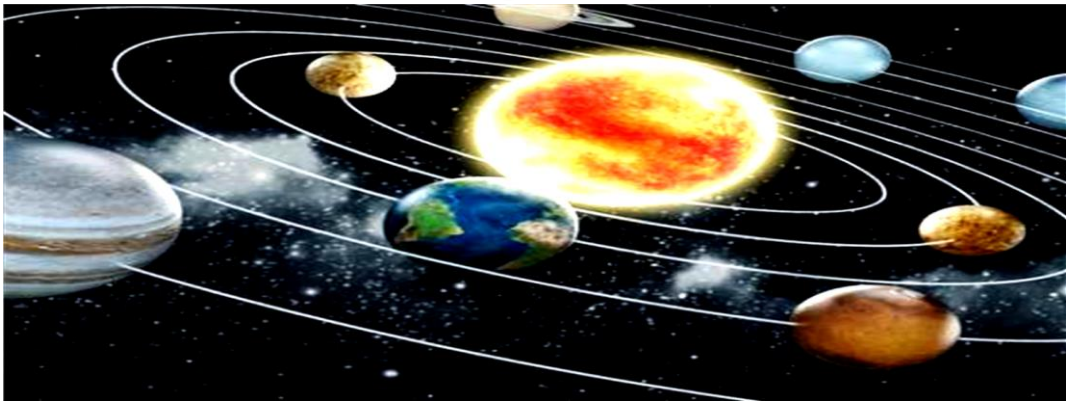
Procedure:

1. **Download a hard copy and copy notes in your note books.**
2. **Alternatively get a copy of this notes in text book prepared by teacher at school or @ ARISTOC BOOKLEX Kampala road, "Title; Understanding Fundamentals of Geography, senior One: New geography syllabus" by Emitu Henry.**

Understanding

Fundamentals Of

Geography



NEW O'LEVEL GEOGRAPHY

SYLLABUS 2020

Senior one.

TOPICS COVERED IN THIS BOOK:

- ✓ Introduction to Geography.
- ✓ Ways of studying Geography
- ✓ Map Reading & interpretation.
- ✓ Photograph interpretation.
- ✓ Field work.
- ✓ Statistics methods & presentation.
- ✓ Earth and its movements.
- ✓ Weather and Climate.

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- ✓ Location, Size & Relief regions of East Africa.
- ✓ Climate & Natural Vegetation of East Africa.

Topic Six : Weather and Climate Weather.

Key words	By the end of this chapter, you should be able to:
• Climate • Condensation • Dew point • Humidity • Isohels • Isohyets • Isonephs • Millibars • Okta • Precipitation • Sleet • Weather • Weather log	a) understand the difference between weather and climate. b) understand the main elements of weather and climate. c) understand how to record the main elements of weather. d) know how to plot weather on maps and the terms used for plotting. e) make some simple instruments for measuring and recording weather. f) read or use maps and graphs to describe weather and climate. g) know the names and characteristics of the main types of clouds and rainfall. h) appreciate that weather affects your day-to-day life and activities. i) appreciate the importance of recording weather for farmers and others.

How is Weather Different from Climate?

Weather reflects short-term condition of the atmosphere while climate is the average daily weather for an extended period of time at a certain location

Weather can change from minute to minute, hour to hour, day to day, and season to season.

Climate is average of weather over time and space.

The condition of the atmosphere is determined by the elements of weather.

Elements of Weather.

1. Temperature.
2. Humidity precipitation.
3. Precipitation.
4. Atmospheric pressure.
5. Wind.
6. Sunshine.
7. Cloud cover.

Study Figure 6.3 above and do the following:
1. identify the weather instrument shown in each picture.
2. Copy and fill in the table below.
3. For each instrument you have identified, write at least three sentences explaining how it is used to measure and record weather.
4. Present what you have written to the class.
5. What is the name of the place where all weather recoding instruments are kept and used?
A place where weather is measured and recoded is called a weather station.

A Weather Station.

Is a facility, either on land or sea with instruments and equipment for measuring atmospheric conditions.

A place where observation, measuring and recording of weather elements is done.

School weather station.

Factors to Be Taken Into Account When Setting a Weather Station.

1. An open place where there is little obstruction of weather elements.
2. Accessible place so that recording can be done easily.
3. A fairly level or gently sloping ground (5°) so that it's easy to position weather instruments.
4. The place should provide a wide view of the surrounding landscape and the sky.
5. The site should be free from flooding.
6. The place should have security.

Instruments for Measuring Elements of Weather.

1. Thermometer-temperature
2. Hygrometer-humidity
3. Rain gauge-rainfall
4. Barometer-air pressure
5. Sunshine recorder-sunshine duration and intensity
6. Wind vane –wind direction

7. Anemometer-wind speed
8. Evaporimeter-rate and amount of evaporation.

The Stevenson Screen.

A white wooden instrument shelter (box) mounted on 4 legs used to house thermometers and hygrometers. It is always installed facing north, to keep the sun from shinning directly on the thermometers and affecting the readings.

The screen is white to reflect the sunlight away and allow for ventilation, with the purpose of preventing sunshine from warming up the instruments.

The screen consists of a box, with sides ventilated louvers, a ventilated floor and upper part and an air space.

It is installed 1.25m /4.1ft above the ground level.

Stevenson screen

The instruments which are found in it are:

1. Maximum thermometer
2. minimum thermometer
3. Six's thermometer
4. Hygrometer-wet bulb and dry bulb thermometer

Importance of a Stevenson screen.

1. Provide shade conditions for accurate temperature recording.

2. Ensure safety of thermometers because they are delicate.

Qualifications Which Make Stevenson Screen Suitable For Its Work

a) Painted white for little absorption of solar heat energy.

b) Made of wood which is a bad conductor of heat.

c) Well ventilated to allow easier flow of air inside it.

d) Raised to prevent contact with terrestrial radiation.

e) Has double roof which acts as an insulator to prevent direct heating from the sun.

f) Recording and Calculating Weather Conditions.

Precipitation and Temperature.

The two most important elements used to describe climate are **precipitation** and **temperature.**

The earth's surface receives moisture from the atmosphere in different forms. All forms of moisture falling from the atmosphere are called **precipitation.**

Precipitation / Rainfall.

It is defined as coalesced water droplets that fall under the influence of gravity. It occurs as a result of condensation of water vapour in the atmosphere.

The water droplets become heavy to be held up in the atmosphere and hence, they later on fall down to the ground under the influence of gravity.

In Uganda and the rest of East Africa, rainfall is the most common and Important form of precipitation received

Types of Precipitation.

<u>The forms of precipitation:</u>

How the earth's surface receives moisture.

1) **Snow** comprises of individual ice crystals that grow while suspended in the atmosphere – usually with clouds-and then fall, accumulating on the ground where they undergo other changes.

Consist of frozen crystalline water throughout its life cycle up to melting.

Solid precipitation formed when tiny water droplets freeze and form ice crystals.

The crystals may fuse to form flakes.

Snow (Ice flakes).

2. Sleet- a regionally vibrant form of precipitation.

- Ice pellets, pellets of ice composed of frozen raindrops or refrozen melted snowflakes.
- Rain and snow mixed, snow that partially melts as it fall.
- Precipitation which is a mixture of rain and snow.

Sleet (ice-pellets)

1. **Hail.**

Pellets of frozen rain which fall in showers from cumulonimbus clouds. 'rain and hail bounced on the tilled roof'

Roughly spherical lumps of ice formed when super cooled cloud droplets mould themselves around ice crystals before cooling. It destroys crops life and house roofs.

Hail

Dew- is water in form of droplets that appears on thin, exposed objects in the morning or evening due to condensation.

As exposed surface cools by radiating its heat, atmospheric moisture condenses at a rate greater than that at which it can evaporate resulting into formation of water droplets.

Dew-small droplets on fresh green grass.

5. Rain.

Precipitation consisting of water drops (droplets) condensed from water vapour in the atmosphere.

It is formed when tiny water droplets merge around particles of matter and become heavy and fall down to the earth.

Rain.

CONDENSATION:

Condensation-water collects as droplets on a cold surface when humid air is in contact with it.

The conversion of water vapour into tiny water droplets as cooling continues below dew point. The droplets join to form clouds.

"cloud is caused by condensation in the air"**.**

Causes Of Condensation.

1. Adiabatic cooling-cooling of moist air as it rises vertically.
2. Orographic cooling-cooling of moist air as it climbs a hill or mountain.
3. Frontal cooling-cooling of warm air mass when it blows towards a cold air mass.
4. Advection cooling-cooling as a result of moist air moving over a cool land or sea.

How Condensation Takes Place/Cloud Formation.

i) Moist air rises to the condensation level (altitude where temperature is below dew point.

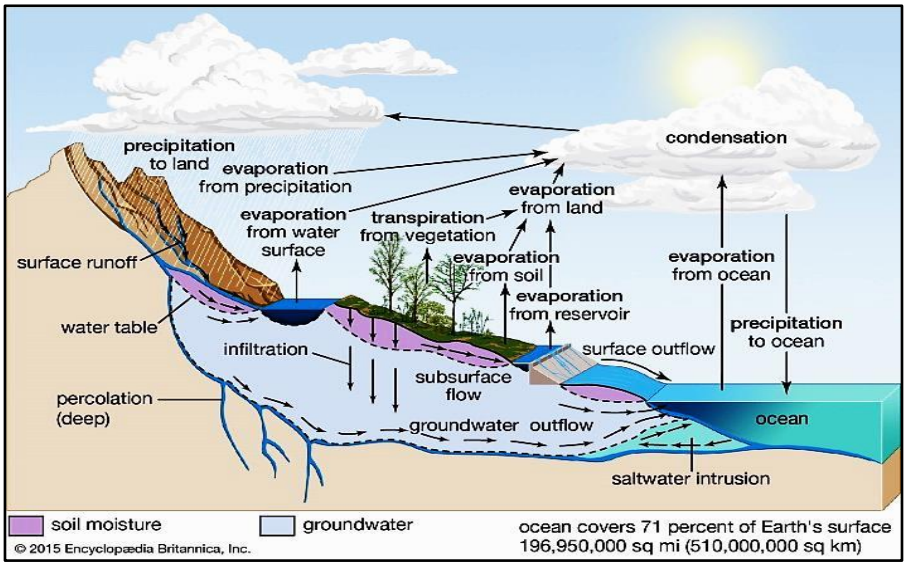
ii) It's cooled below dew point.

iii) Tiny water droplets condense around tiny particles such as dust, smoke particles and pollen grains and salt particles (condensation nuclei) in the atmosphere.

iv) The droplets merge and eventually become bigger and fall as rain at higher altitude. temperatures below freezing point due to lack of sufficient condensation nuclei.

v) Super cooled cloud droplets may mould themselves around ice crystals before freezing to form hail.

