release a lot of ash and dust into the atmosphere. These may reduce the amount of solar energy reaching the earth thus causing cooling for few years. This results into the depletion of ozone layer because of pollutant gases.
- Increased solar radiation to the earth
  This is caused by complex interaction between the sun, the atmosphere, and the land surface and ice and water masses. The relationship between these bodies and the sun forms a complex natural control system that keeps the earth warm enough to sustain life as overheating is prevented.
- Ocean ability
  The ocean absorbs and emits carbon dioxide and heat exchange with atmosphere. The sea absorbs carbon dioxide from the atmosphere which is used by marine organisms and is active in cold regions.
  Also the sea absorbs heat from the atmosphere, where more heating of the ocean make marine organisms less active as a result lower the reduction of carbon dioxide from the atmosphere. This action leaves more chance for carbon dioxide to exist in the atmosphere.
- Nuclear and bombs testing
  During times of war, heavy weapons are used; such as bombs, shells, rockets and grenades are dropped or fired towards the enemy. They explode and produce chrolofluocarbons (CFCs) which causes climatic change since the gases tend to let in solar heat but prevent some surface heat from escaping out of the atmosphere resulting into the rise in temperature near the ground.

The overall effects of these climate changes are called GLOBAL WARMING. **Global warming** is the increase in the average temperature of the earth's atmosphere.

THE EFFECTS OF GLOBAL WARMING

- Occurrence of diseases like skin cancer and respiratory one
- Decrease in rainfall and increase in temperature
- Rise in sea level that is caused by ice melting at the poles and peaks of mountains
- Increased ultraviolet radiation which leads to
    - Increase sunburn
    - Rapid ageing and wrinkling of the skin
    - Increase eye diseases such as cataracts
    - Snow blindness
    - Increased cases of skin cancer
- Ozone layer depletion
- Occurrence of destructive winds, examples are tornadoes and typhoons
- Creation of acid rain which affects the quality of water for human consumption
- Disruption of natural ecosystem here some species of organisms would adopt to the new conditions while others would become extinct.
- It causes flooding from rising sea levels resulting from melting of ice hence add more water into oceanic basin.

- Shifting of climatic and vegetation zones due to some plant species to become extinct.
- Effects on agricultural crop growing areas because of poor soil result in a drop in crop yields.
- Abnormal fast growth of plant since carbon dioxide is a natural plant fertilizers
- City environments would become hotter. Increased carbon dioxide levels in the atmosphere would cause some cities to become unbearably hot. This means that those cities would become uninhabitable.

SOLUTIONS TO EFFECTS OF GLOBAL WARMING

- To use alternative sources of power and energy such as solar energy.
- To control rapid population growth through family planning programmes.
- To practice friendly agricultural practices like proper density farming as per the capacity of environment and use proper irrigation procedures.
- To provide mass education on environmental conservation methods such as destocking, planting trees and reducing the use of fossils.
- To use organic manure instead of using organic fertilizers (chemical fertilizers).
- Recycling materials to reduce waste emission.
- To adopt afforestation and forest conservation policies in order to increase the earth's capacity to produce oxygen to replace the damaged ozone layer.
- To control bushfires
- To reduce the use of atomic bombs and nuclear testing.
- To establish international regulations to control human activities that contributes to climatic change.
- To create organizations to promote anti-climate activities

CHAPTER SIX
MAP WORK

A map is a scaled representation the earth's surface on a flat material for example a piece of paper, wall, clothes and a piece of wood.

A map refers to a flat sheet of paper on which is printed a representation of a part of the Earth's surface drawn to scale.

Map reading is the process of examining the given topographical map, conventional symbols and signs Map interpretation is the process of examining a given topographical map of an area represented for the purpose of identifying the geographical information of an area.

Cartography is a science of making and drawing maps

A cartographer is a person who creates or makes maps.

TYPES OF MAPS

There are two types of maps

- Topographical maps
- Statistical maps

TOPOGRAPHICAL MAPS

The word topography is derived from a Greek word 'topographien' made up up of two words 'topos'- means "place" and 'graphien- means "describe".

Thus topographical maps refer to maps which explain or describe all physical features of a given area. OR

Refer to the map that shows the actual appearance of an area represented by giving out the general land contents of natural and artificial features.

CHARACTERISTICS OF TOPOGRAPHICAL MAPS

- They show both natural and artificial features about the area represented.

- They are drawn on either medium or large scale depending on the size of the area represented.
- They are more detailed as represent small part on large scale.
- They represent small or limited part of the country.

FUNCTIONS

- They are used to show geographical location of an area.
- They are used to show the general appearance of land and landforms such as mountains, hills and rivers
- They are used to show cultural or artificial features like roads, railways, settlement and other structures made by man.

