THE REPUBLIC OF UGANDA

Ministry of Education and Sports

HOME-STUDY LEARNING

SENIOR 6

PHYSICAL GEOGRAPHY

August 2020

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

UGANDA NATIONAL EXAMINATIONS BOARD

Published 2020

ISBN: 978-9970-00-189-7

This material has been developed as a home-study intervention for schools during the lockdown caused by the COVID-19 pandemic to support continuity of learning.

National Curriculum Development Centre
P.O. Box 7002,
Kampala- Uganda
www.ncdc.go.ug

FOREWORD

Following the outbreak of the COVID-19 pandemic, government of Uganda closed all schools and other educational institutions to minimize the spread of the coronavirus. This has affected more than 36,314 primary schools, 3129 secondary schools, 430,778 teachers and 12,777,390 learners.

The COVID-19 outbreak and subsequent closure of all has had drastically impacted on learning especially curriculum coverage, loss of interest in education and learner readiness in case schools open. This could result in massive rates of learner dropouts due to unwanted pregnancies and lack of school fees among others.

To mitigate the impact of the pandemic on the education system in Uganda, the Ministry of Education and Sports (MoES) constituted a Sector Response Taskforce (SRT) to strengthen the sector's preparedness and response measures. The SRT and National Curriculum Development Centre developed print home-study materials, radio and television scripts for some selected subjects for all learners from Pre-Primary to Advanced Level. The materials will enhance continued learning and learning for progression during this period of the lockdown, and will still be relevant when schools resume.

The materials focused on critical competences in all subjects in the curricula to enable the learners to achieve without the teachers' guidance. Therefore effort should be made for all learners to access and use these materials during the lockdown. Similarly, teachers are advised to get these materials in order to plan appropriately for further learning when schools resume, while parents/guardians need to ensure that their children access copies of these materials and use them appropriately.
I recognise the effort of National Curriculum Development Centre in responding to this emergency through appropriate guidance and the timely development of these home study materials. I recommend them for use by all learners during the lockdown.

Alex Kakooza
Permanent Secretary
Ministry of Education and Sports

ACKNOWLEDGEMENTS

National Curriculum Development Centre (NCDC) would like to express its appreciation to all those who worked tirelessly towards the production of home–study materials for Pre-Primary, Primary and Secondary Levels of Education during the COVID-19 lockdown in Uganda.

The Centre appreciates the contribution from all those who guided the development of these materials to make sure they are of quality; Development partners - SESIL, Save the Children and UNICEF; all the Panel members of the various subjects; sister institutions - UNEB and DES for their valuable contributions.

NCDC takes the responsibility for any shortcomings that might be identified in this publication and welcomes suggestions for improvement. The comments and suggestions may be communicated to NCDC through P.O. Box 7002 Kampala or email admin@ncdc.go.ug or by visiting our website at http://ncdc.go.ug/node/13.

Grace K. Baguma
Director,
National Curriculum Development Centre

ABOUT THIS BOOKLET

Dear learner, you are welcome to this home-study package. This content focuses on critical competences in the syllabus.

The content is organised into lesson units. Each unit has lesson activities, summary notes and assessment activities. Some lessons have projects that you need to carry out at home during this period. You are free to use other reference materials to get more information for specific topics.

Seek guidance from people at home who are knowledgeable to clarify in case of a challenge. The knowledge you can acquire from this content can be supplemented with other learning options that may be offered on radio, television, newspaper learning programmes. More learning materials can also be accessed by visiting our website at www.ncdc.go.ug or ncdc-go-ug.digital/. You can access the website using an internet enabled computer or mobile phone.

We encourage you to present your work to your class teacher when schools resume so that your teacher is able to know what you learned during the time you have been away from school. This will form part of your assessment. Your teacher will also assess the assignments you will have done and do corrections where you might not have done it right.

The content has been developed with full awareness of the home learning environment without direct supervision of the teacher. The methods, examples and activities used in the materials have been carefully selected to facilitate continuity of learning.

You are therefore in charge of your own learning. You need to give yourself favourable time for learning. This material can as well be used beyond the home-study situation. Keep it for reference anytime.

Develop your learning timetable to ca ter for continuity of learning and other responsibilities given to you at home.

Enjoy learning

Topic: Climate

Lesson 5: Rainfall

By the end of this lesson you should be able to:

(i) Explain the meaning of rainfall
(ii) Distinguish the types of rainfall
(iii) Draw diagrams to illustrate the formation of the different types of rainfall

Materials you need

Note book, textbook on climate, pen, pencil, rubber, and ICT tools.

Introduction

In senior one, you learnt that **rainfall** is a type of precipitation that falls from the atmosphere in form of water droplets. It occurs when condensation of water vapour takes place in the upper atmosphere. In this lesson, you are going to learn about types of rainfall, and the conditions under which each type occurs.

Activity 1

1. Think of the types of rainfall you know and list them in your notebook.
2. Explain how each type is formed pointing out the conditions under which it is formed.

Activity 2

Read the text below which describes one of the types of rainfall and do the activities that follow.

Convectional rainfall

This is a type of rainfall which occurs when the earth's surface is heated by heat energy from the sun. This type of rainfall occurs throughout the year at the Equator and during summer in the mid-latitudes.

When the ground surface is heated, the air above it becomes warmer and lighter than the surrounding air and rises into the upper atmosphere. This rising of air is accompanied by the sinking of cooler air in the atmosphere. This movement of air in a cycle produces **convectional lifting**.

On rising, the temperature of the warm air decreases by some 10°C for each kilometer it rises; so it cools. This rate of cooling for dry air is called **dry adiabatic rate.** This is illustrated by Figure 5.1.

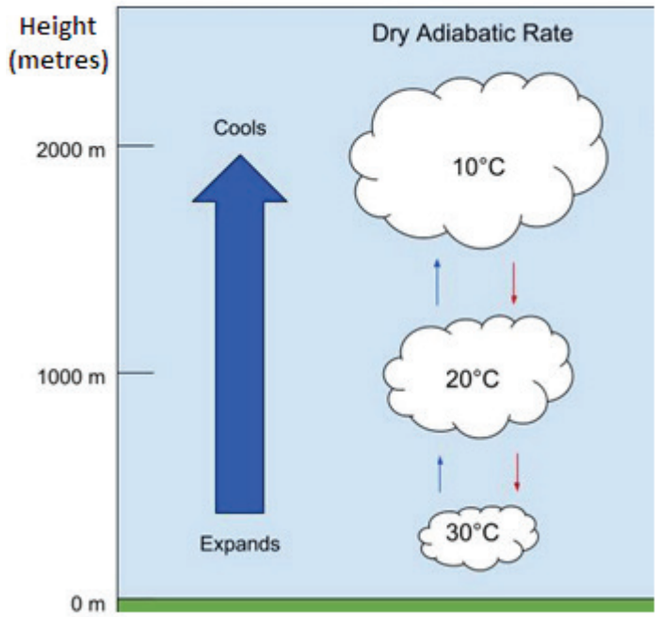

Figure 5.1: Air rises, expands, and cools by 10°C/km

On the other hand, if the rising hot air carries with it water vapour from the ground, open water bodies, and vegetation, it cools at a lower rate of about 6°C for every kilometer. This is known as **moist adiabatic rate.**

As the air cools, its ability to hold water vapour decreases and it becomes saturated. If the rising air cools to its dew point, the water vapour in it condenses and forms **stratocumulus clouds** in the atmosphere. To help you understand this better, look at Figure 5.2.