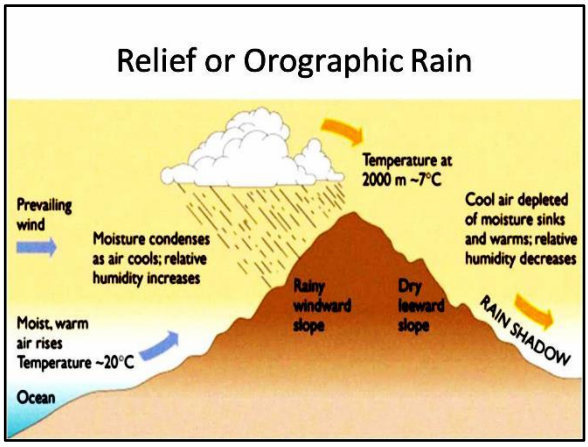
vi) If moisture rises to an altitude where temperature is below 0◦c the condensed water droplets freeze forming ice particles or super cooled water.



Water cycle: How condensation takes place.

TYPES OF RAINFALL.

1. Relief/Orographic/Mountain rainfall.

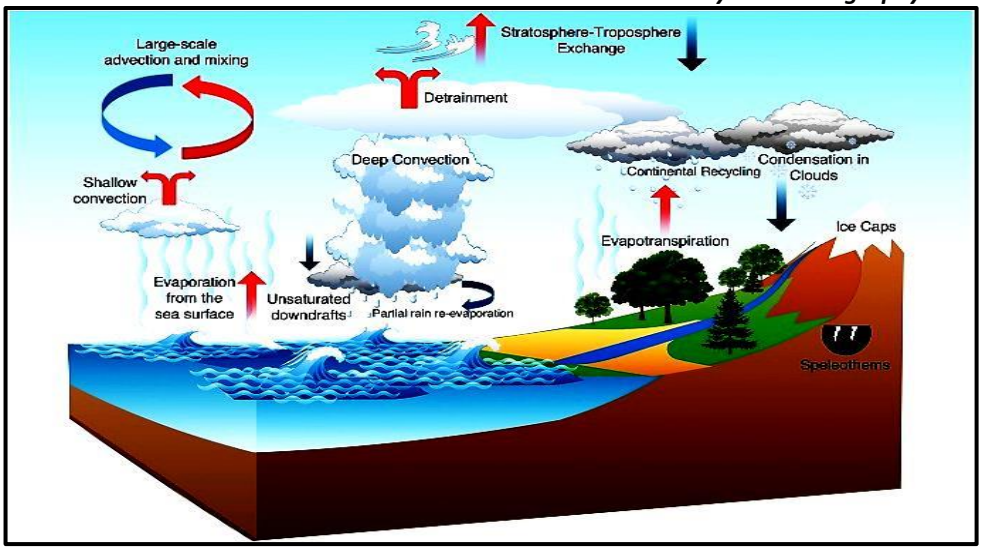


Rain experienced on the windward slopes of mountains or hills formed when moist air is forced to rise over a mountain or a hill.

How it Forms

- Moist air is forced to rise over a hill or mountain.
- The temperature and air pressure decreases making it to expand.
- Air cools due to decreased temperature and decreased pressure causing it to expand.
- Moisture condenses forming tiny water droplets (clouds).
- The tiny water droplets in clouds merge and become too heavy to be suspended in air and fall as rain.
- Air proceeds to the leeward side with low moisture content.
- Since its heavier due to being cool it descends over that side and gets warmed making it to hold onto the little moisture it had causing that side to receive low rainfall (rain shadow).

1. **Convectional Rainfall.**
   Type of rainfall common near large water bodies formed as a result of convective rising and cooling of moist air.



When the energy of sun heats the surface of the Earth, causing water to evaporate to form water vapour. When the land heats up, it warms the air above it.

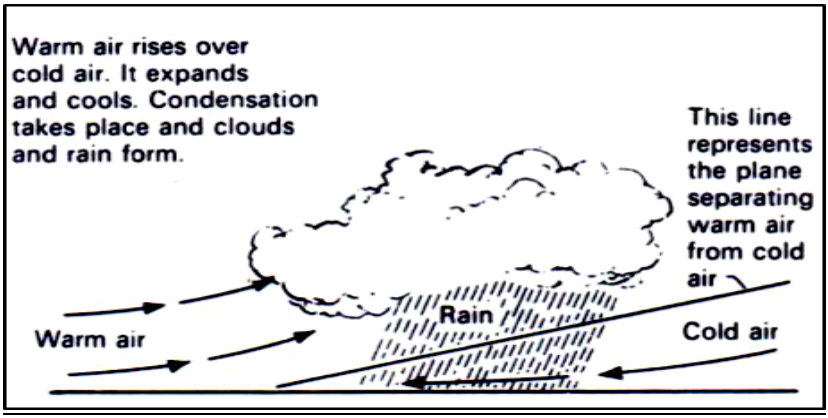
This causes the air to expand and rise it cools and condenses to form clouds with weight of water droplets can eventually lead to precipitation.

It's accompanied by thunderstorms.

How it forms

- Ground or water body is heated causing evaporation.
- There is convective rising and cooling of moist air.
- Condensation takes place forming tiny water droplets (clouds).
- The droplets merge and fall as rain.
- The cooled dry air descends to the surface where its heated and its capacity to hold moisture is increased.
- The process is repeated.

2. Frontal/Cyclonic Rainfall.



Rain caused by cyclonic activity and it occurs along the fronts of the cyclone. It is formed when two air masses of air of different temperature, humidity and density meets.

Type of rainfall common in mid-latitudes formed when warm air blows towards a cold area or when warm air mass meets with a cold air mass.

It's accompanied by cyclones (violent winds).

How it Forms

- Warm moist air mass meets with a cold air mass.
- The warm air is forced to rise as it's less dense.
- It cools as it rises at the line of contact with cold air.
- The moisture condenses forming clouds resulting in frontal rain.

Factors Influencing Types and Amounts of Rainfall.

1. Relief/Topography.

Relief features such as mountains and hills results in the rising and cooling of moist winds to form relief rainfall.

2. Aspect.

Windward slopes which are on the path of rain bearing winds receive heavier rainfall than leeward slopes which face away.

3. Forests and Water Bodies.

Areas near forests and large water bodies experience higher rainfall and more often due to high rate of evaporation.

4. Air pressure.

High pressure areas receive low rainfall than low pressure areas due to pushing of air masses from high pressure to low pressure. The high pressure areas have descending dry air.

5. Air masses.

When warm and cold air masses meet frontal rainfall is formed.

6. Ocean Currents.

It influences rainfall whereby coasts washed by warm ocean currents experience heavy rainfall when moist onshore winds are warmed by the current and made to hold on to moisture which they release on reaching the land.

The coasts washed by cold ocean currents on the other hand experience litle rainfall as a result of moist winds being cooled and moisture in them condensed resulting in rain falling over the ocean thereby bringing little or no rain to the coastal areas.

This is the cause of western margin deserts e.g. Kalahari and Namib deserts.

MIST AND FOG.

Mist and fog are a mass of tiny water droplets suspended in the lower layers of the atmosphere.

Fog is denser cloud that reaches the ground level, even if that "ground" is a hill or mountain.

A mist forms wherever water droplets are suspended in the air by temperature inversion, volcanic activity, or changes in humidity i.e. have more moisture.

Fog is denser than mist and tends to last longer.

Both hinder visibility although fog reduces visibility to less than a kilometer.

When fog mixes with smoke its called **smog**.

Smog .

Smog is a type of intense air pollution. Smog is common in industrial areas and remains in a familiar sight in cities today. Most of the smog we see is photochemical smog.

How They Form.

- Moist air cools below dew point.
- Condensation takes place.
- The resultant water droplets remain suspended in the air.

Types of Fog.

Fog is denser cloud that reaches the ground level.

1. Radiation Fog.

Type formed when moist air is cooled below dew point as a result of intense radiation on the ground at night.

1. Advection Fog.

Type formed when moist air from the sea moves horizontally over a cold surface e.g. snow covered ground.

2. Orographic/Hill/Upslope Fog.

Type formed when moist air is cooled after climbing a hill or mountain.

3. Evaporation Fog.

Type formed when water vapour is added to cold air that is already near saturation causing excess water vapour to condense and form fog.

4. Frontal Fog.

Type formed when warm moist air is cooled from below as it rises over a cold air mass.

5. Steam Fog.

Type formed when moist air passes over the surface of a much warmer fresh water body.

The warm water is cooled from above and condensing water vapour forms fog. It appears to be steaming.

6. Ice Fog.

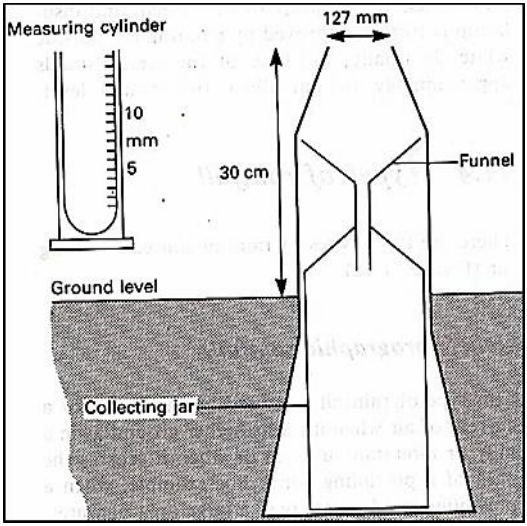
Type formed when water vapour is converted directly into ice crystals when temperatures are below freezing point.

Activity 6.7 (c): Rainfall and how it is measured
You are going to make a rain gauge which you will use to measure rainfall.
This is a short-term gauge so it is checked after each downpour.
Collect the materials listed below and follow the steps outlined to make the gauge.

How to measure and record rainfall.

Rain gauge is the instrument used to measure the amount of rainfall in a day.

It should be made of impermeable material which can't absorb water.



Rain gauge.

(see activity on NCDC prototype page 63)

How It's Used/Works.