IMPORTANCE OF TOPOGRAPHICAL MAPS

- They are used in describing features of the earth.
- They help in finding location of places by using direction.
- They help in finding distances to the given area.
- They are used in land planning on how to use it.
- They can be used to produce personal maps which may illustrate researches, projects and surveys.
- They can be used with other kind of maps such as cadastral maps which have their origins from topographical maps.
- They provide detailed information on the nature and distribution of an area.

DEMERITS OF TOPOGRAPHICAL MAPS

- They do not show the three dimensions of features. Size of features cannot be differentiated quantitatively and qualitatively.
- They do not show clear boundaries between the different features to indicate nature or distribution.

STATISTICAL MAPS

These are the geographical maps which show the distribution of a certain geographical phenomena in a quantitative manner. That is they show the distribution of phenomena of interest in geographical study like temperature, rainfall, cops, minerals, vegetation, pressure and other of related. Examples of statistical maps are isopleths maps, dot maps, chrolopleth maps ad flow line maps.

IMPORTANCE OF STATISTICAL MAPS

- They are useful in planning economic activities such as projects.
- They are useful for showing generalized information on large or small areas.
- They are used in describing the distribution of many things found on the earth's surface such as physical, political, historical or economic features.

COMPONENTS/ESSENTIALS OF A GOOD MAP

A map is good if it contains all the essentials of maps, therefore the essentials are good qualities of maps. The essentials of a good map are:

- Key/Legend/conversional signs.

Is used to interpret symbols and signs found on a map, they appear in a box at one of the bottom corner of the map. A key is important in order to make a map well defined; it becomes easier to interpret a map and get information from it.

- Title;

Used to show what's map is all about. This is the heading of the map. It can appear on top of the map in capital letters. Example MOROGORO: LAND TRANSPORT LAYOUT.

- Indication of North direction;

This is the sign which shows the north direction. Most modern maps are printed with north at top. The significance of it on a map is to enable the map users to recognize very easier the north direction and other important directions of the map like south, west, east etc. also it helps to make a determination of bearing of places, points and features on the map and upon the area represented on the earth's surface. The north direction on a map may be shown by using

- Grid reference
- True North or Geographical North
- Magnetic North
- Margin/framework;

This is a boundary or limit around the map. It gives or shows the reader and interpreter the end of the map.

- Publisher and date publication;

This shows when the map was produced and a publisher.

- Latitude and Longitude / Grid reference.

It used to locate the place on the map. For example the map of Tanzania is located at latitude 6°00' south of the equator and longitude 35°00' east of Greenwich meridian.

- A scale;

It shows the relationship between map distance and the actual ground distance for example 1cm to 10km means one centimeter on the map represents ten kilometers on the ground. It enables the users to understand the relationship of distance on the map to ground which then helps to understand the bigness of the area represented since the map is much smaller in size compared to the actual area represented which is much larger in size.

USES OR IMPORTANCE OF SCALES ON THE MAP

- Scale help to calculate area of a map
- It enables us to calculate distance on a map
- Scale shows the relationship between map distance and the actual ground distance
- Scale helps us to enlarge and reduce the area on a map or the whole map
- Scale can be used to calculate the vertical exaggeration on a map
- Scale is used to calculate the gradient on a map
- It is used in determining the size of the map to be constructed
- It controls the amount of details to appear on the map relatively to the scale size used.

- It is useful in understanding the relative size of the area mapped by considering the used scale size. For example if the used scale size is assessed large, it implies the area represented is smaller and the opposite is true.
- It controls the size f the conventional symbols, signs and abbreviations.
- It controls or determined the size of the ground to be mapped.
- Used to measure the areas of regular objects such as triangles and irregular objects such as pond.
- It is useful in making map projection such as Azimuth and gnomonic projection
- It affects the identification of objects on the map as the smaller the scale the more difficult it is to identify details.

LIMITATIONS OF MAPS IN GEOGRAPHY STUDY

- They take long time to prepare them
- They are selective. It is not possible for all details to appear on the map
- They represent false morphology of objects because features are represented by means of convectional signs and symbols
- They provide the distorted size of features because the features may not be maintained on constant scale
- They are so expensive and take long time to be produced
- They provide outdated information
- They need high skills to construct, read and interpret
- They do not give instance data

MAP SCALE

Is the relationship or ratio between map distance and actual ground distance on the earth's surface.

Mathematically

Scale=

=

WAYS USED TO EXPRESS MAP SCALE.

- Statement scale

  Refers to the scale which is expressed in terms of words or explanation, also it gives a relationship of distance between the map and the actual ground represented by being stated in words. For example one centimeter on a map is equivalent to 10 centimeters on the ground; In short can be expressed as 1cm to 10km.

  Where: map distance is one centimeter (1cm)

  Ground distance is 10 kilometers (10km)

Characteristics of statement scale

- It is expressed as word statement
- It bears specific units of measurement

- It is always having one unit of map measurement while that of ground may be one, or less than one or more than one

Merits

- It is simple to express

Demerits

- It is difficult for users who are not familiar with the unit of measurement used in the scale.