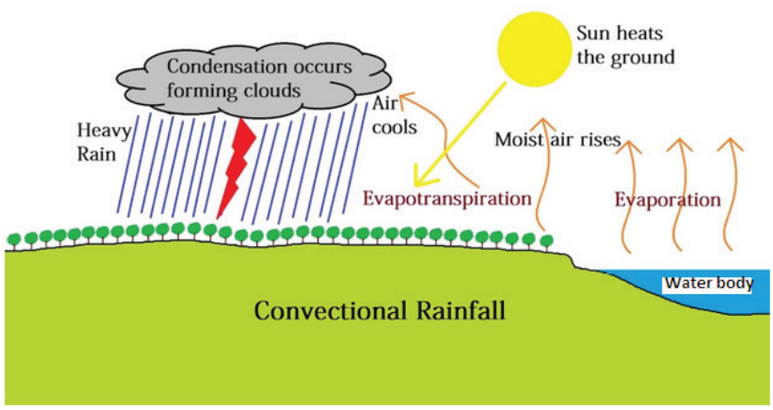

Figure 5.2: Formation of convectional rainfall

The condensation of air releases heat energy that warms the surrounding air and makes it unstable i.e. unable to resist upward movement and further rising. This leads to further cooling and formation of **cumulonimbus** clouds. When the clouds become quite heavy the water droplets in them fall as rainfall often accompanied by thunder and lightning.

Characteristically, convectional rainfall mainly occurs in the afternoon and it is usually torrential; it falls within a short distance and is common in areas with thick vegetation and water bodies such as the lake Victoria Basin. Think of other areas in Uganda which are most likely to receive convectional rainfall.

1. Study **Figures 5.3** and **5.4** carefully and using ideas from the text and diagram of convectional rainfall above, in your notebook describe the formation and main features of:
   (i) Orographic (Relief) Rainfall
   (ii) Cyclonic Rain fall.
2. Suggest at least two areas in East Africa and the rest of the world where each type of rainfall is most likely to occur.

Orographic (Relief) Rainfall

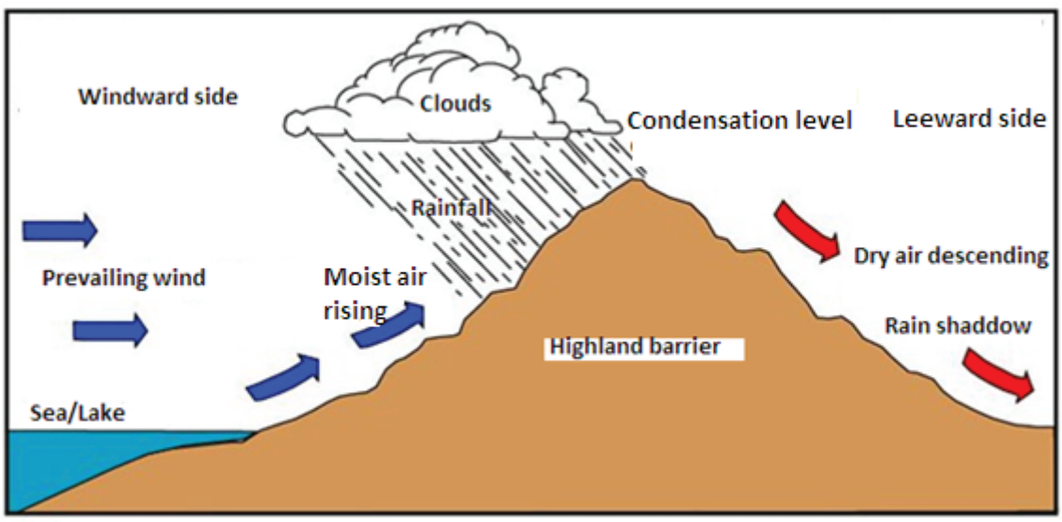

Figure 5.3: Formation of Orographic rainfall

Cyclonic (Frontal) Rainfall

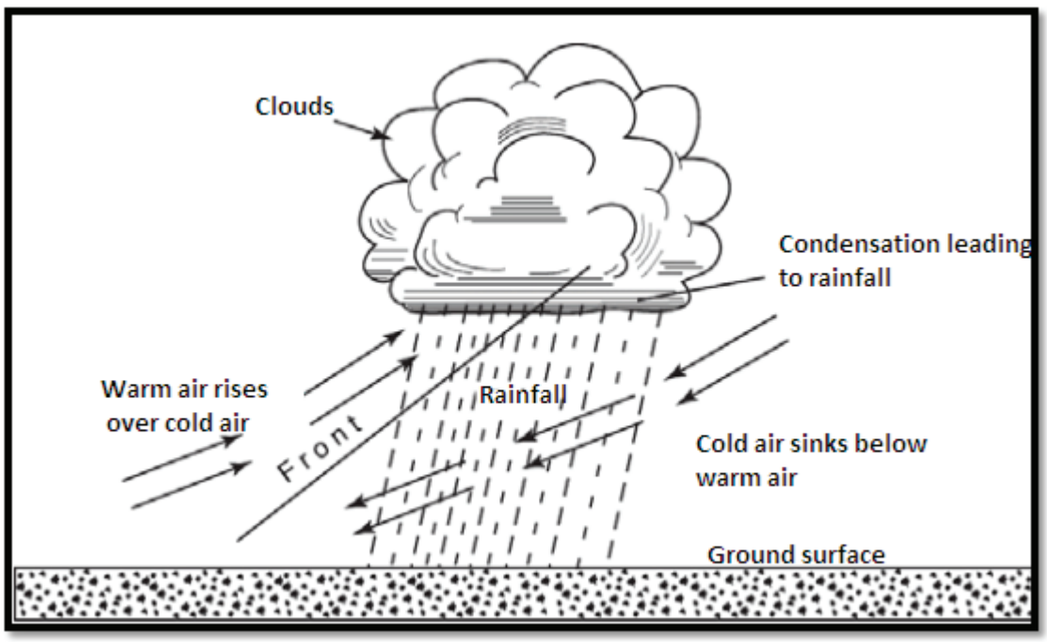

Figure 5.44: Formation of cyclonic (frontal) rainfall

Summary

In this lesson you have learnt that:

- Rainfall is of three types, namely convectional, orographic or relief, and frontal or cyclonic rainfall.
- Each of these types is formed in a different way and under specific conditions.
- Convectional rainfall is a type of rainfall formed when the surface is heated particularly where there are water bodies and vegetation.
- Orographic rainfall is formed in highland areas such as hills and mountains.
- Frontal rainfall occurs when two air masses (larger volumes of wind) meet.
- In all types of rainfall, the air rises and cools forming stratocumulus clouds, and later cumulonimbus clouds that give rainfall.

Follow up Activity

1. Observe rainfall which occurs in your home area and decide which type it is. Give reasons to support your classification.
2. Explain how the type of rainfall received in your home area affects the activities people carry out.

Lesson 6: Rainfall Distribution in East Africa

By the end of this lesson you should be able to:

(i) Explain the factors influencing rainfall distribution in East Africa.
(ii) Explain the effects of rainfall on human activities.

Materials you need

Note book, textbook on climate, pen, pencil, rubber, and Atlas.

Introduction

You could have noticed that in your home area there are certain months of the year when you receive heavy rainfall while in other months rainfall amounts are low. You might also have noticed that some months are rather dry or even practically dry. Similar rainfall patterns occur in other parts of East Africa and elsewhere in the world.

In this lesson you are going to explore how rainfall is distributed across East Africa and the factors influencing the distribution. You will also look at the influence of rainfall distribution on human activities and the lifestyles of different communities.

Activity 1

Look at Figure 6.1 and do the following tasks:

1. Copy Figure 6.1 into your notebook.
2. With the help of the Atlas or any other map showing administrative units of East Africa, identify areas receiving:
   (i) Heavy rainfall
   (ii) Moderate rainfall
   (iii) Low rainfall
3. Explain the reasons for the differences in the amount of rainfall received in East Africa.