- It's taken to an open space to prevent water from dropping into the funnel.
- Its sunk into the ground to prevent evaporation
- The funnel top is left 30cm above the ground to prevent splashes of water and run off.
- After 24 hours water is emptied into the measuring cylinder.
- The reading of the amount of rainfall is got from the measuring cylinder in millimeters.
- The figure represents the millimeters of water falling on each square millimeter of the ground.
- It could be used to measure snow fall by melting it before the readings are gotten.

MEASURING Rainfall.

- Water is removed from the collecting jar to the measuring cylinder.
- The amount is obtained by reading scale and measuring cylinder to obtain accurate measurements.

RECORDING Rainfall.

Daily total rainfall is obtained by daily collections and records.
Rainfall at the weather station is measured by using a rain gauge.
Rain gauge has the following components;

- A metal container
- A funnel
- A measuring cylinder (graduated in mm)
- A collecting jar.

Calculation involved for Rainfall.

1) **Monthly Total Rainfall**.

Is the Sum of the daily rainfall recorded for a full month

MTR = Total Rainfall for a month.

2) **Mean Monthly Rainfall.**

Sum of rainfall totals for a particular month over several years divided by the number of the years of observation.

$$= \frac{Total\ Monthly\ Rainfall}{no.\ of\ days\ in\ a\ month}$$

3) Annual Rainfall Total (ART)

is the (sum) total monthly for 12 months.

4) Mean annual rainfall.

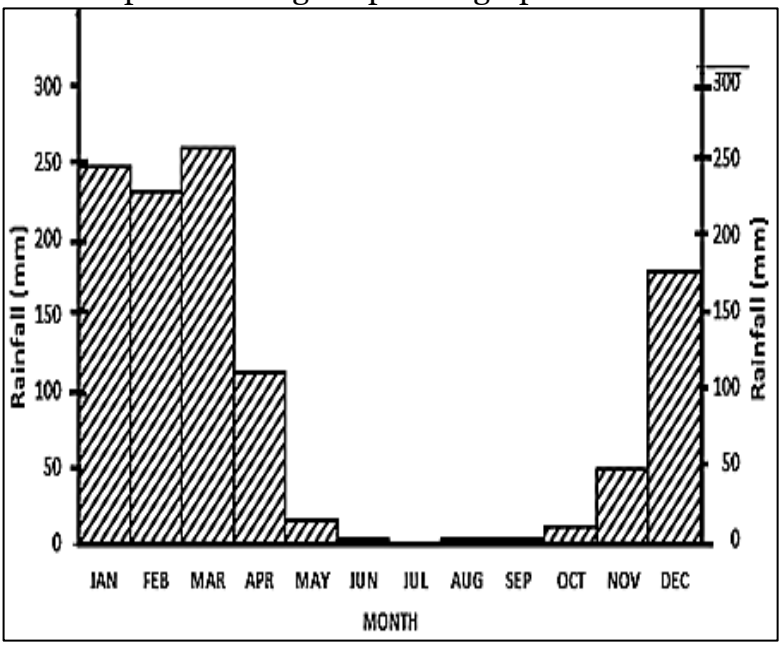
Is the sum of mean monthly rainfall for 12 months of the year.

$$MAT = \frac{Mean\ Monthly\ Rainfall}{12\ months}$$

Expressed in (mm).

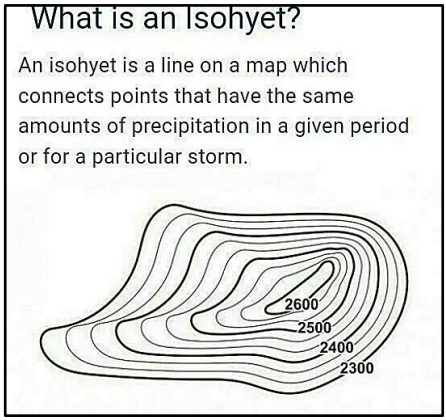
How is rainfall represented? On graphs:

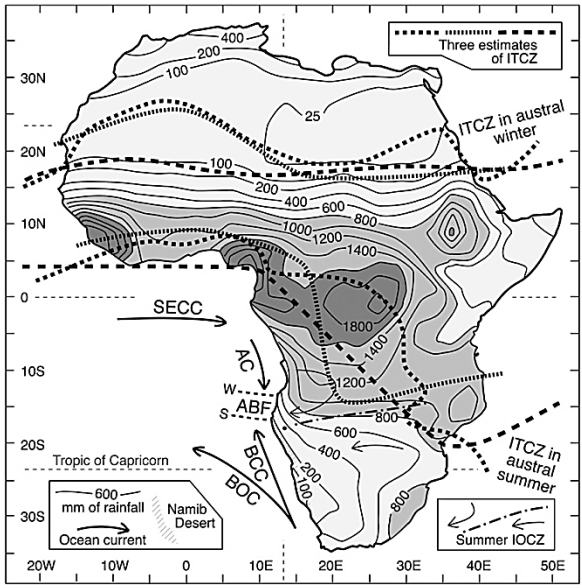
Rainfall is plotted using simple bar graph.



On maps and Isohyets.

Rainfall is plotted using lines called isohyets. These are lines on a map connecting points having the same amount of rainfall in a given period.





Isohyets for annual rainfall of Africa.

Temperature.

Is the degree of hotness or coldness of the atmosphere or a place on some chosen scale.

The amount of heat in the air is called air **temperature**. When you say the morning is cold or the afternoon is hot, you are actually talking about the temperature of the air surrounding you.

It is commonly expressed in Celsius (^oC) or Fahrenheit (^oF)

It's measured using 3 types of thermometers namely:

1. Maximum thermometer,

2. Minimum thermometer,

3. Six's thermometer.

Activity 6.7(b): Measuring temperature.

Work as a group to carry out this activity at school on a daily basis for a period of three months. You will have to keep a record of the weather elements at your school in your weather log for those three months.

1. Get a thermometer from the science laboratory.

2. Measure and record the lowest and highest temperatures of the day.

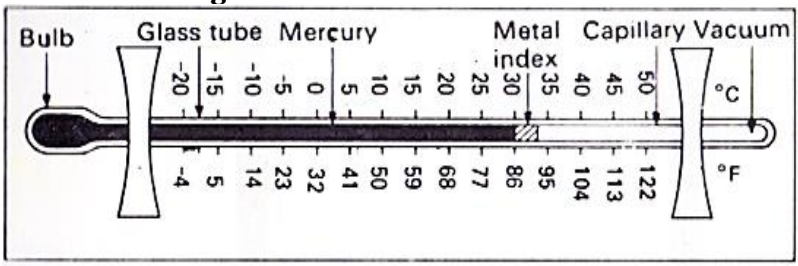
The lowest temperature should be measured between 6.00 a.m. and 7.00 a.m.

The highest temperature should be between 2.00 p.m. and 3.00 p.m.

a) Maximum Thermometer.

- Maximum thermometer can be used to record the hottest temperature of the day.
- Maximum thermometer has components like;
    a) A metal index suspended at the mercury end.
    b) A glass tube.
    c) A graduated scale marked in degrees centigrade and degrees Fahrenheit.
    d) A capillary space/vacuum.

A diagram of maximum thermometer.



How it works:

- When temperature raises, mercury expands
- The metal index is pushed along the glass tube and stops at a point of maximum temperature of the day.
- When temperature fall, mercury contracts. The metal index is left behind.
- Maximum temperature is obtained by reading the scale at the upper end of metal index

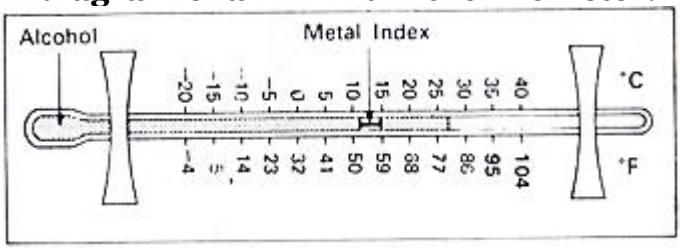
- Metal index is drawn back by using a magnet up to the position of the mercury
- The thermometer is reset.

b) Minimum thermometer.

It records the lowest temperature of the day. It has components like;

- a glass tube
- Alcohol
- A metal index (suspended within the alcohol)
- A capillary vacuum / space
- Graduated scale marked in degrees centigrade and degrees Fahrenheit

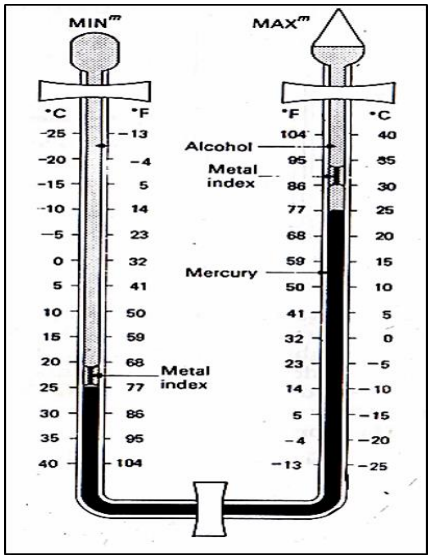
A diagram of a minimum thermometer.



How it works:

- When temperatures fall, alcohol contracts.
- The alcohol meniscus pulls the metal index along the glass tube
- The metal index stops at the point of the coolest temperature of the day.
- When temperatures raise, the alcohol above the metal index expands.
- The metal index doesn't move but remains at the position where it was pulled.
- Minimum temperature is obtained by recording the figure at the lowest position of the metal index.
- By raising the bulb of the thermometer, metal index is returned to the meniscus of the alcohol.
- The thermometer is then reset.

C) The six's thermometer.



Six's thermometer

It measures both maximum and minimum temperatures. It has components like;

- Alcohol
- Mercury
- Metal indices
- Glass tube
- Capillary vacuum
- Graduated scales.

Description.

This is U-shaped parallel tube made up of glass. One side registers the maximum temperature and the other side records minimum temperature. The bend at the bottom of the thermometer contains mercury which moves up or down based on expansion and contraction of alcohol.

<u>How it works.</u>

- When temperatures raise, the alcohol in the left hand limb expands.

- Alcohol pushes the mercury in the left hand limb as it raises in the right hand limb.
- The alcohol in the right hand limb vaporizes in the conical bulb where there is capillary space.
- The maximum temperature is read and recorded from the scale of the right hand limb on the upper position of the metal index
- When temperatures fall, alcohol contracts in the left hand limb.
- Some of the alcohol contracts in the left hand limb.
- Some of the alcohol vapour in the conical bulb liquifies.
- This forces the mercury to flow to the left hand limb.
- As it flows in the left hand limb it pushes the metal index up to the lowest temperature of the day.