- ***Linear scale***

Also is called plain or graphic scale. This is a line which is divided into two parts.
The primary division and secondary division

The secondary are expressed in meters and placed on the left side from zero and primaries are expressed in kilometers and placed on the right side from zero.

- Representative fraction (RF) scale

  Is written as a fraction or ratio for example 1:50,000 or.

  Therefore, RF scale = map distance. The top number (numerator) represents the map distance on the ground and is usually more than 1. Scale conversion

To change statement to R.F scale

- 1cm represents 60km

Solution
1km=100000cm
60km= x
1:6000000
Therefore R.F scale = 1:6000000

- One centimeter represents 0.75km
- 1:25000 To convert into statement scale
  If 1km = 100000 cm
  ? = 25000 cm
  100000cm. x = 25000 cm x 1km
  X=
  X = 1/ 4 Thus, 1 cm represents 0.25

Characteristics

- It is neutral to metric and imperial scale since it does not show unit of measurement
- Always the numerator is reduced to one while the denominator is greater than one. For example 2:200000 should be written as = or 1:100000and not as 2:200000

TYPES OF SCALE

We can classify the scale according to the size in our criteria. There are three types of scales;

- Large scale.

They are used to present information on small areas for example a map of village buildings and farms. The map size involves all numbers less than 1:25000 i.e. 1:10000 and 1:5000.

Characteristics of large scale

- It has smaller numbers in the denominator.
- Covers a small area of land.
- ii) It shows features clearly.
- iii) It contains geographical details.

Uses of large scale on a map

- drawing of maps on small areas
- drawing of building and plots
- suitable for good land use plans
- shows many details of a small area

Demerits of large scale on a map

- difficult to represent large area
- very large piece of paper is needed to represent a small area of land

- **Medium scale.**

  They are used to represent medium details shown on the map. i.e. 1:125,000 and 1:100,000. It is larger than a small scale and smaller than a larger scale. Example of a map that can be drawn using medium scale is a map of a district, region, and city.

Characteristics of medium scale

- It shows medium details
- It has medium denominator among the given scale
- It covers medium area of land surface
- It covers medium area on a piece of paper
- It shows features clearly

Uses of medium scale

- Drawing of cities, towns, districts and regional maps
- Showing of medium areas on maps

- **Small scale.**

  They are used to present information that is long. This type of scale covers a big area with less detail, for example a map of a country, continent or world. May involve numbers between 1: 500,000 to 1: 1,000,000

  Characteristics of small scale

  - It has the largest denominator.
  - Contains a lot of geographical information.
  - It covers smaller area on a piece of paper or board.
  - It shows less detail and gives only a general picture of the area represented.
  - It does not show geographical features clearly.

Uses of small scale

- Showing a large areas
- Showing large features such as rivers, lakes, oceans and mountains on the map.

Weaknesses or demerits of small scale on map

- It is difficult to show all features and details on the map
- It shows only few details out of the large area represented on the map

- It is not easy to show small areas such as towns, villages and villages

THE SIGNS AND SYMBOLS

DEFINITION:
SIGNS: refer to word or marks which are used to represent objects represented on maps.
SYMBOLS: refer to marks or figures used to represent and define natural and artificial features on a map.

DIFFERENCES BETWEEN SIGNS AND SYMBOLS

- Symbols look like the natural and artificial features they represent where as signs are not usually like those objects they represent.
- Most of the symbols used in a map are pictorial whereas most signs are word or marks.

CHARACTERISTICS OF SYMBOLS AND SIGNS

- They should be easy to read.
- They should be easy to understand and interpret.
- They should be correctly and clearly shown on the map.

IMPORTANCE OF SYMBOLS AND SIGNS

- They enable comparisons.
- They reduce the number of items which would have required a lot of space to draw oe by one.
- They save time.
- They help to define and interpret features shown on a map.
- They give good visual impression.
- They simplify interpretation of a map if key is added.
- They are used to improve readability and appearance of the map.
- They act as language of map to provide geographical details of areas represented.

EXAMPLES OF SIGNS AND SYMBOLS

SIGNS	SYMBOLS
Ch- church	Mosque
Po- post office	Church
Mkt- market	Bridge
Sch- school	River
WH- water Hole	Forest
s- spring	Power line
disp- dispensary	Railway line
TC- trading center	Seasonal swamps
Hosp- hospital	Trigonometrically station
CN- cashew nuts	Contour lines
Agri- Agricultural	Sun
DO- District Office	All weather roads- bound surface
DC- District Commission	All weather roads- loose surface

M- Mission TV- Television Vet- Veterinary Qts- Quarters PP, PolP- Police Post T- Telephone Tech- Technical Dept- Department FR- Forest Reserve MoW- Ministry of works Sta, Stn- Station RH, Rho- Rest House Ow- Well, Water tank Mos- Mosque Met- Meteorological VRO- Veterinary Research Organization	Scrub Crater Lake mining Quarrying International boundaries Waterfalls r rapids Depression

QUANTITATIVE INFORMATION ON MAPS

DEFINITION

Quantitative information on maps refers to the studies which involve application of mathematical knowledge in determining measurement, magnitude, size, extent or amount of information from the maps.