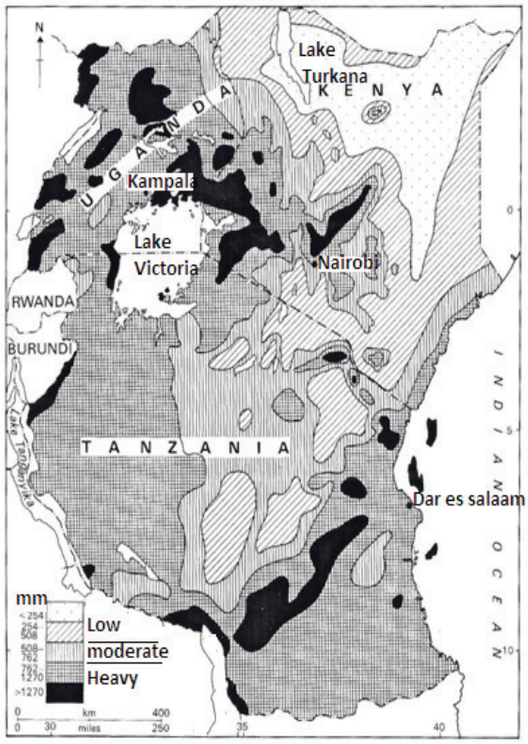

Figure 6.1: (a) Rainfall distribution in East Africa

(b) Scale for rainfall received

Activity 2

With specific examples, explain how the following factors influence rainfall distribution in East Africa:

(i) Latitude
(ii) Relief
(iii) Wind system
(iv) Water bodies
(v) Vegetation
(vi) Inter tropical convergence zone (ICTZ)

Influence of rainfall distribution on human activities in East Africa

If you move around your own country, Uganda, you will realize that different communities carry out different economic activities. You will also realize that different farming communities do activities, such as preparing their fields, planting, and harvesting at different times of the year. These differences can be explained by the fact that some areas of East Africa receive heavy rainfall, some receive moderate rainfall while others receive low rainfall. There are also several variations in the times of the year when different parts of East Africa receive rainfall. Generally rainfall distribution largely

influences the human activities carried out in the region. To help you understand and appreciate this in a better way, do the following activity.

Activity 3

In not less than three sentences, explain how rainfall distribution and amount influences each of the following human activities in East Africa.

(i) Crop Cultivation; including the types of crops grown.
(ii) Forestry and lumbering
(iii) Fishing
(iv) Development of handcraft industry
(v) Hydro-electric power generation
(vi) Settlement
(vii) Livestock farming: dairying, ranching and Nomadic pastoralism
(viii) Wildlife conservation and tourism
(ix) Development of manufacturing industry

Summary

In this lesson you have learnt that:

- Rainfall distribution in East Africa is not uniform; some areas receive low, some moderate while others low mean annual rainfall.
- The heaviest rainfall in East Africa occurs in highlands and areas within the Lake Victoria basin while the least rainfall occurs in the low lying plains of North Eastern Uganda, Northern, and North Eastern Kenya.
- The distribution of rainfall has great influence on the economic activities and lifestyles of the people of East Africa.

Follow up activity

1. Carry out a fieldwork study of your home area
2. Draw a sketch map to show the land use types in the area.
3. Find out the relationship between rainfall distribution and the activities people living in the area carry out.

Lesson 7: Humidity

By the end of this lesson you should be able to:

(i) Distinguish between absolute humidity and relative humidity.
(ii) Explain how humidity is measured and recorded at a weather station.
(iii) Explain factors influencing humidity in East Africa.
(iv) Measure humidity in a local area using suitable instruments.
(v) Explain the influence of humidity on your own life.

Materials you need

Notebook, ruler, pen, rubber, pencil, diagram of a hygrometer, textbook on climate, and ICT tools

Introduction

In Senior One geography, and possibly in physics, you learnt that most of the time the air around us is not dry. It contains some amount of moisture in form of an invisible gas. This gaseous water or moisture is called **water vapour**. The measure of the amount of water vapour held in air is called **humidity.** In this lesson, you are going to learn more about humidity, types of humidity, and factors influencing humidity. You are also going to look at the relationship between humidity and rainfall formation as well as the influence of humidity on our lives.

Activity 1

1. Suggest indicators which you can use to tell that the air around you contains moisture.
2. Think of the types of humidity you know and list them in your notebook.
3. Explain what each type of humidity you have listed means.

You have probably noticed that when you wash your clothes and hang or spread them out to dry, they dry faster on some days than on other days. This is because of the differences in the amount of moisture in the air. It is more correct to call it a difference in humidity. In the same way, humidity in East Africa varies from time to time. It also varies from place to place. Generally, humidity is lower in the dry season than in the wet season.

When the humidity is low the air is thirstier for water, so it dries things faster. When the humidity is high, the air is not thirsty, so things dry more slowly. To help you understand this, look at Figure 7.1.

Figure 7.1: Drying of things depends on humidity

You may also be wondering where the water goes to when your clothes dry. It turns into an invisible gas called water vapour. It is this water vapour which makes the atmosphere humid or moist hence the term **humidity**.

Do you remember the process by which water changes from liquid to gas?

So one way we can tell the amount of moisture in the air around us is by watching how quickly things dry. If the air contains much water vapour the humidity is high and so things dry slowly. If the air contains little water vapour, the humidity is low, and so things dry faster.

Types of humidity

Activity 2

Read the text below on absolute and relative humidity and attempt the activities that follow. **Absolute humidity:** Absolute humidity refers to the amount of water vapour actually present in a given quantity of air at a given time. It may be expressed in grammes per cubic metre or other units. Absolute humidity varies according to temperature and pressure. When the temperature increases humidity increases, because of high evaporation, and the ability of air to pick more water vapour increases.

Relative humidity: Relative humidity is the actual amount of water vapour present in a given volume of air expressed as a percentage or ratio of the maximum it could contain when saturated. Air is said to be saturated when it contains as much water vapour as it can possibly hold at that temperature. This means that at that temperature that volume

of air cannot absorb any more water vapour. For example, air at a relative humidity of 75% contains three-quarters of the total amount of water vapour it can possibly hold. So that air can at any one time form rainfall. A relative humidity of 100% indicates that air is holding all the amount of water vapour it can possibly hold. So that air is saturated and ready to fall as rainfall. To understand this better, look at Figure 7.2.

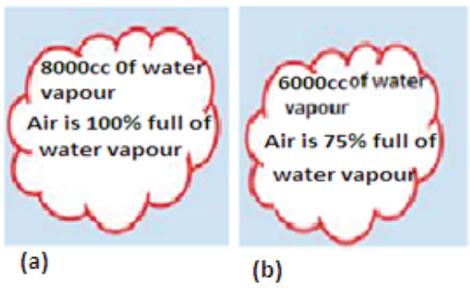

Figure 7.2: A parcel of air at diffent levels of ralatve humidity

Relative humidity depends on temperature and pressure. For example high temperature leads to high humidity because of high evaporation.

How to calculate relative humidity

The total amount of water vapour a given parcel or volume of air can hold is called **saturation content.** We can use absolute humidity and saturation content to determine the relative humidity.

We can express this as:

Relative humidity = Absolute humidity x 100%

Saturation content

For example, in Figure 7.2(a) above, the air parcel can hold 8000cm^3 of water vapour, while Figure 7.2(b) shows that the same parcel is actually holding 6000cm^3 of water vapour. The former figure is the saturation content of that air parcel while the latter is its absolute humidity. When we substitute these values into the formula, the value we get is the relative humidity of that air parcel.

Thus: Absolute humidity = 6000cm^3

Saturation content = 8000cm^3

$$RH = \frac{6000\ cm3}{8000\ cm3} \times 100\%$$

RH = 75%

Activity 3

Using the text above on absolute humidity and relative humidity;

(i) Draw a table with two columns and use it to distinguish absolute humidity and relative humidity.

(ii) Saturated air at 25^{0}C can contain 150 grammes per cubic metre of water vapour. If the mass of air at the same temperature 25^{0}c contains 120 grammes per cubic metre, calculate relative humidity.

How is humidity measured?

Humidity in the atmosphere is measured using a **hygrometer.** The simplest hygrometer is ***a* sling psychrometer.** It consists of two thermometers, a wet bulb and a dry bulb thermometer. The wet bulb is wrapped in a wet cloth and dipped into a bowl of water. This keeps the muslin wet. The wet bulb records a lower temperature.