How to Calculate Temperature.

1. <u>Diurnal /daily Temperature range</u>

Is the difference between the maximum and minimum temperature for any one day.

DTR= Hottest Temp−coolest Temp.

2. <u>Mean Daily Temperature.</u>

Average of the maximum and the minimum daily temperatures.

$$MDT = \frac{Max\ Temp + MinTemp}{2}$$

3. <u>Mean Monthly temperature.</u>

Sum of Mean Daily Temperatures (MDT) in a month divided by the number of days in that month.

$$MMT = \frac{Sum\ of\ MDT\ in\ a\ month}{No.of\ Days\ in\ a\ month}$$

4. <u>Mean Monthly minimum Temperature</u>.

Sum of daily minimum temperatures divided by the number of days in that month.

$$MMMT = \frac{Sum\ of\ DMinTemp}{No.of\ Days\ in\ Month}$$

1. **Mean Monthly Maximum Temperature.**

   Sum of daily maximum temperatures divided by the number of days in that month.

$$MMMaxTemp = \frac{Sum\ of\ DMax\ Temp}{No.of\ Day\ in\ Month}$$

6. Mean Annual Temperature. (MAT)

Sum of mean monthly temperatures divided by 12.

$$MAT = \frac{Sum\ of\ MeanMonthlyTemp}{12}$$

7. Mean Annual Temperature Range.

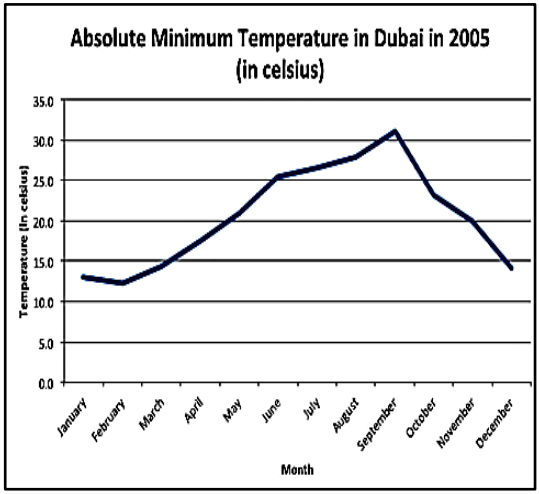
It is the difference between the highest and lowest mean monthly temperature in a year

OR

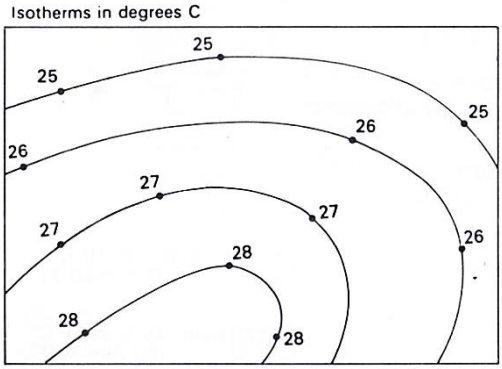
Is the difference between the highest and the lowest mean monthly temperatures in a year.

ATR = Hottest – coolest MMT

On graphs temperature is recorded by using a simple line graph.



On maps temperature is recorded by lines called isotherms.

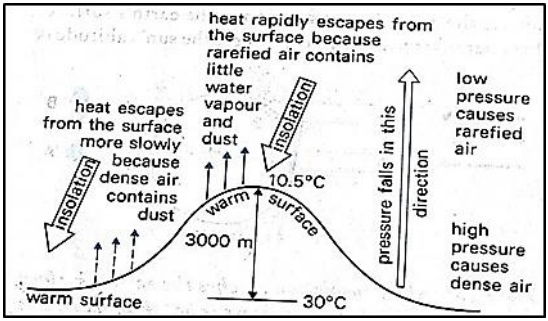


Factors that influence the temperature of a place.

1. Altitude;

Is the height above sea level of a location (elevation).

Temperature decreases with increase in height due to air at higher altitude being thinner and hence there is less particles e.g. gases, dust, smoke and water vapour to store heat so its rapidly lost to the outer space.



2. Latitude;

The distance from the equator.

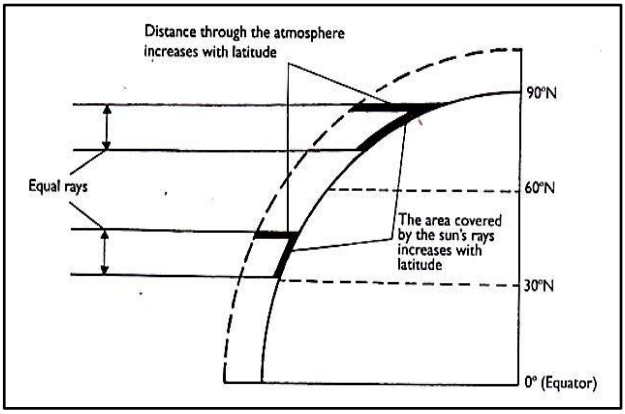
Temperature decreases with increase in latitude.

Places neat equator experience hot temperatures due to the rays of the sun travelling a shorter distance facing less interference from atmospheric conditions hence more solar energy reaches the earth's surface.

Also the rays of the sun strike the earth at right angles (perpendicular) hence solar energy is concentrated over a small area.

At higher latitudes (far away from equator) the rays of the sun travel a longer distance facing more interference from atmospheric conditions hence less solar energy reaches the earth's surface.

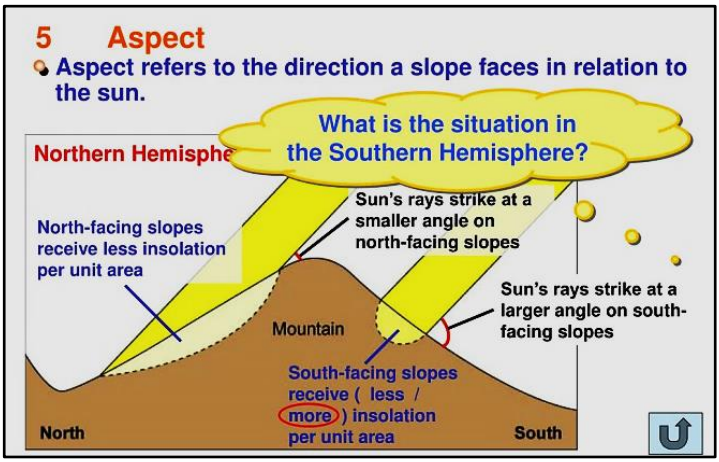
Also the rays of the sun strike the earth at an acute angle (about 60°C) hence solar energy is spread over a large area.



Influence of Latitude on Temperature during Equinox

3. Aspect - Direction of slope.

At higher latitudes slopes facing the equator have higher temperature because they face the sun while those facing the poles have lower temperature have lower temperature because they face away from the sun.



4. Winds - Transfer heat from one place to another.

When they blow from cool areas they take the cooling effect to the areas they blow over and when they blow from warm areas they take warming influence to the places they blow over.

5. Distance from a Large Water Body.

a) Specific heat of water is greater than on land. Areas near a large water body experience hotter temperatures than of land by $1^{o}C$,

b) The water surfaces reflects more of the sun's rays back into the atmosphere than does on land surface. Water takes longer to absorb solar energy than on land.

c) The transparent nature of water allows solar rays to penetrate to greater depths, so more heat is retained in water bodies.

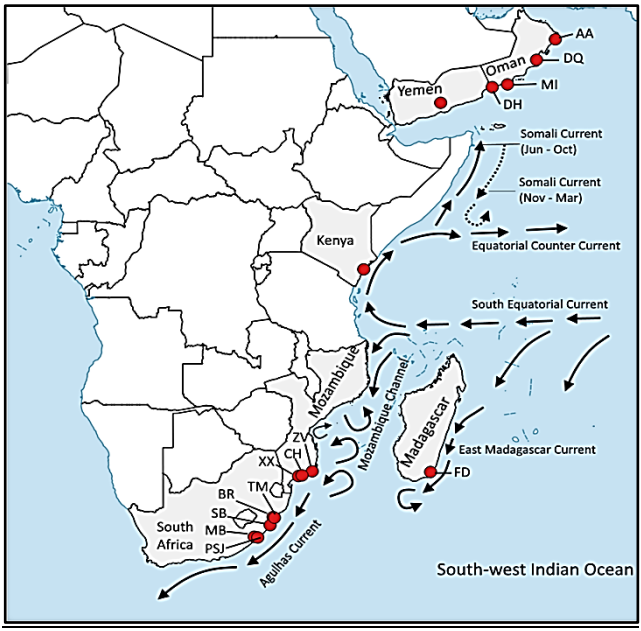
- Areas near the coast whose temperatures are greatly influenced by the sea are referred to as **Maritime or oceanic or insular.**
- Summer temperatures in coastal areas are lower than continental interiors (inland).
- While winter temperatures are hotter on coastal areas than in continental interiors if winds blow towards the shore.

Ocean currents:

Winds blowing over the ocean adopt the temperature of ocean currents and carry this influence to the nearby lands.

Winds passing over warm ocean currents carry warming effect on near land, and raising temperatures

When winds blow over Cold Ocean currents they carry cooling influence of the sea to nearby land.



Influence of ocean currents on Temperature at East African coast.

CLOUD COVER.

Clouds are defined as thick water droplets suspended in the atmosphere as a result of the condensation of water vapour when temperatures drop to the dew point.