This includes;

- Measuring the distance on the map and convert to the actual ground by using scale.
- Calculating areas of regular and irregular figures.
- Identifying the location of position on a map.
- Finding direction and bearing of objects on maps.

A) MEASURING DISTANCE ON THE MAP

Distance is the length of elongated features on the earth's surface such as road, railway, river etc.

How to measure distance

In order to obtain distance of any feature on the map, consideration should be made on whether the distance to be measured is straight or curved.

Straight distance

For all straight distances a ruler is used to obtain the distance (conventional distance) directly from the topographical map given. Conventional distance refers to the length measured on a map. It is also known as map distance. Then convert the conventional distance into actual distance (A.D) by considering map scale.

Curved distance

It becomes difficult to obtain curved distance of the features by the use of a ruler directly from the topographical map when the area is inclined like a road, a railway. In this case the following devices can be used:-

- **A pair of divider.**

A pair of divider is commonly used to measure short straight distance between two points.

PROCEDUCES

- Place the map flat on the table and locate the distance to be measured on the map.
- Mark the two end points using a pencil.
- Divide the elongated feature on the map into short straight length.
- Open your dividers and measure each short straight length along your routine.
- Do not twist the divider and then transfer as it is to the linear scale provided on the map shown to get the actual ground distance of each portion.
- Add up the measurements of portion to get the total distance.
- Add up the portions to get conventional distance then convert it into actual distance by considering map scale given.
  Example
  Determine the distance between the point A and B, map scale is 1:50,000

  Solution
  Length between AC=2.2cm
  CD=3cm
  DE=4cm
  EB=4.5cm
  Total distance is 13.7cm
  Convert into actual distance
  1cm=km
  13.7cm=x
  X=13.7cm×
  X=13.7×0.5km
  X=6.85km
- **A piece of a string or thread**

Procedures

- Identify the two end points on the graphical map using a pencil.
- Get thin, won elastic longer than the distance to be measured and mark one end of the string in ink.
- Place the marked end of the string on the starting point on the map and run the string along the line following the curves and bends.
- At the end points on the map, use ink to mark the point on the string.
- Place the string on the linear scale and read the distance.
- If the scale is in use is a R.R scale or a statement scale, place the string on the ruler to get the map distance and then calculate the actual distance using the scale given.

For example:
Measure the distance of railway line in km from point A to B

Scale: 1:50,000
Solution

A thread has 10.4cm length
Convert it into actual distance since the scale is R.F scale
1km=100,000cm
X=50,000cm
X=
X=km or 0.5km
Into statement, 1cm represent into 0.5km
Convert map distance into actual distance
1cm=0.5km
10.4cm=x
X=10.4×0.5km
X=5.2km

Caution: these two methods are both rather than clumsy and time consuming; that is pair of dividers and a thread. The thread method is subject to some errors, because the thread may stretch when straightened out to measure its length on the linear scale. When using dividers the marked parts are all treated as if they were straight, when they are really not, and in that way a distance may be more r less exaggerated thereby affecting the final result. The best method that is both easy and has lesser room for error is the paper edge method.

C.A piece of paper with straight edges

Procedures

- Locate the distance to be measured on the map. Use a pencil to mark the two end points.
- Mark and number a starting point on one end of the straight edge of the paper.
- Place the piece of the paper with the starting point on the paper against the marked starting point on the map.
- Hold the paper in place using the needle of a pair of dividers or an ordinary needle at the starting point until it covers a short straight portion.
- Hold the paper firmly in place and move the needle of the dividers to the new position which becomes the new point of the rotation.
- Repeat the procedure in (IV) until the whole distance is covered. Mark the end point on the edge of the paper.
- Place the straight edge at the paper on a linear scale and read the actual distance or calculate it using the given map scale.

For example:
The railway distance from station A to B was 20 cm, find ground distance in km if the scale used to construct a map is 1:50000
20 cm map distance
Scale distance=

Scale: 1:50000
If 1km = 100000 cm
? = 50,000 cm
100000x cm = 1km x 50,000 cm
100000x cm/ 100000 cm =50,000km/100,000
x= ½ km
1cm=0.5km
20cm=x
X=20×0.5km
X=10km
The ground distance of railway from station A to B is 10 km

MEASURING GROUND AREAS FROM A MAP/CALCULATE AREA OF REGULAR AND IRREGULAR
Area is the amount of space covered by a flat surface or a piece of land.
OR
Area is the extent of coverage of phenomenon expressed in square units of measurement.
OR
Area size refers to the bigness or smallness of an area on the earth's surface i.e. the bigness or smallness of earth's surface from topographical map consideration should be made whether the area is regular or not.
TYPES OF AREA SIZE
There are three types of area size