When water evaporates from the wet cloth it takes away heat with it. This leads to cooling on the wet bulb thermometer, and thus giving a lower reading. The dry bulb records the hotter temperature. It is kept in the normal environment. The difference in temperatures recorded by the two thermometers is the humidity in the air. A large difference means humidity is low and a small one means humidity is high. If there is no difference, the air is said to be **saturated** i.e. it is holding the maximum amount of moisture it can possibly hold.

Activity 4

Study Figure 7.3 showing a simple hygrometer and Figure 7.4 showing a relative humidity table and do the tasks that follow.

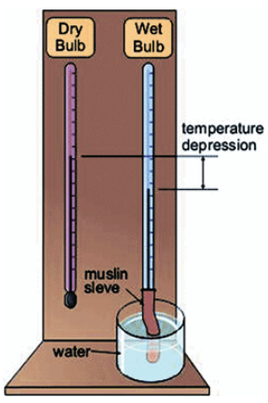

Figure 7.3: A simple hygrometer

Dry-Bulb Temperature (°C)	Difference Between Wet-Bulb and Dry-Bulb Temperatures (C°)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
−20	100	28														
−18	100	40														
−16	100	48														
−14	100	55	11													
−12	100	61	23													
−10	100	66	33													
−8	100	71	41	13												
−6	100	73	48	20												
−4	100	77	54	32	11											
−2	100	79	58	37	20	1										
0	100	81	63	45	28	11										
2	100	83	67	51	36	20	6									
4	100	85	70	56	42	27	14									
6	100	86	72	59	46	35	22	10								
8	100	87	74	62	51	39	28	17	6							
10	100	88	76	65	54	43	33	24	13	4						
12	100	88	78	67	57	48	38	28	19	10	2					
14	100	89	79	69	60	50	41	33	25	16	8	1				
16	100	90	80	71	62	54	45	37	29	21	14	7	1			
18	100	91	81	72	64	56	48	40	33	26	19	12	6			
20	100	91	82	74	66	58	51	44	36	30	23	17	11	5		
22	100	92	83	75	68	60	53	46	40	33	27	21	15	10	4	
24	100	92	84	76	69	62	55	49	42	36	30	25	20	14	9	4
26	100	92	85	77	70	64	57	51	45	39	34	28	23	18	13	9
28	100	93	86	78	71	65	59	53	47	42	36	31	26	21	17	12
30	100	93	86	79	72	66	61	55	49	44	39	34	29	25	20	16

Figure 7.4: Relative Humidity table

To determine relative humidity follow the following steps:

1. Record temperatures from the two thermometers
2. Subtract the wet-bulb temperature from the dry-bulb temperature.
3. Consult a relative humidity chart or table and find this figure—the difference in

degrees—at the top of the chart and place your finger on it.
4. Find the dry-bulb temperature in the first column on the left. Place your finger on it.
5. Bring your fingers down the column and across the row. The relative humidity percentage appears where the column and the row intersect on the chart.

Activity 5

You now know that humidity is the measure of water vapour in the atmosphere, describe how the following factors influence variations in humidity in East Africa:

- Temperature
- Altitude
- Water bodies
- Vegetation cover
- Man's activities
- Continentality (distance from the sea)

Summary

In this lesson, you have learnt the difference between absolute humidity and relative humidity, how to measure humidity at a weather station, and how to record and determine relative humidity.

Follow up activity

In your notebook,

1. Suggest areas of high humidity in East Africa.
2. Suggest areas of low humidity in East Africa.
3. Explain the significance of humidity to the environment.

Lesson 8: Winds

Learning objectives:

By the end of this lesson you should be able to:

i) Describe how wind speed and wind direction are measured and recorded at a weather station.

ii) Explain factors influencing the occurrence of land and sea breezes.

iii) Describe the formation of land and sea breezes.

iv) Explain the effects of land and sea breezes on climate of the surrounding areas.

Materials you need

Notebook, pen, rubber, , pencil, and foot ruler

Introduction

In O-Level you learnt about wind. Do you still remember what wind is? How wind speed is measured? How wind direction is measured? What land and sea breezes are? In this lesson you are going to learn more about measurement and recording of wind speed and wind direction respectively. You are also going to look at the causes, formation of land and sea breezes, and their effects on climate.

Measuring wind speed

Activity1

Look at Figure 8.1 and also read the text below explaining how wind speed is measured and recorded.

Wind speed is measured using Anemometer. The instruments consist of three or four metal cups fixed on vertical shaft with a meter to record the speed of wind. The metal cups rotate freely on the vertical shaft.

When there is wind the cups rotate. The higher the speed of wind the faster the cups rotate. The number of rotations is recorded on a meter to indicate the speed of wind in kilometers per hour. The anemometer is placed in an open space where there are no obstacles to wind movement.

Measuring wind direction

Activity 2

Look at Figure 8.1 and use it to describe how wind direction is measured and recorded at a weather station.

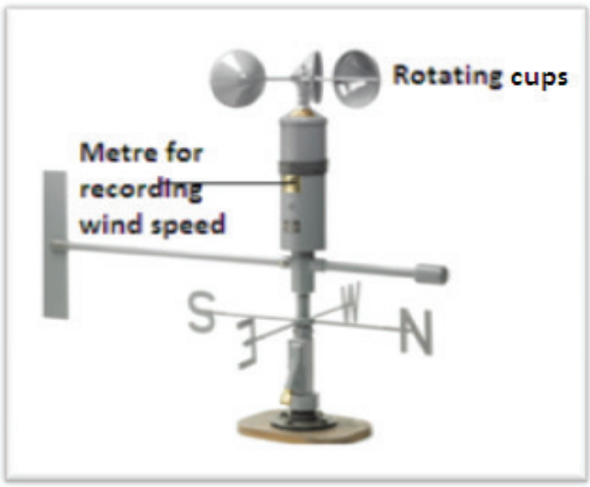

Figure 8.2: In-line cup Anemometer and a wind vane

Activity 3

Read the texts below on factors for the occurrence of land and sea breezes, processes for their formation, and do activities that follow.

Land and sea breezes

You have probably wondered sometimes when you stand or walk outside on a sunny day and feel cool wind blowing past. In the same way, when you stand by the lake shore or a river bank you feel it cool even when the sun is high up in the sky. What kind of wind do you think that is? Where does it come from? It is a cool breeze and it originates in an area where it has just rained or from a water body.

Land and sea breezes are local winds which occur in areas where the land is lying close to the water body like the shores of Lake Victoria and the East African coast. The sea breeze blows from the sea to the land and occurs during the day while land breeze blows from the land to the sea and occurs during the night. Similar breezes occur in places with lakes and large rivers. In this case they are called land and lake breezes or simply land and water breezes.

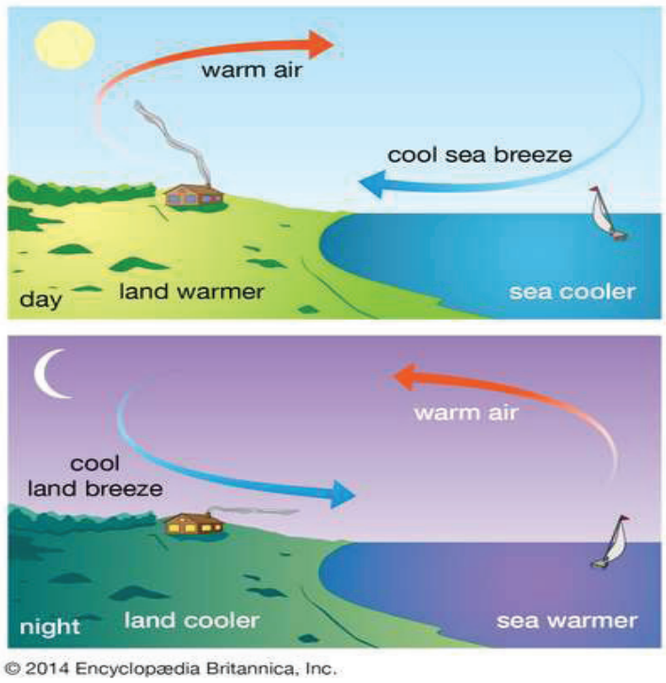

Figure 8.3: Land and Sea breeze

Activity 4

Look at Figure 8.3 and do the following tasks:

1. Copy the two diagrams into your notebook.
2. Suggest at least 4 places in East Africa which experience land and water breezes. Give reasons for your answer.
3. Explain four effects of sea breeze and four effects of land breeze on the climate of the areas where they occur. You may consider how they affect temperature, Humidity, Cloud cover, and Rainfall.