Clouds in the atmosphere affect the weather conditions of a given place in the following ways:

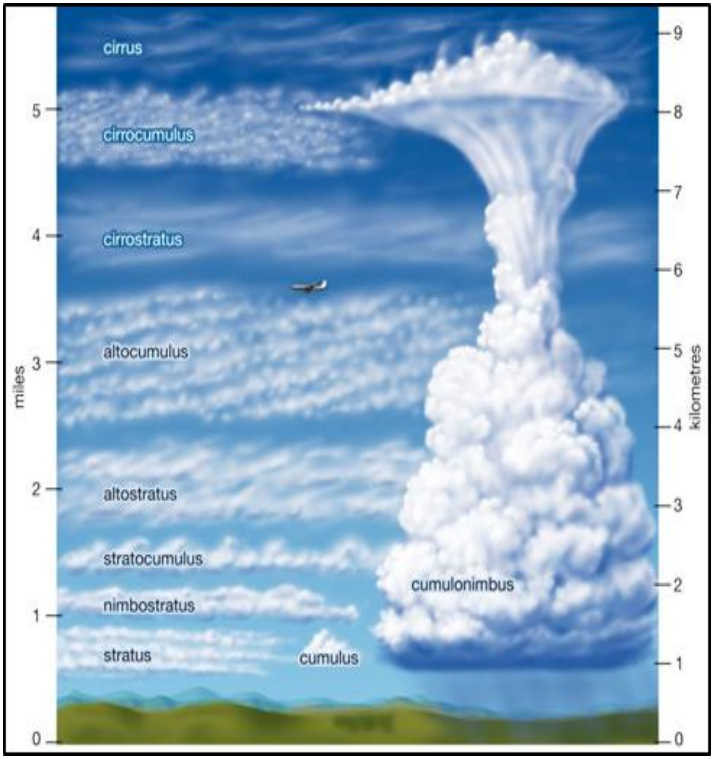
How Cloud are formed.

- Clouds are condensed tinny water droplets in the atmosphere.
- When air is cooled, some of its water vapour condenses to form clouds.
- The temperature and altitude at which the change takes place is called the **dew point temperature.**
- Clouds are made of water droplets or ice particles i.e. mist and fog forming low level clouds.
- The shape, height and movement of clouds can determine the type of weather in a specific place and time.

– The following symbols are used on weather maps to show the amount of cloud cover.

Cloud Amount (oktas)	Symbol	Cloud cover description
0	○	Clear sky
1	◴	One-eighth cover
2	◔	Two-eights cover
3	◔	Three-eighths cover
4	◑	Half of sky covered
5	◑	Five-eighths cover
6	◕	Three-quarters cover
7	◕	Seven-eighths cover
8	●	Complete cloud cover
	⊗	Sky obscured (fog)
	⊗	Missing/doubtful data

Oktas grid



Oktas in photograph.

Oktas is a unit of measurement used to describe the amount of cloud cover at any given location as a weather station.

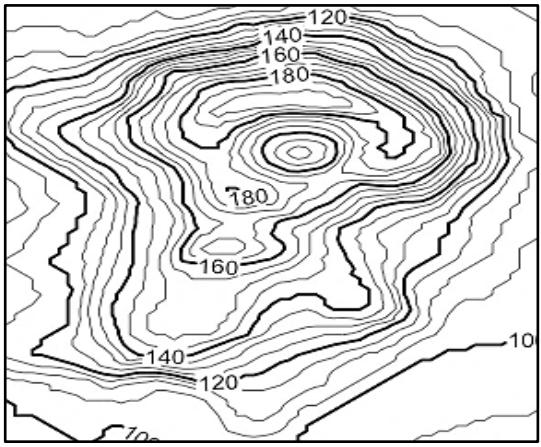
Sky conditions are estimated in terms of how many eights of the sky are covered in cloud, ranging from Zero (0) Oktas (completely clear sky) through to eight (8) Oktas (completely overcast)

The amount of cloud cover is observed using our eyes.

It's given in **Oktas grid.**

Oktas = approximately $\frac{1}{8}$ of sky is covered with clouds.

Lines drawn through all points on a map having the same amount of cloudiness. Or places with same amount of cloud cover are called ISONEPHS.



Activity:

Observation of clouds is equally important activity.

Student should be able to observe clouds at specific times.

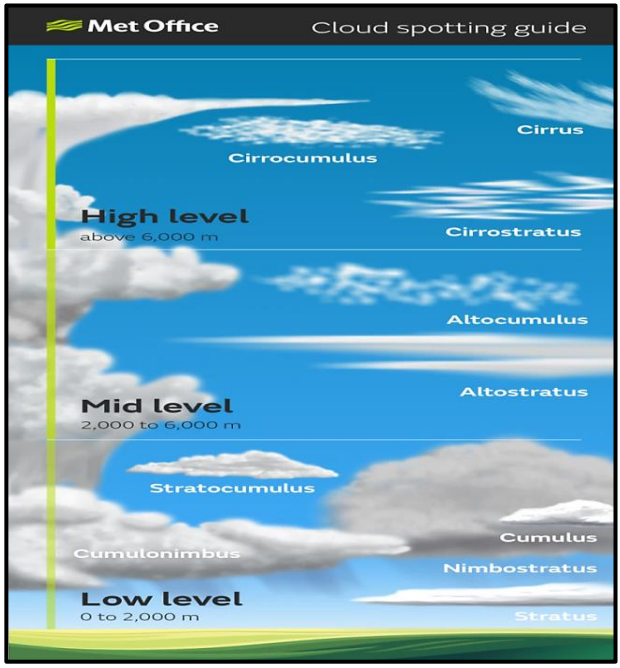
Learner should be able to identify different types of clouds; for example; cumulus, cumulonimbus, cirrus, stratus, etc. important to record the state of cloud clover in the sky i.e. sky is fully covered or scattered etc.

Three Cloud Forms.

2. **Cirroform**
   - These are high clouds existing between -25^{o}C and - 85^{o}C.
   - As a result, when near the horizon, their reflected light transverse a sufficient thickness of air to often cause them to take on a yellow or orange tint even during the midday period.
   - They are thin and wispy clouds composed of ice crystals.

Characteristics:

- They form in very cold air at high altitudes.
- Made up of ice crystals, they have a wispy or feathery appearance.
- Strong winds often blow streamers or "tails" off cirrus clouds.
- These features show the direction of wind in the upper troposphere. They are high-level-clouds; cirrus cirrostratus and cirrocumulus.



Types of clouds and Heights.

3. **Stratiform** -Appear as greyish sheets or blankets covering most of the sky and are rarely broken into units.

They range from 100m to 6km thick in the vertical, but can have a horizontal extent of 100km to 1000km.

- They are not vertically developed.
- Form in relatively stable condition, where lifted air will be restricted and instead be spread out horizontally.
- The cloud base may be quite low, if not actually touching the ground(fog).

Stratiform clouds cover large areas.

3. Cumuliform.

Cumulus clouds are clouds which have flat bases and are often described as "puffy", "cotton-like" in appearance.

- They are convective cloud with vertical development, formed by rising air currents in unstable air.
- These clouds are cauliflower-like in appearance with appreciable vertical development and dome-shaped upper surface.

- Cumuliform clouds are usually separate and distinct from each other. Are massive rounded with a flat base and limited horizontal extent and billow upwards to great heights.
- Cumuliform cloud bases range from 1,000 feet or less to above 10,000 feet.

Cumulus-clouds.

Basic Cloud Types.

a) **Stratus Clouds:**

Are low-level clouds characterized by horizontal layering with uniform base, as opposed to convective or cumuliform clouds that are formed by rising thermals.

b) **Nimbus Clouds:**

- Are clouds that already have rain or snow falling from it.
- Are dark and seen during a thunderstorm along with thunder and lightning.
- Are dark at the base and sometimes white at the sides and cause rain and thunderstorms.

c) **Cirro-cumulus:**

- Are made up of lots of small white clouds called cloudlets, usually grouped together at high levels.
- Composed almost entirely from white ice crystals.
- Are high-altitude tropospheric clouds, these other two being cirrus and cirrostratus. Occur at an altitude of 5km to 12kms.

d) **Nimbostratus:**

- A rain cloud which is multi-level, grey often dark, formless layer, nearly uniform cloud that usually produces rain, snow or sleet but no lightning or thunder.
- Medium-level clouds that occur at altitude 500-5500m (2000 – 18,00ft) and spreads over the sky in low uniform layers.
- It is associated with weather which will often bring precipitation which last several hours until the associated front passes over.

e) **Cumulus Clouds-**

- Are clouds with a flat horizontal base, massive, rounded and less horizontal extent.
- Usually indicate fair weather, similar to that they have some vertical development. Up to altitude 200-2000m, (2,000-7,000ft). low-level clouds.
- They can grow into cumulus congestus or even cumulonimbus clouds which can produce heavy rain, lightning, severe, hail and even tornadoes.

f) **Alto cumulus:**

- Is a middle-altitude cloud that belongs to mainly the stratocumuliform.
- Characterized by globular masses or rolls in layers or patches, the individual elements being larger and darker than those cirrocumulus and smaller than those stratocumulus.
- High clouds at altitude 2,000-7,000 m; (7,000-23,000ft) that is composed of ice crystals.
- Made up of droplets and appear as grey puffy masses. If they are seen in the morning, be prepared to see thunderstorms in the late afternoon, which indicate fair weather.

Effect of cloud cover on weather of a place.

- Clouds reduce the amount of solar energy reaching the surface by absorbing, scattering and reflecting solar radiation.

- When there are clear skies during the day the temperature is higher due to the earth receiving maximum solar insolation.
- During clear nights there are very low temperatures due to a lot of terrestrial radiation being lost to the outer space.
- Cloudy nights on the other hand are warmer due to clouds radiating to the earth heat absorbed during the day.

Cloudy Day influence on Temperature.

Cloudy night- influence on temperature.

SUNSHINE.

This refers to the amount of solar radiation received on the earth's surface in a specific place and a particular time.

Sunshine is measured by a sunshine recorder or a Campbell-stokes sunshine recorder.

This is a glass sphere which is partially surrounded by a metal frame on the inside of which there is a sensitized card.

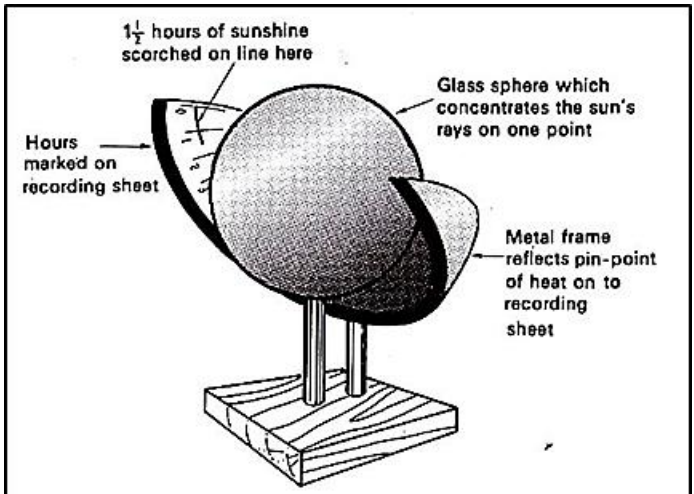


Diagram of Campbell-Stokes Sunshine Recorder

How It Works

- Spherical lens focuses light on sensitized paper.
- The paper burns when the sun is shining.
- The total hours of sunshine is got by adding all the burnt sections from calibrations on the side of sensitized paper.
- The sensitized paper is changed every day.