- Areas of regular polygons or shapes
- Areas of irregular polygons
- THE AREAS OF REGULAR SHAPE

Regular polygon is a figure which has all sides equal or numbers of sides are known and all size of interior angles is given.
These are areas with definite shapes such as squares; triangles etc. to calculate the area size of these figures apply the relevant mathematical formula depending on the shape of the figures given.
For examples

- Rectangular shape=length x width
- Triangles=½×base×heght
- Squares= side x side or length × length
- Circles=

- THE AREAS OF IRREGULAR SHAPE

These are areas with indefinite shapes such as lakes, farms; ponds dam, islands, forest
It is the irregular shape s that often poses problems when measuring areas on the maps, the following key points must be observed

- Area is stated in square units, for example square meters or square kilometers
- To work out area, we need such dimensions as length, breadth, radius, diameter and circumference
- When using grid squares to estimate areas, areas must always be calculated.

- Because the area size of irregular polygons can be done accurately by simple methods, there are three methods used to calculate areas of irregular shapes. These are;
    - The grid square method
    - Strip method
    - Geometrical method or composite method or division method

THE GRID SQUARE METHOD

It is also known as grid method.

In this method, the grid reference system is used. Grid lines form a system of squares which are used to calculate the areas. In a topographical map of scale 1: 50,000, the distance between two grid lines is 2cm. this convert to 1km. therefore, every grid square on a map 1:50,000 maps represents a ground area of $1km^2$.

It is useful to note that the grids on almost all East African maps are in metric units of 2cm grid, making 1km where printed squares are on 1: 50,000 maps

Look at the following diagram calculate the area covered by a forest in square km.

Scale is 1:50,000

Steps

- Work out the area of one grid square on the map. Given the scale of the map is 1:50,000. Convert it into statement scale.

1km=00,000cm

X=50,000cm

Km

Into statement scale, 1cm represents Km

Length of a grid square

1cm= Km

2cm=x

x=

x=1km

Area of one grid square= side × side

=1km×1km

Area of each one square is $1km^2$

- Determine the number of squares that the object occupies by:
    - Counting all complete or full squares of the grid lines. In the figure above, there are 2 complete squares. Put a tick in each complete square.
    - Counting all incomplete squares. In the figure there are 16 squares. Put a cross in each incomplete square.
    - Divide the half squares by 2 to get the full squares.
    - Add the results of (i) and (ii) to obtain the total full squares as:

Total full squares= full squares+
=2+
=2+8
=10

- Multiply the number of grid squares that the object occupies by the area of one grid square to get the total area in km^2 as:
  10squares×1km²
  10km²
  Therefore the total area covered by a forest reserve is 10km²

GEOMETRICAL METHOD OR COMPOSITE METHOD OR DIVISION METHOD

This method is suitable when a map has no grid reference system and also when tracing and graph papers are not provided. It converts an irregular shape from a map extract into a series of smaller regular shapes whose areas can be calculated by known formulas.

Procedures

- Identify the surface whose area is to be calculated on the map.
- Divide the area into regular shapes such as rectangles, squares or triangles.
- Calculate the area of each regular shape.
- Add up the areas of all the shapes to get the total area.
- Convert that total area into actual ground area with respect to the map scale given.

For example:

Calculate the area of a lake drawn below if a map scale is 1:100,000

Area of A is $(2.6\times1.8)\ cm^2=4.68\ cm^2$
B is $(2.2\times1.7)\ cm^2=3.74\ cm^2$
C is $(0.5\times1.8\times2.2)=1.98cm^2$
D is $(0.5\times3.5\times1.7)=2.975cm^2$
E is $(0.5\times1.0\times2.2)=1.1cm^2$

Total area is A+B+C+D+E
$=4.68\ cm^2+3.74\ cm^2+1.98cm^2+2.975cm^2+1.1cm^2$
$=14.475cm^2$

Actual area:

Convert map scale into statement scale.

1km=100000cm
=100000cm

=

=1km

Area is 1km×1km=1km^2

Thus actual ground area=total area×1km^2

= 14.475×1km^2

= 14.475km^2

In this method we have to note that the small regular shapes cannot coincide exactly with all lines of the irregular shape, which may have many small curves along the edges. Some of the lines of the regular shapes we draw will be inside and some will be outside the boundaries of the lines of the irregular shape. It is important to make sure that the small areas left inside the boundaries are very nearly equal to the areas left out. In this way small errors cancel each other out, this procedure is termed "give and take"

STRIP METHOD OR THE GRAPH PAPER METHOD

Procedures

- Identify the shape whose area is to be calculated on the map
- Trace the boundary of the shape onto a tracing paper and place the tracing paper over a graph paper having one cm square and attach it securely with drawing pins or transparent tape.

THE LOCATION OF POSITIONA OF A MAP

Definition

Position in a map work refers to a place where an object is situated on the earth's surface.

METHODS USED TO SHOW OR LOCATE POSITIONS OF A PLACE ON A MAP

The following are major methods used to show positions of a place on a map.