The following are factors which lead to the occurrence of land and sea breezes. First, the differences in specific heat capacities of land and sea lead to land and sea breezes. The land has low specific heat capacity while the sea has high specific heat capacity which leads to differences in heating.

The mobility of water compared to solid land lead to land and sea breezes. Waves and tides mix water and transport temperatures to lower layers while only a small layer of solid land is heated.

Differences in heat transmission between water and land lead to land and sea breezes. Water is transparent which enables heat to penetrate to deep layers while the land is opaque leading to only a small layer being heated, and thus the land is hot during the day.

The differences in the reflecting capacity of land and water lead to land and sea breezes. While water is shinny and tends to reflect more heat leading to cool temperatures, the land is dull, and thus absorbs more heat during the day leading to hot temperatures.

Sea breeze

During the day the land is heated more than the sea, therefore, the land is hot while the sea is cool. Warm air over the land rises leading to low pressure while over the sea there is high pressure because of cool conditions. Cool moist wind blows from the sea where there is high pressure to the land where there is low pressure. This is called *a* **sea breeze**

Land breeze

During the night the land cools faster than the sea leading to cold temperatures and high pressure over land and warm temperatures over the sea.

Cool air over the land blows to the sea where there is low pressure hence **land breeze.**

Summary

In this lesson you have learnt:

- How wind speed is measured using the anemometer and wind direction is measured using the wind vane.
- Factors responsible for the occurrence of land and sea breeze, such as differences in specific heat capacities, mobility of water while earth is solid, differences in heat transmission, and differences in reflecting capacity between land and sea water.
- That *a* sea breeze occurs during the day and moves from sea to land while *a* land breeze occurs during the night and moves from land to sea.
- The effects of sea breeze like lowering temperature over land, leading to high humidity over land, dense cloud cover over the land, and heavy rainfall over the land
- Effects of land breeze like lowering temperature over the sea, high humidity over the sea, dense cloud cover over the sea, and high rainfall over the sea.

Follow up activity

You have learnt how land and sea breezes influence the climate. In your notebook explain how land and sea breezes influence the following human activities:

i. crop cultivation
ii. forestry
iii. industrialization

iv. hand craft industry
v. transport
vi. commerce and trade especially in open air markets

Lesson 9: Ocean currents

Learning objectives

By the end of this lesson you should be able to:

i) Describe the areas affected by ocean currents
ii) Explain the causes of ocean currents
iii) Describe the characteristics of ocean currents
iv) Explain the effects of ocean currents on the climate of the surrounding area.

Materials you need

Atlas, notebook, pen, rubber, pencil, and foot ruler

Introduction

In O-Level you learnt about ocean currents around Africa. You learnt that ocean currents are slow movements of ocean water. Write down areas affected by ocean currents in your notebook. How do these ocean currents affect the climate of coastal areas? In this lesson, you are going to learn about causes of ocean currents, characteristics of ocean currents, and effects of ocean currents on climate and human activities.

Activity 1

Study Figure 9.1 and do the tasks that follow.

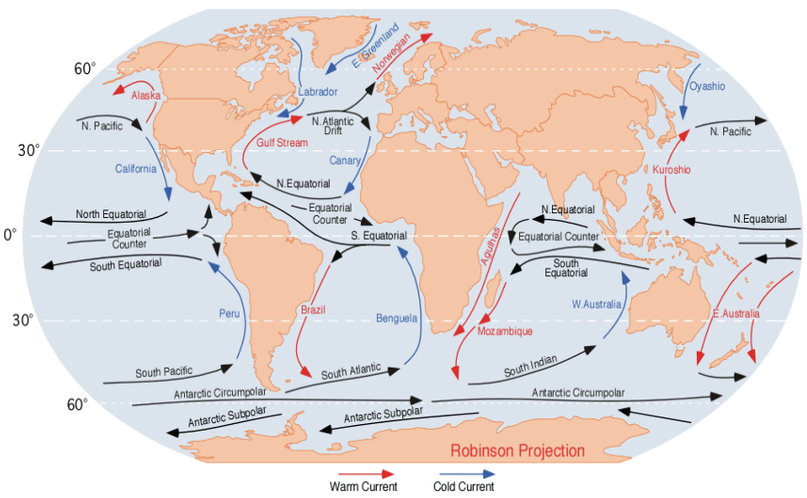

Figure 9.1: Major ocean currents of the World

1. Copy the map into your notebook and on it mark and name the: Brazil current, Mozambique current , Guinea current, North Atlantic drift, North pacific current, Kuro Siwo current, Oya Shio current, Benguela current, Canary current, Labrador current, Peruvian

(Humboldt) current, and Californian current.
2. Draw a table to summarise the ocean currents which you have marked on your map as warm ocean currents and cold ocean currents.
3. Explain why some ocean currents are warm while others are cold.
4. Determine which ocean current is likely to affect the climate of:
    - East Africa
    - West Africa
    - Southern Africa
5. Give reasons for your suggestion in each case.

What causes ocean currents?

Activity 2

Read the text below about causes of ocean currents and characteristics of warm ocean currents and do the activity that follows.

Wind is a major cause of ocean current. As the wind blows over the ocean surface there is friction between it and the water surface causing the water to move in the direction of the wind. Some winds blow continuously in a specific direction forcing ocean water to move in the same direction. The westerly winds have contributed to north Atlantic drift and Kuro Shio current.

Differences in water density cause ocean currents depending on the temperature and salinity. When the temperature of the waterfalls the density increases and vice versa; when the salinity increases the density increases and vice versa. Within the ocean, water moves from a region of high density to a region of lower density.

The rotation of the earth influences the movement of the ocean current. The earth rotation causes ocean current to be deflected to the right in the northern hemisphere and to the left in the southern hemisphere.

The shape of land masses determines the direction of ocean current. The north Equatorial currents in the North Atlantic is divided into two by the Caribbean islands while the south Equatorial currents in the Indian ocean is divided into two by Madagascar's. If an ocean current is forced through openings between islands, it increases in velocity. The Florida current between Florida peninsular and Cuba comes out of Florida as Gulf Stream and flows northwards along the coast of North America as strong fast current.

Characteristics of warm ocean currents

Activity 3

1. Carry out textbook or internet research about the characteristics of ocean currents.
2. Draw a table similar to the one below to summarise the characteristics of cold and warm ocean currents.

Cold ocean currents	Warm ocean currents

Activity 3

Read the text below on the effects of cold ocean currents on the climate of the surrounding

areas and do the tasks that follow

Cold ocean currents have several effects on the climate of the adjacent coastal areas. They lower the temperature of adjacent land masses; result in low humidity in atmosphere as a result of low evaporation rates. They also result in low cloud cover because of limited water vapour which would condense to form clouds. This is because cold ocean currents bring about low temperature conditions.

Cold ocean current lead to low rainfall and desert conditions in adjacent areas. Furthermore, these ocean currents lead to fog when warm air passes over a cold water surface. This leads to cooling of water vapor in the warm air which results in the formation of advection fog.

1. Suggest areas around the world where each of the effects explained in the text occurs. Give reasons to support your response.
2. Explain how the effects of cold ocean currents might affect human activities in coastal areas and the adjacent lands.

Activity 4

1. Identify areas which have desert climate as a result of cold ocean currents. List them in your notebook.
2. Explain the effects of warm Ocean current on the climate of surrounding areas in terms of temperature, humidity, cloud cover, and rainfall.