Factors that influence amount of solar radiation (sunshine)

a. **Length of Day.**

The longer the period of solar insolation during the day, the greater the quantity of solar radiation a place receives and hence the more the heat (temperature) that will be generated by the earth and vice versa.

b. **Solar Altitude.**

- At equinox when the earth is farthest from the sun the temperature on the earth is cool due to less solar radiation reaching the earth's surface due to travelling a longer distance and hence facing great interference from atmospheric conditions.
- At solstices the earth receives more solar energy due to travelling a shorter distance and hence facing less interference from atmospheric conditions.

c. **Solar Input.**

Sometimes the sun gives out more heat due to reactions being violent causing temperature on the earth to be higher. When it gives out less heat the temperature on the earth is lower.

d. **Surface Conditions.**

- Light surfaces e.g. smooth surfaces reflect sunlight and hence less solar energy reaches the earth's surface.
- Dark and irregular surfaces such as with vegetation absorb more heat leading to higher surface temperatures.

Atmospheric Humidity or Air Humidity.

Most of the time, the air around us is not dry. It contains some amount of Water in the form of an invisible gas.

This gaseous water or moisture is Called **water vapour**. The amount of water vapour held in air is called

Activity 6.9:
Proving that air contains water. Get a cold mirror or a piece of glass or if your classroom has glass windows, close the window and do the following:

1. **Breathe onto the mirror or glass. What do you notice? Have you seen anything coming out of your mouth? Do you see anything on the glass? What happens when you let the glass stay for some time?**
2. **Write down your observations and share what you have written with your friends.**

Humidity.

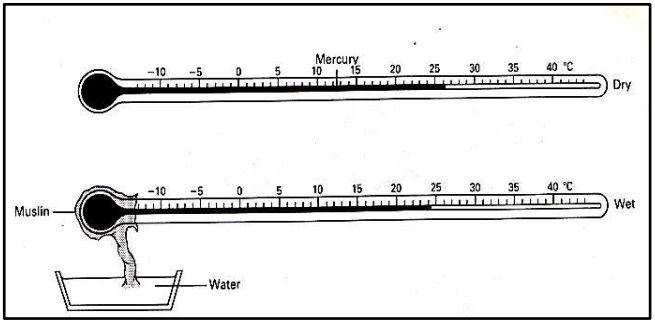
The water in air comes from different sources, such as from open water bodies and soil by evaporation and from vegetation and other plants by transpiration. Humidity influences the formation of clouds and precipitation.

How is humidity measured?

Humidity is the condition of atmosphere with reference to its water content.

It's measured with hygrometer or psychrometer which consists of wet and dry bulb thermometers kept in Stevenson screen.

Dry bulb thermometer is a thermometer covered with muslin bag immersed in water while dry bulb thermometer has no muslin.



Hygrometer.

How It Works

When air is dry there is a lot of evaporation from the muslin.

Evaporation cools the bulb of thermometer resulting in a low temperature reading.

When humidity is high there is little evaporation from the muslin.

The wet bulb thermometer is cooled at a slower rate and both thermometers show almost the same temperature reading.

The difference in readings between the two thermometers is used to determine relative humidity.

Interpretation of Hygrometer Readings.

• When the 2 readings are the same, relative humidity is 100% i.e. the air is saturated.

• If the difference is small, humidity is high.

• If the difference is big, humidity is very low.

Calculating Humidity.

Absolute Humidity.

Actual amount of water vapour a given volume of air can hold. It's expressed in g/m^3.

Specific Humidity.

Mass of water vapour in a given mass of air. It's expressed in g/km.

Relative Humidity.

Is the ratio between the absolute humidity and the maximum amount of water the air can hold expressed in a percentage.

$$\textbf{Relative Humidity} = \frac{\textbf{the amount of water vapour in the Air}}{\textbf{the amount ot water the air can hold at the same temperature}}$$

Example.

If the air at 20◦c contains 10g/m3 and given air can hold a maximum of 20g/m3.calculate the relative humidity.

10×100/20=50%

Factors that influence the Humidity of a place.

1. Temperature

• Places with high temperature experience high humidity due to high evaporation and air having high capacity to hold moisture.

• Places with low temperature have low humidity due to low evaporation and air having low capacity to hold moisture.

2. Source of Moisture.

- Areas near water bodies e.g. Kisumu and Mombasa experience high humidity due to evaporation of water from the water body.
- Places near thick vegetation also have high humidity due to evapo transpiration.
- Areas far away from water bodies such as the middle of deserts have low humidity.
- Areas receiving heavy rainfall also have high humidity.

3. Air Pressure

- There is high humidity at low altitudes because high pressure compresses air warming it increasing its capacity to hold moisture and also causes high evaporation.
- There is low pressure at high altitudes because air expands and cools thus reducing its capacity to hold moisture.

4. Latitude.

- Low latitudes experience high humidity due to high temperatures resulting into high rates of evaporation and air having high capacity to hold moisture.

- High latitudes experience low humidity due to low temperatures resulting into low rates of evaporation and air having low capacity to hold moisture.

Significance of Humidity/Moisture.

1. Affects rain formation in such as way that places with high humidity are likely to experience higher rainfall than those with low humidity.

2. Regulates the heat loss from the earth's surface by absorbing terrestrial radiation (process in which the earth gives off heat into the atmosphere).

3. It affects sensible temperature in that the higher the humidity the more we experience sensible temperature.

Wind.

It is defined as moving air or air in motion. Air usually moves in a definite direction and is therefore referred to as a wind system.

Winds often blow from regions of high pressure to regions of low pressure determined by temperature differences.

Winds are either local or global. **Global winds** are generally referred to as Air masses and they have great influence on the climate of extensive areas while.

Local winds have micro climatic influence. Winds may also be referred to as breezes when they are light.

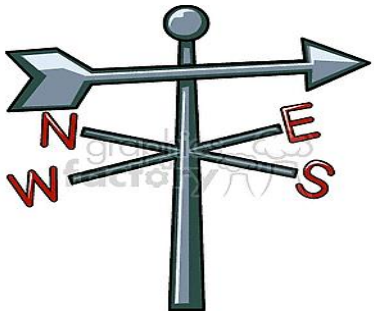
MEASURING AND RECORDING WIND.

How to determine the wind direction.

Wind direction is measured by using **a wind wave.**

Is an instrument which shows the direction from which the wind is blowing. It consists of a rotating arm pivoted on a vertical shaft.

The arrow of the wind vane always points in the direction from which the wind blows. The wind is named after its direction. The diagram of the wind vane shows that the wind direction is North-East wind.



Wind vane

How It Works.

• As the wind blows the arrow swings.

• The arrow points in the opposite direction of the wind flow.

• The direction is read from the cardinal compass points.

• The arrow will point in the direction from which the wind is blowing.

• For instance if it points S the wind is blowing from S towards N.

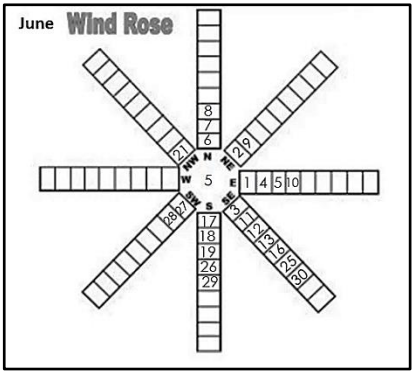
(a) **<u>A wind rose.</u>**

– Wind direction is measured by using a **wind rose.**

– The main purpose of a wind rose is to record wind direction for a specific place.

– It consists of an octagon, each side of which represents a cardinal point.

- Rectangles are drawn on each side and each day when there is a wind, a line is ruled across the rectangle representing the direction from which the wind is blowing.
- This is done for one month.
- The number of days when there is no wind is recorded in the circle in the centre of the octagon.
- For example if five days went without wind, figure 5 is recorded in the centre of the octagon.



(b) **<u>Wind Sock.</u>**

- Wind direction can also be determined by an instrument called **A wind sock**.

A wind sock is a sack of material that is sown into the shape of a tube.

- The tube material is cut to form a taper when stitched together. This taper effect allows the wind sock to float in the air due to the pressure causes inside.
- The tunneling effect of the wind through the tapered "sock" causes lift and makes the wind sock stick out showing the wind direction.
- The angle of the wind sock from the ground determines the strength of the wind.
- Used to indicate the general direction of wind flow.

- Not kept in a weather station because it doesn't give the accurate direction of wind flow.
- Seen near airstrips for the benefit of pilots.

How it works.

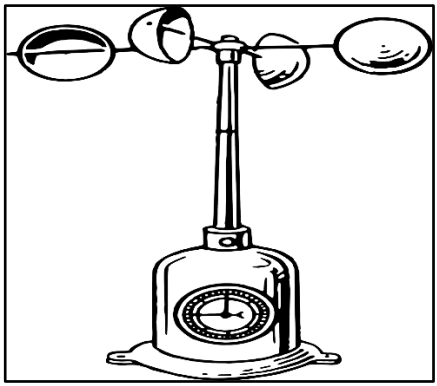
When it is bent low, the wind speed and strength is low. When it is high and straight and almost round, the wind energy is high or strong. However, this only works when there is wind to blow through the sock.

Wind sock.

Wind speed/Velocity.

The speed of the wind is measured by an instrument called the **anemometer.** The instrument has three or four horizontal arms pivoted on a shaft. Metal cups are fixed to the ends of the arms so that they rotate in case there is wind.

The movement operates a meter which records the speed of wind in kilo metres per hour.



Anemometer-wind speed in weather station.

How It Works.

When wind blows hemispherical cups rotate.

The number of rotations is obtained from the metre on the lower part of the anemometer.

The units for measuring wind are called **knots.**

Atmospheric or Air Pressure.

It is the weight (force) of the air exerted per unit area on the earth's surface. It is mathematically expressed as:

$$\textbf{Pressure} = \frac{\textbf{Force}}{\textbf{Area}}$$

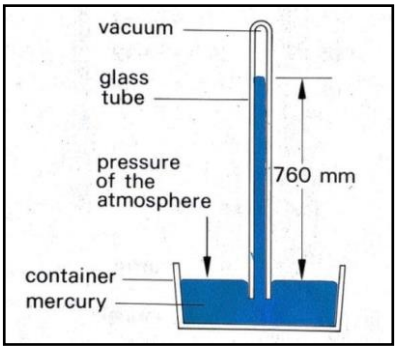
The weight of air is the vertical column exerted from the upper limit of the atmosphere to the earth's surface which is approximately 1.034kg/cm^3 over the sea level.