- Grid references.
- Place names.
- Bearing and compass direction.
- Latitude and longitude.

- **Place name.**

This is a simple and a traditional way of identifying places on maps. Once given a map and a name of a well known feature or place, one can easily locate the position of the feature or

place. Once the name of the famous place is known, it becomes easy to tell other places surrounding it. For example once you know the position of the Arusha international conference centre (AICC), it is easy to find your way around.
Also it involves referring to a nearby prominent landmark, such as a bridge, a river, a railway station, a plantation etc, we may also quote exactly distance from such obvious points. Such simple methods are informal and not very accurate. More accurate methods include using grid references, compass direction and bearings, and latitudes and longitudes.

- **Grid reference**

Grid reference refers to a network of horizontal vertical lines drawn on the face of map which they have no reality on the ground.
A grid system is an order of drawing horizontal and vertical lines n map by forming squares of the same sizes.
Eastings are the vertical lines of grid whose numbers increases towards the east from the south west corner.
Nothings are the horizontal lines of grid whose numbers increase towards the northwards from the south west corner.
Grid reference is the reading in a grid system which is given either in four, six or eight figures number.

Each grid line has two sets of numbers, the larger ones and the smaller ones example $^{99}08$; we normally use the larger ones for references. The smaller figure indicates the series of the grid lines. The larger numbers are two digits, starting from 00 to 99, the series changes example $^{98}97$, $^{98}98$, $^{98}99$, $^{98}00$, $^{98}01$ and so on. On the same map only the larger numbers are shown so as to make it easier to read.
According to the grid system, the position of any point on a map is given by its grid coordinates by spefify the easting grid line through or nearest to it followed by the northing grid line through or nearest to it. That is when giving position using a grid reference system we always start with EASTINGS followed by NORTHINGS- the grid reference be written as a number EASTINGNORTHING without commas or decimal points.
From the above, the points are located at the following grid references.

Point A

Easting- 690 and Nothings – 080

Point A is located at grid reference 690080

Point B

Easting -700 and nothings- 095

Point B is located at grid reference 700095

Point C

Easting – 715 and northing -095

Point C is located at grid reference 715095

On the map the difference between one grid value (the number shown against grid lines) and the next known as the grid interval which a unit grid is subdivided into ten equal parts to get the second, third or fourth digit for Easting or Northing. This makes on any one map the grid lines to be numbered at equal intervals.

TYPES OF GRID REFERENCE SYSEMS

There are three types of grid reference systems used as:

- Four figures grid reference
- Six figures grid reference
- Eight figures grid reference

THE FOUR FIGURES GRID REFERENCE

Examples are:

- 4024-where easting-40 and northing-24
- 2609-where eastin-26 and northing-09

THE SIX FIGURES GRID REFERENCE

Examples are:

- 285058- where easting-285 and northing-058
- 810167- where easting-810 and northing-167

THE EIGHT FIGURES GRID REFERENCE

Examples are:

- 39454006- where easting-3945 and northing-4006
- 14795612- where easting-1479 and northing-5612
- COMPASS DIRECTION OR BEARING

COMPASS DIRECTION

Direction refers to the line or course upon which something is facing, pointing or moving. Direction is stated from a known position towards a prominent feature, example the people went toward s the hill. This means that they went in the direction of the hill.

Compass is a magnetic instrument consisting of a magnetized needle mounted on a pivot so that it can turn freely while measuring direction of a place. The needle, when it comes to rest, always points to the north because it is the North direction of the Earth magnetic fields.

PARTS OF A COMPASS

A simple magnetic compass consists of four main parts as:

- Magnetic needle- this shows direction
- Base plate- this is the part that supports the compass.
- Orienting arrow- this shows the direction of the magnetic North
- Orienting line- these are used to line the compass needle up.

DIVISION OF COMPASS DIRECTION

The compass direction is divided into;

- THE CARDINAL POINTS

  These are the main compass directions which are marked by 90°. They are like NORTH (N), SOTH (S), EAST (E) and WEST (W). They are determined clockwise from North.

North

West east

South

- THE EIGHT POINTS

  The four cardinal points can further be divided into eight, as shown below:

North

North West north east

West east

Sw se

S

- THE SIXTEEN POINTS

The eight points of the compass can further be subdivided into 16 points as illustrated in the following diagram

N

NW NNW NNE

NE

WWN EEN

W E

WWS EES

SW SE

SSW S SSE

PROCEDURES F DETERMINING DIRECTION

- Identify the two points given on the map.
- Join the identified points with a straight line by using a ruler.
- Draw the cardinal points at a place of observer. It is the reference point.
- Then find the bearing of a point or object from the observer and convert them in reference to special angles given.