Summary

In this lesson you have learnt:

- That ocean currents are slow movements of ocean water.
- Causes of ocean currents which are wind, water density, earth rotation, and shape of land masses.
- Characteristics of warm ocean currents like warm temperature, flowing from low latitudes to high latitudes, flow on Eastern sides of continents in low latitudes and western sides of land masses in mid and high latitudes.
- Effect of cold ocean currents, such as leading to low rainfall, low humidity, low cloud cover, low temperature, and fog.

Lesson 10: The Climate of East Africa

Learning objectives

By the end of this lesson you should be able to:

(i) Describe the climatic region in East Africa
(ii) Describe the characteristics of Equatorial climate in East Africa
(iii) Explain the factors responsible for Equatorial climate in East Africa.

Introduction

In senior two you learnt about climate of East Africa. In your notebook, outline the different climates of East Africa and areas where they are found. In this lesson you are going to learn more about characteristics of Equatorial climate, factors responsible for the occurrence, and effects of Equatorial climate in East Africa.

Read the text below on characteristics of Equatorial climate and do activities that follow

Equatorial Climate in East Africa

In East Africa equatorial climate is found in the Lake Victoria basin. Outside East Africa it is found in Congo basin, southern parts of West Africa, Amazon basin in southern America and some parts of southern East Asia like Indonesia and Malaysia. The Equatorial climate in East Africa has the following characteristics:

Heavy rainfall ranging between 1000mm and 2000mm on average. However some areas experience rainfall of over 2000mm. Rainfall is reliable and well distributed throughout the year with no clear marked dry season. Areas with equatorial climate experience two rainfall peaks in a year. Each peak is associated with a rainy season. The first rains fall in March-April while the second rains fall in October- November. The two rainfall seasons coincide with the equinoxes.

Rainfall is mainly convectional accompanied by lightning and thunderstorms; and usually occurs in the afternoon. The temperature is hot throughout the year ranging between 23^0- 29^0c. The maximum temperature is around 38^0c while minimum temperature is around 15^0c depending on the location. The annual temperature range is small, usually 1^0- 4^0c on average. Diurnal temperature range is also small. Relative humidity is high, around 80%, due to high rates of evaporation and evapo-transpiration.

A typical equatorial region has dense cloud cover due to high evaporation and condensation.

Areas with an equatorial climate are also dominated by air masses that converge at the Intertropical Convergence Zone (ITCZ) due to persistent low pressure belts or doldrums.

Activity 1

You now know the characteristics of Equatorial climate in East Africa.

1. Write at least one paragraph to explain how each of the following factors has led to the occurrence of Equatorial climate in East Africa:
    - Latitude
    - Altitude
    - Water bodies
    - Air masses
    - Inter-tropical convergence zone and apparent movement of the overhead sun

Activity 2

1. Basing on the characteristics of areas with an Equatorial climate, explain the influence of Equatorial climate on:
    - Agriculture

- Forestry and lumbering
- Fisheries resources and fishing
- Crafts industry
- Wildlife conservation and tourism, and
- Human settlement.

2. How far do you agree with the assertion that climate is by far the most important factor affecting human activities and development in the equatorial region of East Africa?

Activity 3

Look at Figure 10and do the following tasks:

1. Draw the map in your notebook and on it mark all the climatic regions shown.
2. With the help of an atlas or textbook map, complete the map by naming the climatic regions labeled 1 to 6.
3. Describe the main characteristics of each climatic region, except the Equatorial region.

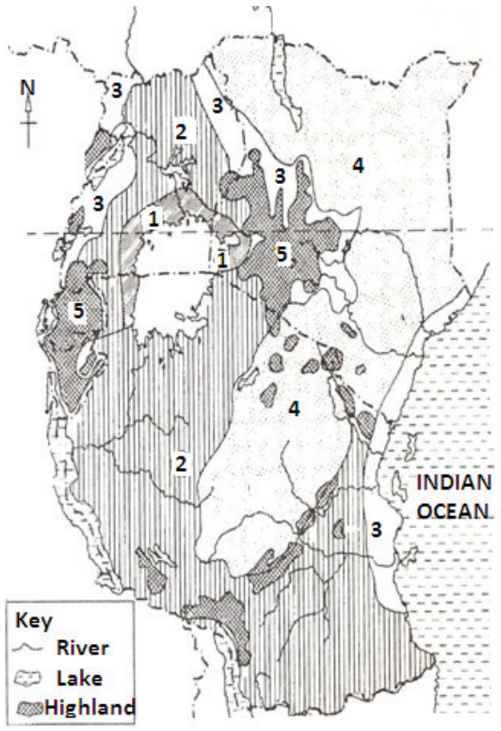

Figure 10.1: Climatic regions of East Africa

Summary

In this lesson, you have learnt that:

- In East Africa equatorial climate occurs in the Lake Victoria basin.
- The characteristics of equatorial climate include heavy rainfall, rainfall throughout the year, double maxima of rainfall, high humidity, dense cloud cover, hot temperatures, and small annual temperature range.
- The factors that lead to the occurrence of equatorial climate of East Africa are

latitude, altitude, water bodies, vegetation cover, air masses, dense cloud cover and the presence of the intertropical convergence zone.

- Equatorial climate influence human activities, such as plantation agriculture, forestry and lumbering, fishing, handicraft industry, wild life conservation, tourism, and settlement.

Follow up activity

Using the knowledge gained from this lesson and what you learnt in senior two;

1. Explain the relationship between climate and human activities in East Africa

Lesson 11: Aridity in East Africa

Learning objectives

By the end of this lesson you should be able to:

(i) Identify the areas affected by aridity in East Africa.
(ii) Describe the characteristics of aridity in East Africa.
(iii) Explain the causes of aridity in East Africa.
(iv) Suggest ways of overcoming the problem of aridity in East Africa.

Materials you need

Notebook, pen, pencil, rubber, ruler, and map of East Africa showing areas affected by aridity.

Introduction

In Senior Two you learnt about the climate of East Africa and you were able to identify arid areas. In this lesson you are going to learn more about the characteristic of aridity, factors responsible for aridity, effects of aridity, and ways of combating aridity in East Africa.

Activity 1

Read the text below about areas affected by aridity and characteristics of aridity and do the task that follows:

In East Africa numerous areas are affected by aridity. They include North Western Kenya (Turkana land) Northern Kenya, North Eastern Kenya, North Eastern Uganda (Karamoja) Ankole-Masaka corridor, central Tanzania and Maasai land.

These areas experience aridity with the following characteristics: low and unreliable rainfall of less than 750mm, rainfall is in one season, one long dry season and one short rainy season, low humidity of less than 30%, low cloud cover, high temperature of a round 30^0c, high diurnal temperature range and annual temperature range, and strong winds particularly during the dry season.

1. In your notebook draw a map of East Africa showing areas affected by aridity.

Activity 2

Read the text below on some factors responsible for aridity in East Africa and do the activities that follow.

Factors responsible for aridity in East Africa

Dry winds lead to aridity in East Africa. The North East trade winds originate from the Arabian desert. On reaching the Ethiopian highlands, they climb leading to rainfall on the windward side leaving North Eastern Uganda, and North Western Kenya dry. The South East trade winds pick water vapour from the Indian Ocean which they deposit in form of rain at the coast and when they reach central Tanzania they are already dry leading to arid conditions. When they reach Uganda after collecting moisture from Lake Victoria, they are deflected leaving Ankole-Masaka corridor dry. The westerly winds from the Congo basin deposit moisture in form of rain on the windward side of Rwenzori Mountain leaving parts of Kasese and Lake Albert flats experiencing aridity.

The Coriolis Force effect leads to aridity. According to Ferrell's law any loose object flowing in the northern hemisphere is deflected to the right of its path due to the rotation of the earth. As a result, the South East trade winds blowing across Kenya are deflected towards the Indian Ocean leaving North Western and Northern Kenya experiencing aridity.