It is measured and recorded in units known as **Millibars**.

However, the average pressure or weight of the air on the earth's surface is measured in **Millibars per unit area**.

Atmospheric pressure is measured using a mercury barometer or an aneroid barometer.

A **mercury barometer** consists of a glass tube which is inverted over a bowl of mercury. The glass tube is marked in millimeters as illustrated below:



Mercury Barometer

How It Works.

- Air exerts pressure on the mercury in the beaker.
- The height of mercury in the tube is proportional to the atmospheric pressure.
- The readings are taken in mmHg.
- Its 760mmHg at sea level.

Aneroid Barometer.

An **aneroid barometer** comprises of a small metal container with most of the air driven out to form a vacuum.

Since there's practically no pressure at all inside the box, any increase in pressure on the outside of the box will cause the lid to move inwards hence registering high pressure by the indicator on the revolving dial.

When there's a decrease in pressure, the lid springs outwards registering or recording (indicating) low pressure by the indicator on the revolving dial.

Pressure varies from one place to another and from time to time.

Aneroid Barometer.

How It Works

- Has air tight compartment (vacuum).
- Compartment expands when pressure decreases.
- It collapses when pressure increases.
- The movement is transmitted by lever to a pointer on a dial.
- The readings are in kg/cm^3.

Factors Influencing Atmospheric Pressure.

Altitude.

Pressure decreases with increase in altitude because the column of air becomes shorter hence it exerts less weight.

Temperature;

When air is heated it expands and exerts pressure over a large area resulting in reduced pressure.

When it's cooled it contracts and exerts pressure over a small area resulting in increased pressure.

Rotation of the earth.

Rotation pushes air masses from poles towards the equator causing air to spread out and occupy more space causing it to expand making pressure to decrease.

When air from the equator moves towards the poles it occupies less space causing it to contract resulting into high pressure.

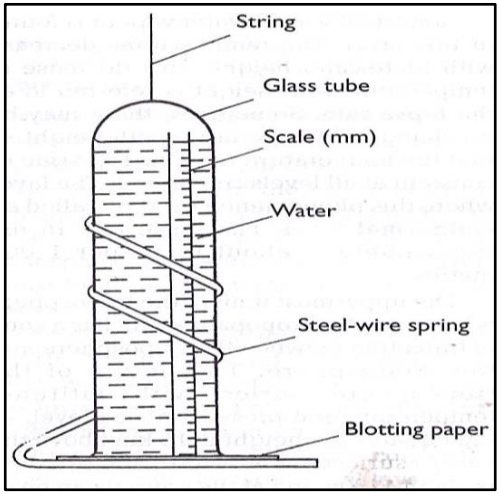
Evaporation.

Evaporimeters are the apparatus used to measure the rate and the amount of evaporation. There are two types of evaporimeters, namely, Piche and tank evaporimeters

Piche Evaporimeter, consists of a glass tube filled with water. The open side of the tube is covered with a blotting paper which is slightly fixed to the tube by means of steel-wire spring.

The tube is inverted and then suspended by means of a string. The blotting paper absorbs water from the glass tube, evaporation starts to take place particularly when there is a lot of sunshine.

The level of the water in the glass tube subsequently starts to go down. By looking at the scale on the outside of glass tube, the rate and the amount of evaporation can be determined in millimeters.

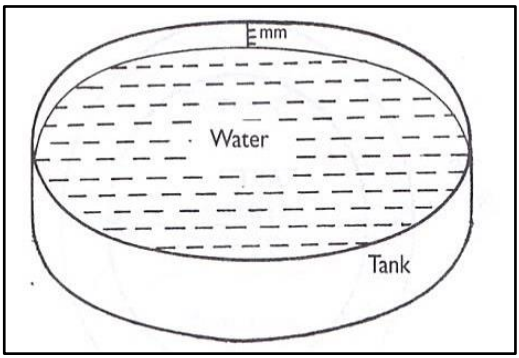


A piche evaporimeter.

Tank Evaporimeter – is another instrument used to measure the rate and amount of evaporation. It is by exposing water in a fairly large and

shallow tank in the open air. Water evaporates when there is a lot of sunshine. The falling level of the water can be measured at intervals.

The rate and amount of evaporation is got from calibrations in the inner side of the tank in mm.



Tank evaporimeter.

Weather Forecasting.

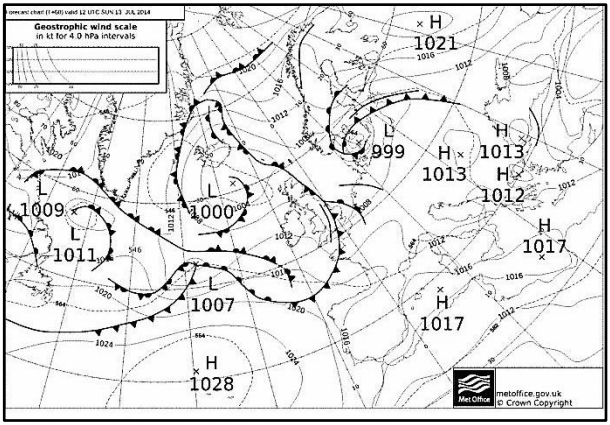
Prediction of the conditions of the atmosphere for a given place for a certain period.

Methods of Weather Forecasting.

Is the prediction of the state of atmosphere in particular a region over a period of 24 to 48 hours. Weather stations worldwide are used to collect information concerning weather.

A country distributes weather stations all over the country to gather weather information. (Name towns with weather stations in your country)

Analysis of data is done and charts and are drawn indicating weather conditions in the various parts of the country using charts called **Synoptic charts.**

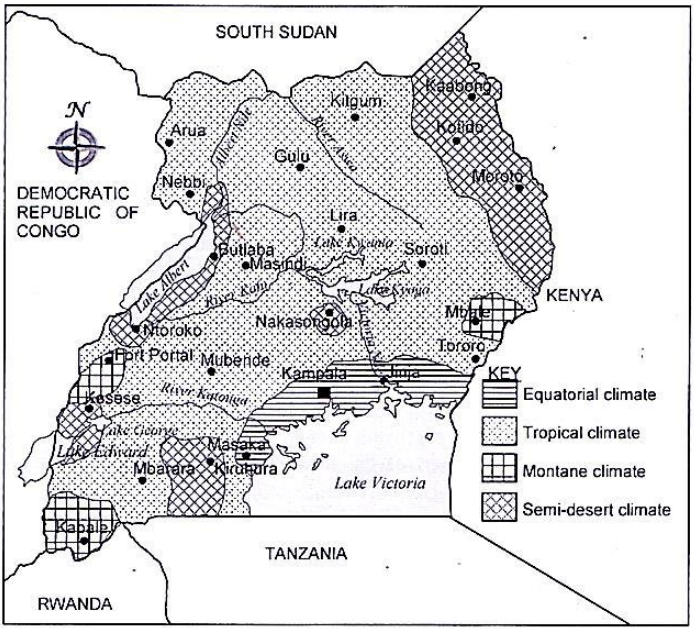


Example of Synoptic chart.

A Synoptic weather map.

Shows weather patterns over a large area by putting together many weather reports from different locations all taken at the same moment in time.

SKETCHMAP OF UGANDA SHOWING CLIMATIC REGION



Synoptic weather map.

In order to predict expected weather conditions, certain weather elements must be observed. These elements include; wind direction, atmospheric pressure, temperature, rainfall, cloud cover etc.

Pressure and temperature are registered from the ground level to roughly 12km above the ground by an instrument called **Radiosonde**

- The instrument is fixed in a balloon which is released into the atmosphere every day at particular time, from different weather stations.
- The radiosonde transmits signals to the ground station where they are interpreted. The signals give readings for pressure and temperature at different altitudes.

- Today, weather forecasting has been made easier **by use of satellites**.
- They move round the earth transmitting photographs on weather conditions on a daily basis.
- These photographs show the cloud systems. The movement of the clouds can be predicted from an analysis of the movement of winds for a period 24 hours.
- Satellites also transition formation on the movement of cyclones and possible path that they will follow over the oceans.
- Computers-electronic device used to store, analyse and display weather information.

Radiosondes (weather ballons).

Traditional methods of weather forecasting based on traditional beliefs and facts.

- Plants shedding leaves indicates period of drought.
- Safari ants indicate it will rain.
- Migration of butterflies also indicates it will rain.
- Croaking of frogs during dry season indicate it's going to rain.
- Flowering of certain plants indicates the onset of rainfall.
- Changes in the intensity of sunshine indicate it's going to rain.

Effects of Weather on your Life and that of your Community.

Weather forecasting is very important because we can adjust our daily activities if we know in earlier the weather condition expected. Most

countries inform their people over telecast, broadcast on the following conditions

Weather forecasting is very important to various groups of people in the following areas:

Significance/Importance of Weather Forecasting.

1. Helps us to be aware of natural calamities related to weather before they occur so as to take precautionary measures.

2. Guiding tourists' activities such as visiting national game parks.

3. Helps farmers to plan their activities in their farming calendars as planting, harvesting, etc.

4. It is important at major international airports and harbors. Aviation weather forecasting for aircraft take-offs and landing. This information is relayed to the pilot as the aircraft is approaching an airport. Water transport is carried out safely with help of weather information at port.

5. Weather forecast information is important to sporting people to plan their training and competition schedules.

6. Helps people to plan many other activities such as mining, electricity generation, holiday events, etc.

7. Military personnel need this information to plan their military training activities.

8. Helps fishermen / communities to plan their to carry out fishing activities.

9. Helps the urban people on the type of dress appropriately, plan their activities of the day like sports, movement schedules etc.

Factors Hindering Weather Forecasting.

1. Inadequate skilled labour due to brain drain and under training on use of modern facilities.

2. Shortage of modern equipment leading to wrong forecasts.

3. Natural calamities such as storms and earthquakes.
4. Extreme weather conditions which may damage or displace instruments.
5. Use of faulty instruments.
6. Human error.
7. Poor sitting of instruments.

Air Masses.

Distinct large parcels of air moving in one direction

Originate from areas of uniform weather and topography from where they derive their characteristics e.g. flat areas, forests, deserts, and snow covered areas.