For example; determine the direction of point B from A in the following drawing:

N (0°)

B

W (270°) A E (90°)

S (180°)

Use a special angle to get the direction of the asked point as follows:

Bearing of point B from A is 270°+31°=301° this is equivalent to either 292.5° or 315° by determining the difference between them and take the direction of that bearing with the smallest difference as:

301°-292.5°=10.5° or 315°-301°=14°

It is approximately to 292.5° which is WNW. Thus point B is WEST NORTH WEST of point A.

TYPES OF NORTH

The direction can be further measured in relation to the sixteen points as NNNE, SSSW, and NNNW etc

Most map nowadays are drawn with the top facing North direction rather than in old days when any map that was drawn always had the top facing East. This system is known as ORIENTATION OF MAPS which was derived from the Latin word “orients” which means EAST and the word ORIENTATION refers to the relationship between the direction on the map and compass directions.

Therefore when using a map it is easy to tell the direction of a place because a user is already able to tell where north is facing.

North is geographically defined as a zero degree bearing. In geography there are three types of North

- True north
- Magnetic north
- Grid north

TRUE NORTH

- True North is the position on the global where all longitudes meet.
- It is the position of the geographical North Pole.
- It is the most useful geographical North shown on the map by the star headed line.
- It does not change over time because the North Pole position is constant.

MAGNETIC NORTH

Magnetic North is the position of the earth's magnetic North pole where the compass needle is pointed when the map was blushed.

It is based on the earth's magnetic field given by the line with half arrow head.

It is constantly changing slightly every year and the rate per annum is noted.

It is obtained when the needle of the compass is left to swing freely it comes to rest in a North-South position.

GRID NORTH

Grid north refers to the direction towards the North in those maps drawn to grid system

It is unpointed North line shown on the map which follows the system of easting grid lines.

It is always fixed, it does not move. What it was last year is what it is today.

It represents a line parallel with the North-South grid lines on the map.

A declination diagram

A declination diagram is a diagram which shows the direction of Magnetic, Grid and True North and the angle between them.

COMPASS BEARING

A bearing is the degree angle of the observation line connecting the points measured clockwise from the North.

The bearing shows the direction of a point by measuring its degrees with respect to another point using a protractor clockwise from the North.

The bearing can be represented in degrees (°), minutes (') and seconds ('') such as 112°50'36'' where 112°- degrees, 50'- minutes and 36'' –seconds.

There are 360° in the circle and the direction North begins at 000°clockwise, East-90°, south-180° and West-270°and finally North again with 360°. Its diagram is shown as follows.

Procedures of determining bearing

- Identify the points required
- Draw a straight pencil line joining the places A and B
- At point B draw a line parallel to the North-South line or compass direction sign that is given on a map.
- Using a protractor measure the angle A from North towards line AB clockwise.

Example; determine the bearing of point A from B

Thus the bearing of point A from point B is 300°

Types of bearing

a) Forward bearing

b) Backward bearing

- Forward bearing Is a bearing into a subject.

Procedures to calculate forward bearing

- Identify the two points.
- Join them with a straight lines
- Draw north direction on a second point.
- Measure the angle by using a protector. State the bearing in terms of degrees of the direction.
- Backward bearing. Is the opposite of forward bearing, it's taken from the object to the observer while forward bearing is taken from observer to the object.

How to determine the back bearing

- Find forward bearing.
- Mark the cardinal point north direction of the opposite point
- Find the bearing of the observer along the straight line principally to determine the back bearing = FB + OR – 180° BB= FB +180° if FB < 180° BB= FB -180° if FB >180°.

For example: The forward bearing (FB) of Tukuyu from Kyela is 45° , Back bearing (BB) will be; BB = FB + or – 180°. BB = 45° + 180° (FB added because it's not greater than 180°).
Therefore Back bearing is 225°

- **LATITUDES AND LONGITUDES**

These are imaginary lines drawn on a globe to enable easy location of places and time on the earth's surface.

LONGITUDES are angular distances East and West of prime meridian from the centre of the earth.

LATITUDES are angular distances North and South of the equator measured from the centre of the earth.

Latitudes and longitudes are called "angular distances" because they are constructed by measuring the angle between a reference plane (equatorial plane for latitudes and Greenwich plane for longitudes) and the lines joining a point on the surface of the earth to the centre of the earth. Then all locations on the surface of the earth sharing the value of such an angle are joined to form one longitude or latitude line.

APPLICATION IN DETERMINING POSITION

In determining location of a place on the map always state latitude first and N or S must be added, then longitudes follow while E or W must be added to it.

It is usual to write the degrees (°), minutes (') and seconds ('') in two figure groups such as write 17°04'09'' N rather than 17°4'9'' N.

Write the location of position of points A,B and C.

Solution

Location of point A

Latitude is 15°S and longitude is 20°W

Therefore A is located at 15°S20°W

Location of point B

Latitude is 15°N and longitude is 20°E

Therefore B is located at 15°N 20°E

Location of point C

Latitudes= 15°+7.5°

= 22.5°N

= 22°30'

Longitudes = 40°+10°

= 50°E

Therefore C is located at 22°30'N50°E

SHOWING RELIEF FEATURES ON MAPS

Definition

- Relief refers to the general outlook of the earth's surface.
- It is concerned with all matters concerning height and depth, flatness and steepness of slopes, forms of valley and hills.