Perturbation, which is a condition whereby there is persistent low pressure over the Indian Ocean that attracted winds from the mainland, leads to aridity. Warm moist air over the land is diverted to the sea leaving Northern Kenya and North Eastern Kenya dry.

Coastal configuration where the East Africa coast is aligned in the North East- South west direction lead to aridity in East Africa. As a result of this, the North East trade winds blow parallel to the coast without penetrating leaving the Northern and North East Kenya dry.

1. In your notebook explain how the following factors have led to aridity in East Africa:
   (i) distance from the sea or continentally,
   (ii) absence of high mountains in some areas,
   (iii) limited water bodies,
   (iv) limited vegetation cover ,and
   (v) industrialization and global warming.

Activity 3

In your notebook, explain how the following human factors lead to aridity in East Africa:

(i) Unregulated cutting of trees and forests
(ii) Overstocking and overgrazing
(iii) Burning of vegetation cover
(iv) Swamp reclamation
(v) Sinking boreholes.

Activity 4

Using the knowledge you have acquired about the characteristics and causes of aridity, explain how aridity may affect:

(i) The physical environment
(ii) Human activities and development in East Africa.

Summary

In this lesson you have learnt:

- Characteristics of aridity which include low and unreliable rainfall, low humidity, low cloud cover, hot temperatures, high diurnal and annual temperature range.
- Factors that are responsible for aridity, such as dry winds, Coriolis Force and its effect on the movement of winds, peturbation, coastal configuration, Continentality, absence of high mountains, limited water bodies, and human activities, such as deforestation, burning of vegetation cover, swamp reclamation, and sinking boreholes.
- The effects of aridity, such as lowering the water table, hot temperatures, saline soils, wild fires, deterioration of vegetation, low agricultural production, death of livestock, shortage of water, and air pollution.

Follow up activity

In your notebook:

1. Explain how aridity has affected the environment of the area where you live.
2. Explain how the following methods can be used to combat aridity in East Africa:
   (i) mass education,
   (ii) forestation and reforestation,
   (iii) use of modern methods of farming,
   (iv) use of energy saving stoves and alternative source of fuel,
   (v) government legislation and enforcement of laws, and
   (vi) environmental conservation measures

Lesson 12: Soil, Soil formation, and Soil development

Learning objectives

By the end of the lesson you should be able to:

(i) Describe the components of soil
(ii) Describe a soil profile
(iii) Explain the processes of soil formation and soil profile development in East Africa.
(iv) Explain the factors of soil formation and soil profile development in East Africa.

Materials you need

Notebook, pen, pencil, rubber, ruler, and diagrams of soil profiles.

Introduction

In senor two you learnt about soil and the soil profile. You learnt that soil is a loose thin surface layer of the top of the Earth crust that supports plants growth. You learnt about components of good soil. In your notebook describe five components of good soil. You also learnt about the soil profile. In this lesson, you are going to look at the processes of soil formation and development with special focus on East Africa.

Soil formation and development

If you have ever dug or ploughed a certain field, you could have noticed that soils differ in colour, texture, structure, and depth. This is because soils are formed by different processes and also develop under different conditions. Remember what you learnt about the soli profile in O-Level.

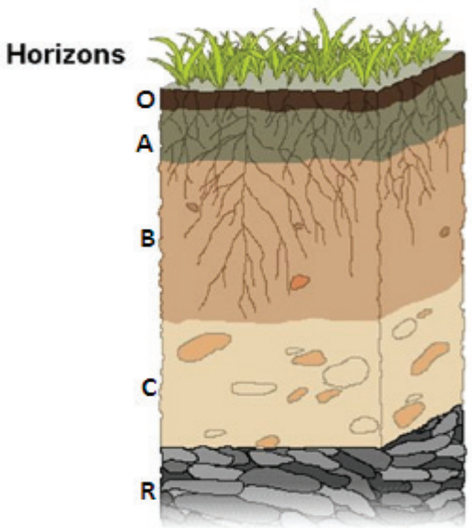

Figure 12.1: A generalized soil profile

Activity 1

Look at Figure 12.1 and do the following:

1. Explain what is meant by soil profile.
2. Copy the figure into you notebook and complete it by naming all the layers or horizons (O-R).
3. Describe the main features of each horizon.
4. Explain the factors which influence formation of soil from horizon C to horizon O.

In the previous Activity you have found out that except horizon O, all the horizons develop from the parent rock. As you have noted this is a generalized soil profile. In reality, different places have different soil profiles depending on the factors affecting soil formation and development.

At this level you need to look at a fully developed soil profile in order to understand and appreciate the influence of the various factors affecting soil formation and development.

To learn this in great detail, do the following Activity.

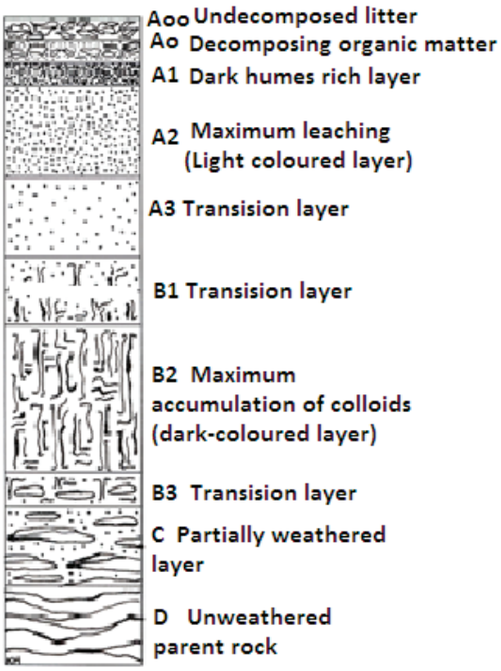

Figure 12.2: A fully developed soil profile

Note: instead of transision layer, the spelling should be transition layer

Activity 2

Carefully look at Figure 12.2 and do the following tasks:

Copy the diagram of a fully developed soil profile into your notebook and on it mark and label all the horizons.

1. Describe the features of a fully developed soil profile.
2. In what ways does a fully developed soil profile differ from a generalized soli profile?
3. Here is a diagram showing the soil profile.
4. Explain the factors responsible for the development of a fully developed soil profile.

Activity 3

Read the text below about soil formation processes which take place in East Africa and do the activities that follow.

Soil forming processes in East Africa

Mineralization is the soil formation process that occurs in A horizon. It is a process where the decomposition of organic matter goes further than humification; where organic residues or humus further breaks down into mineral substances like carbon dioxide, water, silica, and calcium which is easily utilized for plant growth. It mainly occurs in Equatorial vegetation areas like Lake Victoria basin and savanna vegetation areas like Northern Uganda under hot and humid conditions.

Salinization occurs in hot and dry areas where evaporation is greater than precipitation. Water moves upwards with dissolved salts to A horizon of the soil profile. When it

reaches the surface, water evaporates leaving behind salts leading to saline soils. It occurs in dry areas, such as Kasese, Katwe area, and Northern Kenya.

Laterization is the process that occurs in hot warm tropical areas and involves leaching taking place vertically in solution of silica from top layers (A horizon) while iron and aluminum are deposited in top layers where they harden to form reddish brown soils known as lateritic soils. This process is common on Buganda hills.

Gleization is a partial(there is some missing word) that is formed in poorly drained areas where there is partial decomposition of organic matter by bacteria due to poor drainage. This happens in A horizon of the soil profile. It occurs in poor drained lowlands and valleys like those in Lake Kyoga basins and valleys of Kigezi.

Activity 2

In your notebook complete the following paragraphs to explain how each of the processes contributes to formation of soil. To help you with this, a brief description of each process has been given.

Leaching

This is the removal of mineral materials which are soluble, such as salts, carbonates, and humid acid from A to B horizon of the soil profile…….

Eluviation

Involves the movement of mineral materials in soluble and suspension vertically and lateral from A to B horizon of the soil profile……..

Illuviation

Is the deposition and accumulation of eluviated and leached materials in the B horizon of the soil profile……..