Characteristics of Air Masses.

• A large volume of air.

• Covers an extensive area.

• Has uniform temperature and humidity.

• Distinct from the surrounding air.

• Retains its characteristics when it moves away.

Types of air Masses.

1. **Equatorial Air Mass;**
   - Originate from equatorial oceans.
   - It's hot and unstable.

2. Sub-tropical Air Mass.
   - Forms near sub-tropical high pressure belt.

3. Polar Air Mass.
   - Forms near the poles or temperate low pressure zone.
   - It's cool.

4. Arctic and Antarctic air Masses

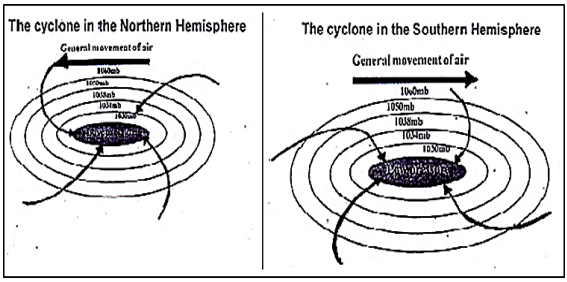
- Forms over the ice sheets of Greenland and Antarctica respectively.

Effect of air masses on Weather.

- When warm moist air mass and cool air mass meet cyclonic rainfall is formed e.g. tropical maritime and polar maritime.
- Cool air masses take cooling effect to the areas they move to e.g. polar continental.
- If they are warm they take warming influence to the area they move to e.g. tropical continental.

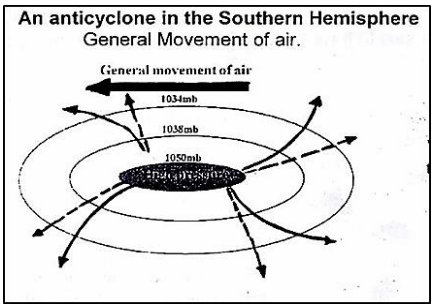
Pressure Systems in the World.

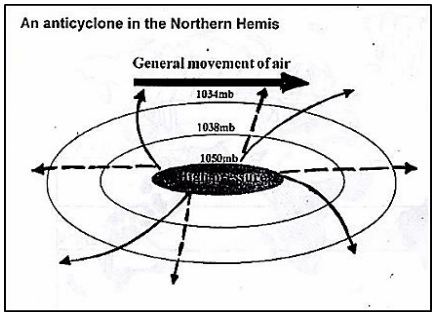
1. Cyclone.



- It's a low pressure system characterized by low pressure at the centre and increases outwards.
- Starts in areas where air ascends from the ground to the atmosphere and descends at high altitude.
- It's of two types. Tropical cyclones e.g. hurricane, typhoon and willy willies and depressions which are characterized by temperate latitudes.
- The movement of wind is anticlockwise in the N. hemisphere and clockwise in the S. hemisphere.

2. Anticyclone





- A high pressure system characterized by high pressure at the centre and decreases outwards.
  - It starts in areas where air is descending from the atmosphere onto the ground and then blows outwards on the ground.
  - The movement of wind is clockwise in the Northern hemisphere and anticlockwise in the S. hemisphere.

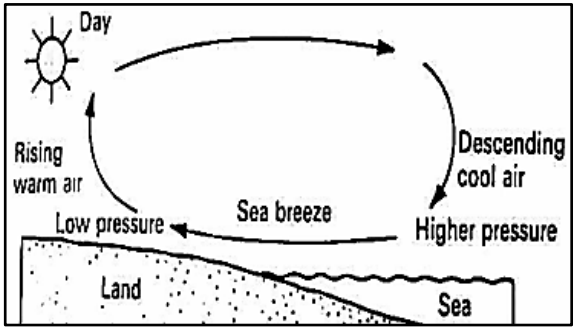
Local Winds.

Which occur regularly for a short period of time affecting a limited area.

Modify the weather of the area they blow to.

1. Sea Breeze.

A light and gentle wind which blows from the sea to the adjacent land.

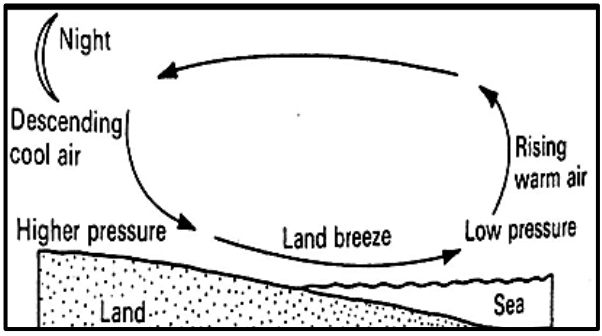


How it Forms.

- During the day land is heated faster than the sea.
- Air over the land is warmed and rises.
- Air from the sea moves to the land to replace the rising air.
- The rising air from the land cools and descends over the sea at high altitude.
- Circulation continues until the pressure difference is reversed at night.
- Its effect on weather is that, it takes cooling on land in a hot afternoon.

2. <u>Land Breeze.</u>

A light and gentle wind which blows from land to the sea during the night.



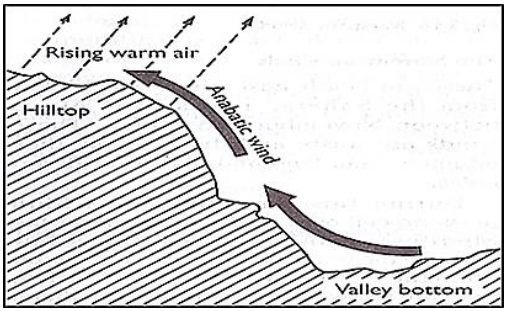
How it Forms.

- At night land loses heat faster than the sea.
- Air over the sea is warmed and rises.
- Air from the land moves to the sea to replace the rising air.
- Rising air from the sea descends over land at high altitude.
- Circulation continues until pressure difference is reversed during the day.

Effects on weather.

It causes early morning showers through moisture brought towards land at high altitude.

3. Anabatic winds (Valley Breeze).



Cool local winds which blow from the valley to the hill tops during summer afternoons.

How it Forms.

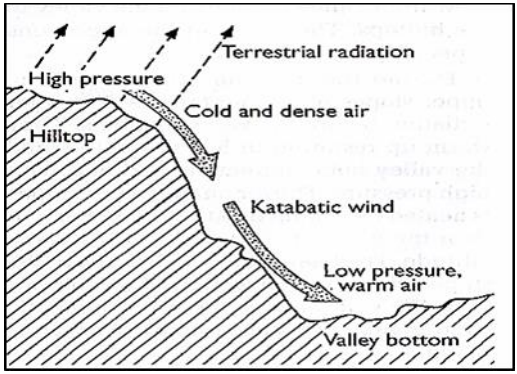
- During the day hill tops are heated more than valley bottoms.
- Air over the hill tops is warmed and rises.
- Cool air over the valley move up to the hill to replace the rising air.

Effect on weather.

Causes afternoon showers on hilly grounds.

4. Katabatic/Descending Winds

- Cold local winds which blow from hill tops to the valley during the night.
- During the night hill tops lose heat faster than the valley.
- Air over the valley is warmed and rises.
- Cool air over the hill tops move to the valley by gravity to replace the rising air.



Effects on Weather.

It takes chilly conditions on valley bottoms.

5. <u>Harmattan Winds.</u>

Northeast winds which originate from Sahara and blow across West Africa between November and March taking dry conditions there.

6. <u>Fohn Winds (Alps)</u>

Local cold winds which slide down the leeward side of the mountain at high speed and are warmed producing a temperature rise.

Due to the high speed and temperature they are associated with wild fires.

They are known as Chinook in Rocky Mountains, Santa Anas in California and Mistral in France.

<u>Factors Influencing Wind Flow (Speed and Direction).</u>

1. Pressure Gradient.

If the pressure difference between high and low pressure areas is high the winds blow at high speed (strong) but if it's low they blow at high speed (are gentle).

2. Distance between Places of High and Low Pressure.

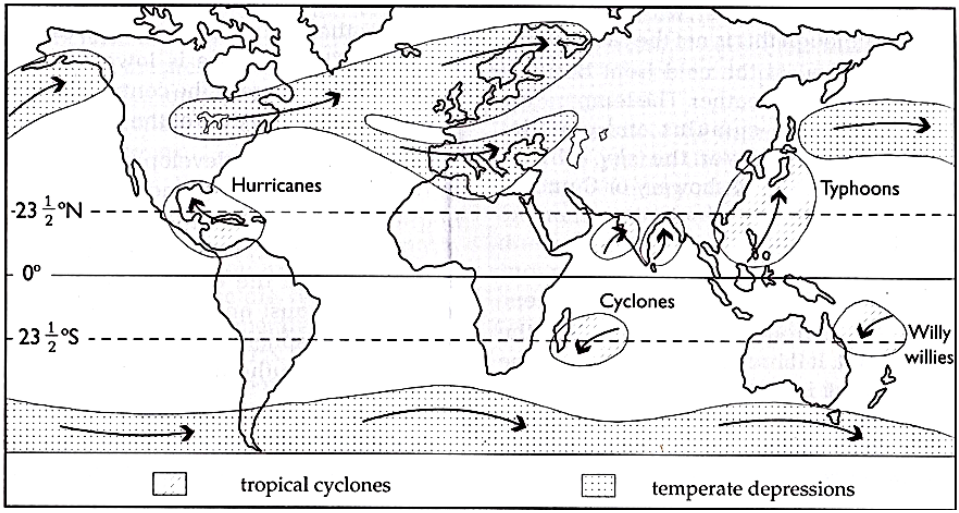
if the high and low pressure areas are near each other winds blow at high speed but if distant from each other winds blow at low speed.

3. Rotation of the earth.

Rotation of the earth deflects winds to the right in the N. hemisphere and to the left in the S. hemisphere.

4. Frictional Force.

If the surface of the earth is rugged or has obstacles such as hills, mountains, valleys or vegetation the wind is blocked causing speed reduction and its direction of flow is also changed..



A map showing a path of depressions and tropical cyclones.

Chapter Summary;

In this chapter, you have learnt:

1. that weather is the condition of the air around us at a certain time and it is described using its elements.
2. that weather changes in a short time, while climate takes long to change.
3. how to measure and record different elements of weather.
4. that precipitation and temperature are the most important elements of weather used to describe the climate of our country.
5. that weather affects our day-to-day activities and general way of life.