METHODS OF REPRESENTING RELIEF

The earth is made up of lowland and highland landforms such as mountains, hills, spurs, escarpment, ridges, plateaus, valley, basins and plains.

There are various ways of representing relief features found on the map. These are like

- Spot height
- Trigonometrical point
- Hachure
- Bench mark
- Layer colouring
- Hill shading
- Conventional signs and symbols
- Form lines
- Contours
- Block diagram

SPOT HEIGTH OR SPOT ELEVATION

Spot height is a point drawn on a map with its exactly height above a known sea level

It is usually marked on a map by a dot or a small circle and numbered the exactly height of that landform beside it.

Example

- 5895

TRIGONOMETRICAL POINTS OR STATION

Trigonometrical point is a small triangle drawn on a map with exactly fixed height on a hill top, mountain peak and followed by the numbers of height of land above sea level.

For example

HACHURES

Hachure is small lines drawn on a map showing the direction and steepness of slopes. The steeper the slope the heavier the lines which are used and they are widely space at a gentle slope.

BENCH MARK (BM)

Benchmarks are height which has been accurately measured by ground or land surveyor then a brass plug or rod is set in concrete marked with heap of stones where it shows the heght. They are shown as 720BM or +720

LAYER COLOURING ORLAYER TINTING OR HYPOSOMETRIC METHOD

Layer colouring refers to the colouring of an area between two or more given heights above or below sea level. The common colours used for this purpose are the blue (water bodies), green (lowland), yellow (highland), brown (permanent ice), and red or pink (very high elevation).

HILL SHADING OR PLASTIC RELIEF

Hill shading is the method of showing relief in which some parts of the map are shaded to indicate the presence of hills as they would appear if a light were shining on them. Usually the slopes which face light are shaded lightly while those facing away are in shadow (hill top and valley bottoms are white, slopes shaded dark).

CONVENTIONAL SIGNS AND SYMBOLS

Are methods used by a cartographer to show relief features by symbols and signs which are interpreted by the key.

For example

FORM LINES

Form lines are dotted and unnumbered lines drawn on a map face joining points of approximately the same heights.

BLOCK DIAGRAM OR PHYSIOGRAPHIC DIAGRAM

Block diagram refers to a drawing in either one point or two points true perspective, giving a three dimensional impression of a landform in effect it is a sketch of a relief model. It reflects the actual appearance of the relief features on land surface.

CONTOURS

Are lines drawn on a map to join or connect all the points with the same height or altitude above the sea level. The map that show contour lines are called **contour maps.** In the modern maps the common unit of measurement which is used to quantify the contour lines is METRES (M). The lowest contour lines are found at sea level where the height is 0m.

CHARACTERISTICS OF CONTOUR LINES

- They never cross or touch each other because no one point can be at two different heights. But they merge to form a single contour line.
- They are closely spaced when representing steep slope features such as hills, mountains.
- They are widely space or far apart, when representing a gentle slope or lowland.
- They are drawn in a specific intervals on the map such as 100,200,300 etc. this interval is known as CONTOUR INTERVAL (C.I).
- They are numbered lines either on contour lines or in contour line system.
    - On contour line system is when the numbers are written on top of the contour lines as follows
    - In or within contour line system is when the numbers are written within the contour line as shown below
- They connect different points on the map with the same elevation or height above the sea level.
- They join around where there is a rounded landform like a hill and close or extend to the map edge.
- They form a V or U shaped pointing upward the highland and open downward the lowland where there is a valley.

- They form a V or U shaped pointing downward the lowland and open upward the highland where there is a spur.

APPLICATION OF CONTOURS IN SHOWING RELIEF

- HILL

A hill is a land that has moderate relief generally between 50m to 300m above the sea level.

- BASIN OR DEPRESSION

Is a part of the land surface that is lower than all the parts surround it.

- PASS OR DEFILE

A pass is an opening or passage that cuts through the mountain ranges.

- ESCARPMENT OR CUESTA

Refer to an area of highland with a very steep slope on one side and a gentle slope on the other side. The steep slope of an escarpment is called the SCARP SLOPE and the gentle slope is the DIP SLOPE.

- SADDLE AND COL
- A saddle is a wider land between two peaks of mountain ranges.
- A col is a narrow land between two peaks of mountain ranges.
- Hence a saddle is usually wider than a col.

- PLATEAUS

A plateau is upland area with steep slopes and a flat or fairly level surface.

IMPORTANCE OF THE USE OF MAPS

a) People use them to reach their directions
b) Maps are used to describe the features of the earth
c) Builders are maps to plan the best use of the land
d) Road constructors use maps to construct new roads
e) Maps are useful in military activities f)Maps are used in conducting various geographical researches