Humification

Is the decomposition of dead plants and animals by living organism in A horizon of the soil profile to form humus……

Weathering

This is the disintegration or decomposition of rocks at or near the earth surface. It may be physical weathering or chemical weathering……..

Activity 4

Read the text below on the role of parent rocks as a factor in soil formation and do the activities that follow.

Parent rock

Hard rock like granite resist physical weathering leading to limited breaking into soil particles resulting into shallow skeletal and immature soils.

Soil rocks like limestone are easily weathered by physical weathering resulting into the breaking of soil particles, and consequently the formation of deep mature soils. The soft volcanic rocks like pumice are easily weathered and broken into soil particles leading to deep mature well developed volcanic soils.

Jointed rocks are easily subjected to physical weathering and breaching into soil particles. As the soil partials accumulate it leads to deep and mature well developed soils. Also when rocks are jointed, water percolates resulting into leaching, eluviation, and illuviation leading to formation of deep mature well developed soils. When rocks are not jointed, there is limited breaking into soil particles leading to shallow mature soils.

Dark coloured rocks like basalt and pumice absorb a lot of heat, expand and easily break into soil partials leading to formation of deep mature soils. Bright coloured rocks like partials and breaking into soils partials leading to shallow immature sandy soils.(what I have underlined is not clear to me. It should be revisited)

Permeable rocks such as limestone allow water to percolate leading to leaching, eluviations, and Illuviation. This in turn results in the development of deep mature soils. Where there are impermeable rocks like clay, there is limited percolation of water leading to eluviation and illuviation resulting into shallow immature soils.

Mineral composition influence soil formation. Quartzite and granite rocks' high silica content resist weathering leading to limited soil particles resulting into shallow immature soils. Limestone rocks give rise to soils in lime. Rocks with iron compounds give rise to lateritic soils. Igneous and previously weathered sedimentary rocks are difficult to weather leading to the formation of shallow immature soils.

In your notebook:

1. Explain the role of relief as a factor in soil formation.
2. Explain the role of living organisms including the activities of man, such as digging, ploughing, mining, and quarrying, the role of plants through their roots and decaying organic matter, and the role of animals that move in the rocks such as rodents, termites, and moles.
3. Explain soil formation processes and the short time operation of the soil formation process. In explaining these factors bring out the process of soil formation, depth, and maturity of the soil and example of areas where the factors are active. Discuss the role of rocks (this question is incomplete).

Summary

In this lesson you have learnt:

- The meaning of soil which is a loose thin surface layer of top soil composed of mineral rocks particles, air, water, humus, and living organisms while soil profile is a vertical section through soil up to the parent rock.
- Soil formation processes of leaching, weathering, Eluviation, Illuviation, humification, mineralization, salinization, laterization, Gleization and calcification.
- Factors influencing soil formation, such as nature of rocks, climate, relief, biotic factors, and time.

Follow up activity

Using the knowledge you have gained from this lesson, explain the role of climate in soil formation. You may consider soil formation in Equatorial climate, Tropical (Savanna) climate, arid and semi-arid climate.

Lesson 13: Soil erosion in East Africa

Learning objectives

By the end of the lesson you should be able to:-

(i) Describe the types of soil erosion in East Africa.
(ii) Explain the causes of soil erosion in East Africa.
(iii) Describe the effects of soil erosion in East Africa
(iv) Suggest ways of controlling soil erosion in East Africa.

Materials you need

Notebook, rubber, pen, pen, and ruler.

Introduction

In senior two, you learnt about soils erosion. In this lesson, you are going to learn more about the types, causes, effects, and ways of combating soil erosion.

Read the text below about the types of soil erosion and do the activities that follow.

Soil erosion is the removal of the top soil from place to place by running water, glaciers, and wind. One type of erosion is soil splash erosion which occurs as a result of rain drops striking the soil.

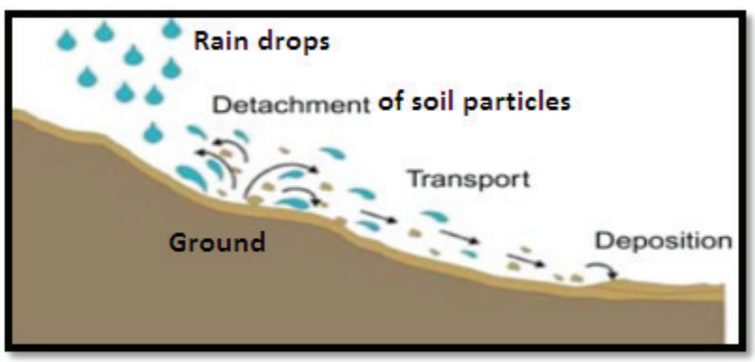

Figure 13.1: Splash erosion

The rain drops detach the soil particles and they get splashed in different directions. Later on the detached soil particles are pulled down to the ground by gravity as shown in Figure 13.1. These particles may finally be carried away by runoff water as shown in Figure 13.1. This type of soil erosion occurs when rain falls on any bare surface.

Sheet erosion involves the uniform removal of the thin surface layer of the top soil. This type of soil erosion involves slow movement, occurs on gentle slope, and on a wide area. It is common in hilly areas where there is up and down ploughing like in Kigezi and

Kenya highlands.

Rill erosion is an even removal of surface soil in form of small channels known as rills. It occurs in areas where precipitation exceeds infiltration. It occurs on gentle slopes and Southern Tanzania highlands.

Figure 13.2: Rills formed by runoff water

Look at Figure 13.2 and find out more about rill erosion and its characteristics.

Gully erosion occurs in form of large channels which develop as a result of heavy rainfall. When there is a lot of rainfall, small channels join and form large channels called galleys which create irregular landscape difficult to work on. Gully erosion is common on steep slopes of Kigezi highlands, Kapchorwa, and Bundibugyo.

Wind erosion or deflation is a type of erosion where by wind blows and detaches soil particles. Wind erosion lead to dust storms that decrease visibility in the atmosphere. It is common in dry areas, such as Northern, North Eastern and North Western Kenya, Karamoja, and Masailand where the vegetation is destroyed by overgrazing.

Activity 1

Using examples given in the above text and knowledge which you have about soil erosion, in your notebook, draw a sketch map of East Africa showing areas affected by soil erosion.

Activity 2

Using information in the text above and information you know about soil, in your notebook,

1. Explain how the following physical factors cause soil erosion in East Africa:
   (i) Steep slopes
   (ii) Heavy rainfall
   (iii) Strong winds
   (iv) Nature of the soil
2. Explain how the following human factors cause soil erosion in East Africa:
   (i) Cutting down forests and other vegetation
   (ii) Overstocking and overgrazing
   (iii) Monoculture
   (iv) Over cultivation
   (v) Cultivating up and down slope
   (vi) Mining

Activity 3

In your notebook, explain how soil erosion may affect the following aspects in the areas where it occurs:

(i) Soil fertility
(ii) Agricultural production
(iii) Underground water table
(iv) Open water bodies and broad valleys
(v) Relief and topography
(vi) Quality of air pollution
(vii) Infrastructure and construction works

In the text below definitions have been given of various soil conservation measures, read them.

Summary

In this lesson you have learnt:

- Meaning of soil erosion which is the removal of top soil from place to place.
- Types of soil erosion, such as soil splash erosion, sheet erosion, rill erosion, gully erosion, and wind erosion.
- Effects of soil erosion, including leading to infertile soils, low agricultural production, aridity and desertification, lowering of water table, siltation of water bodies, creation of rills and gullies, and damage of infrastructure.
- Ways of controlling soil erosion; for instance, contour ploughing, mulching, crop rotation, terracing, strip farming, planting trees, growing cover crops, applying manure and fertilizers, use of ridges and gabions.

Follow up activity

1. Carry out textbook or internet research about the methods of controlling soil erosion and write a report of your findings.
2. Which of the methods of controlling soil erosion would you recommend for your country? Give reasons to support your answer.

National Curriculum
Development Centre,
P.O. Box 7002,
Kampala.

www.ncdc.go.ug